April 2012

WABUSH 3 AND WABUSH 6 HYDROGEOLOGICAL AND HYDROLOGICAL TECHNICAL REPORT

Submitted to:
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REPORT

Report Number: 11-1152-0116

Distribution:

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Executive Summary

Iron Ore Company of Canada (IOC) owns and operates a series of open pit iron ore mines near Labrador City, Labrador. These mines are comprised of the Spooks, Lorraine, Humphrey Main and South, Sherwood and Luce Pits. IOC has additional lands to the south of these pits, referred to as the Wabush 3 and Wabush 6 sites, which required additional study to raise the level of understanding of the developments to Order of Magnitude Study (OMS) level. As a part of this OMS, several technical studies were required including a hydrogeological and hydrological study of the planned open pit developments for the Wabush 3 and Wabush 6 iron ore bodies. These studies provide recommendations for the subsequent Pre-feasibility Level studies for the developments.

The main objectives of this study were to characterize the hydrogeological and hydrological conditions of the proposed Wabush 3 and Wabush 6 mines and the surrounding area; determine the current groundwater levels within the areas of the two proposed pits; provide a preliminary indication of aquifer horizons and transmissivities; determine a preliminary dewatering strategy; specify the work program required for the Pre-feasibility Study; and review the data collection requirements for OMS and Pre-feasibility Studies at IOC.

The initiation of the study included a site visit conducted in September 2011 at, and near, Wabush 3 and 6 during which time the surface drainage was examined and stream flow measurements were carried out. The surface water flow monitoring program at Wabush 3 and 6 consisted of instantaneous flow measurements taken from 11 locations within the Dumbell Lake, Luce Lake and Leg Lake watershed areas. Baseline surface water quality was collected from seven locations. However, hydrogeologic field work was conducted at Wabush 3 only due to wet conditions at Wabush 6 which restricted access.

The hydrogeologic field work at Wabush 3 was carried out between September and November 2011 and consisted of 44 packer tests from five pre existing exploration borehole locations. Based upon the packer testing results, multi-level piezometers were installed in each of the five boreholes at Wabush 3. Each of these wells was installed with data loggers for long term water level monitoring. Baseline groundwater quality samples were also obtained from eight of the multi-level piezometers at Wabash 3.

The results of the Wabush 3 surface water flow measurements indicate that the streams in the Dumbell Lake and Leg Lake watershed areas likely receive a significant amount of groundwater baseflow. Moving downstream of Leg Lake, the unit flow was locally comparable but, further downstream the unit flow rate was lower indicating that the overburden was thinner and the rock may be tighter within this area (relative to other areas) minimizing the groundwater baseflow contribution.

The results of the Wabush 6 surface water unit flow measurements indicated that groundwater contribution to the watercourse did not increase over the Wabush 6 area when compared to the upstream drainage area. The influence of the Luce Pit discharge also influenced this area.

The groundwater investigations provided hydraulic conductivity results from the packer testing of 14 to 17 m test intervals in the boreholes tested. The results varied both spatially and with depth. The hydraulic conductivities for shallower bedrock (0 metres below ground surface (mbgs) to 76 mbgs) generally ranged between 1 x 10^{-5} cm/sec and 7 x 10^{-4} cm/sec; while the deeper bedrock (76 mbgs to 182 mbgs) had hydraulic conductivity that generally ranges between 3 x 10^{-7} cm/sec and 1 x 10^{-4} cm/sec. The exception to this grouping are the results of W3-11-71, where the hydraulic conductivity was controlled by a very permeable opening at

approximately 263 to 264.8 mbgs which had a hydraulic conductivity of 2 x 10^{-2} cm/sec. The open hole testing above this point is 1 x 10^{-3} cm/sec to 3 x 10^{-3} cm/sec. The geomean of these results is 8.03 x 10^{-5} cm/sec and the arithmetic mean is 9.15 x 10^{-4} cm/sec. These results are consistent with geophysical data from Wabush 3 (calliper and acoustic data). The range in hydraulic conductivity from the packer testing at Wabush 3 was also in a similar range to the historical hydraulic conductivities stated in the Piteau 2002 report that reviewed select hydrogeology data from 1965 to 1981.

Surface water and groundwater quality samples were collected and analyzed for a broad suite of parameters including major ions and heavy metals considered appropriate to characterize the groundwater geochemistry and evaluate background water quality conditions. The surface water results were compared to Canadian Council Minister's of the Environment (CCME) Canadian Environmental Quality Guidelines Long Term Exposure Limits surface water quality regulatory criteria. Two surface water samples from downstream of Luce Lake and Luce Pit discharge had Nitrite exceedance. One surface water sample from within Wabush 3, exceeded the total iron, total aluminum and total chromium criteria.

The groundwater results were compared to the Guidelines for Canadian Drinking Water Quality, Health Canada, December 2010 as a relative comparison only. All results of the groundwater quality samples were below the criteria with the exception of exceedances of the Maximum Acceptable Concentration (MAC) for turbidity and the Aesthetic Objective (AO) for manganese in all groundwater samples collected. Two groundwater samples exceeded the AO for aluminum and one groundwater sample exceeded the AO for iron.

Groundwater and surface water quality results were compared to each other for metals to determine if groundwater was potentially discharging to surface water. This comparison showed that there was a significant groundwater inflow at the south west end of Wabush 3 as evident by elevated concentrations of iron, aluminum, titanium and chromium which can be attributed to groundwater flow through iron formations. It should be noted that surface water samples from the Wabush 6 area receive discharge from Luce Pit which is receiving a significant groundwater contribution as evident by elevated concentrations of select metals such as magnesium and elevated hardness which are both attributed to groundwater flow through the dolostone that is adjacent to the iron formation. The discharge is also influenced by the un-combusted materials associated with blasting, such as elevated concentrations of nitrate, nitrite and ammonia. The remaining locations had lower metals concentrations, suggesting they receive limited groundwater contributions.

The results of the field work allowed the development of a conceptual groundwater and surface water model that was used to build a numerical model. The numerical model was used to predict potential seepage and potential impacts of the Wabush 3 and Wabush 6 pits development on nearby groundwater and surface water receptors.

Pit development of Wabush 3 and Wabush 6 will reduce the total drainage area and the runoff and infiltration contributions. For both pit water management estimates, it was assumed that approximately 80% of the precipitation which falls within the ultimate Pit footprint will runoff and report to the pit sump with the remaining 20% of the precipitation evaporating. The estimated dewatering requirements for Wabush 3 (21 million m^3/yr at ultimate development) is similar to the current dewatering rate of the Luce pit (12.5 million m^3/yr) which is not yet fully developed. It is assumed that the Wabush 3 mine water would be directed toward the current mine water discharge to Luce Lake. A higher dewatering rate at the Wabush 6 pit (50 million m^3/yr at ultimate development) reflects the influence of surface water bodies contributing to the groundwater inflow from Luce Lake and Wabush Lake, both being in close proximity. The potential receiving watercourse for Wabush 6 mine water would be the existing watercourse which is currently downstream of Luce Lake.

For surface water management of the Wabush 3 pit, there are no streams that flow onto Wabush 3 from outside of the proposed pit boundary. Therefore no surface water diversion around the pit is required. However Luce Lake currently extends into the proposed Wabush 6 pit boundary and flows in a southerly direction. The outlet of Luce Lake will require a diversion around Wabush 6 in order to reduce potential pumping efforts.

The potential risks and opportunities associated with excavating Wabush 3 and Wabush 6 on the surrounding groundwater and surface water environments and nearby communities are:

- Dumbell Lake will be within the groundwater drawdown cones of Wabush 3 and Wabush 6 and may therefore experience reduced groundwater inputs and the catchment area currently contributing to Dumbell Lake will be reduced by 13% due to the extraction of Wabush 3. Dumbell Lake will therefore likely experience a potential reduction in surface water input. This is notable as Dumbell Lake is the secondary domestic water supply in the area.
- It is assumed that the surface water runoff from the north of Wabush 3 to Leg Lake will be diverted around Wabush 3 by constructing berms and ditches. The diversion of water may lead to erosion of the water course due to the change from sheet flow to a concentrated flow. It is assumed that the Wabush 3 sump water will be discharged to Luce Lake and this increased flow through Luce Lake may lead to erosion of the downstream water course and potential flooding concerns. It is assumed that the Wabush 6 sump water will be discharged to the existing receiving water course which ultimately flows into Wabush Lake. Due to the increased groundwater volume from Wabush 6 the flows into the receiving watercourse will increase. This increased flow through the receiving water course may lead to erosion of the water course and potential flooding concerns.
- No opportunities were identified during the OMS.

A preliminary review of key federal and provincial statutes and regulations was completed from a hydrogeological and hydrological perspective. This review focused on environmental statutes and regulations but was not exhaustive and was not intended to identify all relevant permits, licenses, approvals and authorization for pre-feasibility studies. Such a review should be completed as part of the overall site development and should be finalized based on discussions with provincial and federal regulators.

Golder reviewed IOC's Section 4 Hydrology and Hydrogeology Study Definition Guidelines provided to us that outlines their required level of investigation and documentation for Pre-Feasibility Level Geotechnical and Hydrological/Hydrogeological studies. The findings of this review have been used to recommend additional studies for numerical modelling if a more refined estimate of the results of pit dewatering is deemed necessary; additional groundwater and surface water studies are recommended.

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1.0 INTRODUCTION

Iron Ore Company of Canada (IOC) owns and operates a series of open pit iron ore mines near Labrador City, Labrador. These mines are comprised of the Spooks, Lorraine, Humphrey Main and South, Sherwood and Luce Pits (Figure 1). IOC has additional lands to the south of these pits, referred to as the Wabush 3 and Wabush 6 sites, which require additional study to raise the level of understanding of the developments to Order of Magnitude Study (OMS) level. As a part of this OMS, several technical studies are required including a geotechnical study and a hydrogeological study of the planned open pit developments for the Wabush 3 and Wabush 6 iron ore bodies. These studies will also provide recommendations for the subsequent Pre-feasibility Level studies for the developments.

The hydrogeological and hydrological study includes both groundwater and surface water studies at and in the area around the Wabush 3 and Wabush 6 proposed pit sites. This report presents the findings of the hydrogeological studies, while the geotechnical studies are presented under separate cover entitled *Draft Report on Wabush 3 and Wabush 6 Order of Magnitude Pit Slope Stability Assessment*, December 2011 (Golder, 2011).

1.1 Overview of Project

The main objectives of the hydrogeological and hydrological studies are to:

- Characterize the hydrogeological and hydrological conditions of the proposed Wabush 3 and Wabush 6 mines and the surrounding area;
- Determine the current groundwater levels within the areas of the two proposed pits;
- Provide a preliminary indication of aquifer horizons and transmissivities;
- Determine a preliminary dewatering strategy;
- Specify the work program required for the Pre-feasibility Study; and
- Review the data collection requirements for OMS and Pre-feasibility Studies at IOC.

The work program consisted of the following:

- Data review and compilation;
- Hydrogeological mapping to define groundwater discharge areas;
- Definition of surface water opportunities and risks;
- Identify potential impact on all areas including geotechnical (slope stability) (see Golder's 2012 geotechnical Report), environment and communities;
- Development of basic site flow sheet and average water balance;
- Determination of bedrock hydraulic conductivity (packer tests);
- Installation of drill holes with monitoring wells; and

- Chemical analysis of groundwater and surface water quality.

This report is organized into a main text and supporting figures, tables and appendices. The main text provides a discussion of the regional setting, a summary of the results of the work program, characterization of the hydrologic and hydrogeologic environments, dewatering requirements, potential impacts and the conclusions and recommendations. Details of the field results are provided in the attached appendices as follows:

Appendix A	Borehole Drilling, Monitoring Well Installations, Groundwater Levels and IOC Geological Cross-Sections
Appendix B	Packer Testing Summary Sheets
Appendix C	Groundwater and Surface Water Quality Sampling Results
Appendix D	Surface Water Monitoring Photographs
Appendix E	Select Geophysical Televiewer Log Results by DGI Geoscience Inc.
Appendix F	Groundwater Model Technical Memorandum

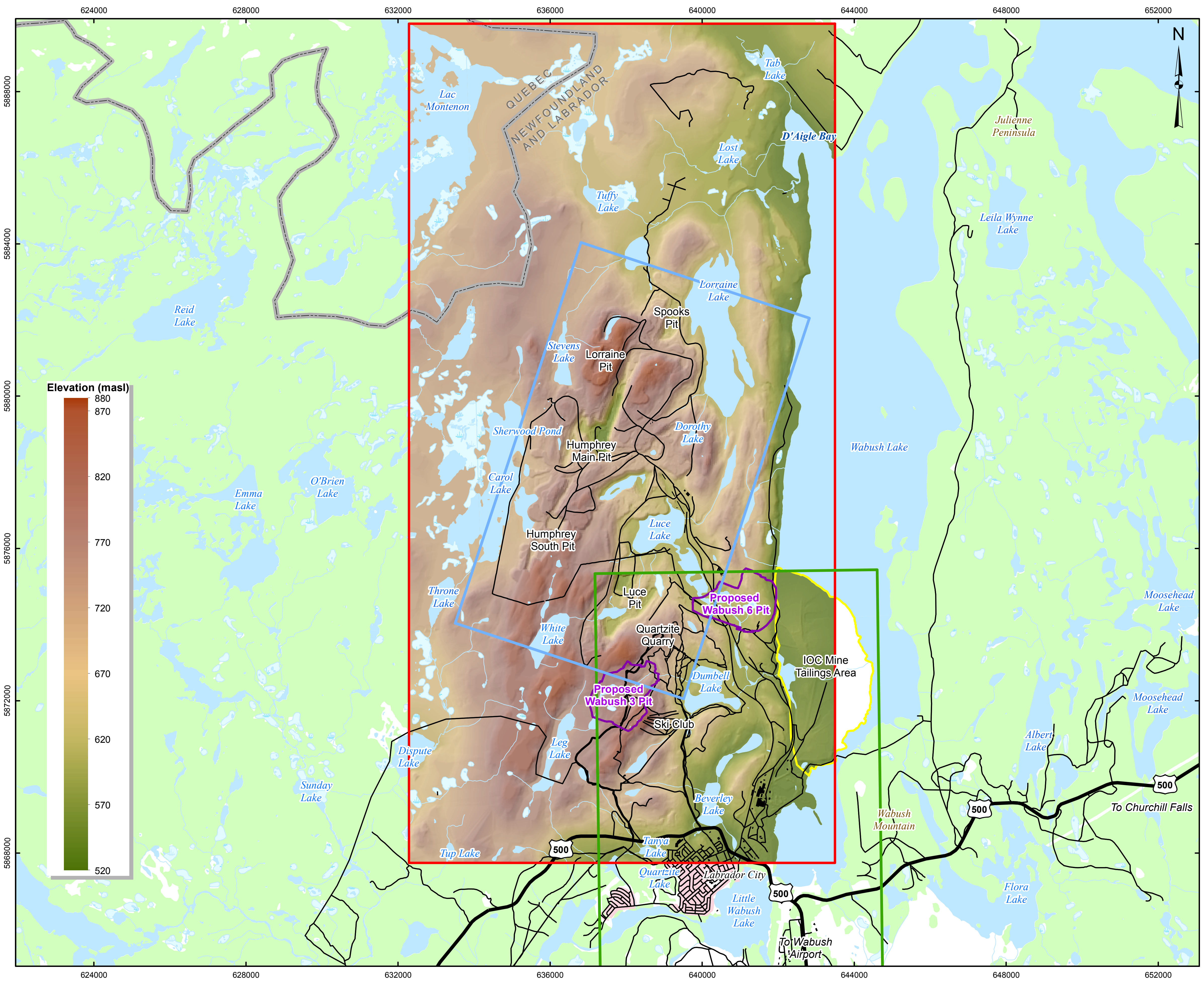
1.2 IOC Background Information

The following information was provided to Golder Associates Ltd. (Golder) by IOC and used as a part of this study:

- Borehole logs of geology and RQD for select wells at the Wabush 3 and Wabush 6 proposed pit sites;
- 1 m topographic contour mapping, which included the area around the Spooks, Lorraine, Humphrey Main and South, Sherwood and Luce Pits dated 2004;
- 1 m topographic contour mapping, which included the area around the proposed Wabush 3 and Wabush 6 pits dated 2011;
- Preliminary extraction plans provided by IOC for proposed Wabush 3 and Wabush 6 pits based upon IOC drilling data up to 2007; and
- Pumping records for the Luce Pit.

2.0 REGIONAL SETTING

The regional study area is defined as the area that includes the IOC Spooks, Lorraine, Humphrey Main and South and Luce Pits and the area going southward to the Wabush 3 and Wabush 6 proposed pits. This area is outlined in red on Figure 1.



LEGEND

- Highway
- Site Access Road
- Other Road / Trail
- 🟨 IOC Mine Tailings Area
- 🟪 Proposed Pit Boundary
- 🟥 Hydrogeological Model Extents

Base Data

- Building
- Watercourse
- Waterbody
- Wetland
- Wooded Area
- Residential Area
- Provincial Boundary

Topographic Dataset Extents

- 🟦 Geomatique G.P.L Consultants, Quebec. Based on aerial photographs taken in 2004. Original scale 1:2,000
- 🟩 Aero-Photo (1961) Inc, Quebec. Based on aerial photographs taken in 2011. Original scale 1:10,000

All Other areas have topography obtained from Canvec V.8, 2011. Original scale 1:50,000

REFERENCE

Base Data - Canvec V.8,2011
Elevation data derived from Canvec and files provided to
Golder Associates by IOC dated 2004 and 2011.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

0 500 1,000 2,000 3,000 4,000 5,000
SCALE 1:100,000 METRES

PROJECT
RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE
LOCATION OF EXISTING IRON ORE MINES AND PROPOSED WABUSH 3 AND 6 IRON ORE MINES

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	1 Dec. 2011	**FIGURE: 1**	
GIS	JO	9 Dec. 2011		
CHECK	PMMC	9 Dec. 2011		
REVIEW	RB	9 Dec. 2011		

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Figure 1 - Existing Mines and Proposed Wabush 3 and 6.mxd

2.1 Physiography

The regional topographical relief and drainage network is shown on Figure 1 and covers approximately 247 km^2. This area was glaciated and the last period of glaciation has eroded away most of the overburden cover leaving only thin overburden and exposed bedrock. The topography of this area is bedrock controlled with the average elevation varying between 520 m and 875 metres above sea level (masl). The terrain is generally rolling, sloping toward the east, with a total relief of several hundred metres. The topographic highs in the area trend generally north south and are typically formed by more resistant quartzites, cherts and silicified horizons of the iron formation. The lows are commonly underlain by softer shale and siltstone bedrock.

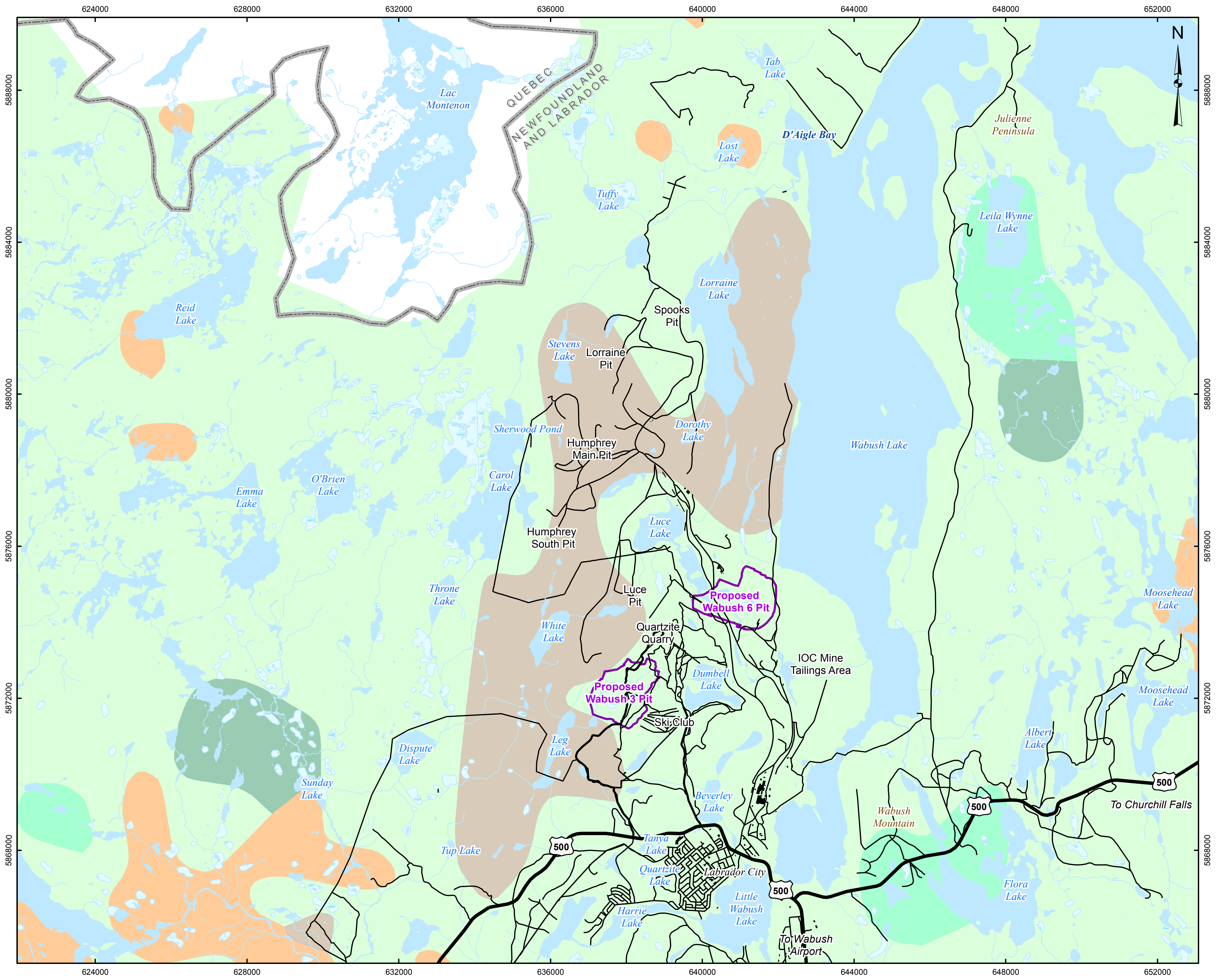
The landscape consists of wet areas, lakes, bare bedrock and approximately 69% of the region is covered by vegetation, which commonly grows directly on glacial sediments. The thin veneer of till in the area is composed of both glacial and glacial fluvial sediments. The composition of till is sandy gravel with lesser silty clay, mostly preserved in topographic lows.

Within the regional study area there are three watersheds that were studied: Luce Lake, Dumbell Lake and Leg Lake. The drainage from Luce Lake and Dumbell Lake combine prior to discharging eastward into Wabush Lake. Luce Lake receives discharge from the Luce Pit and Wabush 6 site is located within this catchment, while Wabush 3 is partially located within the Dumbell Lake watershed. The third drainage area of interest with respect to the study area, and Wabush 3, contributes to Leg Lake, which drains southward to Harrie Lake. Harrie Lake eventually drains into Wabush Lake and from there into the Atlantic Ocean.

2.2 Regional Geology

The regional distribution of surficial deposits is shown on Figure 2 with drift poor areas of >80% exposed bedrock and areas of "undifferentiated till" described as a silty sand to silty sand with gravel (Newfoundland Geosciences Ltd., 2001).

The iron deposits occur in deformed segments of iron-formation in what is known as the Labrador Trough. The western half of the Labrador Trough, consisting of a thick sedimentary sequence, can be divided into three sections based on changes in lithology and metamorphism (North, Central and South). The Trough is comprised of a sequence of Proterozoic sedimentary rocks including iron formation, volcanic rocks and mafic intrusions known as the Kaniapiskau Supergroup (Gross, 1965). The southern part of the Trough is crossed by the Grenville Front. Trough rocks in the Grenville Province to the south are highly metamorphosed and complexly folded. Iron deposits in the Grenville part of the Labrador Trough include Lac Jeannine, Fire Lake, Mounts Wright and Reed and the Luce, Humphrey and Scully deposits in the Wabush area. The high-grade metamorphism of the Grenville Province is responsible for recrystallization of both iron oxides and silica in primary iron formation producing coarse-grained sugary quartz, magnetite, specular hematite schists (metataconites) that are of improved quality for concentrating and processing (McKillen, Hooley and Dufort 2011).



LEGEND

- Highway
- Site Access Road
- Other Road / Trail
- Proposed Pit Boundary

Surficial Geology

Glaciofluvial Deposits

🟧

Proglacial or ice contact sand and gravel; forming ice contact fans and deltas, outwash plains and terraces, pitted outwash, crevasse fillings, kames, and kame terraces; commonly associated with eskers; includes areas of extensive, thick fluvial sediments derived from pre-existing glaciofluvial deposits

Ablation Drift

🟩

Sediments and landforms formed during the disintegration of the ice sheet; predominantly massive to poorly stratified, silty to sandy diamicton and poorly sorted to well sorted sand and gravel; characterized by irregular hummocks and mounds 5 to 10 m high and by extensive meltwater channels; on northern Labrador Peninsula, can include glaciocustrine and glaciomarine deposits

Ribbed (Rogen) Moraine

🟩

Irregular to sinuous ridges which are generally less than 1 km long and 10 m high, or hummocks; composed of massive to poorly stratified; sandy diamicton, gravel and sandy gravel; can be mantled by large boulders. Ridges trend roughly perpendicular to ice flow; field of ribbed moraine vary in outline from irregular and blocky to elongate, lying parallel to regional ice movement; in the south ribbed moraine preferentially occurs within valleys

Drift Poor Areas

🟫

Greater than 80% bedrock; includes areas of till and other surficial materials generally <1 m thick and discontinuous; on northern Labrador Peninsula, characterized by extensive boulder fields, dominantly felsenmeer

Till and Other Surficial Deposits (Undifferentiated)

🟩

Predominantly nonstratified, poorly sorted, silty to diamicton, gravel, and sandy gravel; deposited either directly from ice or by meltout during ablation; includes glaciofluvial, glaciolacustrine, marine, and fluvial deposits of either minor areal extent or thin (<2 m) and discontinuous

Base Data

- Building
- Watercourse
- Wetland
- Waterbody
- Provincial Boundary

REFERENCE

Base Data - Canvec V.8,2011
Surficial Geology from Klassen, Paradis, Bolduc and Thomas, 1992.
Surficial Geology GIS data obtained from Newfoundland Labrador
GeoScience Atlas, http://gis.geosurv.gov.nl.ca/. Downloaded Nov 28, 2011.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

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SCALE 1:100,000 METRES

PROJECT
RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE
REGIONAL SURFICIAL GEOLOGY

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116 (2000)			SCALE AS SHOWN	REV. 0.0
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GIS	JO	9 Dec. 2011		
CHECK	PMMC	9 Dec. 2011		
REVIEW	RB	9 Dec. 2011		

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Figure 2 - Regional Surficial Geology.mxd

The distribution of the regional bedrock geology is shown on Figure 3. As described from ground surface downward the bedrock geology consists of variable thicknesses of schists of the Menihek Formation, then the iron ore Sokoman formation, then the quartzite Wishart formation, followed by the dolomitic Denault formation and schist of the Attikamagen formation, which are found in the Lower Proterozoic (Aphebian) Autchithonous and Parautochithonous aged rocks. Some of these formations may be intruded by the Shabogamo gabbro intrusive. A summary of the regional bedrock lithology is provided on Figure 3.

The Regional Structural geology is described in detail in the geotechnical study report entitled *Draft Report on Wabush 3 and Wabush 6 Order of Magnitude Pit Slope Stability Assessment*, December 2011 (Golder, 2011).

2.3 Regional Climate

The regional study area has a sub-arctic continental taiga climate with very severe winters. Meteorological data was obtained for the Wabush Airport station (Climate ID 8504175) from Environment Canada (EC) for the period of record of 1961 – 2010. Daily average temperatures exceed 0°C for 6 months of the year. Daily mean temperatures at the Wabush Airport average – 22°C and – 21°C in January and February, respectively. Mean daily average temperatures in July and August are 14°C and 12°C, respectively. Snowfall from November to March generally exceeds 65 cm per month and the wettest summer month is July, with an average rainfall of 111 mm.

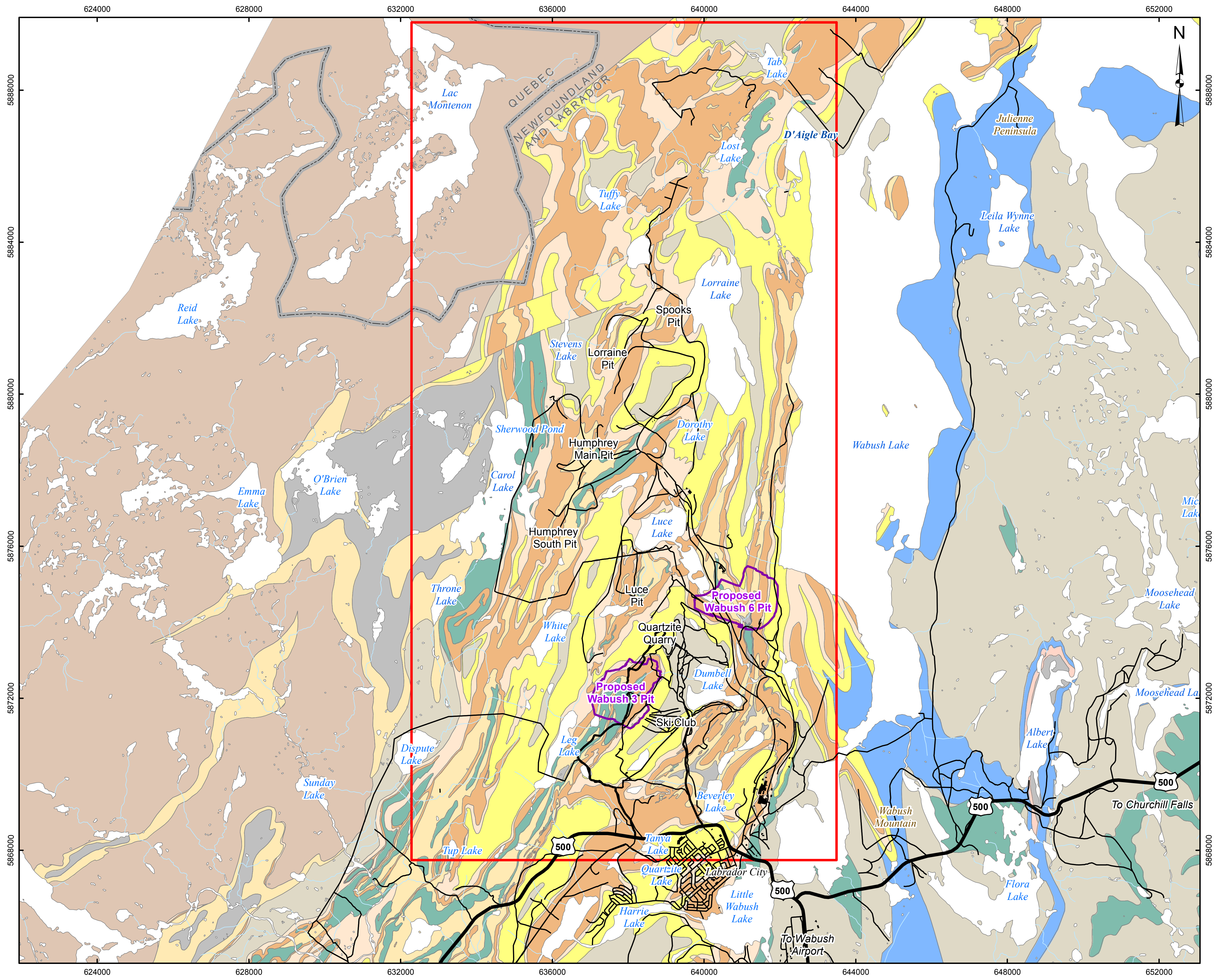
Figure 4 provides the annual precipitation for the period of record and the average annual precipitation. The average annual precipitation for the region is 873 mm based on the Wabush Airport period of record from 1961 – 2010. The precipitation record for 2011 is from January 1 to December 5, 2011 and is therefore incomplete. Figure 5 provides the daily precipitation and daily temperature throughout 2011.

2.4 Surface Water and Groundwater Use

It is our understanding that the drinking water source for all users within the regional area is municipal (Labrador City) water, which is obtained from Beverly Lake as the main source and Dumbell Lake as a secondary source when required.

2.5 Regional Hydrogeology and Hydrology

Regionally the groundwater table is influenced by the existing streams and lakes, existing and past pit excavation, and dewatering activities. The groundwater table near the active Sherwood, Humphrey Main and Luce Pits, which are actively dewatered, will have a water table near the pit that is equal to the base of the pit. The Humphrey South, Spooks, Lorraine North and South Pit areas that have flooded to form lakes will have higher water tables defined by these lake elevations. In areas where extraction has not taken place, surface water in the valleys may contribute to the shallow water table and on topographically high areas the water table could be at least as deep as 80 metres below ground surface (mbgs).



LEGEND

▬ Highway
— Site Access Road
— Other Road / Trail
☐ Proposed Pit Boundary
☐ Hydrogeological Model Extents
☐ Waterbody

Detailed Bedrock Geology

- 🟩 Shabogamo Intrusive
- ▨ Menihek Formation
- ▨ Undifferentiated Iron Formation
- ▨ Upper Iron Formation
- ▨ Middle Iron Formation
- ▨ Lower Iron Formation
- 🟨 Wishart Formation
- 🟦 Denault
- ▨ Attikamagen Formation

Unconformity

- ▨ Ashuanipi Complex

REFERENCE

Base Data - Canvec V.8,2011
Detailed Geology data obtained from IOC.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

0 5001,000 2,000 3,000 4,000 5,000
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PROJECT
RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE
REGIONAL BEDROCK GEOLOGY

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116		
DESIGN	JO	1 Dec. 2011
GIS	JO	9 Dec. 2011
CHECK	PMMC	9 Dec. 2011
REVIEW	RB	9 Dec. 2011

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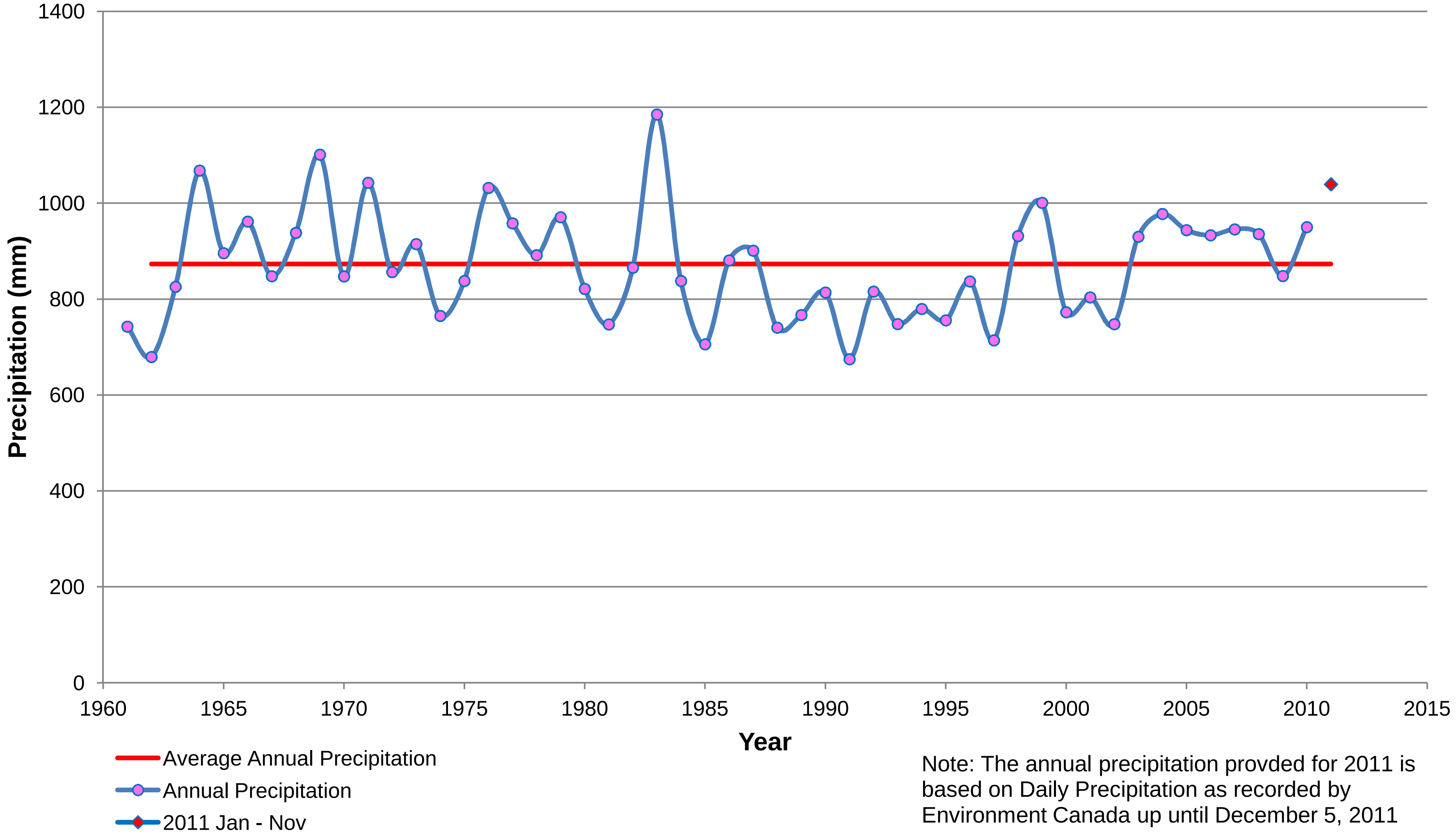
FIGURE: 3

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Figure 3 - Regional Bedrock Geology.mxd

Wabush Airport Climate Station (ID 8504175) Precipitation

Figure 4



Note: The annual precipitation provded for 2011 is based on Daily Precipitation as recorded by Environment Canada up until December 5, 2011

DATE: December 2011

PROJECT: 11-1152-0116

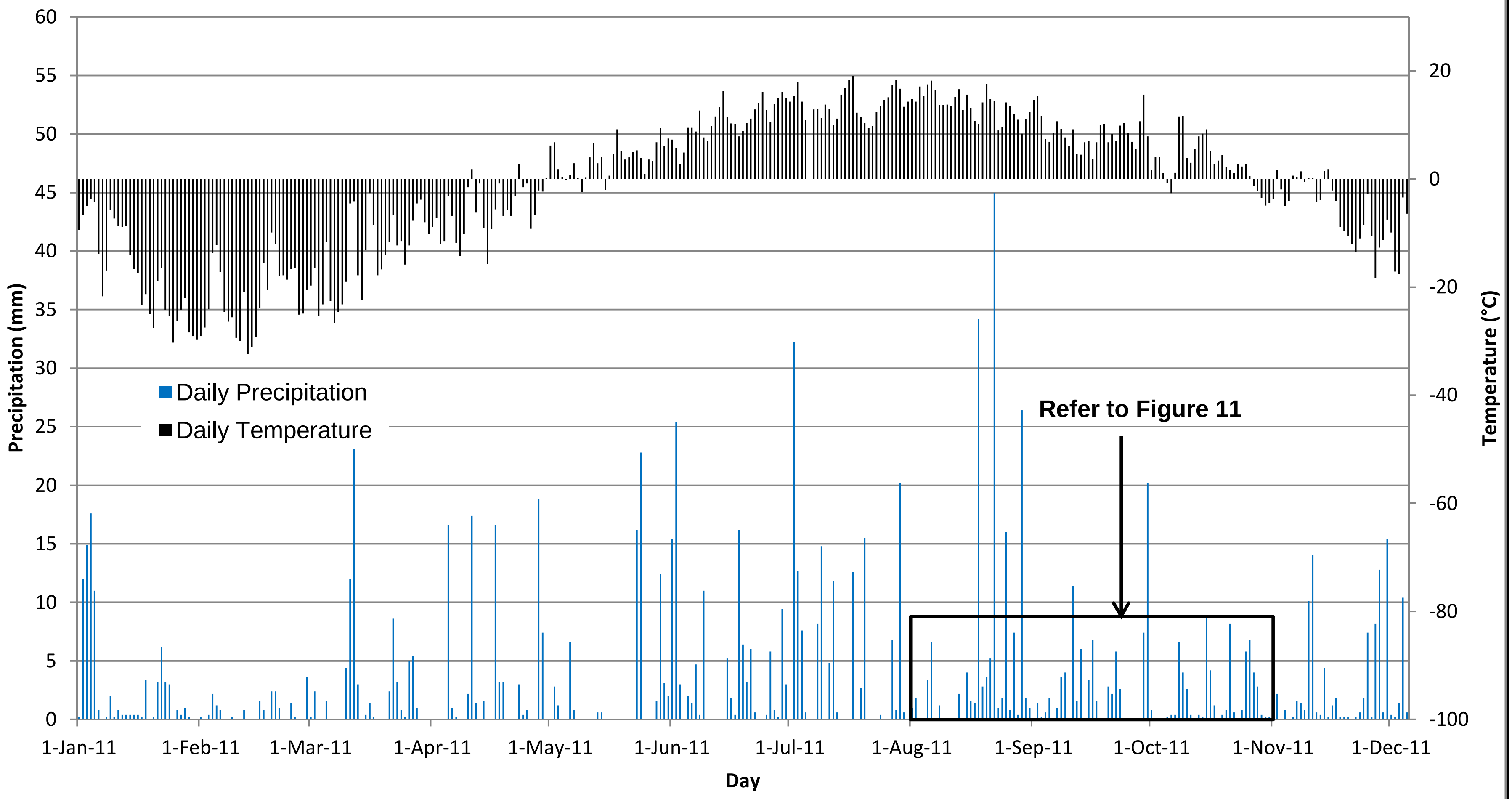
Golder Associates

prepared by: **MK**

CHK: **PMcC**

2011 Daily Precipitation - Wabush Airport Climate Station (ID 8504175)

Figure 5



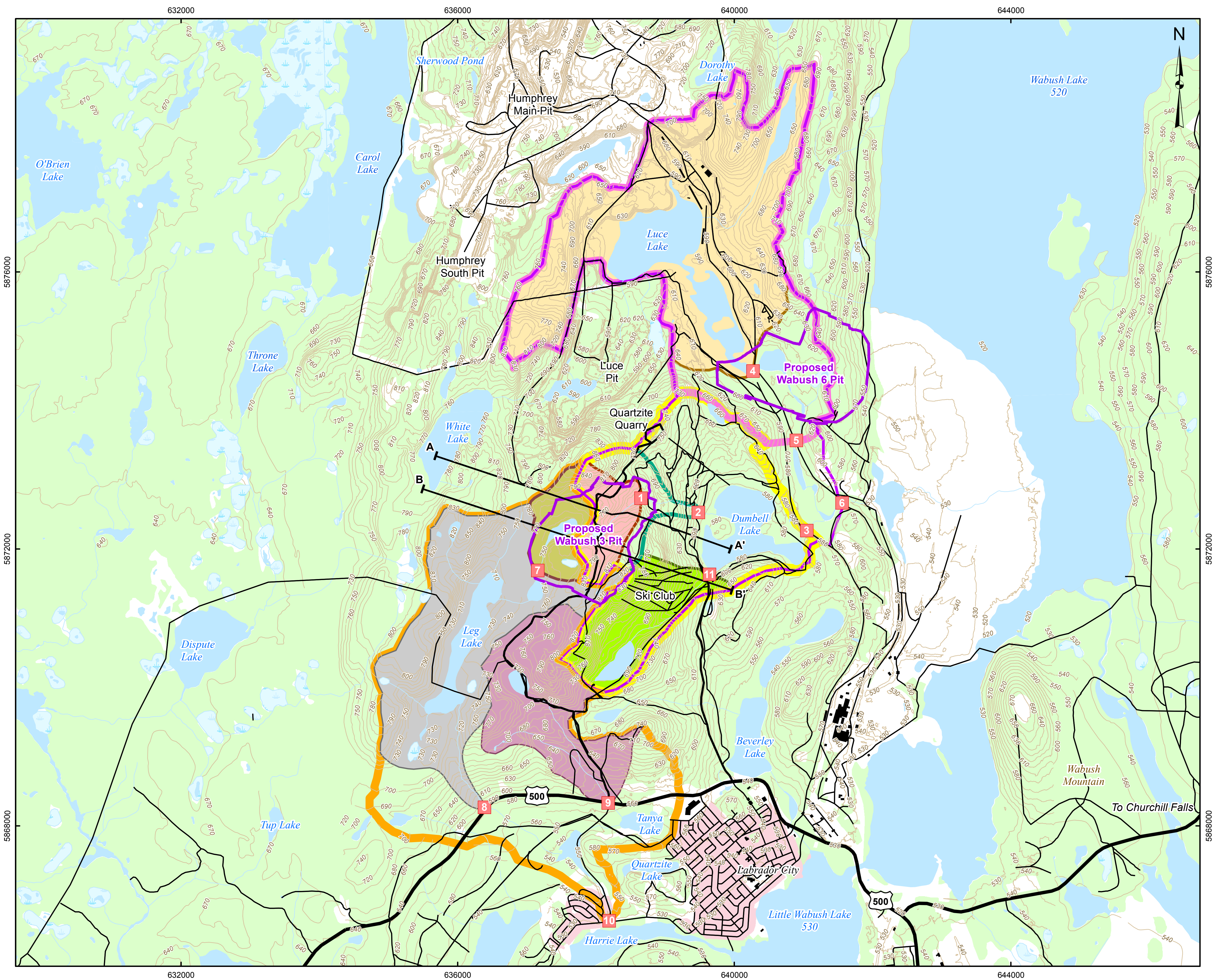
DATE: December 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: **MK**

CHK: **PMcC**



LEGEND

- Cross Section Lines
- Contours (10m Interval)
- Proposed Pit Boundary
- 1 Surface Water Monitoring Locations

Subcatchments to Monitoring Locations

- 1 (Area: 1.01km^2)
- 2 (Area: 1.83km^2)
- 3 (Area: 8.28km^2)
- 4 (Area: 10.17km^2)
- 5 (Area: 12.62km^2)
- 6 (Area: 21.98km^2)
- 7 (Area: 1.06km^2)
- 8 (Area: 7.17km^2)
- 9 (Area: 3.30km^2)
- 10 (Area: 16.01km^2)
- 11 (Area: 2.14km^2)

Regional Watersheds

- Luce Lake
- Dumbell Lake
- Leg Lake

Base Data

- Building
- Watercourse
- Wetland
- Waterbody
- Wooded Area
- Residential Area
- Provincial Boundary

REFERENCE

Base Data - Canvec V.8,2011
Elevation data derived from Canvec and files provided to
Golder Associates by IOC dated 2004 and 2011.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

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PROJECT
RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE
WATERSHED AND SUBCATCHMENT LOCATIONS

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116			SCALE AS SHOWN	REV. 0.0
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CHECK	PMMC	9 Dec. 2011		
REVIEW	RB	9 Dec. 2011		

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Phase1000\Figure 6 - Location of Subcatchments.mxd

The surface water regional area was divided into three watersheds: Luce Lake, Dumbell Lake and Leg Lake as shown on Figure 6. Luce Lake is north of Luce Pit and drains in a south-easterly direction through the proposed Wabush 6 area. The drainage area of the Luce Lake watershed upstream of the confluence with Dumbell Lake (surface water monitoring location SW5) is approximately 13 km^2. In conjunction with the runoff and infiltration from the upstream catchment Luce Lake also receives discharge from the Luce Pit.

Dumbell Lake has a drainage area of approximately 8 km^2 (surface water monitoring location SW3) and receives upstream runoff and infiltration from approximately half of the proposed Wabush 3 area. The south-western half of Wabush 3 is located in the third watershed, Leg Lake. The drainage area of Leg Lake to the confluence of Harrie Lake (monitoring location SW10) is approximately 16 km^2.

2.5.1 Existing Pit Water Handling

Humphrey Main pit has a continuous pumping routine that maintains the level of groundwater at an elevation of approximately 480 masl. Humphrey South is not being dewatered but is flooded to an elevation of approximately 670 m. Spooks Pit is flooded and the water elevation is approximately 608 masl. Lorraine South is currently being pumped into Lorraine North and both pits are flooded. Sherwood pit is not being dewatered and Sherwood Pond was partially drained to enable mining of Sherwood pit. Luce pit is dewatered to Luce Lake; the groundwater elevation within Luce pit is estimated from IOC mapping to be approximately 590 masl.

2.5.2 Regional Infiltration Estimate

The regional infiltration was estimated based on precipitation data obtained from EC Wabush Airport station water budget information (1961 to 2007), which indicated a mean annual precipitation of 867 mm/yr. Based on the soils within the regional area, which consist of granular till that is comprised of poorly sorted silt, sand and gravel, it was assumed that approximately 20% (173 mm/yr) of the total precipitation over the regional area infiltrates while the remaining 80% either evapotranspirates or is overland flow (i.e., surface runoff). It was assumed that the infiltration was the same for both the granular till and the drift poor areas. The estimated infiltration was used to estimate the groundwater inflow into Wabush 3 and Wabush 6 and is described in more detail in Section 7.4.2 and Appendix F.

2.5.3 Watershed Characterization

The following sections characterize each of the three watershed areas within the surface water regional area.

2.5.3.1 Luce Lake Watershed

The Luce Lake watershed upstream of the confluence with Dumbell Lake watershed (surface water monitoring location SW5) is approximately 13 km^2, as shown on Figure 6. The watershed area consists of coniferous forest, walking trails, lakes, pits and industrial waste piles (i.e., tailings). The soils within the area consist of granular till that is poorly sorted silt, sand and gravel and bedrock at surface in the north east portion of the watershed.

In conjunction with the runoff and infiltration from the upstream catchment, Luce Lake also receives discharge from the Luce Pit located directly south. The Luce Pit has a drainage area of approximately 4.6 km^2 in addition to the 13 km^2 drainage area of Luce Lake.

Luce Lake drains in a south-easterly direction towards Wabush Lake through the proposed Wabush 6 area and across the IOC tailing basins.

2.5.3.2 Dumbell Lake Watershed

Dumbell Lake has a drainage area of approximately 8 km^2 (refer to Figure 6 and surface water monitoring location SW3) and is the secondary source of municipal water to Labrador City. The watershed area consists of coniferous forest, walking trails, ski runs and lakes. The soils within the area consist of granular till that is comprised of poorly sorted silt, sand and gravel.

Dumbell Lake receives upstream runoff and infiltration from approximately half of the proposed Wabush 3 area (1.1 km ^{2}). As shown on Figure 6, Dumbell Lake watershed confluences with the Luce Lake watershed east of Wabush Lake prior to draining into Wabush Lake.

2.5.3.3 Leg Lake Watershed

Leg Lake has a drainage area of approximately 16 km^2 and confluences with Harrie Lake (refer to Figure 6, surface water monitoring location SW10). The watershed area consists of coniferous forest, lakes, walking trails, roads and residential areas (Labrador City). The watershed area consists mostly of bedrock at surface and large areas of granular till and other surficial soils.

The south-western half of Wabush 3 is located in the Leg Lake watershed area and contains two lakes which drain southwest into Leg Lake.

3.0 LOCAL SETTING

The following provides a description of the geology, hydrogeology and surface water regime in the local areas of the proposed Wabush 3 and Wabush 6 pits.

3.1 Land Use

The land use within the area consists mainly of coniferous forest, open and closed mines, industrial waste areas (i.e., tailings) and Labrador City (Figures 1, 6, 8a and 8b). The coniferous forest areas are hilly with slopes ranging from 13% to 17%. Wabush 3 currently consists of coniferous forest and two lakes. Wabush 6 is located east of the existing Luce Pit and consists of coniferous forest, lakes and roads.

3.2 Wabush 3 and Wabush 6 Sites

The topographical relief and drainage network within Wabush 3 and Wabush 6 is shown on Figures 8a and 8b. Wabush 3 is approximately 2.1 km^2 and generally ranges in elevation from 697 to 821 masl. Wabush 3 is within two watersheds, Dumbell Lake and Leg Lake. The drainage area within Wabush 3 that contributes to Dumbell

Lake is approximately 1.1 km^2. The drainage area of Wabush 3 within the Leg Lake watershed is approximately 1.0 km^2.

Wabush 6 is approximately 2.2 km^2 and generally ranges in elevation from 585 to 651 masl. Wabush 6 falls within two watersheds, Luce Lake and Wabush Lake. The drainage area of Wabush 6 contributing to Luce Lake is approximately 1.4 km^2. The portion of Wabush 6 that drains directly to Wabush Lake is approximately 0.8 km^2.

The surface water flow direction within Wabush 3 and Wabush 6 is provided on Figure 7.

The geological conditions beneath Wabush 3 and Wabush 6 were assessed based upon the results of the various IOC core drilling investigations (Figure 8a and 8b). Based upon investigations at the Carol Project area located to the north west of Wabush 3 and Wabush 6, the main lithological units are of sedimentary origin and consist of paragneiss, schist, marble, quartzite and iron formation. Associated with these units are gabbroic intrusives that display prominent contact metamorphism on a local scale. Due to significant deformation from tight folding and local thrust faulting, stratigraphic repetitions and thickening of units are common.

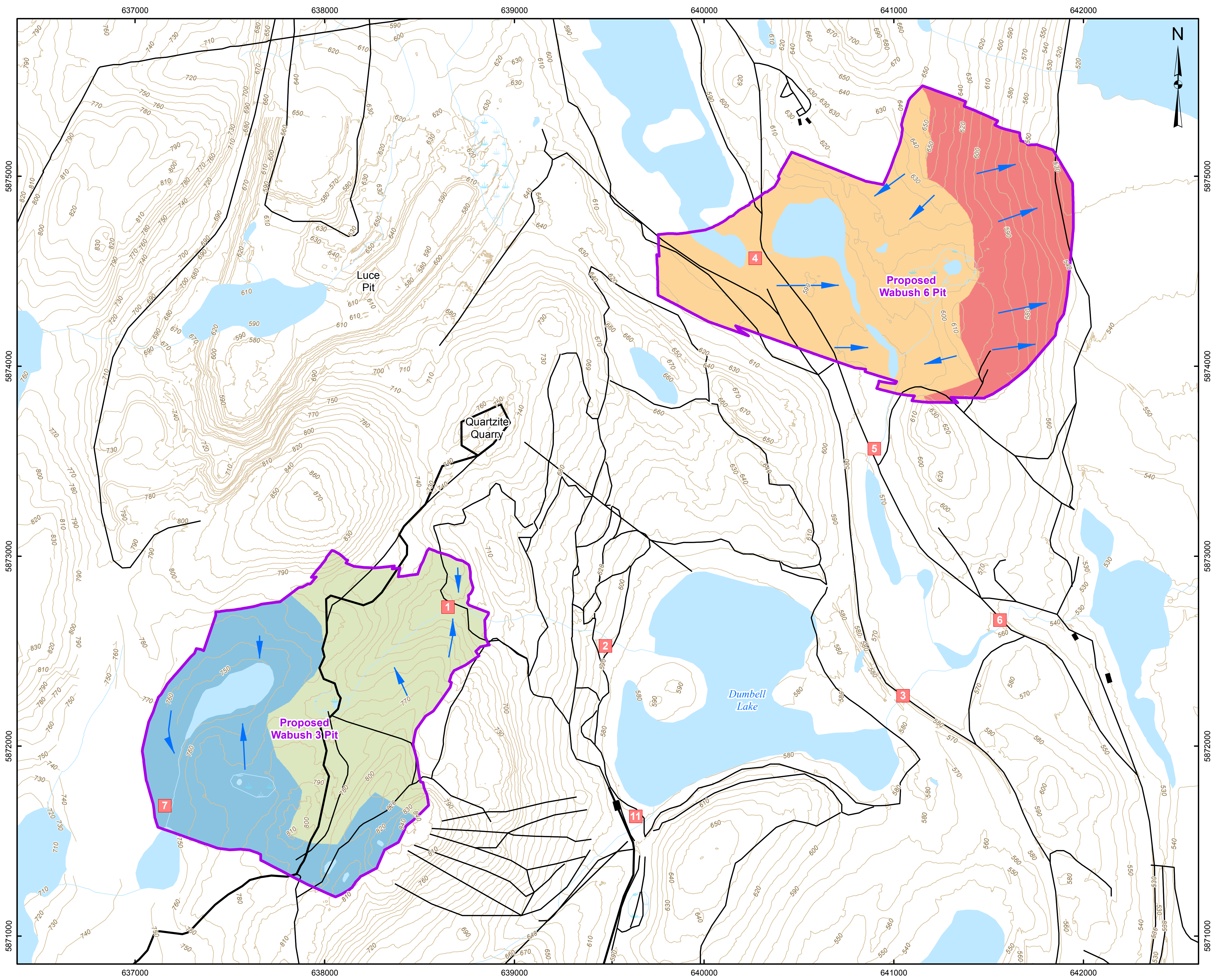
The thickness of the surficial overburden beneath Wabush 3 and Wabush 6 sites, based upon IOC borehole drilling collar lengths, typically ranges from approximately 1 m to 15 m. The Newfoundland and Labrador Department of Natural Resources overburden geological map indicates that the study area is underlain by “undifferentiated till”, consisting of glacial till described as a silty sand to silty sand with gravel (Newfoundland Geosciences Ltd., 2001).

Bedrock geology mapping provided by IOC is shown on Figures 3, 8a and 8b and in Appendix A, which details the main lithologic formations and rock units encountered surficially in the area of Wabush 3 and Wabush 6. An overview of the main formations is provided below. The formations are referred to by the names provided by the Geological Survey of Canada (GSC), with local formation names in parentheses.

The Sokoman (Wabush Iron) Formation, which hosts the iron ore deposits, is underlain by the Wishart (Carol) Formation. The Wishart Formation consists mainly of massive, medium to coarse-grained, white orthoquartzite, and has an estimated thickness ranging between 60 and 90 m. The upper contact is gradational with the Sokoman Formation. The Wishart Formation and the upper unit in particular, can be encountered in a friable state due to leaching. In this state, the rocks are generally enriched by limonite, goethite and pyrolusite.

The Sokoman (Wabush Iron) Formation hosts the iron ore deposits, and consists of three members: the Upper, Middle and Lower Iron Formation members. The following summarizes iron formation facies within each member of the Wabush Iron Formation, based on Piteau (2002).

The Lower Iron Formation (LIF) consists of mainly carbonate or carbonate-silicate facies iron formation, with zones of oxide-facies iron formation containing magnetite. The Middle Iron Formation (MIF) is the main ore zone, and consists of oxide facies iron formation that contains abundant magnetite and specularite. The magnetite content is variable, such that it is generally more abundant near the base and the top of the member, and relatively scarce in the middle of the member. The Upper Iron Formation (UIF) consists mainly of carbonate-silicate facies iron formation with secondary zones of oxide facies iron formation.



LEGEND

- Contours (10m Interval)
- Surface Water Flow Direction
- 1 Surface Water Monitoring Locations

Contributing Area To Watershed

- 🟦 Dumbell Lake
- 🟩 Leg Lake
- 🟧 Luce Lake
- 🟥 Wabush Lake
- ☐ Proposed Pit Boundary

Base Data

- Building
- Watercourse
- Wetland
- Waterbody

REFERENCE

Base Data - Canvec V.8,2011
Elevation data derived from Canvec and files provided to
Golder Associates by IOC dated 2004 and 2011.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

0 125 250 500 750 1,000
SCALE 1:20,000 METRES

PROJECT
RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

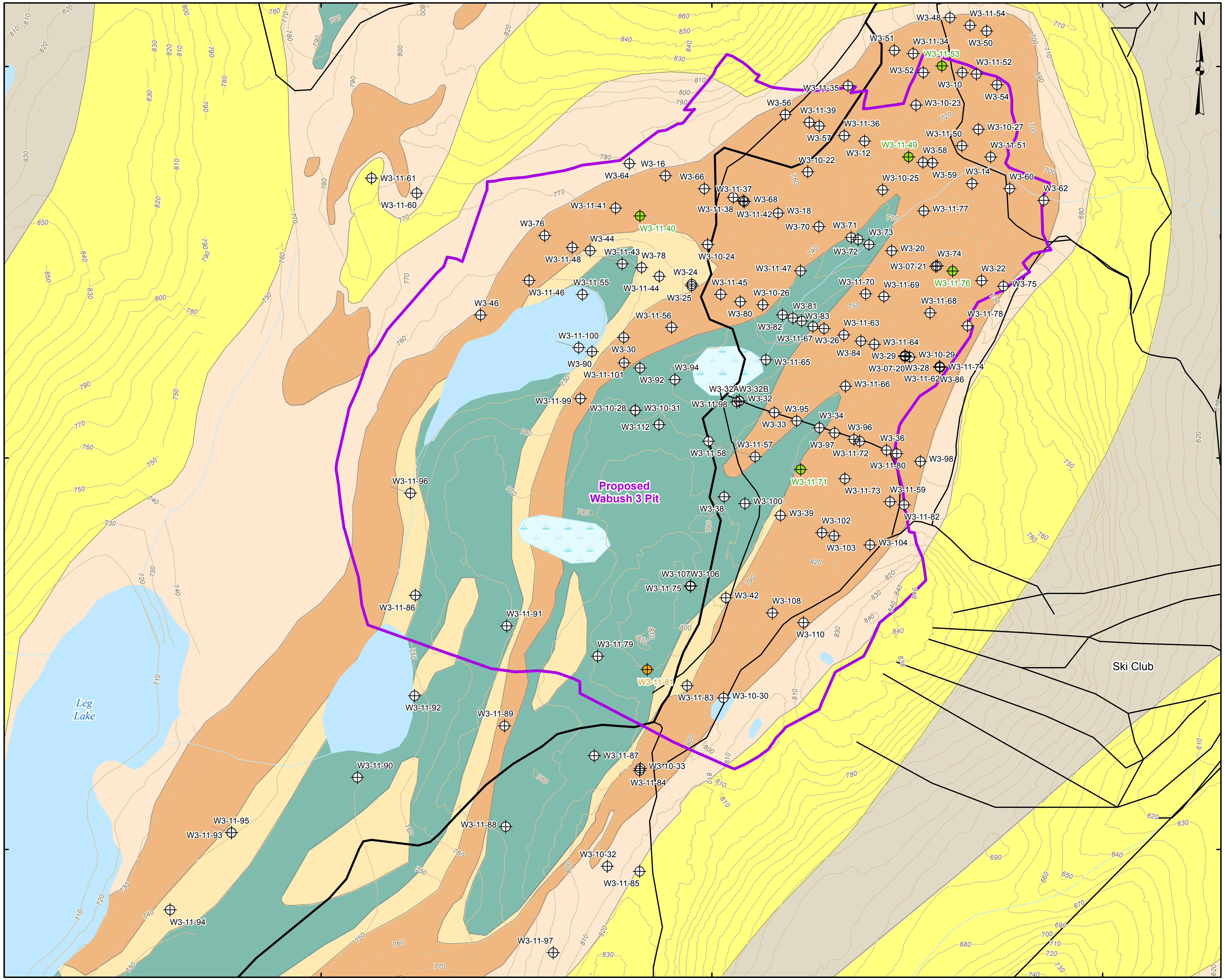
TITLE

SITE FLOW SHEET FOR WABUSH 3 AND WABUSH 6

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	1 Dec. 2011	FIGURE: 7	
GIS	JO	9 Dec. 2011		
CHECK	PMMC	9 Dec. 2011		
REVIEW	RB	9 Dec. 2011		

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Phase1000\Figure 7 - Site Flow Sheet for Wabush 3 and Wabush 6.mxd



LEGEND

- ⊕ IOC Borehole Location
- ⊕ IOC Cored Boreholes
- ⊕ IOC Cored Boreholes (Not Packer Tested)
- Contours (10m Interval)
- Highway
- Site Access Road
- Other Road / Trail
- ▭ Proposed Pit Boundary

Detailed Bedrock Geology

- 🟩 Shabogamo Intrusive
- ▨ Menihek Formation
- ▨ Undifferentiated Iron Formation
- ▨ Upper Iron Formation
- 🟧 Middle Iron Formation
- ▨ Lower Iron Formation
- 🟨 Wishart Formation
- 🟦 Denault
- ▨ Attikamagen Formation

Unconformity

- ▨ Ashuanipi Complex

Base Data

- Watercourse
- Wetland
- Waterbody

REFERENCE

Base Data - Canvec V.8,2011
Elevation data derived from Canvec and files provided to Golder Associates by IOC dated 2004 and 2011.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

0 50 100 200 300 400
SCALE 1:10,000 METRES

PROJECT
RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE
LOCATION OF WABUSH 3 IOC CORED BOREHOLES AND SELECT BOREHOLES PACKER TESTED AND MONITORING WELLS INSTALLED

Golder Associates
Mississauga, Ontario

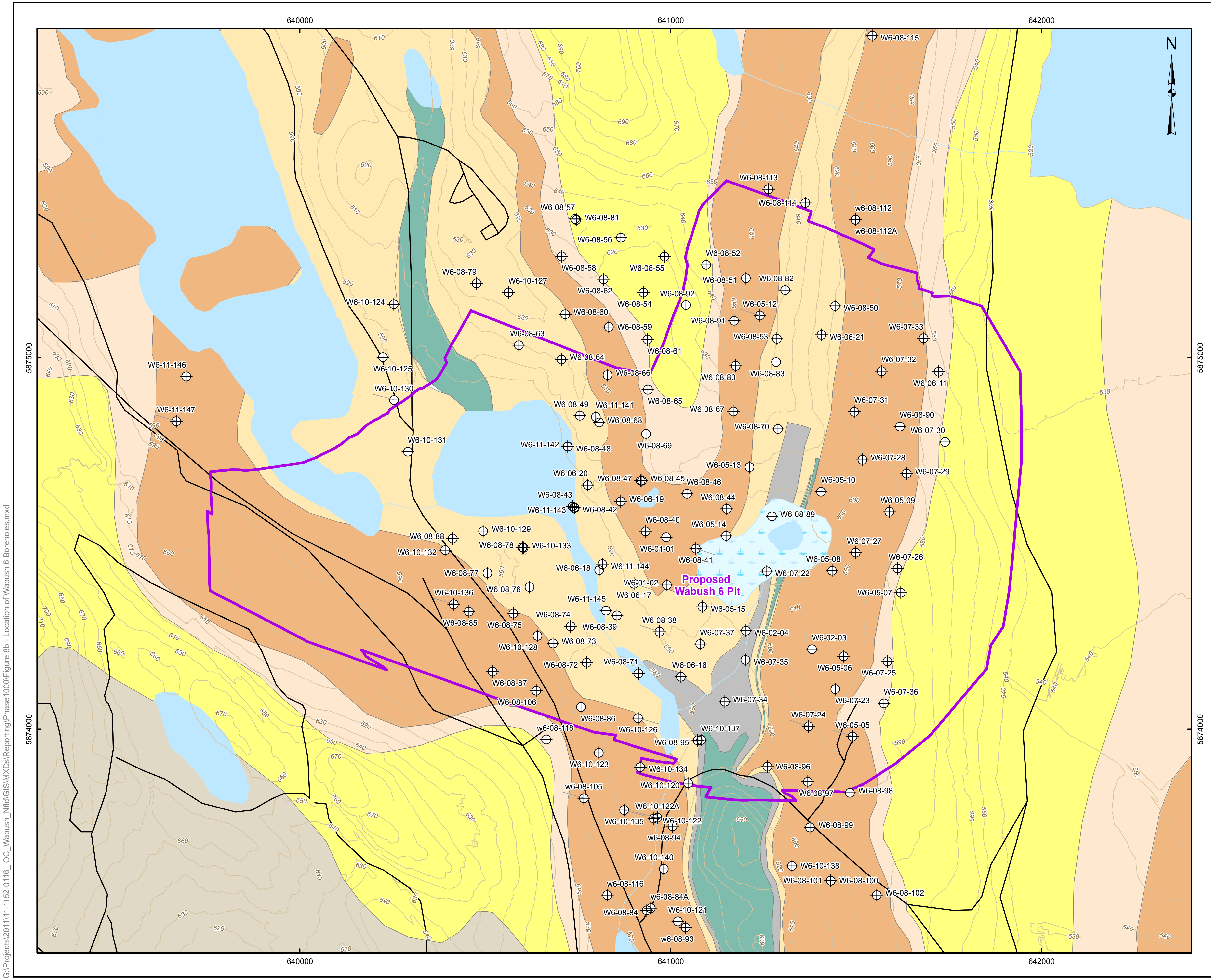
PROJECT NO. 11-1152-0116		
DESIGN	JO	1 Dec. 2011
GIS	JO	9 Dec. 2011
CHECK	PMMC	9 Dec. 2011
REVIEW	RB	9 Dec. 2011

SCALE AS SHOWN
REV. 0.0

FIGURE: 8a

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Phase1000\Figure 8a - Location of Wabush 3 Boreholes.mxd

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Phase1000\Figure 8b - Location of Wabush 6 Boreholes.mxd



LEGEND

⊕ IOC Borehole Location
⊕ IOC Cored Boreholes
⊕ IOC Cored Boreholes (Not Packer Tested)
— Highway
— Site Access Road
— Other Road / Trail
— Contours (10m Interval)
▭ Proposed Pit Boundary

Detailed Bedrock Geology

▨ Shabogamo Intrusive
▨ Menihek Formation
▨ Undifferentiated Iron Formation
▨ Upper Iron Formation
▨ Middle Iron Formation
▨ Lower Iron Formation
▨ Wishart Formation
▨ Denault
▨ Attikamagen Formation

Unconformity

▨ Ashuanipi Complex

Base Data

— Watercourse
▨ Wetland
▨ Waterbody

REFERENCE

Base Data - Canvec V.8,2011
Elevation data derived from Canvec and files provided to
Golder Associates by IOC dated 2004 and 2011.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

0 50 100 200 300 400
SCALE 1:10,000 METRES

PROJECT

RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE

LOCATION OF WABUSH 6 IOC CORED BOREHOLES AND SELECT BOREHOLES PACKER TESTED AND MONITORING WELLS INSTALLED

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116			SCALE AS SHOWN	REV. 0.0
DESIGN	JO	1 Dec. 2011		
GIS	JO	9 Dec. 2011		
CHECK	PMMC	9 Dec. 2011		
REVIEW	RB	9 Dec. 2011		

FIGURE: 8b

Overlying the Sokoman Formation is the Menihek (Nault) Formation, which is approximately 15 to 30 m thick and is comprised of graphitic and micaceous schists. The most recent rocks are comprised of gabbroic intrusives that exhibit local contact metamorphism.

Cross-sections of the geology through Wabush 3 and Wabush 6 were supplied by IOC and are provided in Appendix A. The geology data used to create these cross-sections are based upon IOC geologic interpretation of drill hole data up to approximately 2007/08 and are presented in the mine grid orientation.

4.0 FIELD PROGRAM METHODOLOGY

The groundwater and surface water field program consisted of the following tasks:

- packer testing of select boreholes to estimate the hydraulic conductivity of the bedrock;
- installation of monitoring wells for water level monitoring and groundwater quality sampling; and
- measurement of surface water flow rates and collection of surface water quality samples.

4.1 Hydraulic Conductivity Testing

Field testing of hydraulic conductivity was carried out through packer testing of the IOC cored boreholes W3-11-53, W3-11-49, W3-11-76, W3-11-40 and W3-11-71 (for borehole locations see Figure 8a). Results of the field testing are discussed further in Section 5.

A total of 44 packer tests were carried out to assess the hydraulic conductivity of the bedrock beneath the proposed Wabush 3 location. These tests were conducted in open core holes following the drilling. Typically the tests were conducted over vertical intervals ranging from 14 m to 17 m in length in each of the core holes except for the bottom of each hole, which was tested at intervals ranging from 23 m to 112 m in length, depending upon the geology. The intervals were tested from the bottom up. One exception was borehole W3-11-71, which was tested using a single packer assembly moving up the hole at increments ranging from about 48 m to 62 m. This method was used due to inclement weather conditions that required a quicker testing method to get a bulk hydraulic conductivity.

Depending upon specific borehole conditions the following packer testing procedures were implemented on-site:

- NQ wireline packer testing carried out with NQ rods and core barrel in the borehole for situations where the borehole competency is suspect; and
- Open hole packer testing using BQ rods to suspend the packer assembly and act as the test riser pipe for boreholes considered competent with limited risk of caving.

A logger was placed in the test interval and a real time reading transducer was placed at surface, both of which were used to analyse the test response. A falling head test was conducted on each test interval and if a static water level was achieved within a short period of time (<30 minutes) then a constant head test was conducted on that test interval.

4.2 Monitoring Well Installation

The following section summarizes the installation details for the five IOC boreholes (W3-11-53, W3-11-49, W3-11-76, W3-11-40 and W3-11-71) where monitoring wells were installed. It should be noted that borehole W3-11-81 was not installed with a monitoring well due to winter weather conditions.

Geological logs for the above outlined boreholes and monitoring wells are provided in Appendix A. The geologic descriptions provided in these logs were supplied by IOC. These borehole log details are provided along the borehole and have not been corrected for dip. The five boreholes were completed as multi-level piezometer nests. Screened intervals of the multi-level piezometers were positioned based upon hydraulic conductivity testing. Screened intervals were properly sealed with bentonite and/or bentonite grout to eliminate vertical hydraulic connection between isolated screened units.

Installation of PVC monitoring wells (piezometers) were completed by the drilling contractor, Les Forages LBM Inc. with guidance from Golder. The number of piezometers installed varied from two to three per borehole using PVC pipe risers and slotted screens that ranged from 3/4” to 2” diameter. A sandpack was placed around the slotted screen extending across the interval of interest. A hydraulic seal of bentonite was placed between nested sandpack intervals to hydraulically separate the monitored zones. Above the shallowest interval, the hole was infilled with bentonite or grouted to surface and completed with a protective lockable lid above the ground casing.

4.3 Baseline Monitoring

Baseline monitoring was carried out for both groundwater and surface water locations on and near the Wabush 3 and surface water locations near the Wabush 6 proposed pit sites (see Figure 6 and 8a for locations).

4.3.1 Groundwater Level Monitoring

At Wabush 3, groundwater levels were collected during monitoring well installation and water level data loggers were installed at the six corehole locations. A summary the wells with logger installations is provided in Table 1 below.

Table 1: Summary of Groundwater Level Data Logger Installations

Well ID	Monitoring Well Installation	Diameter Monitoring Well	Loggers Installed	Barologger Installed
W3-11-53 (P-03)	3 Wells	1 "	Deep, Middle, Shallow	
W3-11-49 (P-08)	3 Wells	1 "	Deep, Middle, Shallow	
W3-11-76 (P-16)	2 Wells	1 "	Deep	
W3-11-40 (P-18)	3 Wells	1 "	Deep, Middle	Shallow
W3-11-71 (P-49)	2 Wells	3/4 " in deep and 2" in shallow	Shallow well only	
W3-11-81 (P-64)	NA	NA	one	

The loggers were set to record four times a day, which allows for approximately six to eight months of data collection between data logger downloads. Given that loggers can sometimes fail, it is advisable to download the loggers quarterly as access allows. The hydrographs for these wells are presented in Appendix A. These hydrographs currently only show one manual groundwater level and these will be updated with logger data once they are downloaded in the Spring of 2012.

At Wabush 6, groundwater level data for IOC boreholes was not available from IOC therefore hydrogeologic conditions will be inferred from data gathered from Wabush 3.

4.3.2 Groundwater Quality Monitoring

Groundwater quality sampling was conducted at Wabush 3 to characterize the existing groundwater quality at the site, provide water quality data to assess potential discharge water quality and determine the baseline bedrock groundwater quality.

Sampling occurred in October and November, 2011 at these five monitoring well nests at Wabush 3 (W3-11-53, W3-11-49, W3-11-76, W3-11-40 and W3-11-71). Samples were obtained from a select number of monitoring well intervals based upon obtaining a representative sample and available water.

Sampling was conducted in accordance with standard practices to obtain a representative sample and to avoid cross contamination between monitoring locations. Chemical analysis was carried out by Maxxam Analytics Inc. (Maxxam) of Nova Scotia; a specialist environmental laboratory with extensive experience in chemical analyses of groundwater.

A total of eight groundwater samples were collected as part of this sampling event as summarized in Table 2 below.

Table 2: Summary of Groundwater Quality Sampling Locations

Well ID	Water Quality Sample
W3-11-53 (P-03)	Deep and Middle (and duplicate from deep well)
W3-11-49 (P-08)	Deep, Middle and Shallow
W3-11-76 (P-16)	Deep only
W3-11-40 (P-18)	Deep only
W3-11-71 (P-49)	Deep only
W3-11-81 (P-64)	NA

For QA/QC purposes, one blind duplicate sample was obtained. The analytical laboratory (Maxxam) regularly conducts internal QA/QC programs, which are required in order to meet the requirements of the Canadian Association of Environmental Analytical Laboratories (CAEAL).

Groundwater quality samples were collected from each developed well for the analyses of a broad suite of inorganic parameters including pH, conductivity, major ions and heavy metals, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), nitrates, nitrites and ammonia. The one duplicate sample was collected to verify that the laboratory's analytical methods are reproducible and reliable.

The results were tabulated and compared to the Guidelines for Canadian Drinking Water Quality, Health Canada, December 2010. This was done to provide a relative comparison only, as the water will not be used for human consumption.

4.3.3 Surface Water Flow Monitoring

The surface water monitoring program consisted of instantaneous flow measurements taken from September 15 to 17, 2011 at 11 locations within the Dumbell Lake, Luce Lake and Leg Lake watershed areas, as shown on Figure 6. Photographs of this monitoring are presented in Appendix D. Monitoring locations SW1, SW2, SW11 and SW3 are within the Dumbell Lake watershed, SW4 and SW5 are within the Luce Lake watershed. Locations SW3 and SW5 are on two separate streams, which confluence prior to SW6. Monitoring locations SW7, SW8, SW9 and SW10 are located within the Leg Lake watershed area.

One discrete flow measurement at each monitoring location was made using standard hydrometric methods for flow measurements in natural channels. The hydrometric methods, in general, follow the Hydrometric Field Manual – Measurement of Streamflow prepared by R.A. Terzi (1981). Flow measurements were taken using a Valeport Model 801 Electromagnetic Flow Meter and a Valeport Model BFM002 BRAYSTOKE Impeller Flow Meter. The creek cross-sections were divided into 0.2 m or 0.5 m wide segments. The velocity and depth were measured at each segment. The depth was used to estimate the cross-sectional flow area of each segment of the creek. This area was multiplied by the average velocity in the segment measured at 60% depth (or the 20% and 80% depth during high water level measurements) to estimate the flow in that segment. The sum of the flows in all segments yields the total flow at the station at the time of each measurement.

4.3.4 Surface Water Quality Monitoring

Surface water quality sampling was conducted during the flow monitoring measurements from September 15 to 16, 2011 to characterize the existing surface water quality near Wabush 3 and Wabush 6 and to provide baseline water quality data to compare to potential discharge water quality. Sampling occurred at seven locations: SW2, SW4, SW6, SW7, SW8, SW9 and SW10 as shown on Figure 6.

Sampling was conducted in accordance with standard practices to obtain a representative sample and to avoid cross contamination between monitoring locations. As with the groundwater sampling, chemical analysis was carried out by Maxxam and one blind duplicate sample was taken for QA/QC purposes.

The surface water samples were analyzed for a broad suite of inorganic parameters including pH, conductivity, major ions and heavy metals, TDS, TSS, nitrates, nitrites and ammonia following the same suite as for groundwater. The test results were compared to the Canadian Council Minister's of the Environment (CCME) Canadian Environmental Quality Guidelines Long Term Exposure Limits surface water quality regulatory criteria.

5.0 HYDROGEOLOGY FIELD PROGRAM RESULTS

The hydrogeological characteristics of the bedrock formations in the Wabush 3 area have been assessed based on hydraulic conductivity testing of the bedrock, groundwater levels measured to determine flow directions and groundwater quality analysis results from this investigation.

5.1 Hydraulic Conductivity

Hydraulic conductivity was estimated for the bedrock units based on the field testing results at Wabush 3. Testing was carried out in the form of packer testing in the core holes. The following discusses the results of the testing, while the detailed analyses are provided in Appendix B.

Packer Testing

The results of 44 packer tests from five borehole locations in the vicinity of Wabush 3 were analysed using the Hvorslev method for the falling head test and the Thiem method for the constant head test analysis.

A summary of the packer test results is provided in Table 3 attached and detailed summary sheets are provided in Appendix B.

The core logging and packer testing results indicate that the permeability of the bedrock is primarily related to open, near-horizontal bedding partings within the rock. Therefore, the hydraulic conductivity values determined during packer testing are considered to primarily reflect horizontal permeability along the open bedding partings.

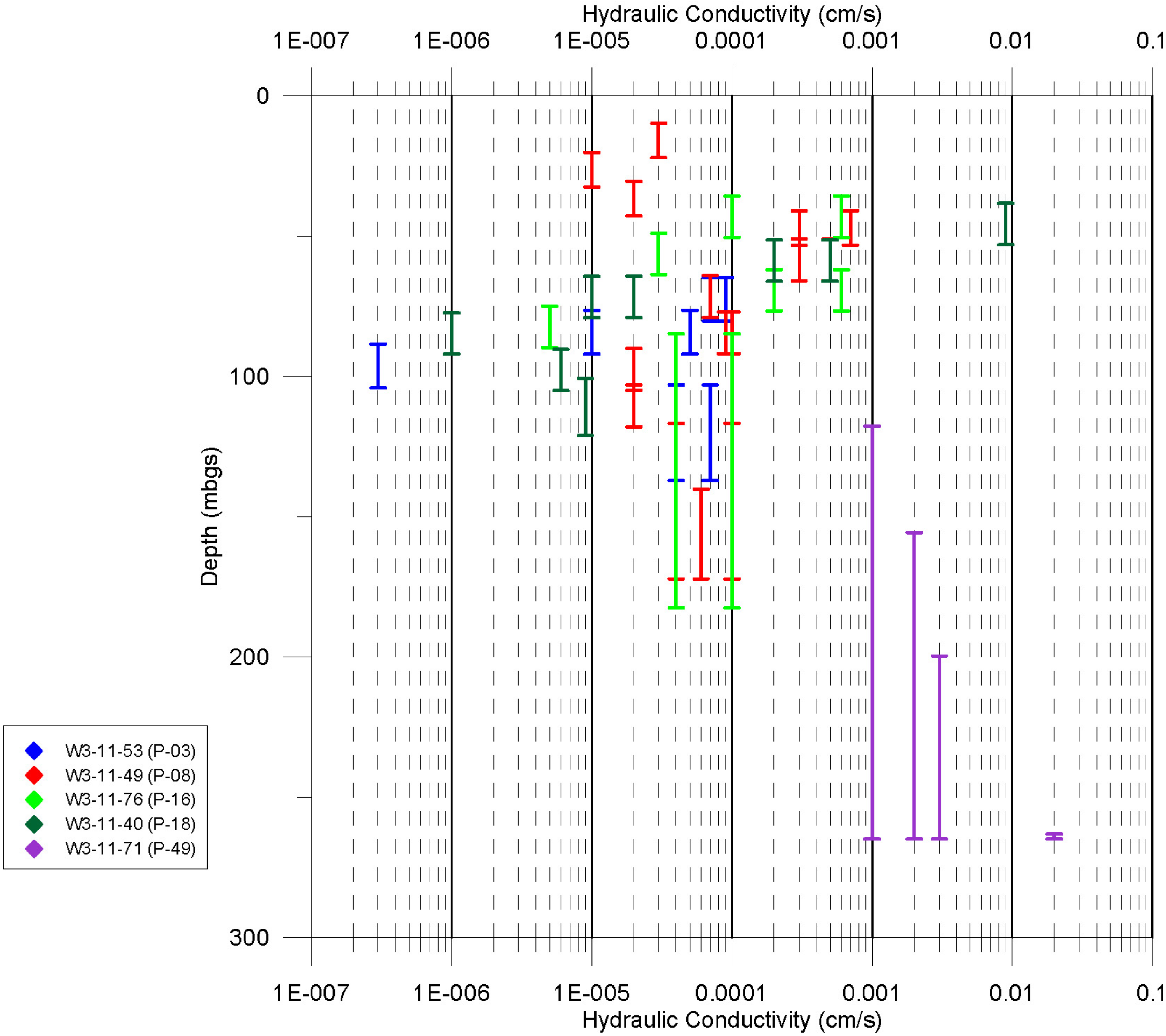
The packer testing results are presented in the form of a scatter plot with increasing depth below ground surface (refer to Figure 9). There is variation in hydraulic conductivity both spatially and with depth but there are two groups of hydraulic conductivities as follows:

- Shallower bedrock (0 mbgs to 76 mbgs) has hydraulic conductivity that generally ranges between 1 x 10^{-5} cm/sec and 7 x 10^{-4} cm/sec; and
- Deeper bedrock (76 mbgs to 182 mbgs) has hydraulic conductivity that generally ranges between 3 x 10^{-7} cm/sec and 1 x 10^{-4} cm/sec.

The exception to this grouping are the results of W3-11-71, which shows how the bulk hydraulic conductivity can be controlled by a very permeable opening as seen at approximately 263 to 264.8 mbgs which has a hydraulic conductivity of 2 x 10^{-2} cm/sec. The open hole testing above this point is 1 x 10^{-3} cm/sec to 3 x 10^{-3} cm/sec.

The geomean of these results is 8.03 x 10^{-5} cm/sec and the arithmetic mean is 9.15 x 10^{-4} cm/sec.

The results of the packer testing generally indicate a wide range of hydraulic conductivity over the discrete 14 m to 17 m intervals tested. However, the overall, or bulk hydraulic conductivity, will be largely controlled by the more permeable fractures. Where geophysical data from Wabush 3 (calliper and acoustic data) indicated a permeable opening this was confirmed by packer testing results which showed more permeable hydraulic conductivity (see Appendix E for DGI results).



PROJECT
RIO TINTO-IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE
SUMMARY OF HYDRAULIC CONDUCTIVITY WITH DEPTH BELOW GROUND SURFACE

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116		
DESIGN	PMMC	12 Dec. 2011
GIS	JO	12 Dec. 2011
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REVIEW	RB	12 Dec. 2011

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REV. 0.0

FIGURE: 9

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Phase1000\Figure 9 - Summary of hydraulic conductivity with depth below ground surface.mxd

Table 3: Summary of Hydraulic Conductivity Analysis

Well ID	Type of Test	Test interval m along angled hole		Test interval mbgs		Hydraulic Conductivity (cm/sec)	Approximate number of occurrences of conductive sections according to acoustic televiewer and calliper data from DGI	Comment
		Depth	Bottom	Depth	Bottom			
W3-11-53 (P-03)	falling head test	65.33	81.03	64.69	80.33	9.00E-05	85	Televiewer data analysis from 3.20 m to 134.20
W3-11-53 (P-03)	constant rate test	65.33	81.03	64.69	80.33	7.00E-05		
W3-11-53 (P-03)	falling head test	77.13	92.83	76.45	92.09	5.00E-05	31	
W3-11-53 (P-03)	constant rate test	77.13	92.83	76.45	92.09	1.00E-05		
W3-11-53 (P-03)	falling head test	89.17	104.87	88.44	104.08	3.00E-07	0	
W3-11-53 (P-03)	falling head test	103.79	138	103.01	137.09	7.00E-05	293	
W3-11-53 (P-03)	constant rate test	103.79	138	103.01	137.09	4.00E-05		
W3-11-49 (P-08)	falling head test	11.5	25.7	9.79	22.08	3.00E-05	23	Televiewer data analysis from 8.4 m to 176.4 m
W3-11-49 (P-08)	falling head test	23.5	37.7	20.18	32.48	1.00E-05	62	
W3-11-49 (P-08)	falling head test	35.5	49.7	30.57	42.87	2.00E-05	59	
W3-11-49 (P-08)	falling head test	47.5	61.7	40.96	53.26	3.00E-04	54	
W3-11-49 (P-08)	constant rate test	47.5	61.7	40.96	53.26	7.00E-04		
W3-11-49 (P-08)	falling head test	59.15	76.35	51.05	65.95	3.00E-04	53	
W3-11-49 (P-08)	constant rate test	59.15	76.35	51.05	65.95	5.00E-04		
W3-11-49 (P-08)	falling head test	74.15	91.35	64.04	78.94	7.00E-05	81	
W3-11-49 (P-08)	constant rate test	74.15	91.35	64.04	78.94	7.00E-05		
W3-11-49 (P-08)	falling head test	89.15	106.35	77.03	91.93	9.00E-05	32	
W3-11-49 (P-08)	constant rate test	89.15	106.35	77.03	91.93	1.00E-04		
W3-11-49 (P-08)	falling head test	104.15	121.35	90.02	104.92	2.00E-05	10	
W3-11-49 (P-08)	falling head test	119.15	136.35	103.01	117.91	2.00E-05	13	
W3-11-49 (P-08)	falling head test	135	199	116.74	172.17	1.00E-04	199	
W3-11-49 (P-08)	constant rate test	135	199	116.74	172.17	4.00E-05		
W3-11-49 (P-08)	falling head test	162.12	199	140.23	172.17	6.00E-05	11	
W3-11-49 (P-08)	constant rate test	162.12	199	140.23	172.17	6.00E-05		

Well ID	Type of Test	Test interval m along angled hole		Test interval mbgs		Hydraulic Conductivity (cm/sec)	Approximate number of occurrences of conductive sections according to acoustic televiewer and calliper data from DGI	Comment
		Depth	Bottom	Depth	Bottom			
W3-11-40 (P-18)	constant rate test	44.5	61.5	38.38	53.10	9.00E-03	-	Televiewer data analysis from 8.6 m to 138.20 m
W3-11-40 (P-18)	falling head test	59.5	76.5	51.37	66.10	2.00E-04	34	
W3-11-40 (P-18)	constant rate test	59.5	76.5	51.37	66.10	5.00E-04		
W3-11-40 (P-18)	falling head test	74.5	91.5	64.36	79.09	1.00E-05	3	
W3-11-40 (P-18)	constant rate test	74.5	91.5	64.36	79.09	2.00E-05		
W3-11-40 (P-18)	falling head test	89.5	106.5	77.35	92.08	1.00E-06	0	
W3-11-40 (P-18)	falling head test	104.5	121.5	90.34	105.07	6.00E-06	0	
W3-11-40 (P-18)	falling head test	116.5	140	100.74	121.09	9.00E-06	1	
W3-11-76 (P-16)	falling head test	41.5	58.5	35.72	50.45	1.00E-04	2	Televiewer data analysis from 3 m to 110.0 m
W3-11-76 (P-16)	constant rate test	41.5	58.5	35.72	50.45	6.00E-04		
W3-11-76 (P-16)	falling head test	56.8	73.8	48.97	63.70	3.00E-05	17	
W3-11-76 (P-16)	falling head test	71.82	88.82	61.98	76.70	2.00E-04	20	
W3-11-76 (P-16)	constant rate test	71.82	88.82	61.98	76.70	6.00E-04		
W3-11-76 (P-16)	falling head test	86.85	103.85	75.00	89.72	5.00E-06	16	
W3-11-76 (P-16)	falling head test	98.19	211	84.82	182.51	4.00E-05	14	
W3-11-76 (P-16)	constant rate test	98.19	211	84.82	182.51	1.00E-04		
W3-11-71 (P-49)	falling head test	136.18	306	117.77	264.84	1.00E-03	142	Televiewer data analysis from 5.2 to 300.0 m
W3-11-71 (P-49)	falling head test	179.95	306	155.68	264.84	2.00E-03	146	
W3-11-71 (P-49)	falling head test	230.75	306	199.67	264.84	3.00E-03		
W3-11-71 (P-49)	falling head test	303.98	306	263.09	264.84	2.00E-02	-	
					Geomean	8.03E-05		
					Arithmetic mean	9.15E-04		

Typically the sections of the borehole with acoustic and calliper information that indicate a permeable opening had packer testing results that ranged from 10^{-4} to 10^{-5} cm/sec (refer to Table 3).

The range in hydraulic conductivity from the packer testing at Wabush 3 is a similar range to the historical hydraulic conductivities stated in the Piteau 2002 report that reviewed select hydrogeology data from 1965 to 1981. The Piteau 2002 report stated a reasonable average rock mass hydraulic conductivity to be used for seepage calculations is 1×10^{-4} to 5×10^{-4} cm/sec which is also similar to the value of 5×10^{-4} cm/sec Golder used for groundwater seepage estimates as outlined in Section 7 below and in Appendix F.

The hydraulic conductivity results from Wabush 3 are assumed to be similar to the bedrock hydrogeology in the immediate vicinity of Wabush 6.

5.2 Groundwater Levels and Flow Directions

The following is a discussion of the groundwater levels and flow direction at, and within the vicinity of, Wabush 3 based upon the groundwater levels measured at the open borehole and at the monitoring wells water level monitoring.

A summary of the groundwater level monitoring is provided in Table 4. Figures 10a and 10b have a cross-section through Wabush 3 that show select wells Golder obtained water levels from.

A monitoring well nest W3-11-49, which was installed at approximately 25, 87 and 127 mbgs in the topographic low in the north east part of Wabush 3, has a shallow groundwater level of 11 mbgs (704 masl) which was measured in all three wells within the nest. This water level may be partially controlled by the surface water level, which is approximately 700 masl in the area of this well nest. Therefore the groundwater levels in the topographic lows are anticipated to vary in accordance with the stream level.

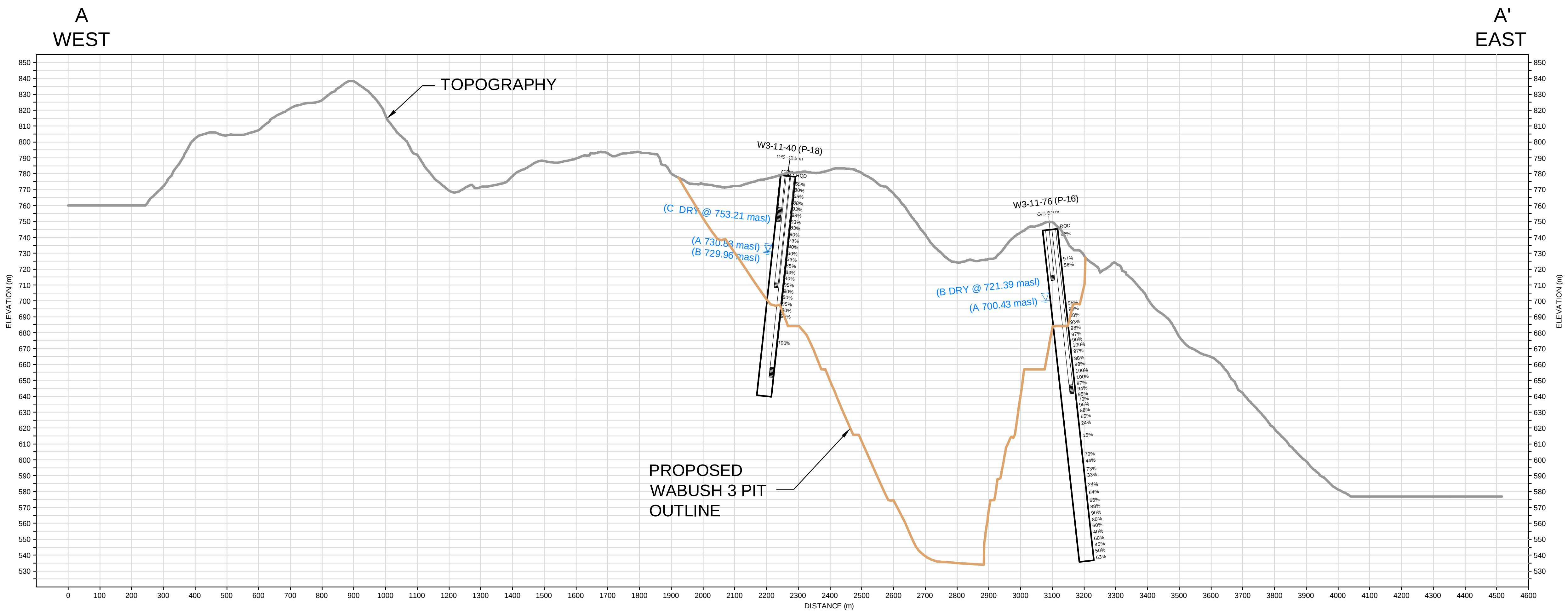
At Wabush 3 the measured groundwater levels in the topographic highs were:

- Dry at 25 to 27 mbgs on the northwest and southeast parts of site.
- 29 to 48 mbgs for the wells installed approximately 72 to 118 mbgs.
- 77 mbgs on the southeast side of the site within the deep well which was drilled to 262 mbgs.
- 20 m below the surface water body elevation at the well on the northwest topographic high. The well is located near a surface water body that has an elevation of approx 745 to 750 masl and the groundwater level in the wells were 117 and 71 mbgs, which represents a water level of approx 730 masl.

Table 4: Summary of Wabush 3 Depth of Monitoring Wells and Groundwater Levels

	Well Depth along hole (mbgs)	Water Level along hole (mbgs)	Vertical Groundwater Level (mbgs)	Vertical Monitoring Well Depth (mbgs)	Groundwater Elevation (masl)	Monitoring Well Depth Elevation (masl)
Information **W3-11-53(P-03)**						
Deep	129.75	35.25	35.12	129.26	690.98	596.84
Middle	80.05	32.05	31.93	79.75	694.17	646.35
Shallow	35.85	31.35	31.23	35.71	694.87	690.39
Casing around 3 PVC wells stick up from ground surface: 0.75 m						
Ground elevation (masl)	**726.1**					
Information **W3-11-49(P-08)**						
Well ID						
Deep	146.63	13.22	11.45	126.99	704.05	588.51
Middle	100.23	13.03	11.28	86.80	704.22	628.70
Shallow	29.33	12.73	11.02	25.40	704.48	690.10
Casing around 3 PVC wells stick up from ground surface: 0.67 m						
Ground elevation (masl)	**715.5**					
Information **W3-11-40(P-18)**						
Well ID						
Deep	136.02	55.16	47.77	117.80	730.83	660.80
Middle	82.72	56.17	48.64	71.64	729.96	706.96
Shallow	29.32		Dry	25.39	dry @ 753.21	753.21
Casing around 3 PVC wells stick up from ground surface: 0.58 m						
Ground elevation (masl)	**778.6**					
Information **W3-11-76(P-16)**						
Well ID						
Deep	104.32	55.62	48.17	90.34	700.43	658.26
Shallow	31.42	Dry	Dry at 27.21	27.21	dry @ 721.39	721.39
Casing around 3 PVC wells stick up from ground surface: 0.68 m						
Ground elevation (masl)	**748.6**					

	Well Depth along hole (mbgs)	Water Level along hole (mbgs)	Vertical Groundwater Level (mbgs)	Vertical Monitoring Well Depth (mbgs)	Groundwater Elevation (masl)	Monitoring Well Depth Elevation (masl)
Information **W3-11-71(P-49)**						
Well ID						
Deep	302.51	88.51	76.65	261.98	705.15	519.82
Middle	115.51	33.46	28.98	100.03	752.82	681.77
Casing around 3 PVC wells stick up from ground surface: 0.49 m						
Ground elevation (masl)	**781.8**					
Information **W3-11-81(P-64)**						
Well ID						
Deep	477	17.3	14.98	413.09	783.62	385.51
Casing around 3 PVC wells stick up from ground surface: 0.50 m						
Ground elevation (masl)	**798.6**					



300 0 300 600

SCALE HORIZONTAL 1:15000 METRES

60 0 60 120

SCALE VERTICAL 1:3000 METRES

REFERENCES:

1. GEOMATIQUE G.P.L. CONSULTANTS, QUEBEC. BASED ON AERIAL PHOTOGRAPHS TAKEN IN 2004. ORIGINAL SCALE 1:2,000.
2. AERO-PHOTO (1961) INC, QUEBEC. BASED ON AERIAL PHOTOGRAPHS TAKEN IN 2011. ORIGINAL SCALE 1:10,000.
3. ALL OTHER AREAS HAVE TOPOGRAPHY OBTAINED FROM CANVEC V.8, 2011. ORIGINAL SCALE 1:50,000.
4. PRELIMINARY EXTRACTION PLANS FOR PROPOSED WABUSH 3 PIT PROVIDED BY IOC OCTOBER 2011 (BASED UPON 2007 IOC DRILLING DATA).

NOTE:

1. FOR CROSS-SECTION LOCATION REFER TO FIGURE 6.

PROJECT
RITO TINTO - IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE

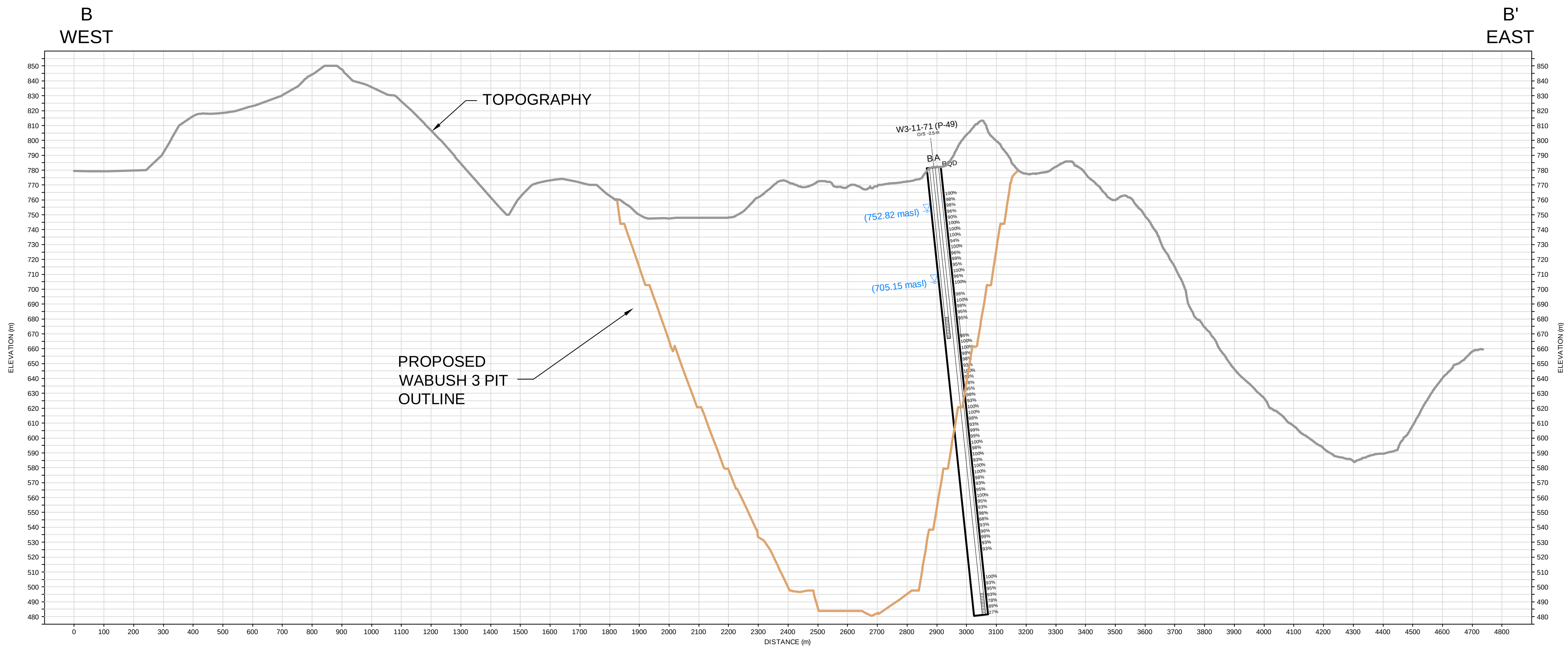
WABUSH 3 CROSS-SECTION A-A'

Golder Associates
Mississauga, Ontario, Canada

PROJECT No.		11-1152-0116
DESIGN		
CAD	JFC	12/16/2011
CHECK	PM	12/16/2011
REVIEW	RB	12/16/2011

FILE No. 1111520116AA010A.dwg
SCALE AS SHOWN REV. A
DRAWING No.
10A

PLOT DATE: December 16, 2011
FILENAME: T:\Projects\2011\11-1152-0116 (IOC, Wabush)\-AA-\1111520116AA010A.dwg



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SCALE HORIZONTAL 1:15000 METRES

60 0 60 120

SCALE VERTICAL 1:3000 METRES

REFERENCES:

1. GEOMATIQUE G.P.L. CONSULTANTS, QUEBEC. BASED ON AERIAL PHOTOGRAPHS TAKEN IN 2004. ORIGINAL SCALE 1:2,000.
2. AERO-PHOTO (1961) INC, QUEBEC. BASED ON AERIAL PHOTOGRAPHS TAKEN IN 2011. ORIGINAL SCALE 1:10,000.
3. ALL OTHER AREAS HAVE TOPOGRAPHY OBTAINED FROM CANVEC V.8, 2011. ORIGINAL SCALE 1:50,000.
4. PRELIMINARY EXTRACTION PLANS FOR PROPOSED WABUSH 3 PIT PROVIDED BY IOC OCTOBER 2011 (BASED UPON 2007 IOC DRILLING DATA).

NOTE:

1. FOR CROSS-SECTION LOCATION REFER TO FIGURE 6.

PROJECT

RITO TINTO - IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE

WABUSH 3 CROSS-SECTION B-B'

Golder Associates
Mississauga, Ontario, Canada

PROJECT No.		11-1152-0116
DESIGN		
CAD	JFC	12/16/2011
CHECK	PM	12/16/2011
REVIEW	RB	12/16/2011

FILE No. 1111520116AA010B.dwg
SCALE AS SHOWN REV. A
DRAWING No.
10B

PLOT DATE: December 16, 2011
FILENAME: T:\Projects\2011\11-1152-0116 (IOC, Wabush)\-AA-\1111520116AA010B.dwg

Based upon these groundwater level observations the following general conclusions can be made about the hydrogeology of Wabush 3:

- The groundwater system is divided into a shallow and deep aquifer system;
- The overall groundwater gradient is downward as shown on Figures 10a and 10b;
- The north part of Wabush 3 has a portion of groundwater flow which is discharging to the on-site stream which flows in an easterly direction;
- The south part of Wabush 3 has a portion of groundwater flow which is discharging to the off-site lake to the southwest; and
- It is unlikely that the surface water body on-site at Wabush 3 is recharging the groundwater in that area.

Groundwater level data for Wabush 6 does not exist; therefore the following assumptions have been applied:

- Based upon IOC borehole data the geology and general fracture frequency of Wabush 6 is similar to Wabush 3;
- Wabush 6 is divided into two watersheds, Luce Lake and Wabush Lake, with the west two thirds of the site having surface water flow south ward and the remaining one third of the site drains to the east to Wabush Lake;
- The topography of Wabush 6 is more gently rolling than Wabush 3 with approximately half the change in relative topography of Wabush 3;
- Wabush 6 has an on-site surface water body at approximately 580 to 585 masl;
- Wabush 6 is located down gradient of Luce Lake with a surface water elevation of approx 580 masl; and
- Directly to the east of Wabush 6 is Wabush Lake with a water level of approx 520 masl.

The groundwater at Wabush 6 is likely heavily influenced by the nearby surface water bodies and therefore the Wabush 6 groundwater regime is assumed to be as follows:

- The groundwater system may be divided into a shallow and deep aquifer system;
- The overall groundwater gradient is downward;
- The western two thirds may have a portion of shallow groundwater flow discharging to the on-site surface water body;
- The eastern one third may have a portion of the shallow groundwater flow discharging to Wabush Lake to the east; and
- It is likely that the surface water bodies to the north and on-site may be recharging the groundwater in that area.

5.3 Groundwater Quality Results

The samples obtained were analyzed for a broad suite of parameters considered appropriate to characterize the groundwater geochemistry and evaluate background water quality conditions. A summary of all analytical results are provided in Table 5 and the original laboratory results are provided in Appendix C.

As mentioned previously, the results were compared to the Guidelines for Canadian Drinking Water Quality, Health Canada, December 2010 as a relative comparison only. The findings are as follows:

- All groundwater samples exceeded the Maximum Acceptable Concentration (MAC) for turbidity. The groundwater samples were only filtered for metals analyses.
- All groundwater samples exceeded the Aesthetic Objective (AO) for manganese of 50 µg/L, with values ranging from 87.2 µg/L to 4040 µg/L. The groundwater samples from the wells W3-11-49-shallow and W3-11-40-deep both exceeded the AO for aluminum of 100 µg/L, with values of 223 µg/L and 141 µg/L, respectively. Only the sample from W3-11-40-deep exceeded the AO for iron of 300 µg/L, with a value of 432 µg/L.
- Overall when comparing the samples from the shallow or middle wells to the samples from the deep wells, there were four main differences in the analytical results. Samples from shallow or middle wells generally had higher values for total organic carbon and turbidity than in samples from deep wells. Whereas, samples from deep wells generally had higher values for hardness and pH than in samples from shallow or middle wells. The groundwater from the shallow and middle wells can be considered “soft”, with hardness values of less than 60 mg/L. In contrast, the deep wells generally contained “hard” water, with hardness values of greater than 60 mg/L. In addition, the samples from the shallow and middle wells generally had higher values for iron, manganese and sodium; whereas the samples from the deep wells generally had higher values for calcium, magnesium and potassium. Due to the higher pH in the deep groundwater, there is likely more carbonate ions to combine with the calcium and magnesium, resulting in greater hardness values. Conversely, the lower pH of the shallow groundwater results in more free ions of iron in solution.

The one duplicate sample was collected to verify that the laboratory’s analytical methods are reproducible and reliable. The duplicate sample for W3-11-53 deep and the original W3-11-53 deep sample agree within 10% for most parameters. The exceptions were for total organic carbon, total suspended solids, aluminum, antimony, cobalt, iron, nickel and zinc, which had differences of up to 38%. The laboratory duplicate sample for W3-11-40-deep was only analyzed for conductivity and pH, both of which agreed within 10% of the original W3-11-40-deep sample. The duplicate sample for W3-11-71-deep was analyzed for metals only, which agreed within 10% of the original W3-11-71-deep sample, with the exception of aluminum and boron, having differences of up to 24%. Given these results, the laboratory’s analytical methods are deemed reproducible and reliable.

Table 5: **Summary of Groundwater Quality**

					11/10/2011	11/10/2011	11/10/2011	11/1/2011	10/31/2011	11/1/2011	11/8/2011	11/11/2011	11/11/2011	11/8/2011	11/8/2011
Parameter	**Units**	**RDL**	**MAC[1]**	**AO[2]**	**W3-11-53 (P-03)-DEEP**	**DUP1 P-03 DEEP**	**W3-11-53 (P-03)-MIDDLE**	**W-3-11-49 (P-08)-DEEP**	**W-3-11-49 (P-08))-MIDDLE**	**W-3-11-49 (P-08)-SHALLOW**	**W3-11-76 (P-16)-DEEP**	**W3-11-40 (P-18)-DEEP**	**W3-11-40 (P-18)-DEEP Lab-Dup**	**W3-11-71 (P-49)-DEEP**	**W3-11-71 (P-49)-DEEP Lab-Dup**
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1			65	65	48	96	60	50	60	135	-	43	-
Carb. Alkalinity (calc. as CaCO3)	mg/L	1			ND	ND	ND	ND	ND	ND	ND	4	-	ND	-
Total Alkalinity (Total as CaCO3)	mg/L	5			65	65	48	96	60	50	60	140	-	43	-
Hardness (CaCO3)	mg/L	1			64	65	31	70	32	21	59	150	-	41	-
Calculated TDS	mg/L	1		500	70	71	54	104	68	61	64	151	-	50	-
Conductivity	uS/cm	1			110	110	84	160	110	92	110	260	260	80	-
Dissolved Chloride (Cl)	mg/L	1		250	ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-
pH	pH	n/a		6.5 - 8.5	7.85	7.84	7.73	7.44	6.99	7.28	8.01	8.46	8.36	7.79	-
Orthophosphate (P)	mg/L	0.01			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-
Total Organic Carbon (C)	mg/L	0.5			2.8	3.2	5.1	22	55	27	0.7	ND	-	0.8	-
Dissolved Sulphate (SO4)	mg/L	2		500	ND	ND	ND	ND	ND	2	ND	7	-	ND	-
Turbidity	NTU	0.1	0.3/1.0/0.1[3]		**2.6**	**2.6**	**13**	**31**	**160**	**74**	**0.5**	**81**	**-**	**4.2**	**-**
Colour	TCU	5		15	ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-
Dissolved Fluoride (F-)	mg/L	0.1	1.5		ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-
Total Suspended Solids	mg/L	1			4	5	43	80	240	160	8	260	-	21	-
Bromide (Br-)	mg/L	1			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-
Nitrate + Nitrite	mg/L	0.05			0.12	0.13	ND	ND	ND	ND	ND	ND	-	ND	-
Nitrite (N)	mg/L	0.01	1		ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-
Nitrate (N)	mg/L	0.05	10		0.12	0.13	ND	ND	ND	ND	ND	ND	-	ND	-
Total Ammonia - N	mg/L	0.05			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Unionized Ammonia	mg/L	n/a			-	-	-	-	-	-	-	-	-	-	-
Metals[4]															
Dissolved Aluminum (Al)	ug/L	5.0		100/200[5]	8.4	12.1	24.5	13.8	40.1	223	12.4	141	-	15.8	12.9
Dissolved Antimony (Sb)	ug/L	1.0	6*		1.2	1.5	1.7	2.3	2.2	2.3	ND	ND	-	ND	ND
Dissolved Arsenic (As)	ug/L	1.0	10		ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Barium (Ba)	ug/L	1.0	1000		2.9	2.6	8.6	7	11.4	61.8	72.9	34.1	-	26.8	25.8
Dissolved Beryllium (Be)	ug/L	1.0			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Bismuth (Bi)	ug/L	2.0			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Boron (B)	ug/L	50	5000*		ND	ND	ND	ND	ND	ND	ND	ND	-	66	ND
Dissolved Cadmium (Cd)	ug/L	0.017	5		ND	ND	ND	0.03	0.048	0.047	ND	0.057	-	ND	ND
Dissolved Calcium (Ca)	ug/L	100			15500	15700	7950	16600	8330	5960	12100	25400	-	11700	11900
Dissolved Chromium (Cr)	ug/L	1.0	50		ND	ND	1.2	1.2	3.4	1.2	ND	ND	-	ND	ND
Dissolved Cobalt (Co)	ug/L	0.40			19.3	12	12.5	27.2	34.9	23.9	10.1	6.56	-	6.51	6.22
Dissolved Copper (Cu)	ug/L	2.0		1000	ND	ND	ND	ND	8.4	5.5	ND	ND	-	ND	ND
Dissolved Iron (Fe)	ug/L	50		300	ND	59	ND	ND	142	432	ND	97	-	ND	ND
Dissolved Lead (Pb)	ug/L	0.50	10		ND	ND	ND	ND	ND	0.81	ND	ND	-	ND	ND

					11/10/2011	11/10/2011	11/10/2011	11/1/2011	10/31/2011	11/1/2011	11/8/2011	11/11/2011	11/11/2011	11/8/2011	11/8/2011
Parameter	**Units**	**RDL**	**MAC[1]**	**AO[2]**	**W3-11-53 (P-03)-DEEP**	**DUP1 P-03 DEEP**	**W3-11-53 (P-03)-MIDDLE**	**W-3-11-49 (P-08)-DEEP**	**W-3-11-49 (P-08))-MIDDLE**	**W-3-11-49 (P-08)-SHALLOW**	**W3-11-76 (P-16)-DEEP**	**W3-11-40 (P-18)-DEEP**	**W3-11-40 (P-18)-DEEP Lab-Dup**	**W3-11-71 (P-49)-DEEP**	**W3-11-71 (P-49)-DEEP Lab-Dup**
Dissolved Magnesium (Mg)	ug/L	100			6190	6270	2660	6800	2640	1530	7090	21100	-	2810	2730
Dissolved Manganese (Mn)	ug/L	2.0		50	305	306	824	3850	4040	2110	130	87.2	-	115	112
Dissolved Molybdenum (Mo)	ug/L	2.0			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Nickel (Ni)	ug/L	2.0			2.7	ND	3.3	4	7.6	5.5	2.1	ND	-	ND	ND
Dissolved Phosphorus (P)	ug/L	100			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Potassium (K)	ug/L	100			784	803	452	1210	913	749	958	2420	-	762	701
Dissolved Selenium (Se)	ug/L	1.0	10		ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Silver (Ag)	ug/L	0.10			ND	ND	ND	ND	0.21	0.46	ND	ND	-	ND	ND
Dissolved Sodium (Na)	ug/L	100		200000	984	1010	7660	11000	11500	14000	1340	2010	-	1910	1850
Dissolved Strontium (Sr)	ug/L	2.0			15.8	15.9	33.4	22.5	15.9	23.2	22.7	53.1	-	21.3	20.4
Dissolved Thallium (Tl)	ug/L	0.10			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Tin (Sn)	ug/L	2.0			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Titanium (Ti)	ug/L	2.0			ND	ND	ND	ND	ND	4.1	ND	ND	-	ND	ND
Dissolved Uranium (U)	ug/L	0.10	20*		ND	ND	ND	ND	ND	0.16	ND	0.25	-	ND	ND
Dissolved Vanadium (V)	ug/L	2.0			ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
Dissolved Zinc (Zn)	ug/L	5.0		5000	46.7	32.5	31.3	37	36.9	63.7	34.8	33.5	-	23.8	21.7
Dissolved Mercury (Hg)	ug/L	0.013	1		ND	ND	ND	ND	ND	ND	ND	ND	-	ND	-

Notes

1. MAC = Maximum Acceptable Concentration, Table 5, Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010; Interim MAC (*); exceedences of MAC are in **red bold**.

2. AO = Aesthetic Objective, Table 5, Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010; exceedences of AO are in red.

3. Health-based turbidity limits (Table 1, SGCDWQ) are 0.3 NTU for conventional treatment, 1.0 NTU for slow sand or diatomaceous earth filtration and 0.1 NTU for membrane filtration; NTU = Nephelometric Turbidity Unit.

4. All groundwater samples were filtered in the field for metals only; therefore, the concentrations of metals are dissolved (not total).

5. Operation guidance values for aluminium are 100 ug/L for conventional treatment plants using aluminium-based coagulants, and 200 ug/L for other treatment systems.

TCU = True Colour Unit

ND = Not detected

n/a = not applicable

6.0 SURFACE WATER FIELD PROGRAM RESULTS

The surface water field program primarily consisted of instantaneous flow monitoring and water quality sampling during the September 2011 site visit.

6.1 Surface Water Flow Monitoring

Surface water flow monitoring was conducted at a total of 11 locations as described in Section 4.3.3 and shown on Figure 6. The instantaneous flow measurements were compiled to provide a baseline characterization of the stream flows surrounding Wabush 3 and Wabush 6. The drainage area upstream of each location and the measured flow were used to estimate the unit flow per square kilometre (L/s/km^2) within each catchment. This provides an indication of the potential groundwater contribution to the flow at each monitoring location. It is assumed that the majority of the water in the streams at the time of the measurements was base flow derived from groundwater discharge since the amount of precipitation within the previous month was minimal.

The instantaneous flow measurements and upstream catchment areas to each monitoring location are outlined in Table 6.

Table 6: Summary of Surface Water Flow Monitoring Data

Date	Location	Measured Flow (L/s)	Catchment (km^2)	Unit Flow L/s/km^2	Notes
Sept 16, 2011	SW1	5	1.0	5	Located in Wabush 3
Sept 16, 2011	SW2	83	1.8	45	Downstream of Falls; upstream of Dumbell Lake
Sept 16, 2011	SW3	219	8.3	26	Downstream of Dumbell Lake
Sept 16, 2011	SW4	659	10.2	65	Downstream of Luce Lake; Located in Wabush 6
Sept 16, 2011	SW5	845	12.6	67	Downstream of a lake between SW4 and SW5
Sept 16, 2011	SW6	977	22.0	44	Catchment SW6 includes SW3 + SW5 flow
Sept 16, 2011	SW7	22	1.1	21	Located in Wabush 3
Sept 16, 2011	SW8	180	7.2	25	Downstream of Leg Lake
Sept 16, 2011	SW9	21	3.3	6	Upstream of Tanya Lake
Sept 16, 2011	SW10	199	16.0	12	Downstream of SW8 and SW9; Upstream of Harrie Lake confluence
Sept 17, 2011	SW11	63	2.1	30	Upstream of Dumbell Lake

Monitoring locations SW3, SW5, SW6, SW8 and SW10 are all located downstream of a lake or water body. A lake/water body can cause a decrease (attenuation) in flow from upstream to downstream depending on the available storage within the water body; therefore, the flows measured at SW3, SW5, SW6, SW8 and SW10 may be influenced by the upstream lakes.

6.2 Precipitation Data during Monitoring

During the flow monitoring field work, from September 15 to 17, 2011 minor precipitation occurred (1.6 to 6.8 mm), as shown on Figure 11. Table 7 provides the date and amount of precipitation which fell based on EC data Climate ID 8504175.

Table 7: Wabush Airport Precipitation September 15 - 17, 2011

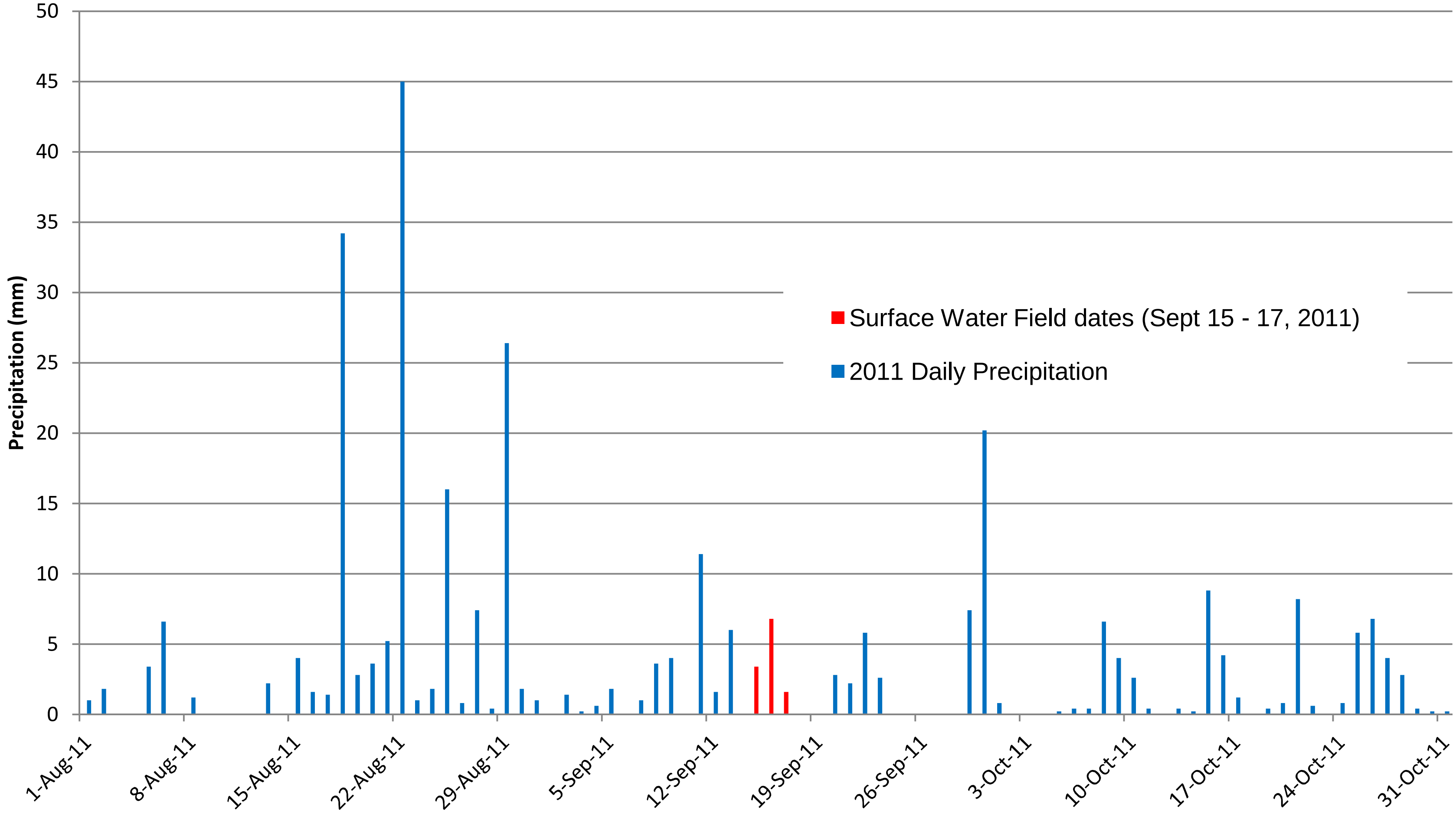
Date	Precipitation (mm)
September 15, 2011	3.4
September 16, 2011	6.8
September 17, 2011	1.6

Wabush 3

Monitoring locations SW1 and SW7 are located within the proposed Wabush 3 pit boundary. Based on the instantaneous measured flow at SW1 the unit flow was approximately 5 and 21 L/s/km^2, respectively. SW2 is located downstream of SW1 (Wabush 3) and upstream of Dumbell Lake. The unit flow for this catchment area was approximately 45 L/s/km^2 which is nine times more than what was measured at SW1. The majority of the drainage area to SW2 is located upstream of SW1, which suggests that SW2 receives a significant amount of groundwater discharge. Monitoring location SW11 is located on a tributary at the south west side of Dumbell Lake. The unit flow for this catchment area was approximately 30 L/s/km^2 which suggests that SW11 also could receive a significant groundwater input. Moving downstream to SW3, downstream of Dumbell Lake, the unit flow decreases to 26 L/s/km^2 reflecting a large watershed with a corresponding large lake.

Monitoring location SW7 is located in the headwaters of the south western drainage area directly upstream of Leg Lake. Since Leg Lake is downstream of SW7 and upstream of SW8, a comparison between these two stations would not accurately represent the groundwater contribution over the increased amount of drainage area. By comparing SW7 to SW1, since both locations are within the Wabush 3 site, SW7 was estimated to have a unit flow of 21 L/s/km^2 which is four times greater than SW1. This indicates that SW7 could receive a significant groundwater input. Moving downstream to SW8, downstream of Leg Lake, the unit flow was approximately to 25 L/s/km^2 which is comparable to SW3. Monitoring location SW9 has a drainage area of 3.3 km^2; and the unit flow for this catchment area is approximately 6 L/s/km^2, indicating that the rock may be tighter within this area (relative to other areas) minimizing the groundwater contribution.

August to October 2011 Daily Precipitation - Wabush Airport Climate Station (ID 8504175) | **Figure 11**



DATE: December 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: **MK**

CHK: **PMcC**

Wabush 6

Monitoring location SW4 is located within Wabush 6 and has an estimated unit flow per km^2 of 65 $L/s/km^2$. SW5 is located downstream of SW4 and has a unit flow of approximately 67 $L/s/km^2$. Both locations exhibit a high unit flow, likely due to the influence of the Luce Pit dewatering discharge into Luce Lake. Since the unit flow at both SW4 and SW5 were similar this indicates that groundwater contribution to the watercourse does not increase over the Wabush 6 area when compared to the upstream drainage area. Location SW6 (44 $L/s/km^2$) is also influenced by the Luce Pit discharge; however, the unit flow at SW6 is also influenced by the storage within the lake downstream of SW5, Dumbell Lake and the unit flow within catchment SW3 which does not receive Luce Pit dewatering discharge.

6.3 Surface Water Quality Results

The samples obtained were analyzed for a broad suite of parameters considered appropriate to characterize the surface water chemistry and evaluate background water quality conditions. A summary of all analytical results are provided in Table 8 and the original laboratory results are provided in Appendix C.

Sampling occurred at seven locations: SW2, SW4, SW6, SW7, SW8, SW9 and SW10 as shown on Figure 6. The results were compared to CCME Canadian Environmental Quality Guidelines Long Term Exposure Limits surface water quality regulatory criteria. The findings are as follows:

- At SW4 and SW6, which are located downstream of Luce Lake and the Luce Pit discharge, Nitrite exceeded the CCME guideline of 0.06 mg/L.
- SW7, which is located within Wabush 3, exceeded the Total Iron criteria of 300 μg/L with a result of 322 μg/L. Total Chromium was analysed to be 6.6 μg/L. The criteria for hexavalent Chromium is 1.0 μg/L and for trivalent Chromium is 8.9 μg/L. The result of 6.6 μg/L of Total Chromium was not separated into hexavalent and trivalent Chromium, therefore, the hexavalent Chromium criteria of 1.0 μg/L was used for comparison purposes to be conservative. Total Aluminum exceeded the CCME guideline of 100 μg/L when pH is > 6.5 with a result of 107 μg/L.
- SW9, which is located upstream of Tanya Lake, showed a result of 1.7 μg/L of Total Chromium. As stated above, the hexavalent Chromium criteria of 1.0 μg/L was used for comparison purposes to be conservative. Therefore, SW9 exceeded the hexavalent Chromium criteria.

A duplicate sample was collected at SW6 to verify that the laboratory’s analytical methods are reproducible and reliable. More than 88% of the 53 measured parameters for the duplicate sample were within 10% of the concentrations measured for the original sample at SW6. The exceptions were for total organic carbon and ammonia, which had differences of up to 21% and Total Suspended Solids (TSS) which differed by 1 mg/L. Therefore the laboratory’s analytical methods are deemed reproducible and reliable.

Table 8: Surface Water Quality Summary

Parameter	Units	RDL	CCME [1,2]	SW2	SW4	SW6	SW7	SW8	SW9	SW10	Dup (SW6)
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1		38	109	98	41	33	43	30	89
Carb. Alkalinity (calc. as CaCO3)	mg/L	1		<1	2	2	<1	<1	<1	<1	1
Total Alkalinity (Total as CaCO3)	mg/L	5		38	110	100	41	33	44	30	90
Hardness (CaCO3)	mg/L	1		34	170	140	39	33	41	29	140
Calculated TDS	mg/L	1		41	238	189	42	38	46	33	181
Conductivity	uS/cm	1		71	430	330	78	65	82	61	330
Dissolved Chloride (Cl)	mg/L	1		<1	33	23	<1	<1	<1	<1	23
pH	pH		6.5 - 9.0	7.87	8.35	8.24	7.84	7.75	7.92	7.71	8.23
Orthophosphate (P)	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Organic Carbon (C)	mg/L	0.5		<0.5	1.1	1.4	3.4	2.3	1	1.9	1.7
Dissolved Sulphate (SO4)	mg/L	2		<2	14	11	<2	2	<2	<2	11
Turbidity	NTU	0.1		<0.1	0.3	0.3	0.3	0.3	0.2	0.9	0.3
Colour	TCU	5		<5	<5	6	18	12	5	12	5
Dissolved Fluoride (F-)	mg/L	0.1	0.12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Suspended Solids	mg/L	1		<2	1	1	8	1	1	4	2
Bromide (Br-)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1
Nitrate + Nitrite	mg/L	0.05		0.14	11	7.6	<0.05	<0.05	0.11	<0.05	7.5
Nitrite (N)	mg/L	0.01	0.06	<0.01	**0.12**	**0.08**	<0.01	<0.01	<0.01	<0.01	**0.08**
Nitrate (N)	mg/L	0.05	13	0.14	11	7.5	<0.05	<0.05	0.11	<0.05	7.4
Total Ammonia - N	mg/L	0.05		<0.05	0.43	0.22	<0.05	<0.05	<0.05	<0.05	0.19
Unionized Ammonia	mg/L	n/a	0.019	0.000	0.017	0.007	0.000	0.000	0.000	0.000	0.006
Metals											
Total Aluminum (Al)	ug/L	5.0	5 - 100 [3]	14.7	26.3	22.3	**107**	26.9	18.5	77.8	20.1
Dissolved Aluminum (Al)	ug/L	5.0		6.5	<5.0	<5.0	18.9	15.1	5.3	9.7	6.6
Total Antimony (Sb)	ug/L	1.0		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Arsenic (As)	ug/L	1.0	5.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Barium (Ba)	ug/L	1.0		2.5	7.3	8.0	9.2	7.3	5.2	7.1	8.2

Parameter	Units	RDL	CCME [1,2]	SW2	SW4	SW6	SW7	SW8	SW9	SW10	Dup (SW6)
Total Beryllium (Be)	ug/L	1.0		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Bismuth (Bi)	ug/L	2.0		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	ug/L	50	1500	<50	<50	<50	<50	<50	<50	<50	<50
Total Cadmium (Cd)	ug/L	0.017	0.011 - 0.052[4]	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017
Total Calcium (Ca)	ug/L	100		8040	33400	26800	10200	8220	10300	7270	26500
Total Chromium (Cr)	ug/L	1.0	1 [5]	<1.0	<1.0	<1.0	**6.6**	<1.0	**1.7**	<1.0	<1.0
Total Cobalt (Co)	ug/L	0.40		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Total Copper (Cu)	ug/L	2.0	2 - 3.72 [6]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Iron (Fe)	ug/L	50	300	<50	141	112	**322**	<50	<50	192	100
Total Lead (Pb)	ug/L	0.50	1 - 6.25 [7]	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.70	<0.50
Total Magnesium (Mg)	ug/L	100		3610	23300	18000	4000	3020	3790	2820	17200
Total Manganese (Mn)	ug/L	2.0		<2.0	27.8	33.5	91.1	3.8	4.2	22.4	31.4
Total Molybdenum (Mo)	ug/L	2.0	73	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	ug/L	2.0	37.3 - 143 [8]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Phosphorus (P)	ug/L	100		<100	<100	<100	<100	<100	<100	<100	<100
Total Potassium (K)	ug/L	100		617	2360	2070	638	741	759	793	1960
Total Selenium (Se)	ug/L	1.0	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Silver (Ag)	ug/L	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Sodium (Na)	ug/L	100		452	15400	11100	472	517	447	767	10700
Total Strontium (Sr)	ug/L	2.0		9.4	33.5	28.5	9.1	9.7	10.5	10.0	27.4
Total Thallium (Tl)	ug/L	0.10	0.8	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	ug/L	2.0		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	ug/L	2.0		<2.0	2.3	<2.0	3.9	<2.0	<2.0	4.3	2.1
Total Uranium (U)	ug/L	0.10	15	<0.10	0.31	0.24	<0.10	<0.10	<0.10	<0.10	0.22
Total Vanadium (V)	ug/L	2.0		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	ug/L	5.0	30	<5.0	<5.0	<5.0	10.0	<5.0	<5.0	8.1	<5.0
Total Mercury (Hg)	ug/L	0.013	0.026	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013

Parameter	Units	RDL	CCME [1,2]	SW2	SW4	SW6	SW7	SW8	SW9	SW10	Dup (SW6)
Notes											

1. CCME = Canadian Council Minister's of the Environment Canadian Environmental Quality Guidelines Long Term Exposure Limits

2. **Exceeds CCME**

3. 5 µg/L for pH <6.5, 100 µg/L for pH >6.5

4. The limit for Cadmium is based on hardness. Limits were estimated using the equation: Limit = $10^{0.86*[Log10(hardness)] - 3.2}$ µg/L

5. Limit is 1.0 µg/L for hexavalent chromium and 8.9 µg/L for trivalent chromium. Hexavalent is assumed as a conservative measure

6. The minimum limit for Copper is 2.0 µg/L. The upper limit is based on hardness using the equation: Limit = $e^{0.8545[\ln(hardness)] - 1.465}$ * 0.2 µg/L

7. The minimum limit for Lead is 1.0 µg/L. The upper limit is based on hardness using the equation: Limit = $e^{1.273[\ln(hardness)]-4.705}$ µg/L

8. The limit for Nickel is based on hardness. Limits were estimated using the equation: Limit = $e^{0.76[\ln(hardness)] + 1.06}$ µg/L

6.4 Groundwater-Surface Water Quality Comparison

Groundwater and surface water quality results were compared to each other for metals to determine if groundwater was potentially discharging to surface water. This comparison showed that there was a significant groundwater inflow to SW7 (which discharges at the south west end of Wabush 3) as evident by elevated concentrations of iron, aluminum, titanium and chromium which can be attributed to groundwater flow through iron formations. It should be noted that SW4 and SW6 receive discharge from Luce Pit which is receiving a significant groundwater contribution as evident by elevated concentrations of select metals such as magnesium and elevated hardness which are both attributed to groundwater flow through the dolostone that is adjacent to the iron formation. The discharge is also influenced by the un-combusted materials associated with blasting, such as elevated concentrations of nitrate, nitrite and ammonia. The remaining locations had lower metals concentrations, suggesting they receive limited groundwater contributions.

7.0 ASSESSMENT OF POTENTIAL IMPACTS

The following sections discuss the potential impacts of pit development on the three regional watersheds as well as the proposed dewatering strategy.

7.1 Potential Impacts to Watershed Areas Due to Pit Extraction

Pit development of Wabush 3 and Wabush 6 will potentially reduce the regional catchment areas, as discussed in the following paragraphs. The potential reductions in catchment areas associated with pit development are discussed. However, influences of waste rock dump development and other land use changes are not taken into account. These features will be designed during Pre-feasibility/Feasibility Studies and their influences on the site water balances would be discussed at that time.

Wabush 3

As stated in Section 3.2, Wabush 3 is located within Dumbell Lake and Leg Lake watersheds. Subject to the dewatering arrangements for the proposed pit, the drainage area to Dumbell Lake could be reduced by approximately 1.1 km^2 due to the extraction of Wabush 3. This will result in a 59% reduction in total drainage area to monitoring point SW2 and a 13% reduction in total drainage area to Dumbell Lake which will reduce the amount of runoff and infiltration contributing to Dumbell Lake.

The drainage area to Leg Lake could reduce by approximately 1.0 km^2 due to the extraction of Wabush 3. This would result in a 15% reduction in total drainage area to monitoring location SW8 which is located downstream of Leg Lake. The extraction of Wabush 3 will reduce the amount of runoff and infiltration contributing to Leg Lake by approximately 17%.

Wabush 6

The majority of Wabush 6 is located within the Luce Lake watershed and approximately 36% drains directly to Wabush Lake. The drainage area contributing to the watercourse downstream of Wabush 6 (SW5) will reduce by approximately 1.4 km^2 due to the extraction of Wabush 6. This will result in a 12% reduction in total drainage area to monitoring point SW5. However, the discharge (surface water and groundwater) from Wabush 6 would be directed toward SW5 then SW6 and eventually to Wabush Lake.

7.2 Potential Surface Water Contribution Estimate to Wabush 3 and Wabush 6

The following sections discuss the estimated potential surface water contribution to the proposed Wabush 3 and Wabush 6 pits based on precipitation data collected at the EC Wabush Airport monitoring station (1961 to 2007) and the 2 year and 5 year 24 hour storm events as provided in the Intensity Duration Frequency (IDF) data (1974 – 2003).

Using the rainfall IDF data from EC for Wabush Airport, as provided in Table 9, the volume of precipitation which falls within Wabush 3 and Wabush 6 during the 2 year and 5 year 24 hour storm events were estimated for dewatering purposes.

Table 9: Intensity Duration Frequency Data - Wabush Airport (Climate ID 8504175) – Rainfall (mm)

Duration	2 Year (mm)	5 Year (mm)	10 Year (mm)	25 Year (mm)	50 Year (mm)	100 Year (mm)
5 minutes	4.2	6.2	7.5	9.2	10.4	11.7
10 minutes	5.9	8.7	10.5	12.8	14.6	16.3
15 minutes	7.0	10.4	12.6	15.4	17.5	19.6
30 minutes	9.7	14.1	17.0	20.7	23.5	26.2
1 hour	11.8	17.2	20.8	25.3	28.7	32.0
2 hours	14.8	20.4	24.1	28.7	32.2	35.6
6 hours	20.7	26.5	30.4	35.3	38.9	42.5
12 hours	27.6	34.5	39.0	44.7	49.0	53.2
24 hours	34.3	43.1	48.9	56.2	61.6	67.0

7.2.1 Wabush 3

Precipitation data collected at the EC Wabush Airport monitoring station (1961 to 2007) indicated a mean annual precipitation of 867 mm/yr. The area of the Wabush 3 proposed pit is approximately 2.1 km^2. It was assumed that approximately 80% of the precipitation which falls within the ultimate footprint will runoff and contribute to the proposed sump with the remaining 20% of the precipitation evaporating. The estimated runoff into Wabush 3 is approximately 1.46 Million m^3/yr. The estimated runoff is based on the footprint of Wabush 3 and assumes that the pit will be bermed in order to divert runoff around the pit.

Based upon an assumed 2.1 km^2 footprint of Wabush 3 the estimated 2 year 24 hour storm event would result in approximately 72,030 m^3 of water and the estimated 5 year 24 hour storm event would result in approximately 90,510 m^3.

7.2.2 Wabush 6

Precipitation data collected at the EC Wabush Airport monitoring station (1961 to 2007) indicated a mean annual precipitation of 867 mm/yr. The area of the Wabush 6 proposed pit is approximately 2.2 km^2. It was assumed that approximately 80% of the precipitation which falls within the ultimate footprint will runoff and contribute to the proposed sump with the remaining 20% of the precipitation evaporating. The estimated runoff into Wabush 6 is approximately 1.53 Million m^3/yr. The estimated runoff is based on the footprint of Wabush 6 and assumes that the pit will be bermed in order to divert runoff around the pit.

Based upon an assumed 2.2 km^2 footprint of Wabush 6 the estimated 2 year 24 hour storm event would result in approximately 75,460 m^3 of water and the estimated 5 year 24 hour storm event would result in approximately 94,820 m^3.

7.3 Luce Pit Dewatering Operations for Groundwater Seepage Model Calibration

Luce Pit is currently active and discharges groundwater and surface water to Luce Lake. The drainage area to Luce Lake is approximately 4.63 km^2. IOC provided pumping records from March to October 2011 for the in pit wells, the exterior pit wells and the sumps. These pumping records were used, in the below described groundwater model, to estimate the amount of groundwater entering the pit under existing conditions.

It is our understanding that Luce Pit currently has at least two in pit wells which pump groundwater to Luce Lake at a combined rate of approximately 90 L/s, according to the provided pumping records. The exterior wells pump a combined rate of approximately 128 L/s to Luce Lake. The sump is pumped at a rate of approximately 180 L/s to a settling pond which drains into Luce Lake. According to IOC, some seepage water was noted to drain back into the pit from Luce Lake which makes its way back to the sump. The recirculation of water from Luce Lake could not be separated from the sump discharge records.

The amount of surface water which contributes to the sump was estimated using the pumping records and the monthly precipitation from March 2011. The pumping records for March 2011 did not have data gaps and was one of the driest months throughout the year. Based on the pumping records approximately 480,400 m^3 was pumped from the sump in March 2011. With a precipitation of 75.7 mm in March 2011 and a catchment area contributing to Luce pit of 4,630,000 m^2 the precipitation contributed during March was approximately 350,490 m^3 disregarding evapotranspiration. Assuming 75% runoff, contribution from precipitation to the sump could have been in the order of 55% of the total sump discharge. The remaining volume would be groundwater taking into consideration that a portion of the remaining volume would be recirculation from the adjacent surface water bodies (e.g., Luce Lake).

7.4 Dewatering Requirements

This section outlines the calculations used to develop an estimate of the dewatering requirements for Wabush 3 and Wabush 6 pits. The estimates assume that each of these two pits have been fully mined as per the preliminary draft extraction plans provided by IOC. However, influences of waste rock dump development and other land use changes are not taken into account.

Sources of inflow (e.g., groundwater and surface water) into the proposed Pits will be comprised of direct precipitation; horizontal groundwater inflow from overburden and rock formations; and upward groundwater seepage from the underlying formations at base of the Pits.

7.4.1 Precipitation Inflow Rates

Average annual precipitation rates for the Wabush Airport meteorological station (Climate ID 8504175) from 1961 through to 2007 as provided by EC, is approximately 867 mm/year. As described in Sections 7.3.1 and 7.3.2 the annual average runoff into each proposed pit is estimated to be approximately 1.46 to 1.53 Million m^3/year (3,990 – 4,180 m^3/day) for Wabush 3 and Wabush 6, respectively.

The 2 year and 5 year 24 hour storm events would result in a stormwater volume of approximately 72,030 m^3 and 90,510 m^3 within Wabush 3 and 75,460 m^3 and 94,820 m^3 within Wabush 6, respectively.

7.4.2 Groundwater Seepage Model Construction and Assumptions

Appendix F outlines the data sources and inputs into the 3D numerical MODFLOW groundwater model of the Wabush Pits operation and regional surrounds. The ultimate goal of this modelling is to estimate inflows to the proposed Wabush 3 and Wabush 6 pits.

Two scenarios examined were:

1) **Existing Conditions:** This scenario approximates the current mining layout and incorporated the present pits, namely: Spooks, Lorraine, Humphrey Main, Humphrey South and Luce pits.

2) **Proposed Conditions:** In addition to the existing pits, this scenario incorporates the proposed Wabush 3 and Wabush 6 pits at full excavation.

It is important to note that the simulated inflows to the pits are, in part, dependent on the contours of the pits themselves (particularly when a pit is being drained to its bottom elevation). It is known that the pits have expanded and/or deepened somewhat since 2004; however, current topography is not available at the time of this analysis. Thus the use of the 2004 topographic data may tend to underestimate inflows to the pits under the Existing Conditions scenario.

Also, external to the Wabush 3 and Wabush 6 pit footprints, the 2004 topography is also used for the Proposed Condition scenario. Golder understands that the present pits will likely be considerably larger than the 2004 data by the time Wabush 3 and Wabush 6 reach their ultimate extent; however, future contours for these pits are not available. Therefore, the model results may tend to under predict future flows at Spooks, Lorraine, Humphrey Main, Humphrey South and Luce pits. Meanwhile, inflows at Wabush 3 and Wabush 6 may be over predicted (as the future additional depressurization from the surrounding pit expansions, particularly Luce, is unaccounted for).

Both scenarios are run to steady-state conditions, and simulated inflow to each pit is evaluated. A limited calibration is undertaken to approximate simulated groundwater inflows with measured groundwater inflows at Luce pit using the Existing Conditions model.

The approach utilized in this study is considered relatively high-level, with the intent to provide preliminary, “order-of-magnitude” estimates of potential pit inflows.

7.4.3 Summary of Dewatering Requirements

Estimates of dewatering, as calculated above, are summarized as follows:

Table 10: Estimated Dewatering Requirements

Location	Contributing Runoff (m^3/day)	Groundwater seepage (m^3/day)/ (m^3/yr)	Total dewatering requirements (m^3/day)
Wabush 3	3,990	59,410/21.7 million *	63,400
Wabush 6	4,180	138,940/ 50.7 million*	143,120

***Note** that these seepage values are likely an over estimation due to the data used to generate the seepage values.

The estimated dewatering requirements for Wabush 3 (21 million m^3/yr at ultimate development) is similar to the current dewatering rate of the Luce pit (12.5 million m^3/yr) which is not yet fully developed.

The higher dewatering rate at the Wabush 6 pit (50 million m^3/yr at ultimate development) reflects the influence of surface water bodies contributing to the groundwater inflow from Luce Lake and Wabush Lake, both being in close proximity.

The model predicts that the radial groundwater drawdown from each of Wabush 3 and Wabush 6 is at least 1 km from the pit. Located within this groundwater drawdown zone is the secondary domestic water supply Dumbell Lake. In addition this lake will have a reduced watershed due to the excavation of Wabush 3 therefore the groundwater and surface water contributions may be reduced by 13%.

In addition, the dewatering requirements for the 2 year and 5 year 24 hour storm events were estimated for the ultimate pit configuration for Wabush 3 and Wabush 6, based on 100% runoff, as described in Section 7.2. It is estimated that in order to dewater the pits within two days following a 2 year 24 hour storm event a pump rate of approximately 420 to 440 L/s would be required in the sumps for both pits. In order to dewater the pits within two days following a 5 year 24 hour storm event a pump rate of approximately 525 – 550 L/s would be required. The pump rate to dewater the pits over a period of three days was also estimated and resulted in pumping rates ranging from 280 – 290 L/s to discharge the 2 year storm event and 350 – 370 L/s to discharge the 5 year storm.

7.4.4 Surface Water Diversions Due to Pit Extraction

Under existing conditions there are two streams that cross Wabush 3. One stream is located within the Dumbell Lake watershed and flows towards Dumbell Lake. The second stream flows south-west towards Leg Lake. There are no streams that flow onto Wabush 3 from outside of the proposed pit boundary. Therefore, no streams require a surface water diversion around the pit. It is assumed that the pit will be bermed along the perimeter to divert runoff from the north around the pit to reduce potential pumping efforts.

Luce Lake currently extends into the proposed Wabush 6 pit boundary and flows in a southerly direction. The outlet of Luce Lake will require a diversion around Wabush 6 in order to reduce potential pumping efforts. It is assumed that the pit will be bermed along the perimeter in order to divert runoff from the upstream catchment either towards Wabush Lake or into the required diversion ditch of the Luce Lake outlet.

7.4.5 Potential Receiving Watercourses

As described above Wabush 3 is divided into two watersheds: Dumbell Lake and Leg Lake. The area of the proposed pit footprint of Wabush 3 will be removed from both the Dumbell Lake and Leg Lake watersheds. At this point it is assumed that the Wabush 3 mine water would be directed toward the current mine water discharge to Luce Lake.

The potential receiving watercourse for Wabush 6 would be the existing watercourse which is currently downstream of Luce Lake, at surface water monitoring station SW5 (refer to Figure 6). Under existing conditions this watercourse is receiving the majority of the runoff and infiltration from the Wabush 6 area. In order to maintain the flow within the downstream watercourse it will be necessary to continue to provide flow to this watercourse. Due to the increase in groundwater discharge the capacity of the receiving watercourse should be assessed to ensure that the watercourse can handle the volume of discharge water.

8.0 RISKS AND OPPORTUNITIES

The risks and opportunities of excavating Wabush 3 and Wabush 6 to the groundwater and surface water environments and nearby communities are described below:

Potential Risks

- The existing secondary domestic water supply from Dumbell Lake will be within the groundwater drawdown cones of Wabush 3 and Wabush 6.
- The catchment area currently contributing to Dumbell Lake will be reduced by 13% due to the extraction of Wabush 3. Therefore Dumbell Lake will experience a reduction in surface water input.
- It is assumed that the surface water runoff from the north of Wabush 3 to Leg Lake will be diverted around Wabush 3 by constructing berms and ditches. The diversion of water may lead to erosion of the water course due to the change from sheet flow to a concentrated flow.

- It is assumed that the Wabush 3 sump water will be discharged to Luce Lake. This increased flow through Luce Lake may lead to erosion of the downstream water course and potential flooding concerns.
- It is assumed that the Wabush 6 sump water will be discharged to the existing receiving water course which ultimately flows into Wabush Lake. Due to the increased groundwater volume from Wabush 6 the flows into the receiving watercourse will increase. This increased flow through the receiving water course may lead to erosion of the water course and potential flooding concerns.

Potential Opportunities

No opportunities were identified during the OMS.

9.0 LICENSING REQUIREMENTS AND REGULATORY FRAMEWORK

A preliminary review of key federal and provincial statutes and regulations was completed from a hydrogeological and hydrological perspective. This review focused on environmental statutes and regulations but is not exhaustive and was not intended to identify all relevant permits, licenses, approvals and authorization for pre-feasibility studies. Such a review should be completed as part of the overall site development and should be finalized based on discussions with provincial and federal regulators.

Table 11: Preliminary Review of Key Federal and Provincial Statutes and Regulations

Statute or Regulation	Specific Permits, Approvals, Authorizations or Licenses	Guidelines to be Followed	Stage of Project
Federal – Government of Canada			
Canadian Environmental Assessment Act	Environmental Assessment Approval		Development
Fisheries Act	Works or Undertakings Affecting Fish Habitat		Development
Fisheries Act	Metal Mining Effluent Regulations		Operations
Provincial – Government of Newfoundland and Labrador			
Water Resources Act (W-4.01)	Alterations to Body of Water	Environmental Guidelines for General Construction Practices; Policy Directive for Infilling Bodies of Water	Development
Water Resources Act (W-4.01)	Culvert Installation	Environmental Guidelines for Culverts; Watercourse Crossings	Development
Water Resources Act (W-4.01)	Bridge Construction	Environmental Guidelines for Bridges	Development
Water Resources Act (W-4.01)	Pipeline Crossing a Water Body	Environmental Guidelines for Pipe Crossing	Development

Statute or Regulation	Specific Permits, Approvals, Authorizations or Licenses	Guidelines to be Followed	Stage of Project
Water Resources Act (W-4.01)	Stream Modification or Diversions	Environmental Guidelines for Diversions, New Channels, Major Alterations; General Construction Practices	Development
Water Resources Act (W-4.01)	Development Activity in a Wellhead Protected Water Supply Area and a Development Activity in a Protected Public Water Supply Area	Policy Directive for Land and Water Related Developments in Protected Public Water Supply Areas	Development
Water Resources Act (W-4.01)	Water & Sewer Works	Guidelines for the Design, Operation, Construction and Operation of Water and Sewerage Systems	Development / Operations
Water Resources Act (W-4.01)	Water Use Authorization	Policy for Allocation of Water Use	
Water Resources Act (W-4.01)	Development Activities in and Affecting Wetlands	Policy Directive for Development in Wetlands	Development
Water Resources Act (W-4.01)	Development Activities in and Affecting Shore Water Zones	Policy Directive for Development in Shore Water Zones	Development
Water Resources Act (W-4.01)	Water Distribution System		Development / Operations
Environment Protection Act (E-14.2)	Environmental Assessment Approval		Development
Environment Protection Act (E-14.2)	Remedial / Rehabilitation Plan (for a contaminated site)	Contaminated Site Cleanup Criteria	Operations
Environment Protection Act (E-14.2)	Environmental Monitoring and Rehabilitation Programs (for a contaminated site)	Contaminated Site Cleanup Criteria	Operations
Environmental Control Water and Sewage Regulations (65/03)	Sewage Discharge Compliance		Operations
Mining Act (M-15.1, 1999) & Mining Regulations (42/00)	Development Plan	Guidelines to the Mining Act	Development
Mining Act (M-15.1, 1999) & Mining Regulations (42/00)	Operational Plan	Guidelines to the Mining Act	Operations
Mining Act (M-15.1, 1999) & Mining Regulations (42/00)	Rehabilitation and Closure Plan	Guidelines to the Mining Act	Development / Operations
Quarry Material Acts (1998)	Quarry Exploration License		Development
Quarry Material Acts (1998)	Quarry Permit		Development

Statute or Regulation	Specific Permits, Approvals, Authorizations or Licenses	Guidelines to be Followed	Stage of Project
Storage and Handling of Gasoline & Associated Products Regulations (58/03)	Fuel Storage and Handling System		Development / Operations

10.0 REVIEW OF IOC SECTION 4 HYDROLOGY AND HYDROGEOLOGY STUDY DEFINITION GUIDELINES

Golder has reviewed IOC's Section 4 Hydrology and Hydrogeology Study Definition Guidelines provided to us that outline the required level of investigation and documentation for OMS and Pre-Feasibility Level Geotechnical and Hydrological/Hydrogeological studies. The findings of this review have been used to confirm the OMS approach as well as provide the basis for the specifications of the work program required for the Pre-Feasibility Level study.

10.1 Review of OMS Requirements

The requirements for the OMS are summarized as follows:

- Obtain preliminary data including: average monthly rainfall, evaporation, catchment mapping, groundwater levels, water flows, water quality;
- Identify uses and users of surface water and groundwater;
- Understand the regional hydrogeological setting and assess local conditions from basic monitoring results indicating major aquifer zones, pressures and water quality;
- Identify aquifers and approximate depth to groundwater, regional water quality and other users;
- Install basic groundwater monitoring in key areas;
- Complete a hydrogeological interpretation of exploration or development drilling results for inflow prediction and control;
- Consider potential water impacts on all discipline areas (geotechnical, environment and communities);
- Delineate surface water catchment areas and define major drainage features;
- Install basic surface water monitoring stations for baseline characterization of flow and quality regimes;
- Understand legal parameters and licensing requirements, regulatory framework such as approvals, licensing etc;
- Complete a preliminary estimate of site water balance, with consideration of effects of seasonal variations;
- Complete a basic flow sheet and annual average water balance if there is a risk of shortages occurring; and

- Identify opportunities and risks of surface water. For example, water resources, flooding and discharge options.

Based upon this summary the required studies have been completed to meet the needs of the OMS for proposed iron ore mine sites Wabush 3 and Wabush 6.

10.2 Recommended Program for Pre-Feasibility

Golder has reviewed IOC's Section 4 Hydrology and Hydrogeology Study Definition Guidelines provided to us that outline the required level of investigation and documentation for Pre-Feasibility Level Geotechnical and Hydrological/Hydrogeological studies. The findings of this review have been used to recommend additional studies required.

If a more refined estimate of the results of pit dewatering is deemed necessary, several model enhancements may be pursued:

- Obtain and implement current topographic contours of the existing pits, and, where applicable, flooded elevations of the pits.
- For forecast simulations, obtain and implement the estimated pit extents for all pits (not just Wabush 3 and Wabush 6).
- Revise the model domain to be more reflective of natural hydrogeologic boundaries (major streams, groundwater divides, etc.).
- Expand the calibration dataset to include measured groundwater and surface water levels and other pit inflows (if available). A more rigorous calibration may suggest that spatially varying hydraulic conductivity and recharge is necessary to satisfactorily match water levels and inflows at other pits.
- Obtain a more detailed layout of the proposed site drainage and/or water management practices and implement model boundary conditions accordingly.
- Dewatering records for all existing pits.

The following groundwater tasks are recommended:

- Installation of select boreholes at Wabush 6 with multilevel monitoring wells.
- Installation of the Wabush 6 multilevel monitoring wells with water level data loggers.
- Water quality testing at Wabush 6.
- Ongoing baseline groundwater level monitoring at Wabush 3.
- Conduct one pumping test at each of Wabush 3 and Wabush 6 locations which would require drilling large diameter pumping wells. These pumping tests could be done to target the 5, 10, 15, 20 years etc. of extraction extents.

- Engage regulators and prepare appropriate documents for permitting.

The following surface water tasks are recommended:

- Continuous level monitoring and monthly flow monitoring at all surface water monitoring locations;
- Seasonal surface water quality sampling at each of the 10 surface water monitoring locations;
- Development of rating curves, level and flow hydrographs for each monitoring station;
- Design of a berm and diversion ditch around Wabush 6 to divert the Luce Lake outflow and the upstream catchment towards Wabush Lake;
- Assess the capacity of the receiving watercourse for the Wabush 6/Luce Lake discharge to ensure that the watercourse can handle the increased volume of discharge water;
- Assess regional and local impacts on surface water flows based upon monitoring data and groundwater modeling results;
- Prepare preliminary Stormwater Management Plan for Wabush 3 and Wabush 6;
- Complete a more detailed water balance for Wabush 3 and Wabush 6 for various ranges of climatic scenarios;
- Evaluate design changes which may impact the site water balances; and
- Engage regulators and prepare appropriate documents for permitting.

11.0 REFERENCES

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Report Signature Page

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APPENDIX A

BOREHOLE DRILLING, MONITORING WELL INSTALLATIONS, GROUNDWATER LEVELS and IOC GEOLOGIC CROSS-SECTIONS THROUGH WABUSH 3 AND WABUSH 6 (in mine grid orientation)

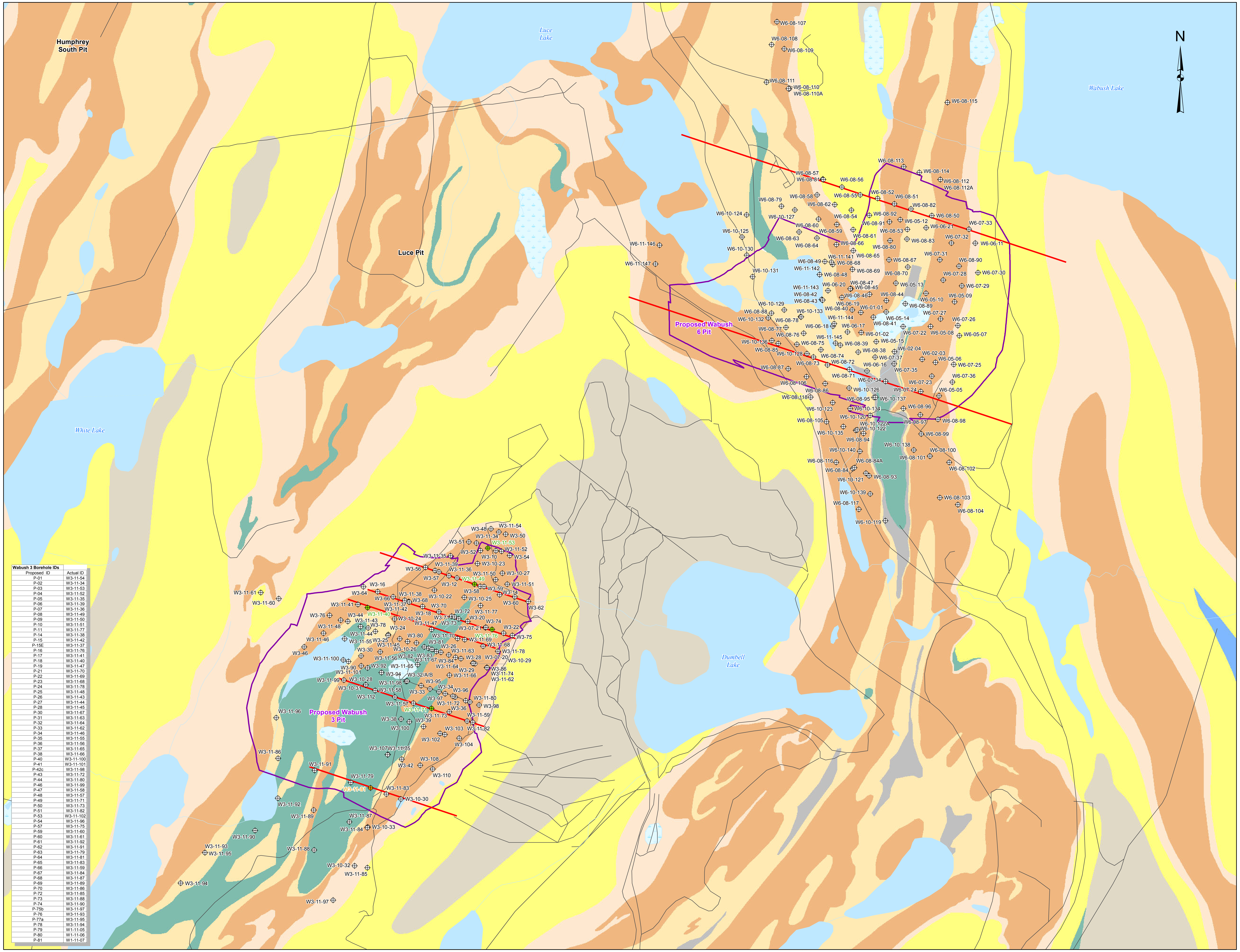
ATTACHMENT 1

Cross-Sections from IOC Wabush 3 and Wabush 6

IOC Cross Section Legend

Wabush 3
Light green – UIF (upper iron)
Red – LMO (low magnetite)
Blue – HMO (high magnetite)
Yellow/orange – LIF (lower iron)
Lt Tan – Overburden
Dark green – hornblende schist (locally known)

Wabush 6
Light green – UIF (upper iron)
Red – LMO (low magnetite)
Blue – HMO (high magnetite)
Yellow/orange – LIF (lower iron)
Lt Brown – Fibre material
Lt Purple – graphite schist
Magenta – Lean high mag



Wabush 3 Borehole IDs	
Proposed ID	Actual ID
P-01	W3-11-54
P-02	W3-11-34
P-03	W3-11-53
P-04	W3-11-52
P-05	W3-11-35
P-06	W3-11-39
P-07	W3-11-36
P-08	W3-11-49
P-09	W3-11-50
P-10	W3-11-51
P-11	W3-11-77
P-14	W3-11-38
P-15	W3-11-42
P-15E	W3-11-37
P-16	W3-11-76
P-17	W3-11-41
P-18	W3-11-40
P-19	W3-11-47
P-21	W3-11-70
P-22	W3-11-69
P-23	W3-11-68
P-24	W3-11-78
P-25	W3-11-48
P-26	W3-11-43
P-27	W3-11-44
P-28	W3-11-45
P-30	W3-11-67
P-31	W3-11-63
P-32	W3-11-64
P-33	W3-11-62
P-34	W3-11-46
P-35	W3-11-55
P-36	W3-11-56
P-37	W3-11-65
P-38	W3-11-66
P-40	W3-11-100
P-41	W3-11-101
P-42c	W3-11-98
P-43	W3-11-72
P-44	W3-11-80
P-46	W3-11-99
P-47	W3-11-58
P-48	W3-11-57
P-49	W3-11-71
P-50	W3-11-73
P-51	W3-11-82
P-53	W3-11-102
P-54	W3-11-96
P-57	W3-11-75
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P-68	W3-11-87
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P-74	W3-11-90
P-75b	W3-11-97
P-76	W3-11-93
P-77a	W3-11-95
P-78	W3-11-94
P-79	W1-11-05
P-80	W1-11-06
P-81	W1-11-07

LEGEND

⊕	IOC Borehole Location
⊕	IOC Cored Boreholes
⊕	IOC Cored Boreholes (Not Packer Tested)
—	IOC Cross Section Locations
—	Road / Trail
—	Watercourse
▨	Wetland
■	Waterbody
□	Proposed Pit Boundary

Detailed Bedrock Geology

■	Denault
■	Shabogamo Intrusive
■	Menihek Formation
■	Undifferentiated Iron Formation
■	Upper Iron Formation
■	Middle Iron Formation
■	Lower Iron Formation
■	Wishart Formation
■	Attikamagen Formation

Unconformity

■	Ashuanipi Complex

REFERENCE

Base Data - Canvec V.8,2011
Detailed Geology data obtained from IOC.
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 19

500 0 500
SCALE 1:12,000 METRES

PROJECT

RIO TINTO – IOC
WABUSH 3 AND WABUSH 6 STUDY
LABRADOR CITY, NL

TITLE

LOCATION OF IOC CROSS SECTIONS

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1152-0116			SCALE AS SHOWN	REV. 0
DESIGN	JO	5 Dec. 2011	FIGURE: A.1	
GIS	JO	5 Dec. 2011		
CHECK	PMMC	5 Dec. 2011		
REVIEW	PMMC	5 Dec. 2011		

G:\Projects\2011\11-1152-0116_IOC_Wabush_Nfld\GIS\MXDs\Reporting\Figure A1- Location of IOC cross sections.mxd

Rio Tinto IOC

Wabush 3

Mine Grid

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Project:IOC_
Drawn By:ABertr
Checked:
Approved:
Drawing No.
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Block model

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Grid lines

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Rio Tinto IOC

Wabush 3

Mine Grid

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Project:IOC_
Drawn By:ABertr
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Approved:
Drawing No.
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Block model
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Grid lines
Absolute

Rio Tinto IOC

Wabush 3

Mine Grid

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Project:IOC_
Drawn By:ABertr
Checked:
Approved:
Drawing No.
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Block model

File

Grid lines

Absolute

Rio Tinto IOC

Wabush 3

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Project:IOC_
Drawn By:ABertr
Checked:
Approved:
Drawing No.
6450.00

Rio Tinto IOC

Wabush 3

Mine Grid

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LEGEND

Data fields

GCODE (File wabush6_191011.dhd.isis)
Annotation and trace scheme GEOL1

-99	01	02	10	11
20	21	30	31	32
34	35	40	42	43
50	51	52	53	60
61	62	63	70	80
81	82	DEFAULT		

△ Start-of-trace symbol
▽ Enter extents symbol
\+ End-of-trace symbol
▽ Exit extents symbol

FE_B (File wabush6_191011.dhd.isis)

MAG (File wabush6_191011.dhd.isis)
Annotation scheme MAG

-99.000	0.000
0.000	14.000
12.000	100.000
DEFAULT	

C (File wabush6_191011.dhd.isis)

TT (File wabush6_191011.dhd.isis)

Digitized drafting

File: IOC_WABUSH6.DGD.ISIS
Layer: UIF
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: GRS
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: LHM
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: LMO
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: HMO
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: MIF
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: LIF
Object: *

File: IOC_WABUSH6.DGD.ISIS
Layer: FIBER_LINES
Object: *

Block model

File

Grid lines

Absolute

Rio Tinto IOC

Wabush 6

Scale:1:2000
Date:17-Nov-2011
Project:IOC_
Drawn By:
Checked:
Approved:
Drawing No.
8767.00

Rio Tinto IOC

Wabush 6

Scale:1:2000
Date:17-Nov-2011
Project:IOC_
Drawn By:
Checked:
Approved:
Drawing No.
9865.00

ATTACHMENT 2

Borehole Logs

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-40 (P-18)

SHEET 1 OF 4

LOCATION: N 5872618.3 ;E 637815.5

DATUM: NAD83

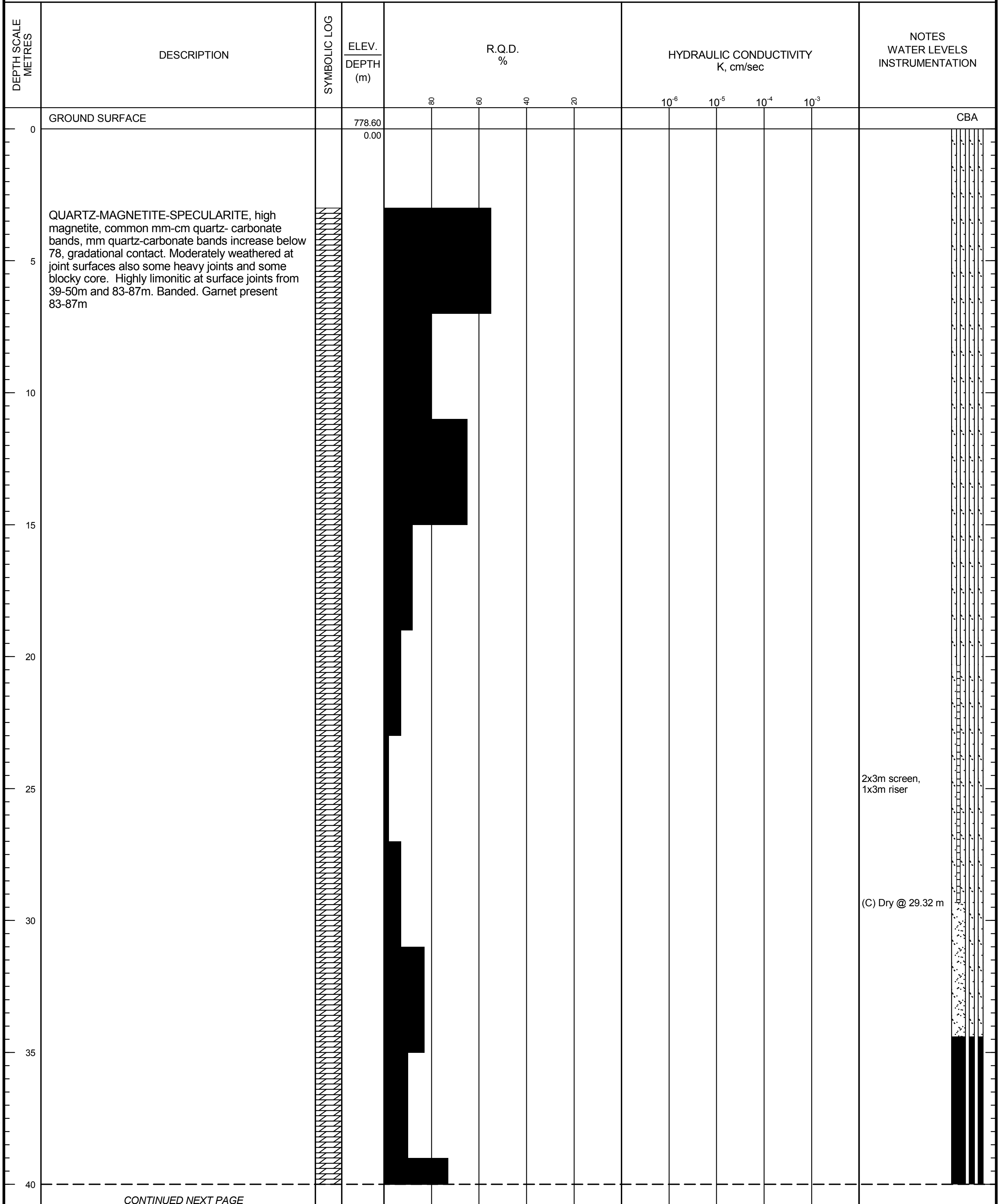
INCLINATION: -60° AZIMUTH: 270°

DEPTH SCALE METRES

DESCRIPTION

GROUND SURFACE

QUARTZ-MAGNETITE-SPECULARITE, high magnetite, common mm-cm quartz- carbonate bands, mm quartz-carbonate bands increase below 78, gradational contact. Moderately weathered at joint surfaces also some heavy joints and some blocky core. Highly limonitic at surface joints from 39-50m and 83-87m. Banded. Garnet present 83-87m



2x3m screen, 1x3m riser

(C) Dry @ 29.32 m

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DEPTH SCALE

1 : 200

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-40 (P-18)

SHEET 2 OF 4

LOCATION: N 5872618.3 ;E 637815.5

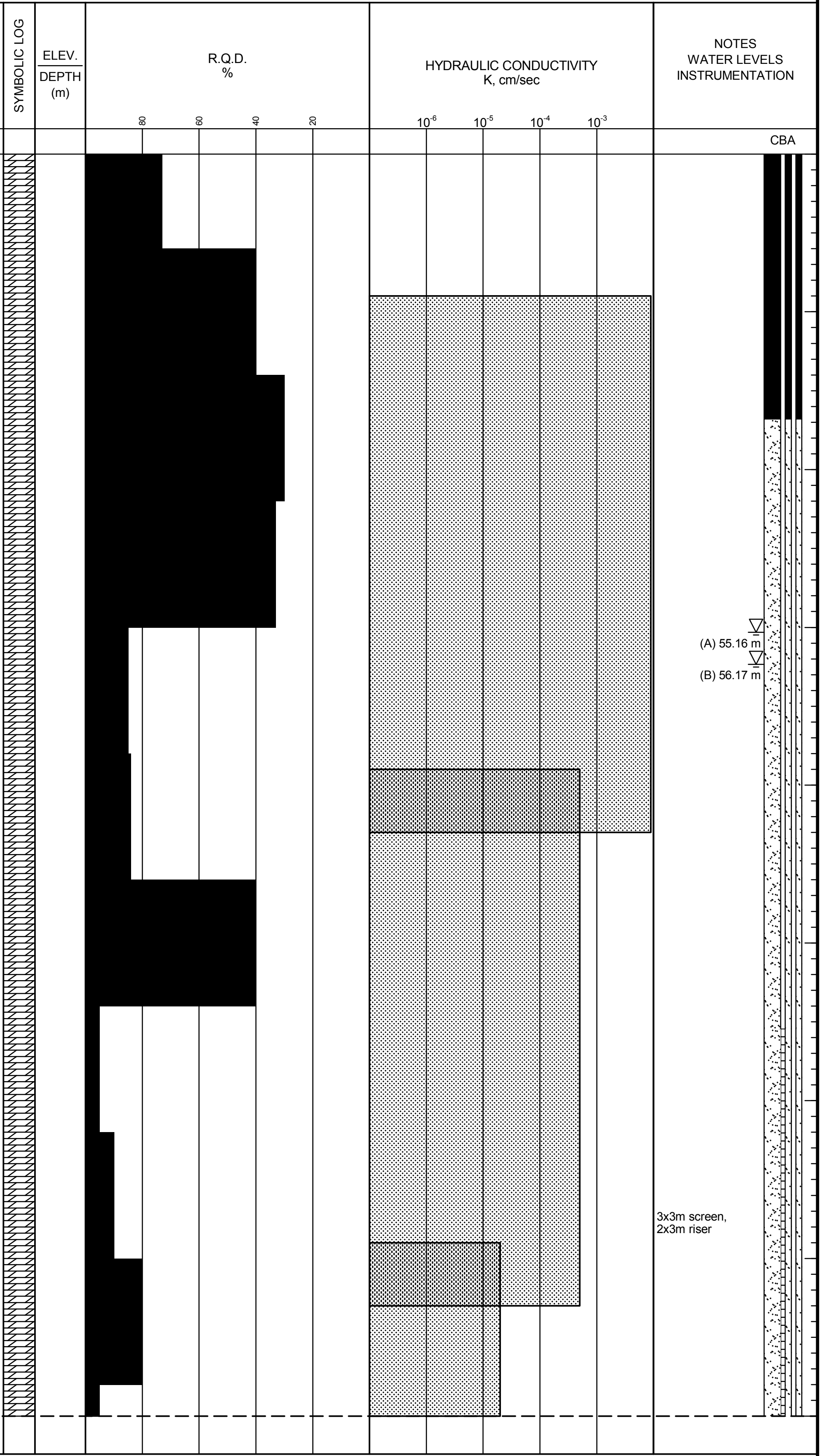
DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

DEPTH SCALE METRES | DESCRIPTION

--- CONTINUED FROM PREVIOUS PAGE ---

QUARTZ-MAGNETITE-SPECULARITE, high magnetite, common mm-cm quartz- carbonate bands, mm quartz-carbonate bands increase below 78, gradational contact. Moderately weathered at joint surfaces also some heavy joints and some blocky core. Highly limonitic at surface joints from 39-50m and 83-87m. Banded. Garnet present 83-87m



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DEPTH SCALE
1 : 200

Golder Associates

LOGGED: CH
CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-40 (P-18)

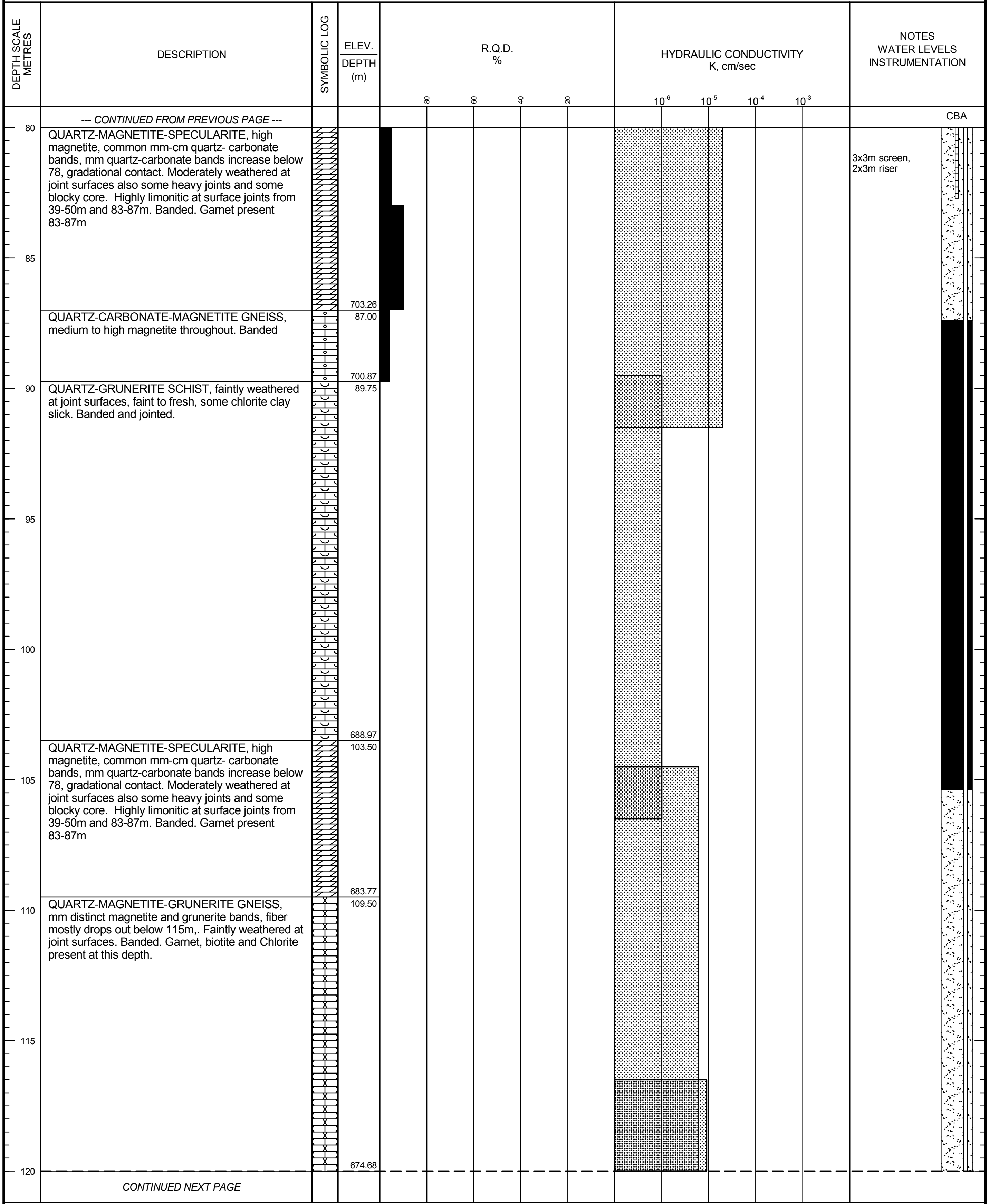
SHEET 3 OF 4

LOCATION: N 5872618.3 ;E 637815.5

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

DESCRIPTION	ELEV. DEPTH (m)
--- CONTINUED FROM PREVIOUS PAGE ---	
QUARTZ-MAGNETITE-SPECULARITE, high magnetite, common mm-cm quartz- carbonate bands, mm quartz-carbonate bands increase below 78, gradational contact. Moderately weathered at joint surfaces also some heavy joints and some blocky core. Highly limonitic at surface joints from 39-50m and 83-87m. Banded. Garnet present 83-87m	
QUARTZ-CARBONATE-MAGNETITE GNEISS, medium to high magnetite throughout. Banded	703.26 87.00
QUARTZ-GRUNERITE SCHIST, faintly weathered at joint surfaces, faint to fresh, some chlorite clay slick. Banded and jointed.	700.87 89.75
QUARTZ-MAGNETITE-SPECULARITE, high magnetite, common mm-cm quartz- carbonate bands, mm quartz-carbonate bands increase below 78, gradational contact. Moderately weathered at joint surfaces also some heavy joints and some blocky core. Highly limonitic at surface joints from 39-50m and 83-87m. Banded. Garnet present 83-87m	688.97 103.50
QUARTZ-MAGNETITE-GRUNERITE GNEISS, mm distinct magnetite and grunerite bands, fiber mostly drops out below 115m,. Faintly weathered at joint surfaces. Banded. Garnet, biotite and Chlorite present at this depth.	683.77 109.50
	674.68
CONTINUED NEXT PAGE	



3x3m screen,
2x3m riser

DEPTH SCALE

1 : 200

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-40 (P-18)

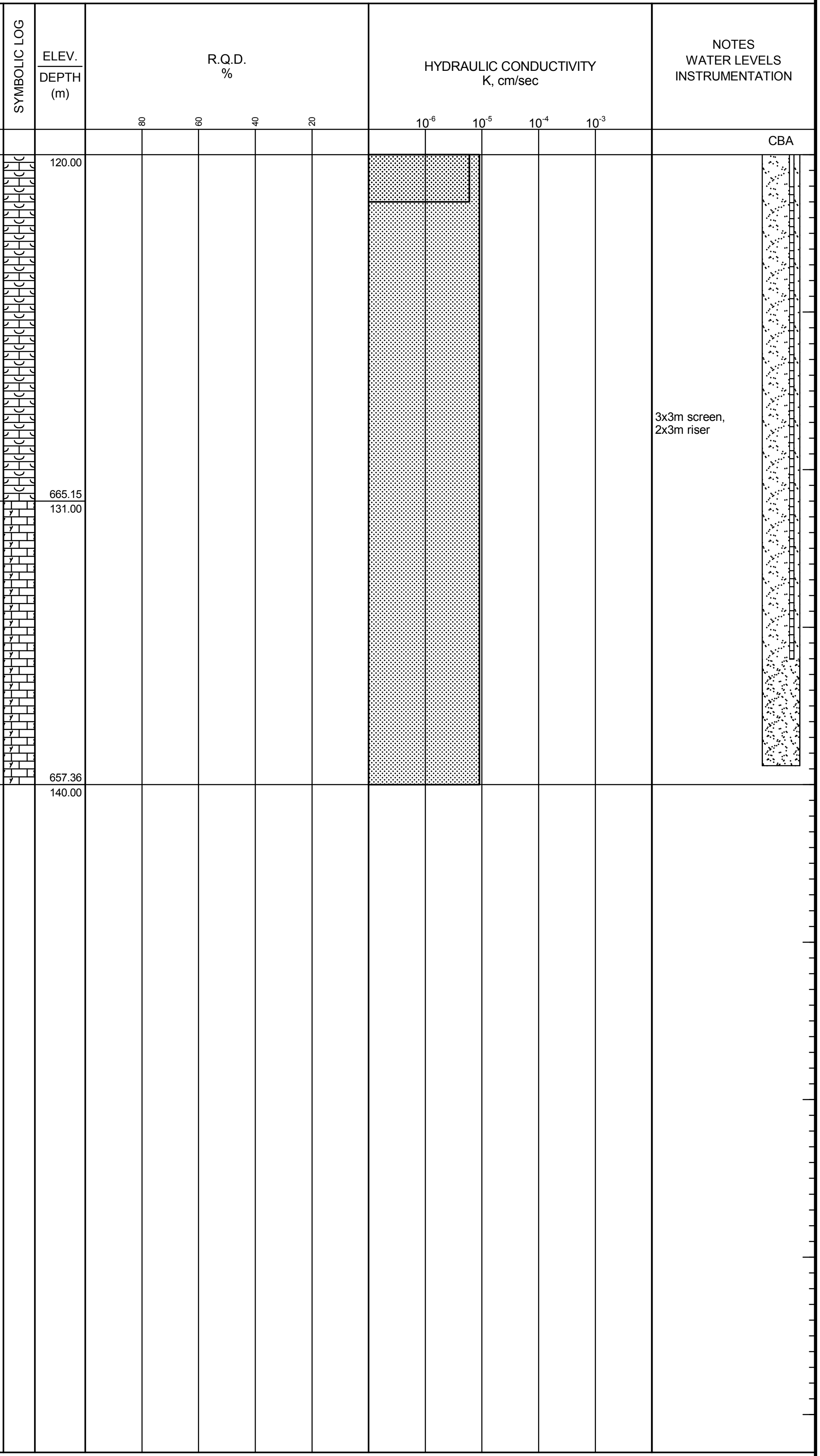
SHEET 4 OF 4

LOCATION: N 5872618.3 ;E 637815.5

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
120	QUARTZ-GRUNERITE SCHIST, garnet-biotite intrusive 128.5-129.3m, faintly weathered at joint surfaces, faint to fresh, some chlorite clay slick. Banded and jointed.	120.00
125		
130		665.15 131.00
	QUARTZ-CARBONATE- GRUNERITE GNEISS, 10cm scale intervals of pure quartz+minor carbonate and quartz-carbonate-grunerite, faintly weathered at joint surfaces, faint to fresh, some chlorite clay slick. Banded and jointed.	
135		
140		657.36 140.00
	END OF DRILLHOLE	
145		
150		
155		
160		



3x3m screen, 2x3m riser

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-49 (P-08)

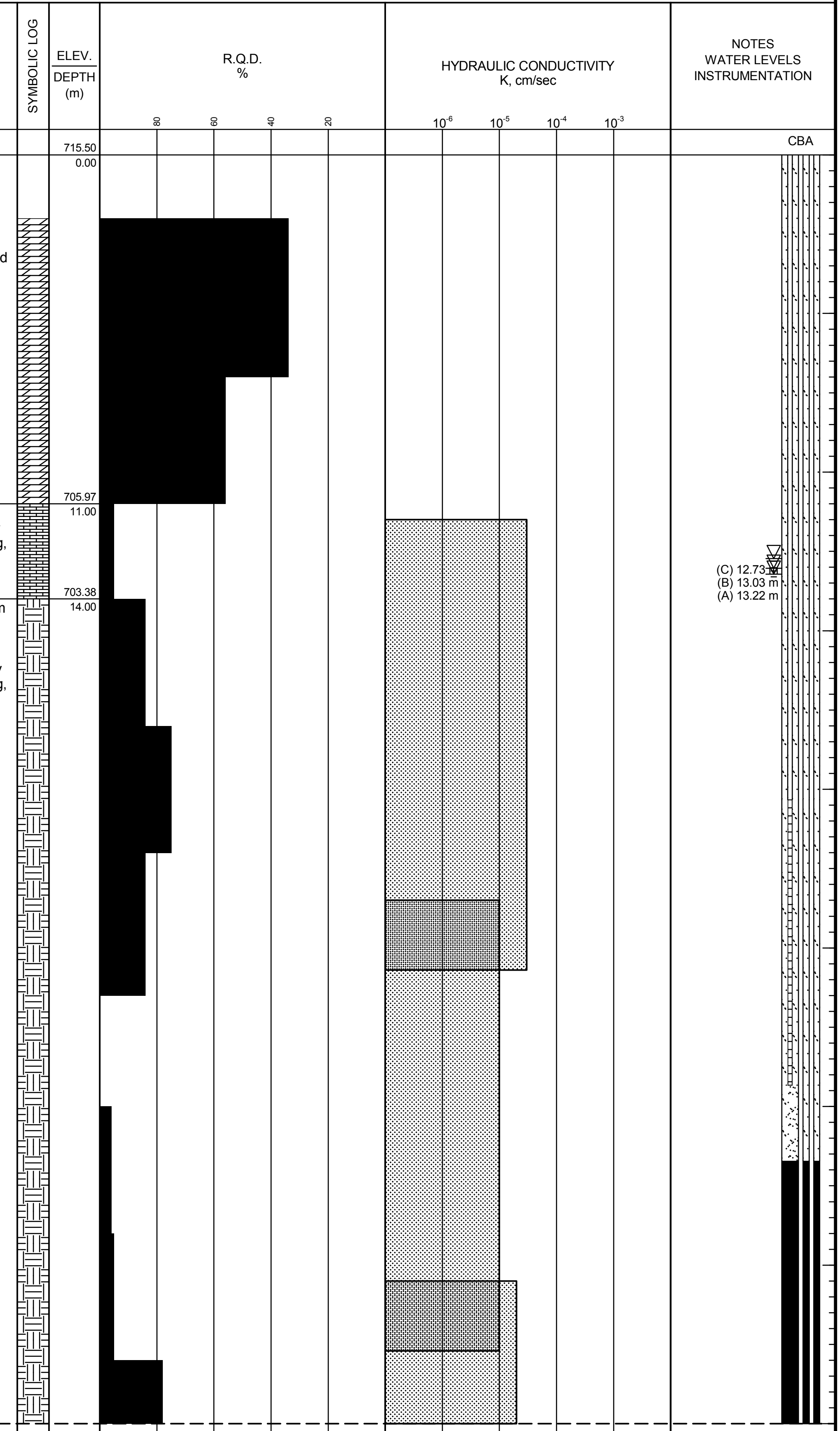
SHEET 1 OF 5

LOCATION: N 5872769.1 ;E 638503.1

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	715.50 0.00
QUARTZ-MAGNETITE-SPECULARITE. Specularite dominant, regular magnetite bands, weathered giving a red and white mm scale banded appearance, 6-6.3m completely limonitic alteration mud zone with sericite-possibly was intrusive. Pretty altered, some weathering, cm scale. Crumbly sections throughout. Banding consistent near the beginning, becomes kind of massive towards bottom. Broken rock in and out.	705.97 11.00
METAGABBRO, up to cm size garnets, limonitic, pretty altered, some weathering, cm scale crumbly sections throughout. Consistent near the beginning, becomes kind of massive towards bottom, broken rock	703.38 14.00
QUARTZ-SPECULARITE SCHIST, red colour from alteration, alteration intrusives 26.8-27.3m and 29.3-29.7m, rare magnetite bands, gradational lower contact to quartz-magnetite-specularite. Pretty altered, some weathering, cm scale crumbly sections throughout. Consistent near the beginning, becomes kind of massive towards bottom, broken rock	



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DEPTH SCALE

1 : 200

Golder Associates

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-49 (P-08)

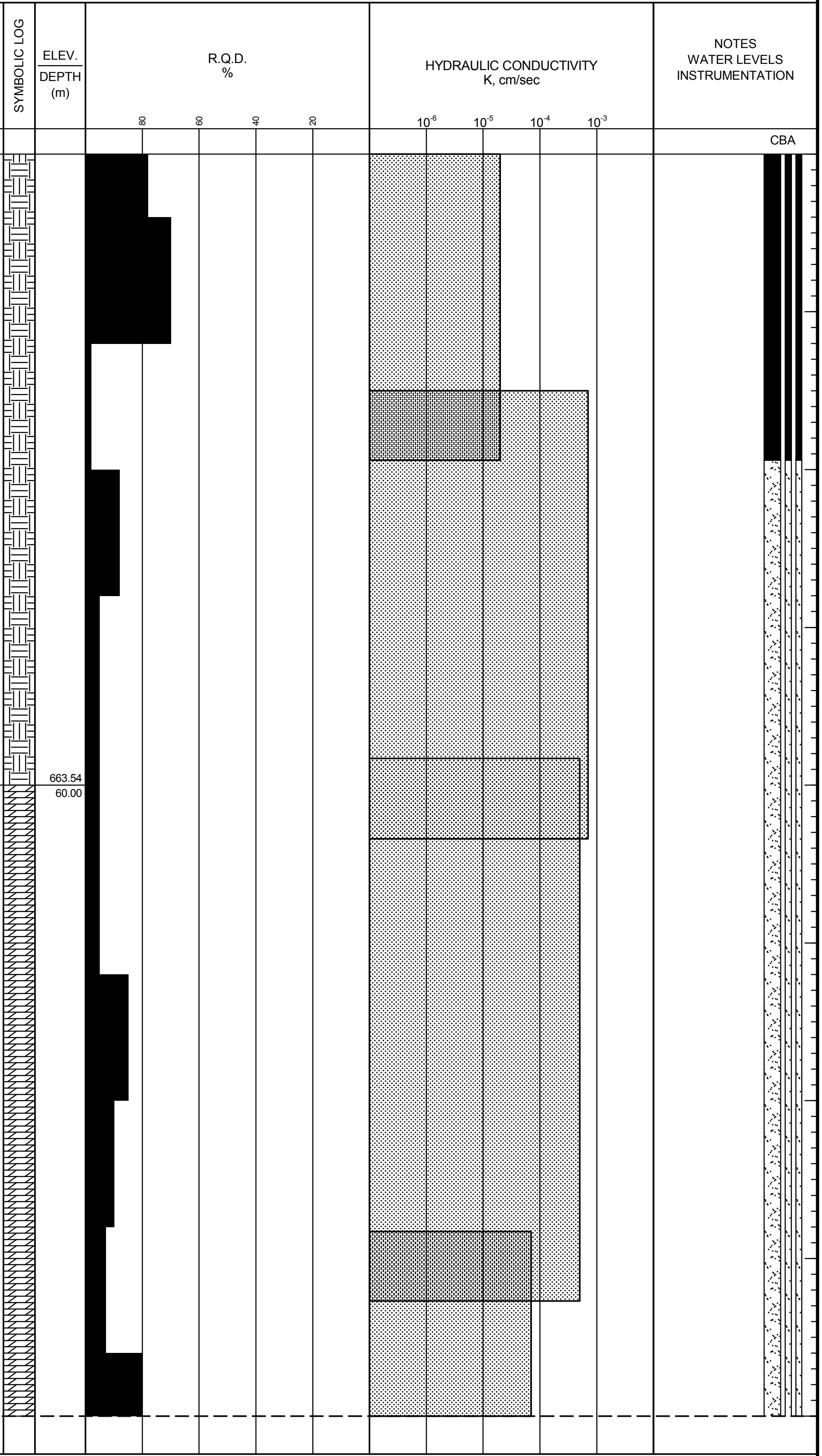
SHEET 2 OF 5

LOCATION: N 5872769.1 ;E 638503.1

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

DEPTH SCALE METRES	DESCRIPTION
	--- CONTINUED FROM PREVIOUS PAGE ---
40	QUARTZ-SPECULARITE SCHIST, red colour from alteration, alteration intrusives 26.8-27.3m and 29.3-29.7m, rare magnetite bands, gradational lower contact to quartz-magnetite-specularite. Pretty altered, some weathering, cm scale crumbly sections throughout. Consistent near the beginning, becomes kind of massive towards bottom, broken rock
60	QUARTZ-MAGNETITE-SPECULARITE. Specularite dominant, minor magnetite bands to 105m then becomes magnetite dominant, red colour except 108-121m which is more grey, high grade M-C specularite bands alternate on cm scale with finer siliceous rock might TT badly. Pretty altered, some weathering, cm scale. Crumbly sections throughout. Banding consistent near the beginning, becomes kind of massive towards bottom. Broken rock. Banded, some massive sections, broken rock
80	*CONTINUED NEXT PAGE*



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

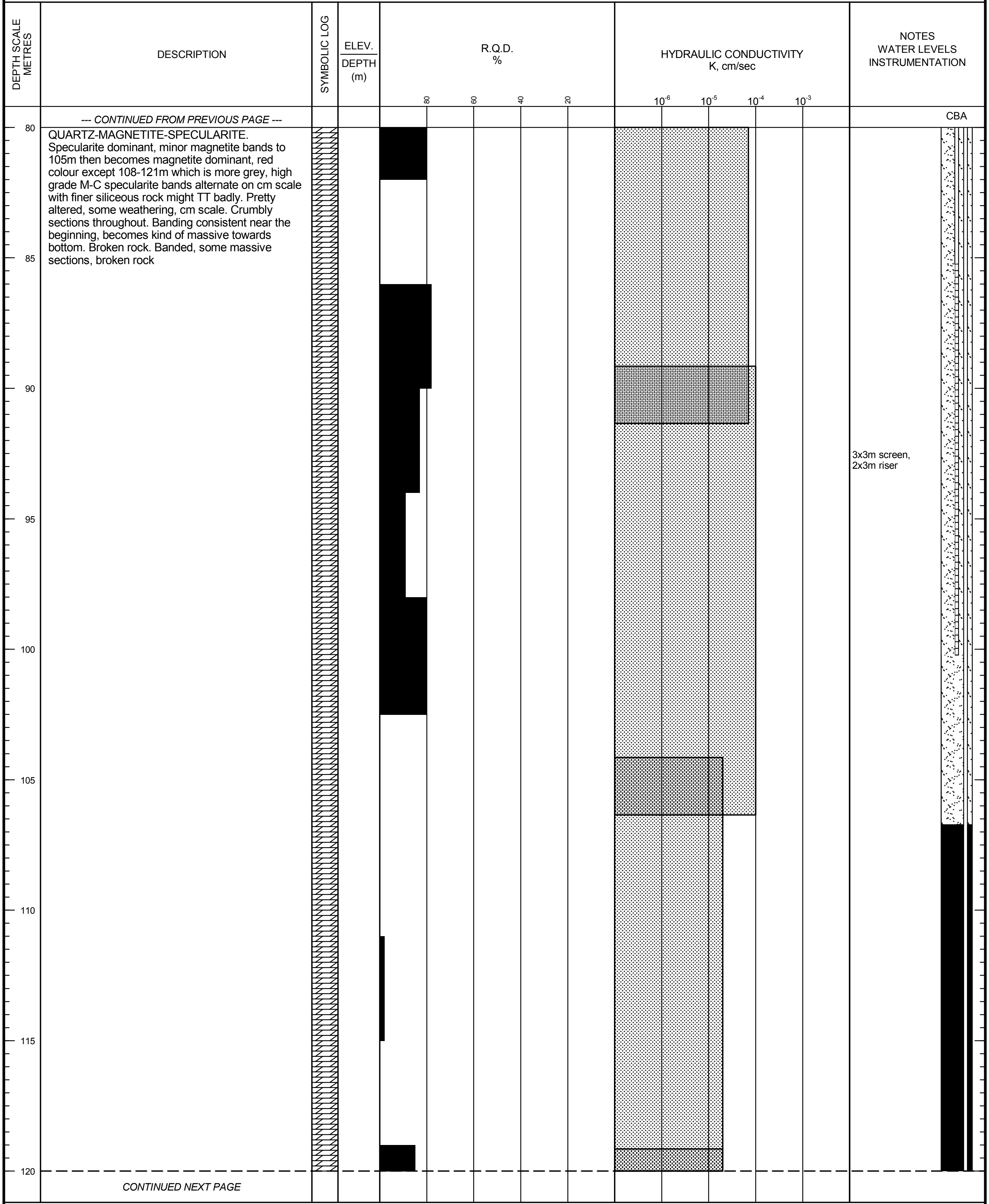
RECORD OF Drillhole: W3-11-49 (P-08)

SHEET 3 OF 5

LOCATION: N 5872769.1 ;E 638503.1

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°



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QUARTZ-MAGNETITE-SPECULARITE. Specularite dominant, minor magnetite bands to 105m then becomes magnetite dominant, red colour except 108-121m which is more grey, high grade M-C specularite bands alternate on cm scale with finer siliceous rock might TT badly. Pretty altered, some weathering, cm scale. Crumbly sections throughout. Banding consistent near the beginning, becomes kind of massive towards bottom. Broken rock. Banded, some massive sections, broken rock

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-49 (P-08)

SHEET 4 OF 5

LOCATION: N 5872769.1 ;E 638503.1

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

--- *CONTINUED FROM PREVIOUS PAGE* ---

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
120	QUARTZ-MAGNETITE-SPECULARITE. Specularite dominant, minor magnetite bands to 105m then becomes magnetite dominant, red colour except 108-121m which is more grey, high grade M-C specularite bands alternate on cm scale with finer siliceous rock might TT badly. Pretty altered, some weathering, cm scale. Crumbly sections throughout. Banding consistent near the beginning, becomes kind of massive towards bottom. Broken rock. Banded, some massive sections, broken rock	
	METAGABBRO, up to cm size garnets and hornblende in felsic matrix, altered. limonitic, pretty altered, some weathering, cm scale crumbly sections throughout. Banded, some massive sections, broken rock	605.08 127.50
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, specularite dominant with minor magnetite bands, bands of grunerite throughout, altered. limonitic, pretty altered, some weathering, cm scale crumbly sections throughout. Banded, some massive sections, broken rock	603.35 129.50
	QUARTZ-SPECULARITE SCHIST, minor magnetite bands, some siliceous. Pretty altered, some weathering, cm scale crumbly sections throughout. Banded, some massive sections, broken rock	601.62 131.50
	METAGABBRO, altered, mica related orange mush with cm size altered garnets throughout. limonitic, mush. Banded, some massive sections, broken rock	598.59 135.00
	QUARTZ-MAGNETITE-SPECULARITE, highly altered, just some mineralized sand. Moderately weathered across whole rock. Banded, some massive sections, broken rock	597.50
	QUARTZ-CARBONATE-MAGNETITE GNEISS, highly altered, mostly waste, perhaps a little FeOx, coarse quartz sand 151-153m. Moderately weathered whole rock. Banded, some massive sections, broken rock, common joint angle 1jn/m.	587.76 147.50
160	QUARTZ-MAGNETITE-SPECULARITE, highly altered, some just consolidated mud, more competent rock tends to be siliceous and very lean, several 10cm scale alternated intrusives - most of 174.5-179.5m. Moderately weathered across whole rock from 155.5-165m and from 171-178.5m, limonitic faintly weathered from 165-171m. Banded, some massive sections, broken rock, common joint angle 1jn/m.	580.83 155.50

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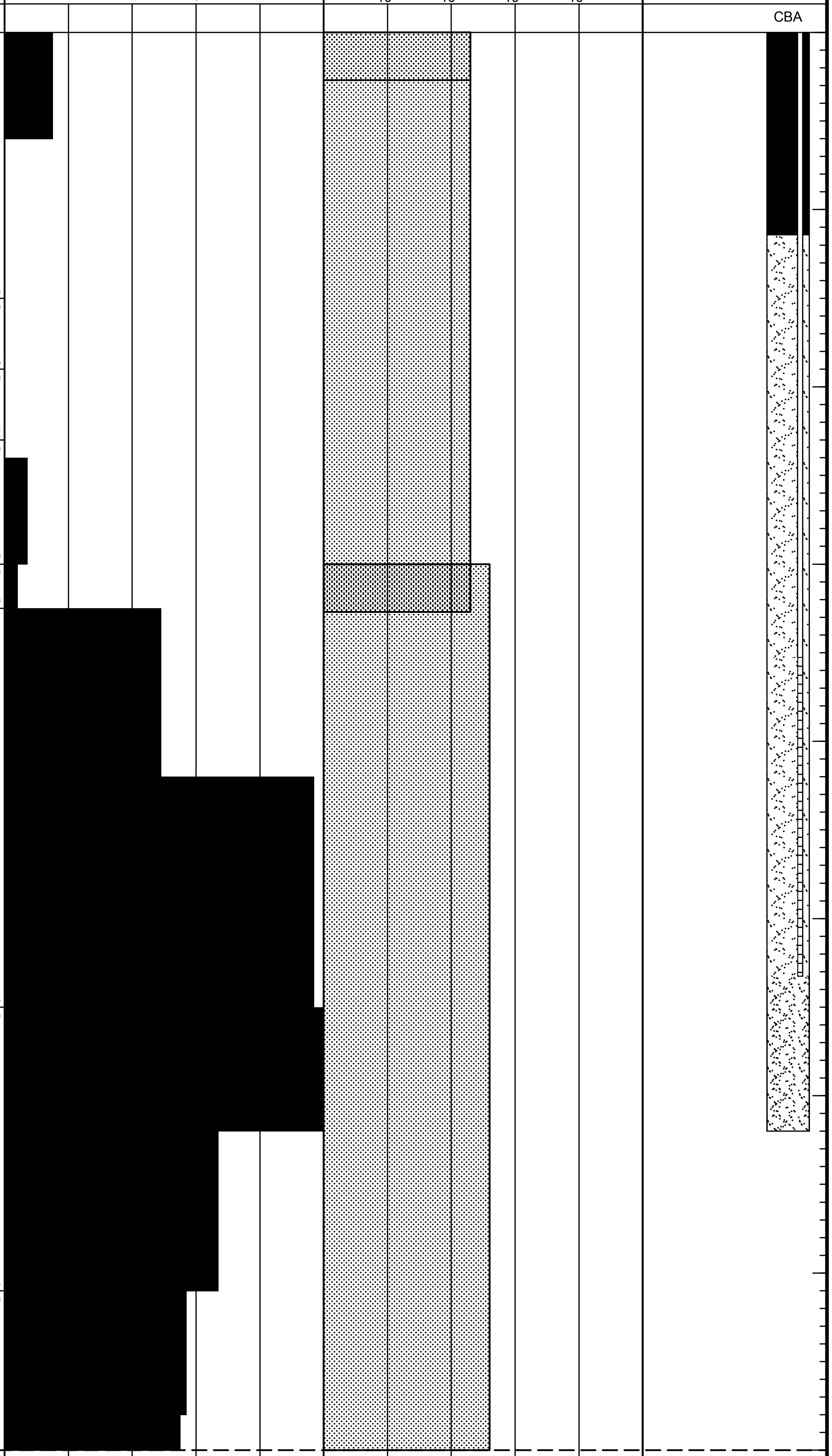


DEPTH SCALE

1 : 200

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-49 (P-08)

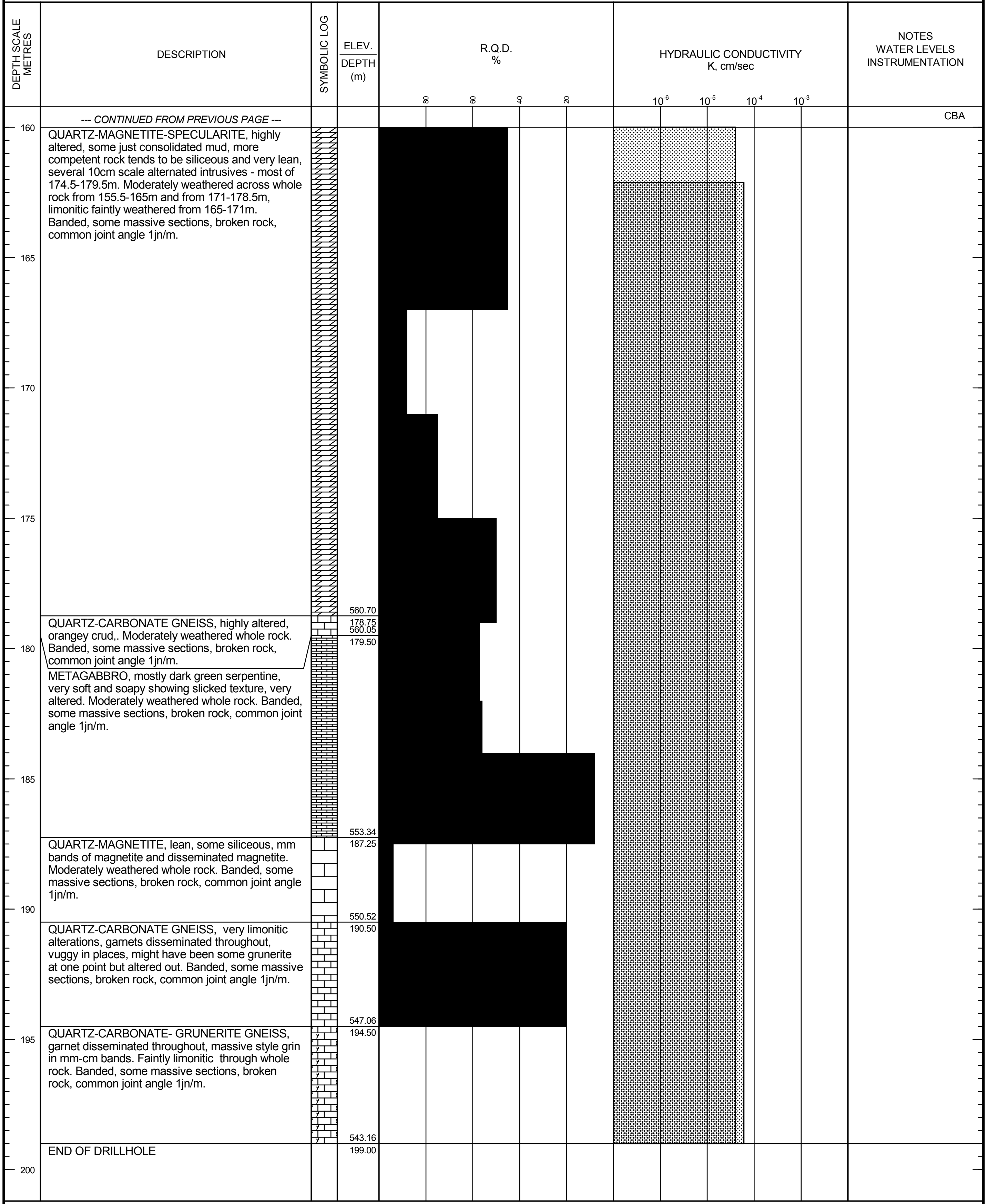
SHEET 5 OF 5

LOCATION: N 5872769.1 ;E 638503.1

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 270°

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
160	QUARTZ-MAGNETITE-SPECULARITE, highly altered, some just consolidated mud, more competent rock tends to be siliceous and very lean, several 10cm scale alternated intrusives - most of 174.5-179.5m. Moderately weathered across whole rock from 155.5-165m and from 171-178.5m, limonitic faintly weathered from 165-171m. Banded, some massive sections, broken rock, common joint angle 1jn/m.	
	QUARTZ-CARBONATE GNEISS, highly altered, orangey crud,. Moderately weathered whole rock. Banded, some massive sections, broken rock, common joint angle 1jn/m.	560.70 178.75
	METAGABBRO, mostly dark green serpentine, very soft and soapy showing slicked texture, very altered. Moderately weathered whole rock. Banded, some massive sections, broken rock, common joint angle 1jn/m.	560.05 179.50
	QUARTZ-MAGNETITE, lean, some siliceous, mm bands of magnetite and disseminated magnetite. Moderately weathered whole rock. Banded, some massive sections, broken rock, common joint angle 1jn/m.	553.34 187.25
	QUARTZ-CARBONATE GNEISS, very limonitic alterations, garnets disseminated throughout, vuggy in places, might have been some grunerite at one point but altered out. Banded, some massive sections, broken rock, common joint angle 1jn/m.	550.52 190.50
	QUARTZ-CARBONATE- GRUNERITE GNEISS, garnet disseminated throughout, massive style grin in mm-cm bands. Faintly limonitic through whole rock. Banded, some massive sections, broken rock, common joint angle 1jn/m.	547.06 194.50
	END OF DRILLHOLE	543.16 199.00



DEPTH SCALE

1 : 200

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-53 (P-03)

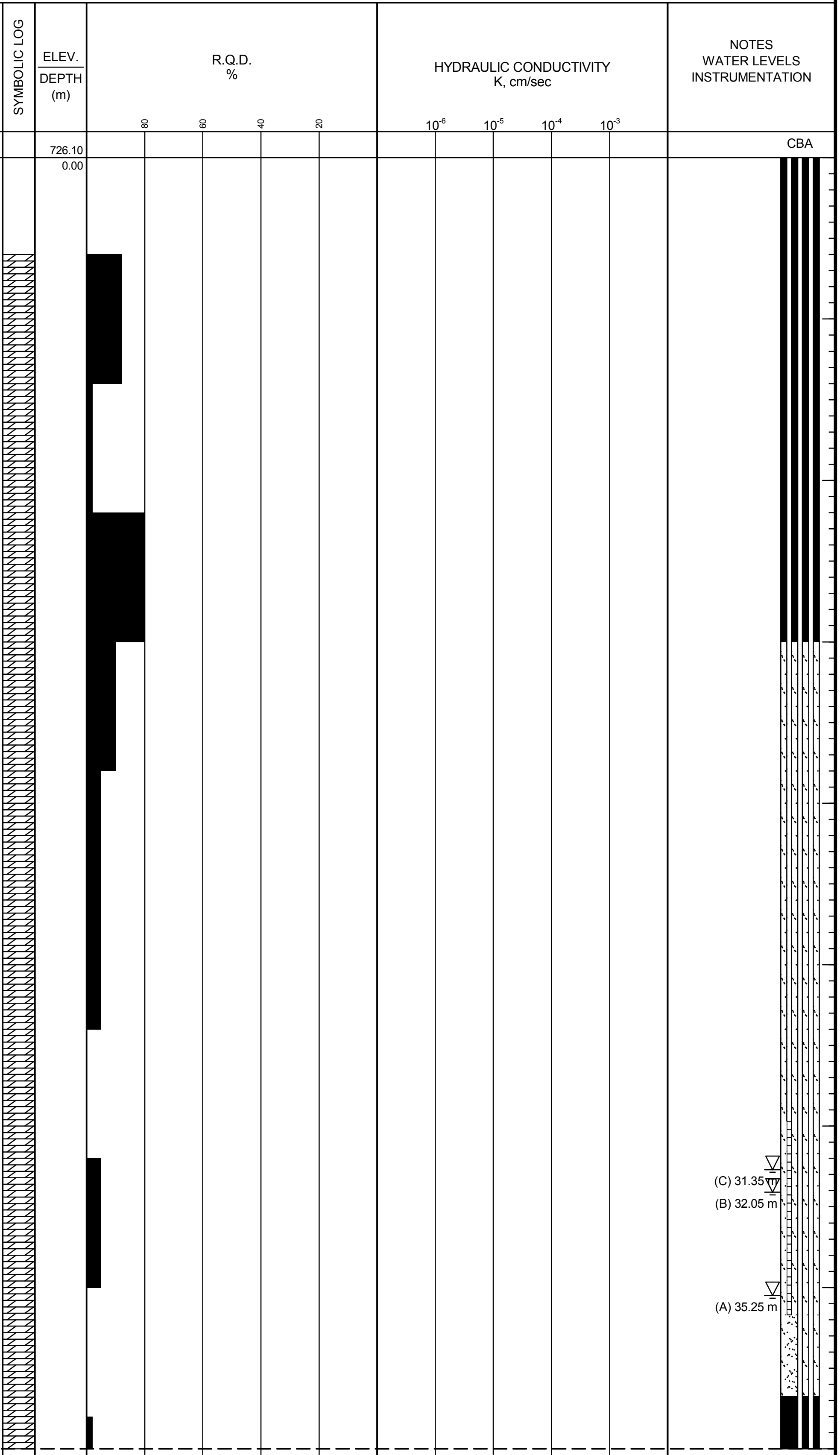
SHEET 1 OF 4

LOCATION: N 5873001.6 ;E 638588.1

DATUM: NAD83

INCLINATION: -85° AZIMUTH: 270°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)
	GROUND SURFACE	726.10
0		0.00
3–40	QUARTZ-MAGNETITE-SPECULARITE, light limonitic alteration throughout, generally only seen on joints, occasionally as vugs, alteration is locally more pervasive. Lean specularite starting at 42m, 0.5m broken rock sections from 3-15m, talc in joints at 26.9m. Banding at joints, varies, 5+ foliation fractures per meter.	
40	CONTINUED NEXT PAGE	



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-53 (P-03)

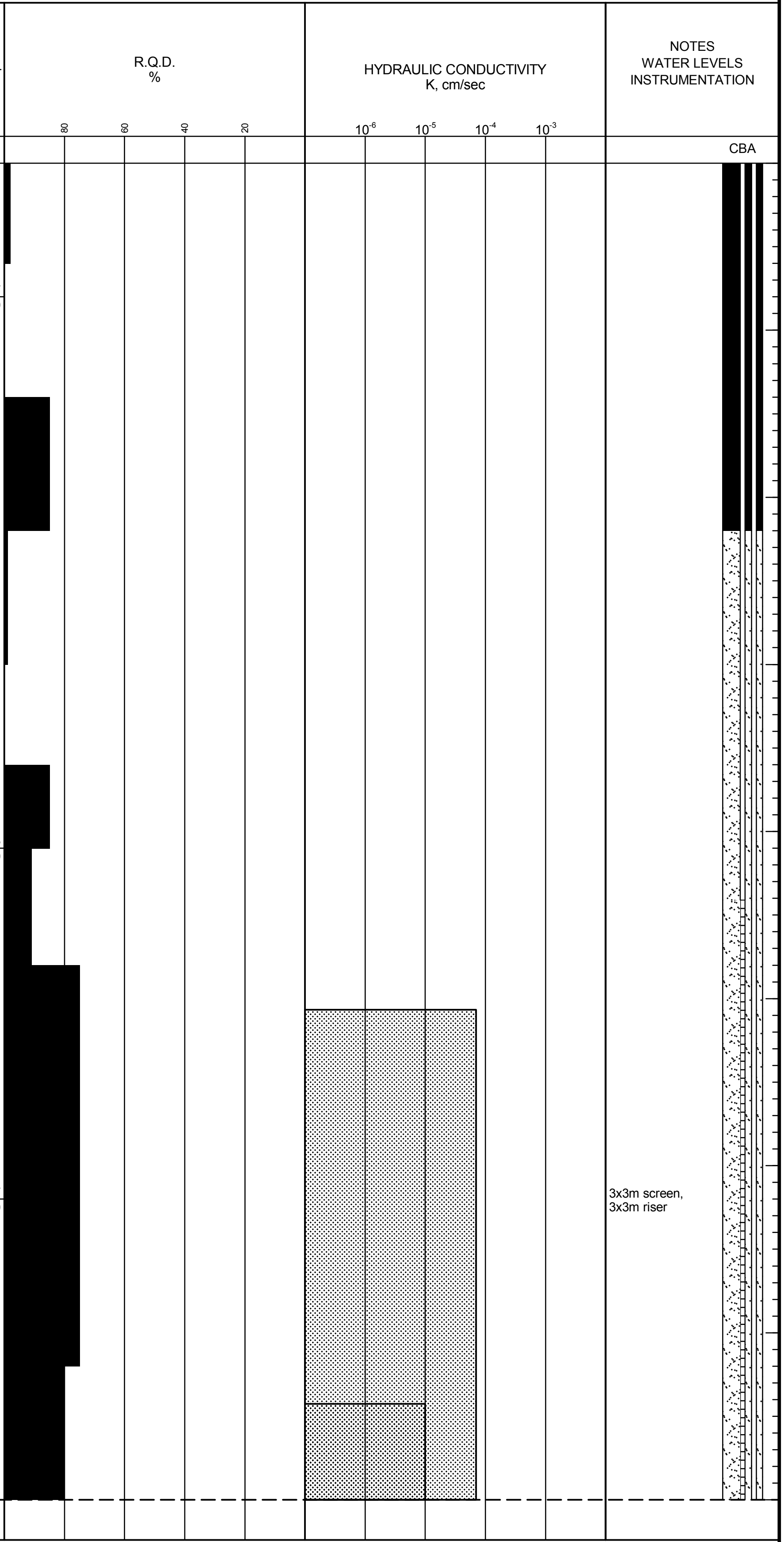
SHEET 2 OF 4

LOCATION: N 5873001.6 ;E 638588.1

DATUM: NAD83

INCLINATION: -85° AZIMUTH: 270°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---		
40	QUARTZ-MAGNETITE-SPECULARITE, light limonitic alteration throughout, generally only seen on joints, occasionally as vugs, alteration is locally more pervasive. Lean specularite starting at 42m, 0.5m broken rock sections from 3-15m, talc in joints at 26.9m. Banding at joints, varies, 5+ foliation fractures per meter.		
45	QUARTZ-MAGNETITE, light alteration throughout, generally only seen on joints, occasionally as vugs, alteration is locally more pervasive. Very lean specularite 44-45m,weathered from 48-60.6m 0.5m. Banding at joints and varies, 5+ foliation fractures per meter.		682.27 44.00
50			
55			
60	QUARTZ-CARBONATE GNEISS, heavy limonitic weathering, very soft/friable, highly altered interval. Alteration has destroyed much of the primary texture. Sandy or friable from top to bottom. Banding varies, 5+ foliation fractures per meter.		665.83 60.50
65			
70	QUARTZ-MAGNETITE-SPECULARITE, heavy weathering from 71.1-81m very soft. Magnetite banding from 81-87.1m. Highly altered interval. Alteration has destroyed much of the primary texture. Sandy or friable from top to bottom. Core takes on a reddish hue below 72m due to presence of specularite. Becomes moderately altered and broken at 80.5m. Alteration visible in bands and on joints. Moderately vugged. Banding, varies, 5+ foliation fractures per meter.		655.37 71.00
75			
80	*CONTINUED NEXT PAGE*		



3x3m screen,
3x3m riser

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-53 (P-03)

SHEET 3 OF 4

LOCATION: N 5873001.6 ;E 638588.1

DATUM: NAD83

INCLINATION: -85° AZIMUTH: 270°

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)
80	QUARTZ-MAGNETITE-SPECULARITE, heavy weathering from 71.1-81m very soft. Magnetite banding from 81-87.1m. Highly altered interval. Alteration has destroyed much of the primary texture. Sandy or friable from top to bottom. Core takes on a reddish hue below 72m due to presence of specularite. Becomes moderately altered and broken at 80.5m. Alteration visible in bands and on joints. Moderately vugged. Banding, varies, 5+ foliation fractures per meter.	
87.00	QUARTZ-SPECULARITE SCHIST, lean in areas, small gabbro intrusions at 88-88.4m. Limonitic alterations faintly at joint surfaces. Banding which varies, 5+ foliation fractures per meter.	639.43 87.00
93.50	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, bands of specularite and anthophyllite. Possibly some actinolite. Limonitic alterations faintly at joint surfaces. Banding which varies, 5+ foliation fractures per meter.	632.96 93.50
97.50	QUARTZ-SPECULARITE SCHIST, bands of specularite. Limonitic alterations faintly at joint surfaces. Banding which varies, 5+ foliation fractures per meter.	628.97 97.50
101.75	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, Limonitic alterations faintly at joint surfaces. Banding which varies, 5+ foliation fractures per meter.	624.74 101.75
104.50	QUARTZ-SPECULARITE SCHIST, lean in some areas, high specularite bands throughout. Limonitic alterations faintly at joint surfaces. Banding which varies, 5+ foliation fractures per meter. Becomes broken and weathered throughout from 108-116m. Dominated by specularite. Limonitic, moderately broken, locally friable. Alteration increases downhole.	622.00 104.50
116.00	QUARTZ-CARBONATE GNEISS, limonitic weathering throughout, very pitted. Highly altered waste rock. Often friable and pitted. Locally sandy. High core loss.	610.54 116.00
120		

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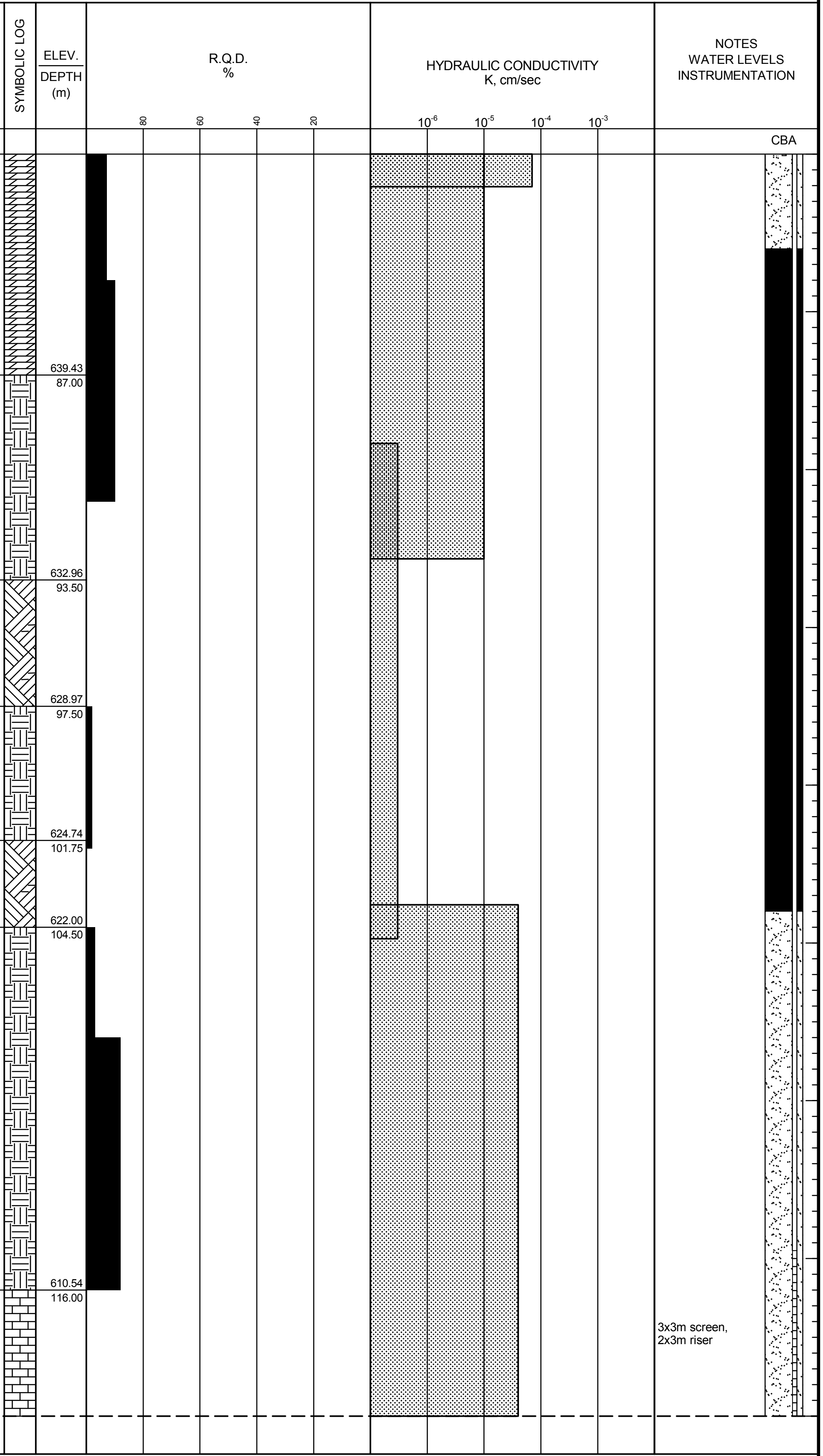


3x3m screen,
2x3m riser

DEPTH SCALE
1 : 200

Golder Associates

LOGGED: CH
CHECKED: PMMC

PROJECT: 11-1152-0116

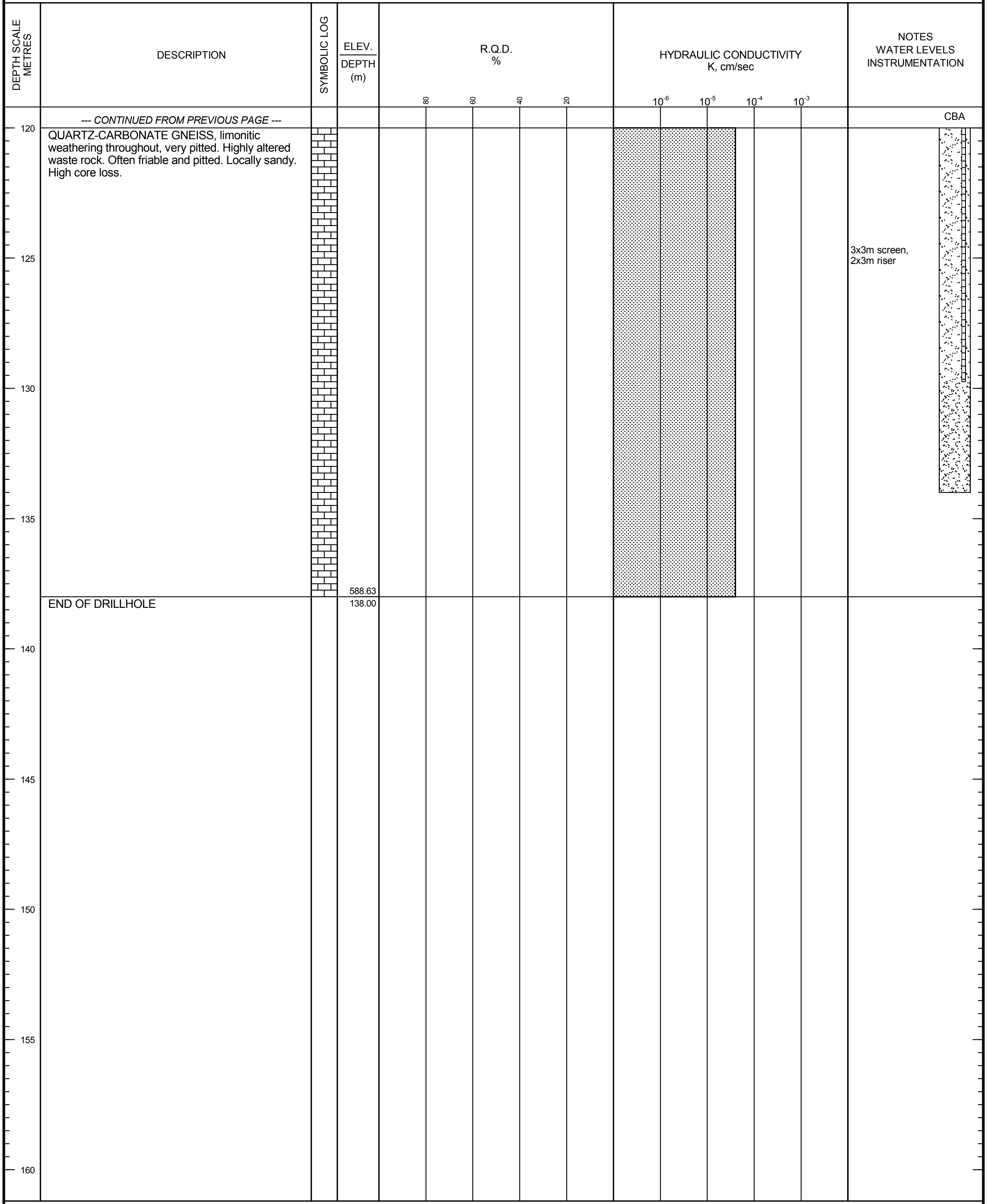
RECORD OF Drillhole: W3-11-53 (P-03)

SHEET 4 OF 4

LOCATION: N 5873001.6 ;E 638588.1

DATUM: NAD83

INCLINATION: -85° AZIMUTH: 270°



DESCRIPTION	ELEV. / DEPTH (m)	NOTES WATER LEVELS INSTRUMENTATION
--- CONTINUED FROM PREVIOUS PAGE ---		
QUARTZ-CARBONATE GNEISS, limonitic weathering throughout, very pitted. Highly altered waste rock. Often friable and pitted. Locally sandy. High core loss.	588.63	3x3m screen, 2x3m riser
END OF DRILLHOLE	138.00	

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: CH

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

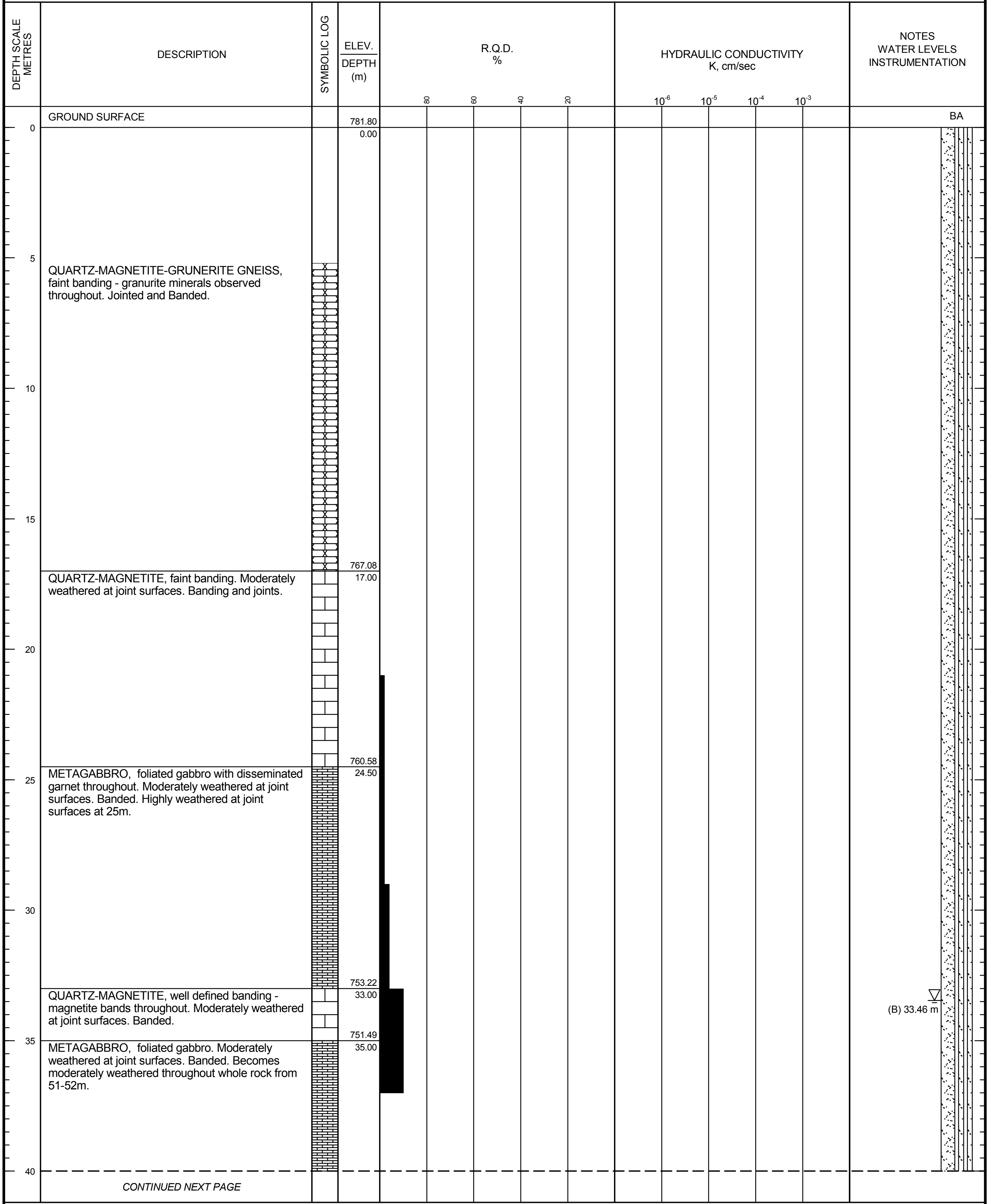
SHEET 1 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	781.80	0.00
QUARTZ-MAGNETITE-GRUNERITE GNEISS, faint banding - granurite minerals observed throughout. Jointed and Banded.	767.08	17.00
QUARTZ-MAGNETITE, faint banding. Moderately weathered at joint surfaces. Banding and joints.	760.58	24.50
METAGABBRO, foliated gabbro with disseminated garnet throughout. Moderately weathered at joint surfaces. Banded. Highly weathered at joint surfaces at 25m.	753.22	33.00
QUARTZ-MAGNETITE, well defined banding - magnetite bands throughout. Moderately weathered at joint surfaces. Banded.	751.49	35.00
METAGABBRO, foliated gabbro. Moderately weathered at joint surfaces. Banded. Becomes moderately weathered throughout whole rock from 51-52m.		



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DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

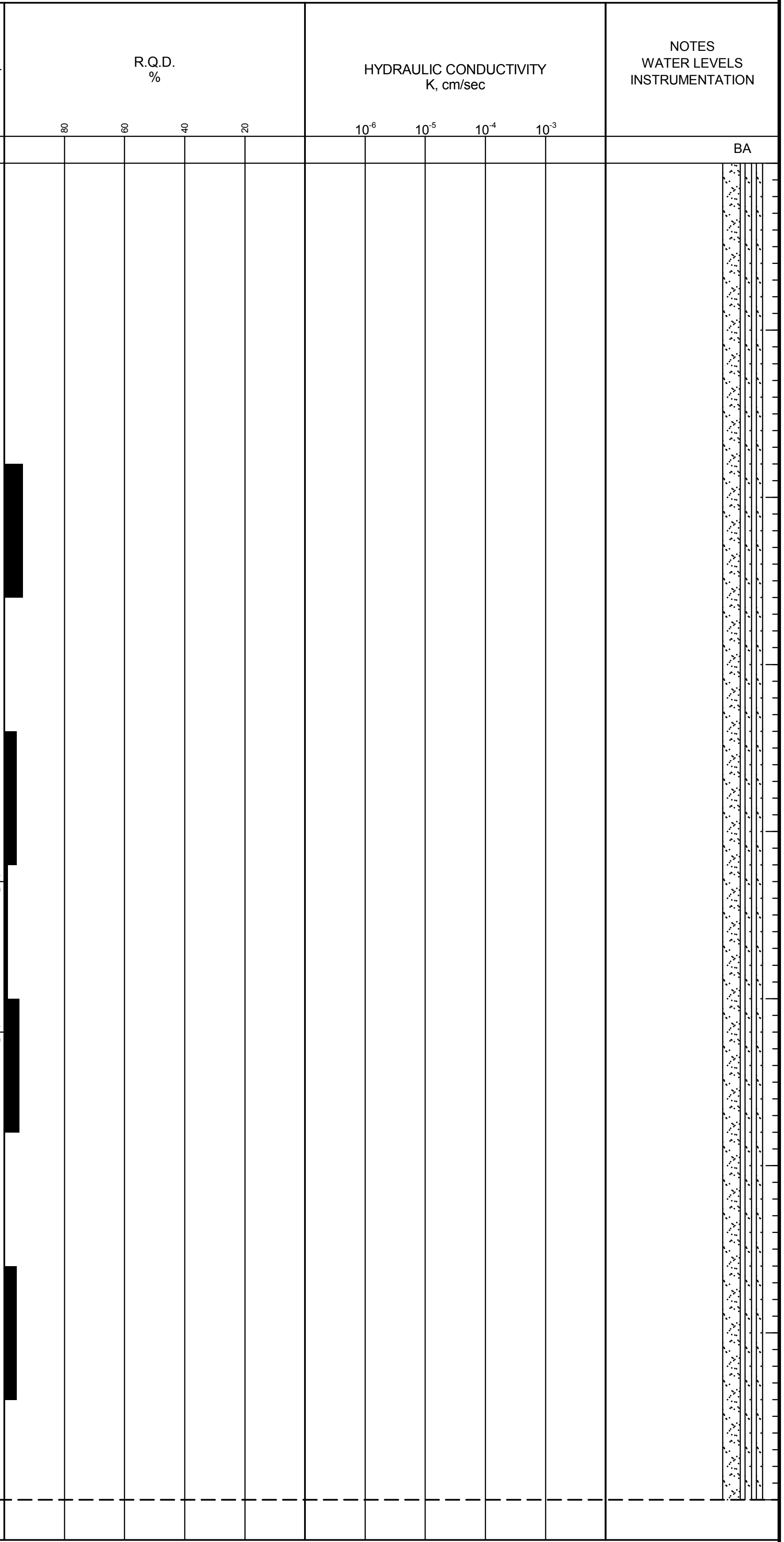
SHEET 2 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---		
40	METAGABBRO, foliated gabbro. Moderately weathered at joint surfaces. Banded. Becomes moderately weathered throughout whole rock from 51-52m.		
45			
50			
55			
60			728.54 61.50
	QUARTZ-MAGNETITE, faint banding - magnetite bands throughout.		
65			724.64 66.00
	QUARTZ-MAGNETITE-SPECULARITE, undulating banding from 69 to 75m - fold structures, chlorite bands at end of unit, mostly irregular banding throughout.		
70			
75			
80			
	CONTINUED NEXT PAGE		



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

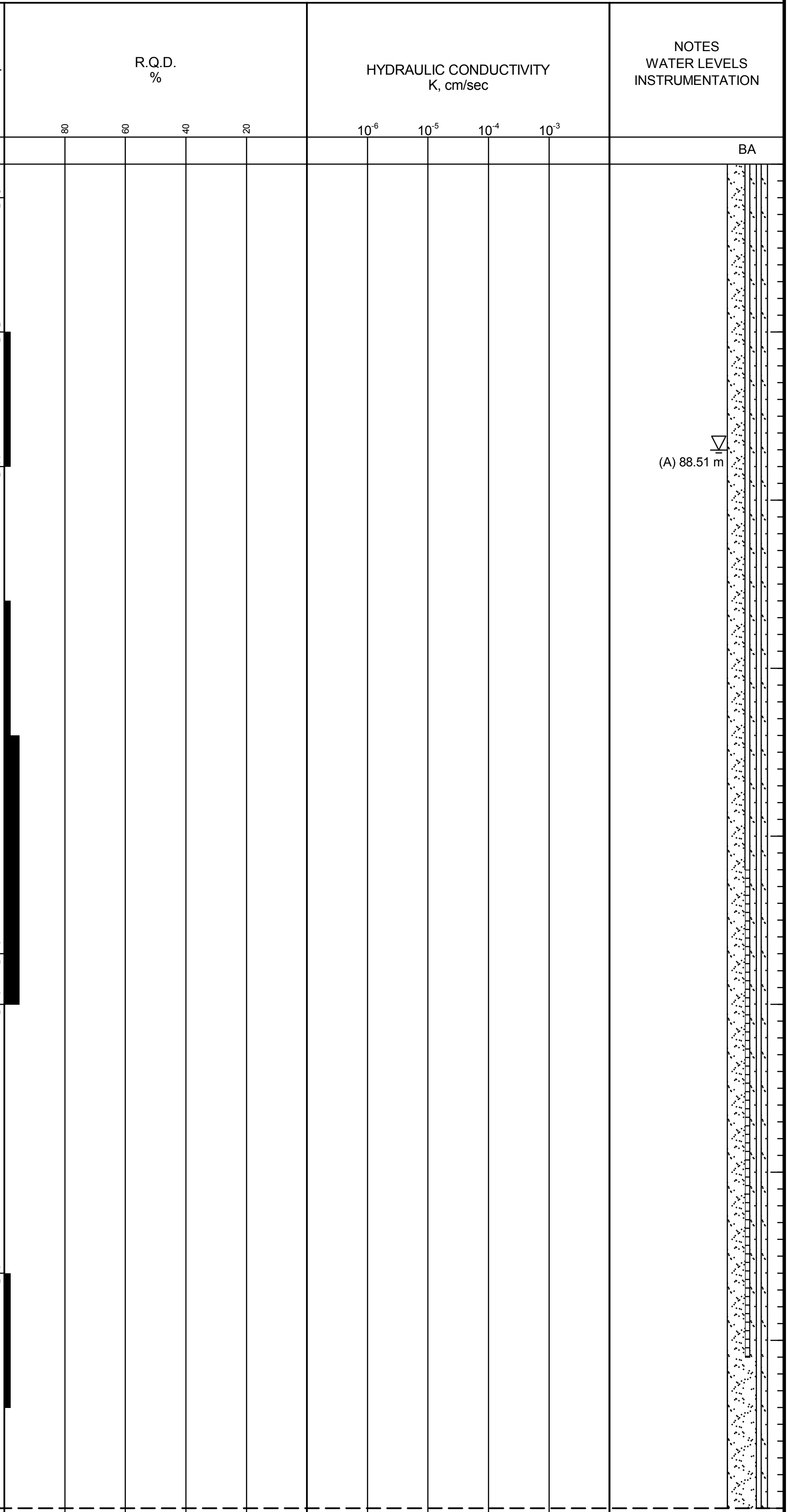
SHEET 3 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
80		711.65 81.00
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, irregular banding throughout - visible fold structures, fibers minerals seen throughout.	708.19 85.00
85	QUARTZ-MAGNETITE-SPECULARITE, similar to previous unit. From 61-81m	704.72 89.00
90	METAGABBRO, foliated gabbro, garnet throughout- garnet bands	692.17 103.50
95		
100		
	QUARTZ-MAGNETITE, irregular banding. jointed	690.87 105.00
105	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, carbonate bands throughout, specularite dominant. Highly weathered through whole rock from 106-106.5m	683.94 113.00
110		
	QUARTZ-MAGNETITE-SPECULARITE, carbonate bands throughout, specularite dominant. Banded and jointed	
115		
120	*CONTINUED NEXT PAGE*	



DEPTH SCALE
1 : 200

Golder Associates

LOGGED: SDR
CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

SHEET 4 OF 8

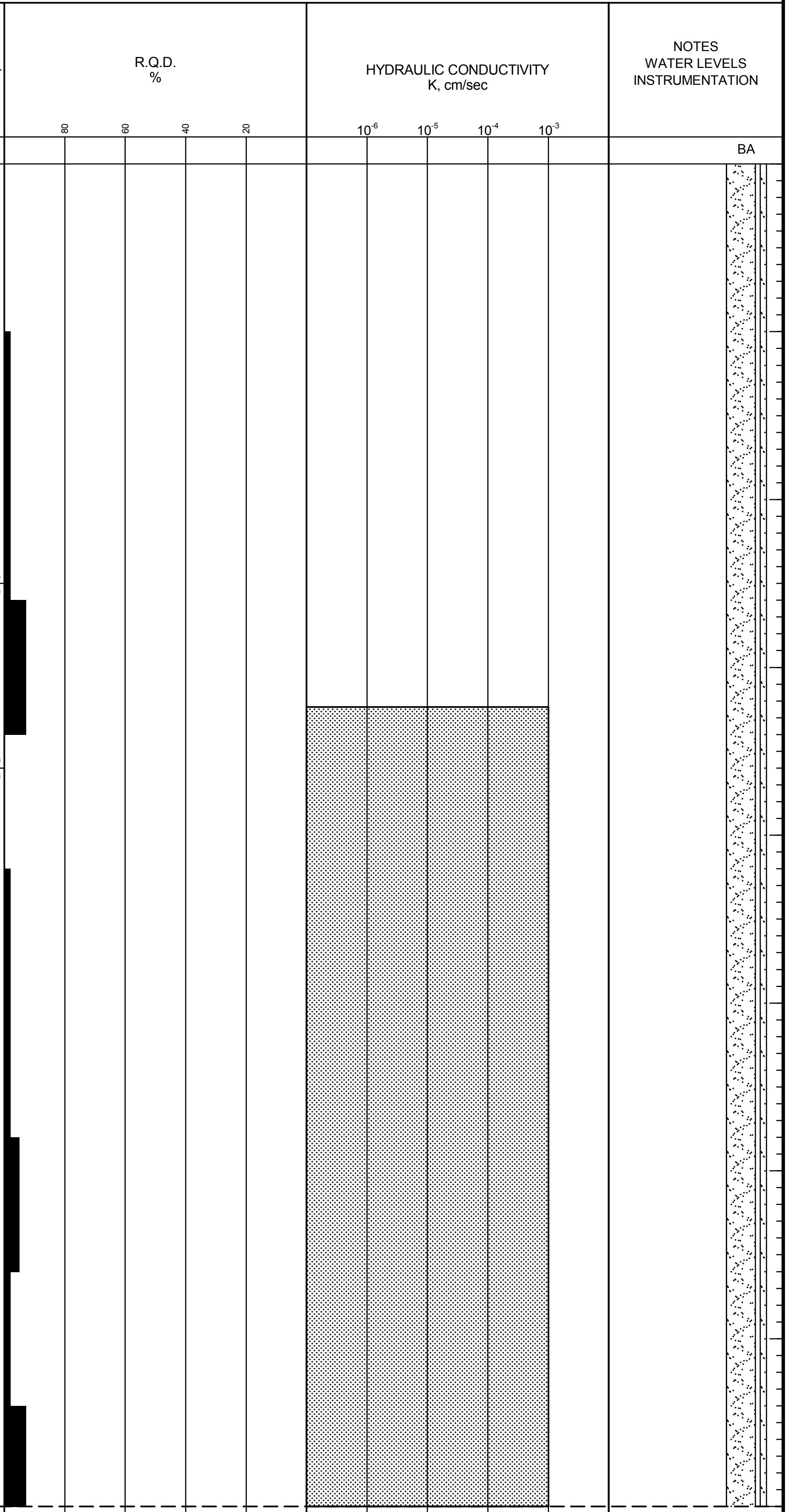
LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

--- *CONTINUED FROM PREVIOUS PAGE* ---

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)
120	QUARTZ-MAGNETITE-SPECULARITE, carbonate bands throughout, specularite dominant. Banded and jointed		
125			
130			
	QUARTZ-MAGNETITE, magnetite bands and disseminated magnetite throughout.		667.05 132.50
135			
	QUARTZ-MAGNETITE-SPECULARITE, intrusion of unit 60 from 162.8 to 163.9m, specularite dominant, magnetite bands throughout. Banded.		662.29 138.00
140			
145			
150			
155			
160			



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DEPTH SCALE
1 : 200

LOGGED: SDR
CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

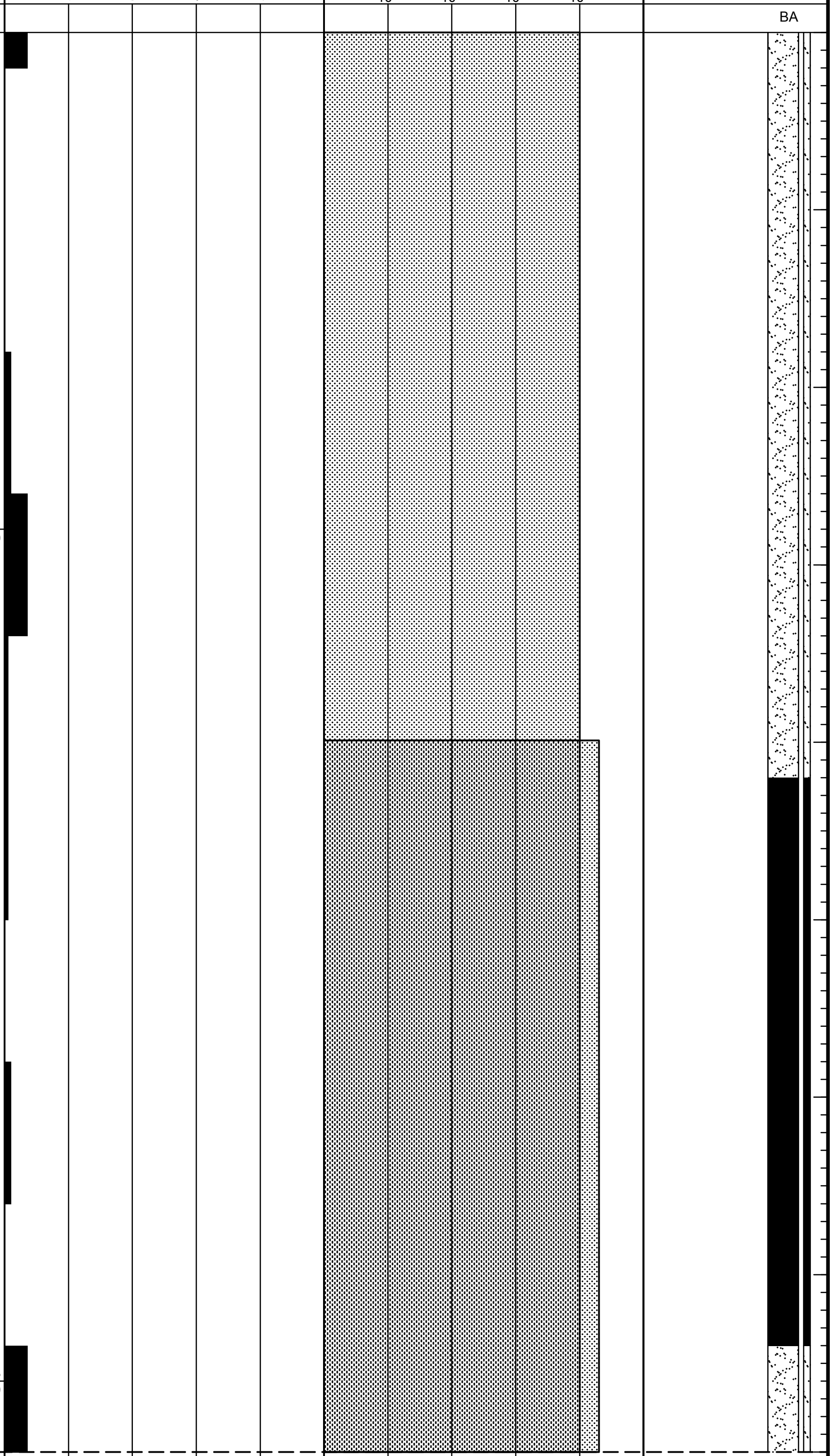
SHEET 5 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
160	QUARTZ-MAGNETITE-SPECULARITE, intrusion of unit 60 from 162.8 to 163.9m, specularite dominant, magnetite bands throughout. Banded.	
174	QUARTZ-MAGNETITE, intrusion of quartz-magnetite-specularite from 189 to 190m, magnetite bands throughout, undulating banding from 180 to 198m. Moderately limonitic at joint surfaces from 182.5-183m. Banded.	631.11 174.00
198	QUARTZ-CARBONATE GNEISS, gradual contact with previous unit, faint banding.	610.33 198.00
200	*CONTINUED NEXT PAGE*	



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

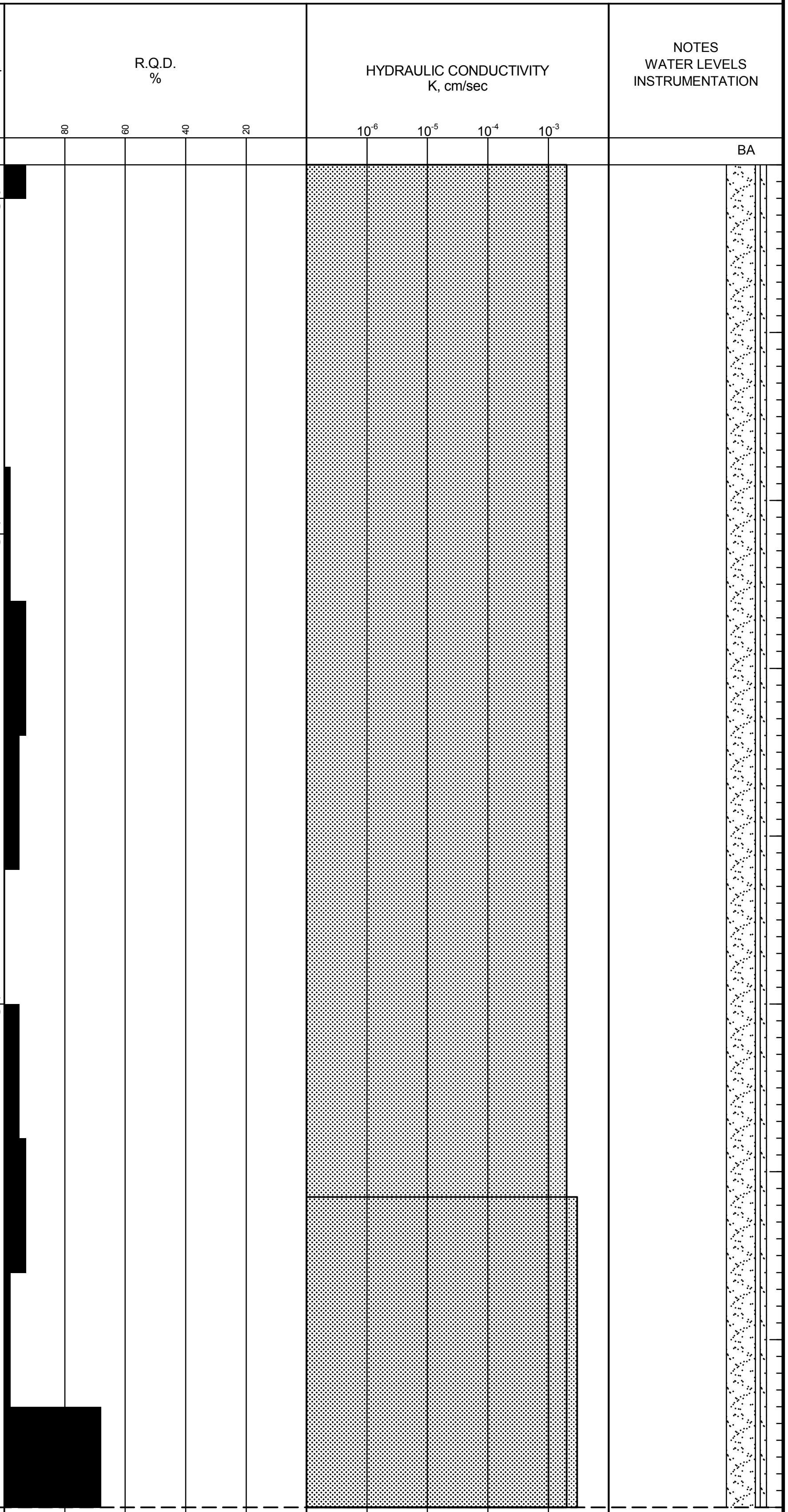
SHEET 6 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
200		
	QUARTZ-MAGNETITE, undulating - irregular banding, magnetite bands throughout.	607.73 201.00
205		
210		
	QUARTZ-CARBONATE GNEISS, massive structure, similar to previous quartz-carbonate unit.	599.07 211.00
215		
220		
225	QUARTZ-MAGNETITE-SPECULARITE, from 225 to 227m : no specularite with a lot of magnetite bands throughout, from 227 to 247 : specularite dominant, faint banding, disseminated magnetite, felsic intrusion with magnetite minerals throughout. Becomes moderately weathered at joint surfaces at 235.5m.	586.94 225.00
230		
235		
240		
	CONTINUED NEXT PAGE	



DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

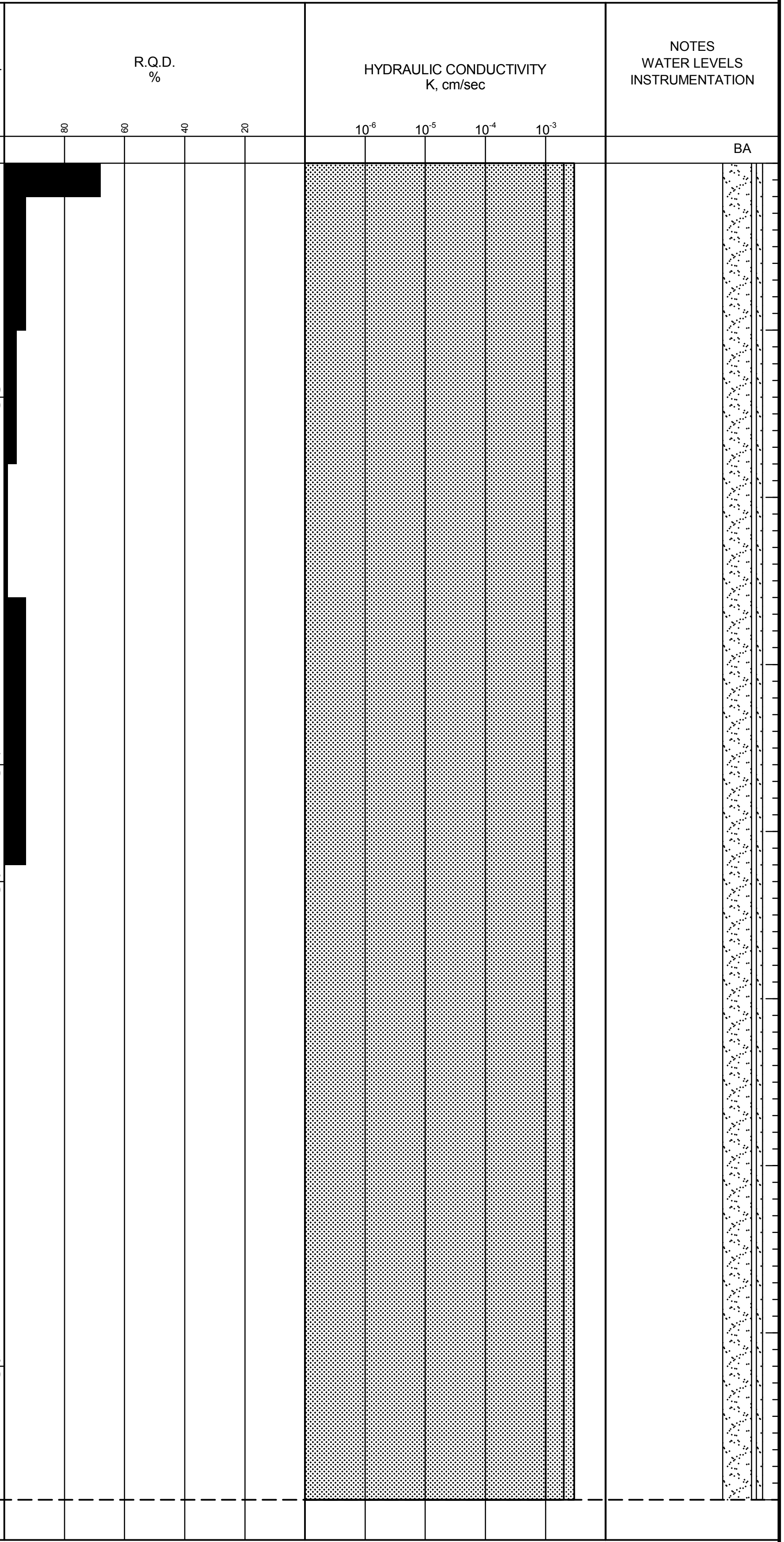
SHEET 7 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
240	QUARTZ-MAGNETITE-SPECULARITE, from 225 to 227m : no specularite with a lot of magnetite bands throughout, from 227 to 247 : specularite dominant, faint banding, disseminated magnetite, felsic intrusion with magnetite minerals throughout. Becomes moderately weathered at joint surfaces at 235.5m.	
245		
	QUARTZ-MAGNETITE, abundant magnetite bands undulating with felsic intrusions, irregular-undulating banding throughout, vuggy texture. Moderately weathered at joint surfaces to 252.5m.	567.89 247.00
250		
255		
	METAGABBRO, faint laminations, garnet rich, quite massive. Disseminated throughout.	558.37 258.00
260		
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, fibrous minerals founded from 261.5 to 276m, irregular banding with felsic intrusions throughout - vuggy texture, low magnetite.	555.33 261.50
265		
270		
275		
	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous run without fibers minerals throughout. From 292-293m moderately weathered at joint surfaces, locally highly weathered. From 300-303m moderately weathered at joint surfaces, locally highly weathered. from 303-306m highly limonitic throughout whole rock.	542.78 276.00
280		
	CONTINUED NEXT PAGE	



DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-71 (P-49)

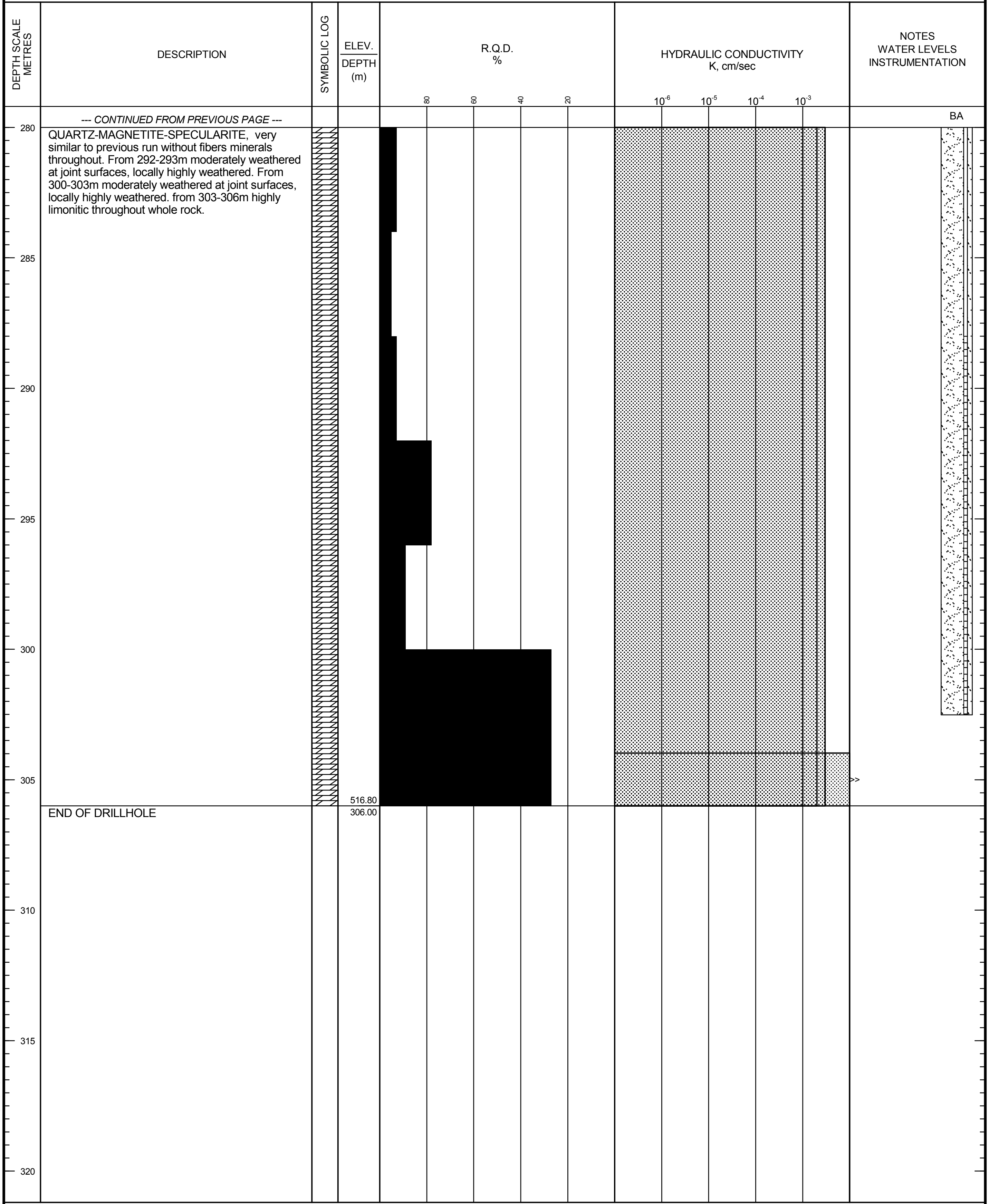
SHEET 8 OF 8

LOCATION: N 5871970.6 ;E 638226.8

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
280	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous run without fibers minerals throughout. From 292-293m moderately weathered at joint surfaces, locally highly weathered. From 300-303m moderately weathered at joint surfaces, locally highly weathered. from 303-306m highly limonitic throughout whole rock.	
305		516.80
	END OF DRILLHOLE	306.00



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-76 (P-16)

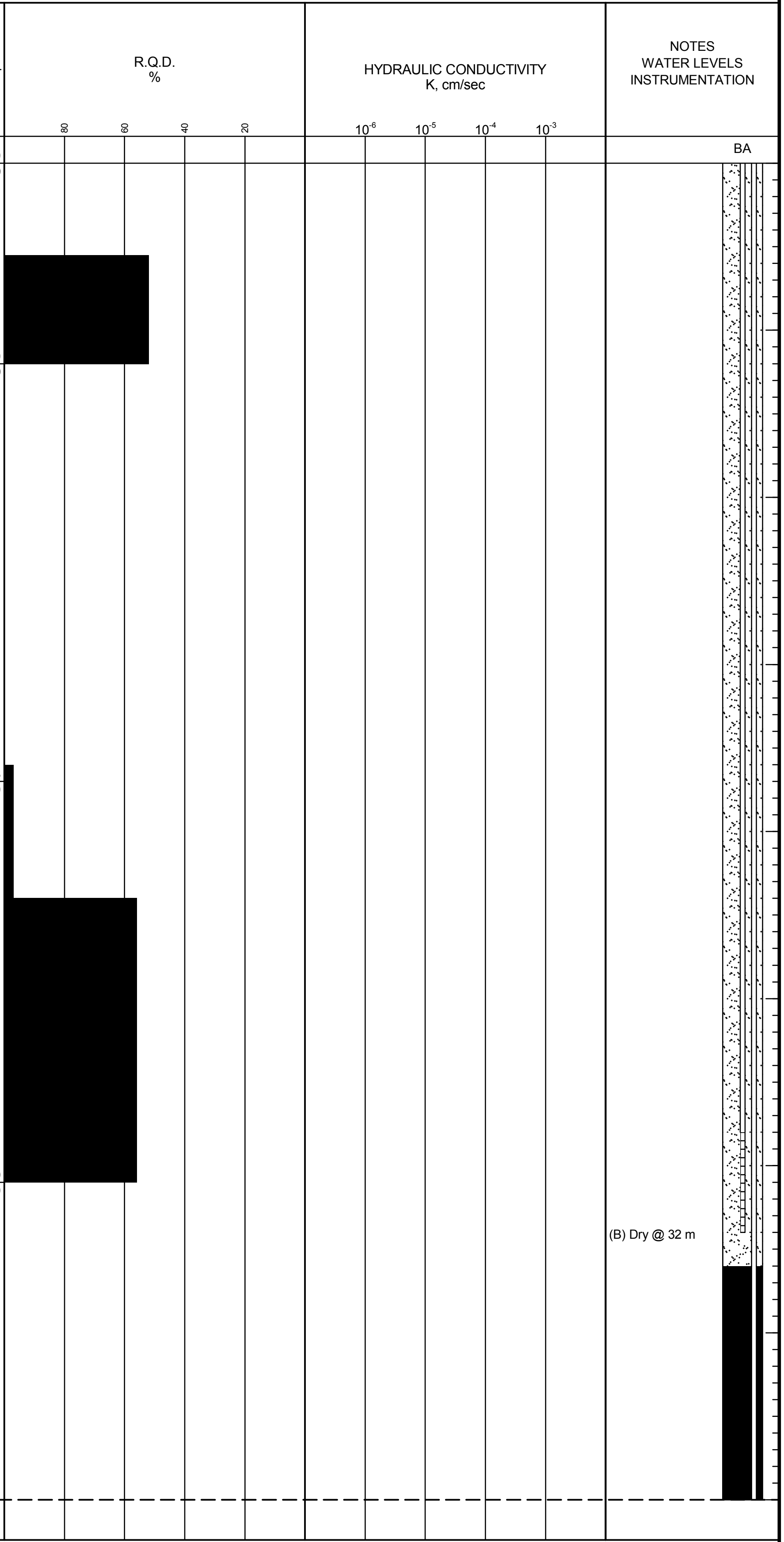
SHEET 1 OF 6

LOCATION: N 5872478.0 ;E 638615.7

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)
	GROUND SURFACE	748.60
0	QUARTZ-MAGNETITE-SPECULARITE, Coarse grained, high specularite, fibrous ore unit. Often friable due to alteration. Radiating needles of anthophyllite often observed. Banding shallows towards the lower fibrous contact. Continued pervasive alteration of joints and disseminations. Light to moderate alteration as vugs and on joint surfaces. Locally friable in high specularite zones. Faintly weathered at joint surfaces. Banded and jointed. 4+ foliations per meter.	0.00
5		743.40
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, A zoned fibrous ore unit. Intervals of abundant coarse specularite and anthophyllite tend to have a very well defined foliation and increased friability. These zones have a crenulated texture. Zones of lower specularite and fiber are banded. Light to moderate alteration throughout as vugs and on joints. Light to moderate alteration as vugs and on joint surfaces. Locally friable in high specularite zones. Faintly weathered at joint surfaces. Banded and jointed. 5+ foliations per meter from 6-7m and then 2-3 foliations per meter from 12-18.5m.	6.00
10		
15		732.58
	QUARTZ-MAGNETITE-SPECULARITE, Moderate specularite and magnetite throughout, specularite is generally coarser than magnetite. Continued light to moderate alteration throughout, with the exception of intensely altered intrusives from 24.5-26.3m and 27.4-27.7m. Alteration is locally observed confined to bands from 27-27.4m. These intrusives are entirely incompetent and crumble under low pressure. Primary texture has been destroyed. Contacts of this ore unit are marked by the presence of anthophyllite. Light to moderate alteration throughout as vugs and on joints. Light to moderate alteration as vugs and on joint surfaces. Locally friable in high specularite zones. Faintly weathered at joint surfaces. Becomes highly weathered at joint surfaces at 24.5-25.5m and 27-27.5m. 4 foliation fractures per meter. becomes 2-3 foliation fractures per meter at 22m. Fracture frequency reasonably consistent through	18.50
20		
25		
30		722.19
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, Very similar to the previous fibrous interval. The coarsened high specularite/fiber zones are less pronounced and broken but still have distinct margins. The crenulations are less severe in this unit. Alteration has decreased. Moderately weathered at joint surfaces. Lightly to moderately vugged throughout. Joints are generally altered. Banded and jointed. 2-3 foliation fractures per meter. Fracture frequency reasonably consistent throughout this zone.	30.50
35		
40		



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DEPTH SCALE

1 : 200

LOGGED: WS

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-76 (P-16)

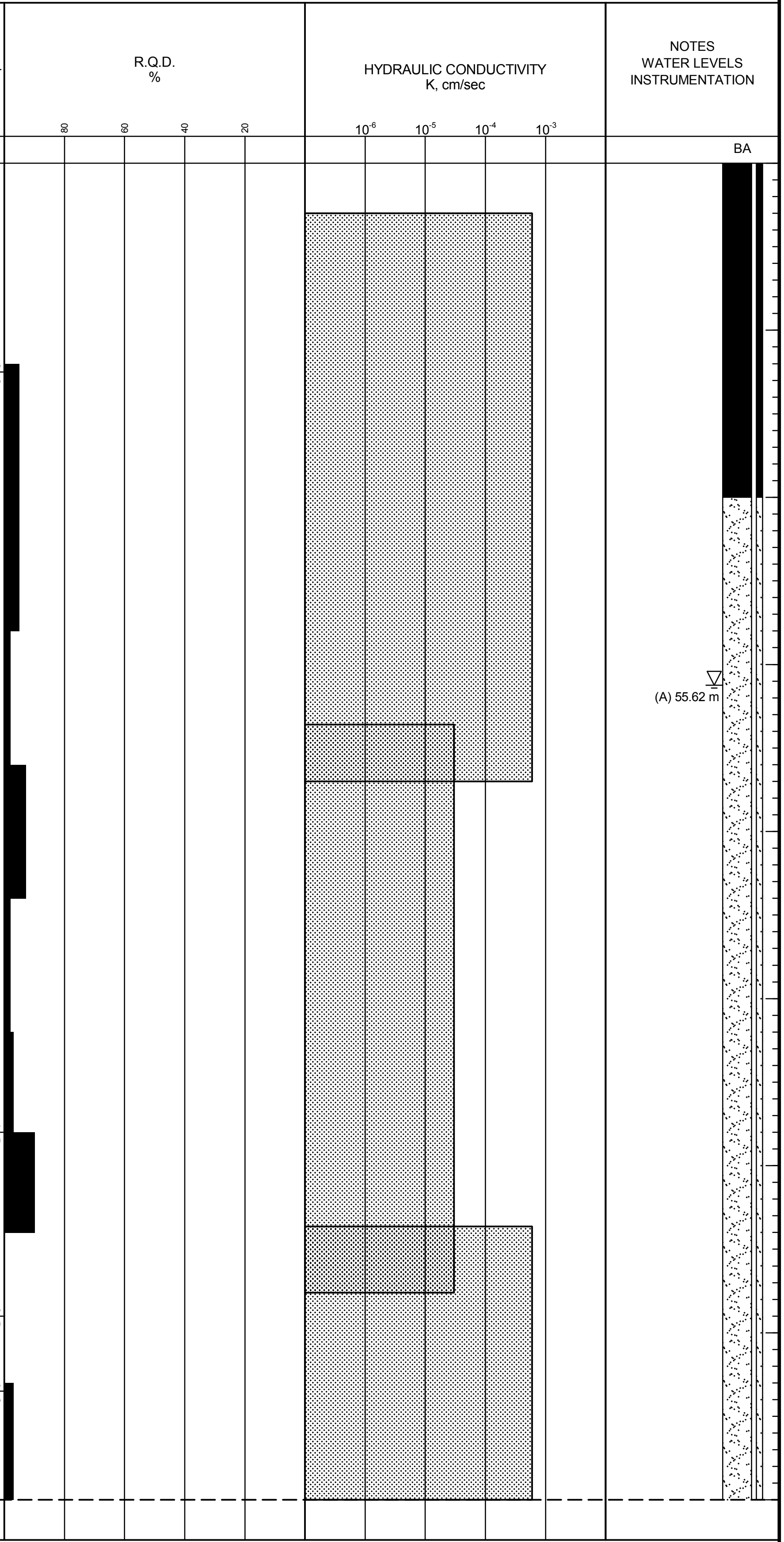
SHEET 2 OF 6

LOCATION: N 5872478.0 ;E 638615.7

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
40	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, Very similar to the previous fibrous interval. The coarsened high specularite/fiber zones are less pronounced and broken but still have distinct margins. The crenulations are less severe in this unit. Alteration has decreased. Moderately weathered at joint surfaces. Lightly to moderately vugged throughout. Joints are generally altered. Banded and jointed. 2-3 foliation fractures per meter. Fracture frequency reasonably consistent throughout this zone.	
45		
	QUARTZ-MAGNETITE-SPECULARITE, A magnetite dominant quartz-magnetite-specularite ore. Faintly banded throughout. Reddish staining in zones of increased specularite. Light to localized moderate alteration as vugs and on joint surfaces. Pyrolusite is occasionally present in association to high magnetite zones. Lower contact marked by the absence of specularite. Rare joint showing trace fiber. Moderately weathered at joint surfaces. Lightly to moderately vugged throughout. Joints are generally altered. 2-3 foliation fractures per meter. Fracture frequency reasonably consistent throughout this zone.	708.55 46.25
50		
55		
60		
65		
	QUARTZ-MAGNETITE, High magnetite ore with variable alteration. Vugged core throughout including a porous zone from 71.7-71.9m. Continued pyrolusite presence. Pyrite cluster from 74.2 74.4m. Moderately weathered at joint surfaces. Jointed.	688.84 69.00
70		
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, Effectively the same as the previous unit with the addition of anthophyllite. Pyrite observed throughout. Locally abundant pyrolusite. Moderately weathered at joint surfaces. Jointed.	684.08 74.50
75		
	QUARTZ-MAGNETITE, Light to moderate vugging throughout, joints are often altered. Pyrolusite locally abundant, these zones tend to have a brecciated texture. Trace specularite. Moderately weathered at joint surfaces. Jointed and banded.	682.13 76.75
80	*CONTINUED NEXT PAGE*	



DEPTH SCALE
1 : 200

LOGGED: WS
CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-76 (P-16)

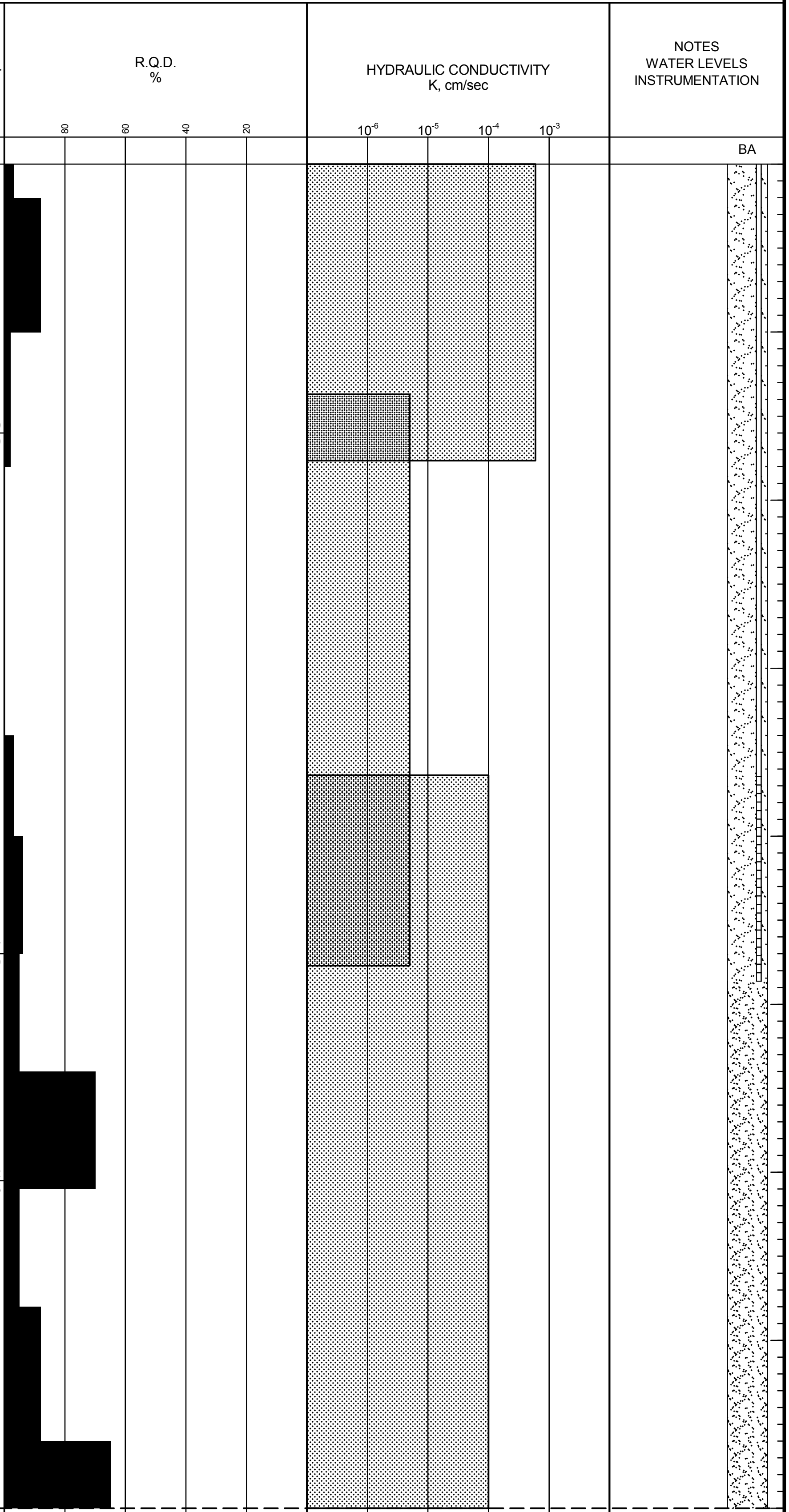
SHEET 3 OF 6

LOCATION: N 5872478.0 ;E 638615.7

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
80	QUARTZ-MAGNETITE, Light to moderate vugging throughout, joints are often altered. Pyrolusite locally abundant, these zones tend to have a brecciated texture. Trace specularite. Moderately weathered at joint surfaces. Jointed and banded.	
88	QUARTZ-MAGNETITE-SPECULARITE, A magnetite dominant ore with alteration locally vugging the core and lightly altering many joints. Decreased pyrolusite. Rhodochrosite often seen in vugs from 89-91.5m. Specularite decreases towards the lower, sharp contact. Moderately weathered at joint surfaces. Jointed and banded.	672.39 88.00
103.5	METAGABBRO, Sharp, broken contacts to this intrusive. Abundant garnets throughout, ranging from 1mm-10cm in diameter. Alteration is generally only on joints, but a few friable intervals are present. Occasional calcite+garnet veinlets. Moderately weathered at joint surfaces. Altered joints, locally broken and friable.	658.97 103.50
110.25	QUARTZ-MAGNETITE, A lean quartz-magnetite ore. The light vugging increases to moderate-strong alteration below 117m. This alteration is often confined to bands and includes increased vugs. Trace specularite increases to minor specularite below 117m Discontinuous magnetite-specularite veinlets are occasionally observed in the lowered, more altered region. Combined with occasional chert clasts, this area locally displays a brecciated texture. Faintly weathered at surface joints with vugs in joints, Becomes moderately limonitic through whole rock at 118m. banded and jointed. 2-3 foliation fractures per meter.	653.12 110.25
120	*CONTINUED NEXT PAGE*	



DEPTH SCALE

1 : 200

LOGGED: WS

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-76 (P-16)

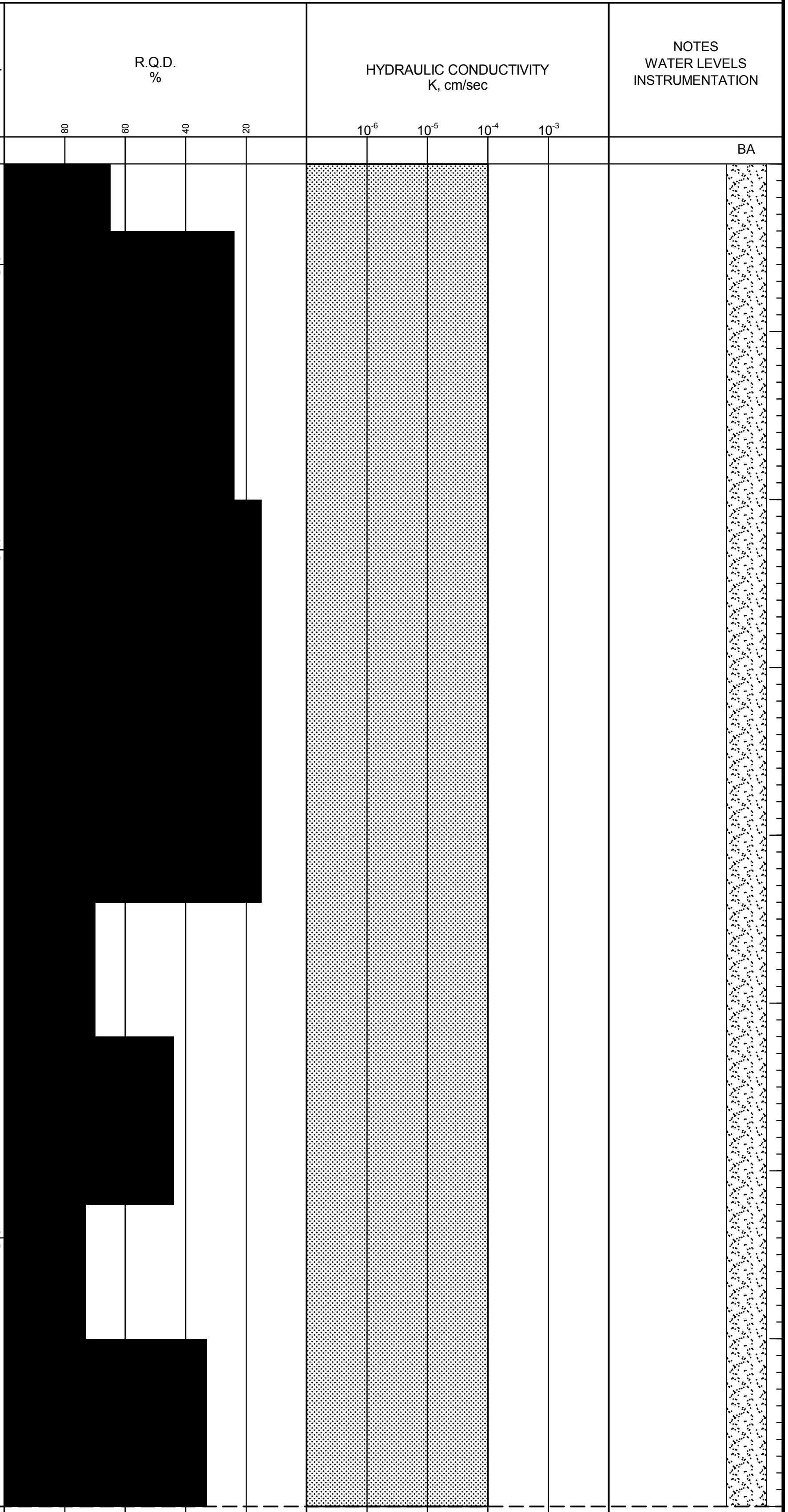
SHEET 4 OF 6

LOCATION: N 5872478.0 ;E 638615.7

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)
	--- *CONTINUED FROM PREVIOUS PAGE* ---		
120			
	QUARTZ-MAGNETITE-CARBONATE GNEISS, Localized banding. This unit has many rubble zones and has significant core loss. Core is highly vugged, pitted and altered. Pyrolusite and goethite are often observed. Moderate to high limonitic alteration. High core loss. Rubble zones. banded and jointed. 2-3 foliation fractures per meter. Graphite present.		642.08 123.00
125			
130			
	QUARTZ-CARBONATE GNEISS, Intensely altered waste rock, particularly the upper 8m. Core is highly pitted and vugged with localized friable and sandy zones. Pyrolusite present in more altered zones. Highly limonitic through whole rock from 131.5-140m. Extreme core loss, mostly sandy and friable recovered core. Becomes moderately limonitic through whole rock from 140-152m. Moderate to intense limonitic alteration. Jointed. Goethite, Pyrolusite and graphite present.		634.72 131.50
135			
140			
145			
150			
			616.96 152.00
155			
160			
	CONTINUED NEXT PAGE		



PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-76 (P-16)

SHEET 5 OF 6

LOCATION: N 5872478.0 ;E 638615.7

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES | DESCRIPTION

--- CONTINUED FROM PREVIOUS PAGE ---

160

QUARTZ-SPECULARITE SCHIST, High alteration gives this unit a reddish colouration. Core is often friable and sandy. Rainbow tarnish on joints from 176.4-177m. Grain size and ore quality decreases downhole. Trace pyrolusite. Becomes a lean quartz-specularite ore, possible better described as a quartz-magnetite-carbonate gneiss quality rock. Reddish colouration seen in bands throughout. Banding is highly deformed and often brecciated. Moderate to strong alteration throughout creates broken zones and occasional friable zones. Localized coarse grained intervals. Highly limonitic through whole rock. Moderate to intense alteration. Primary texture is often obscured. Locally sandy and friable. Banded and jointed. 1-2 foliation fractures per meter from 183-191m. Becomes moderate to localized high alteration creates broken and friable zones. Occasional red colouration in specularite bands. Moderate vuggin

165

170

175

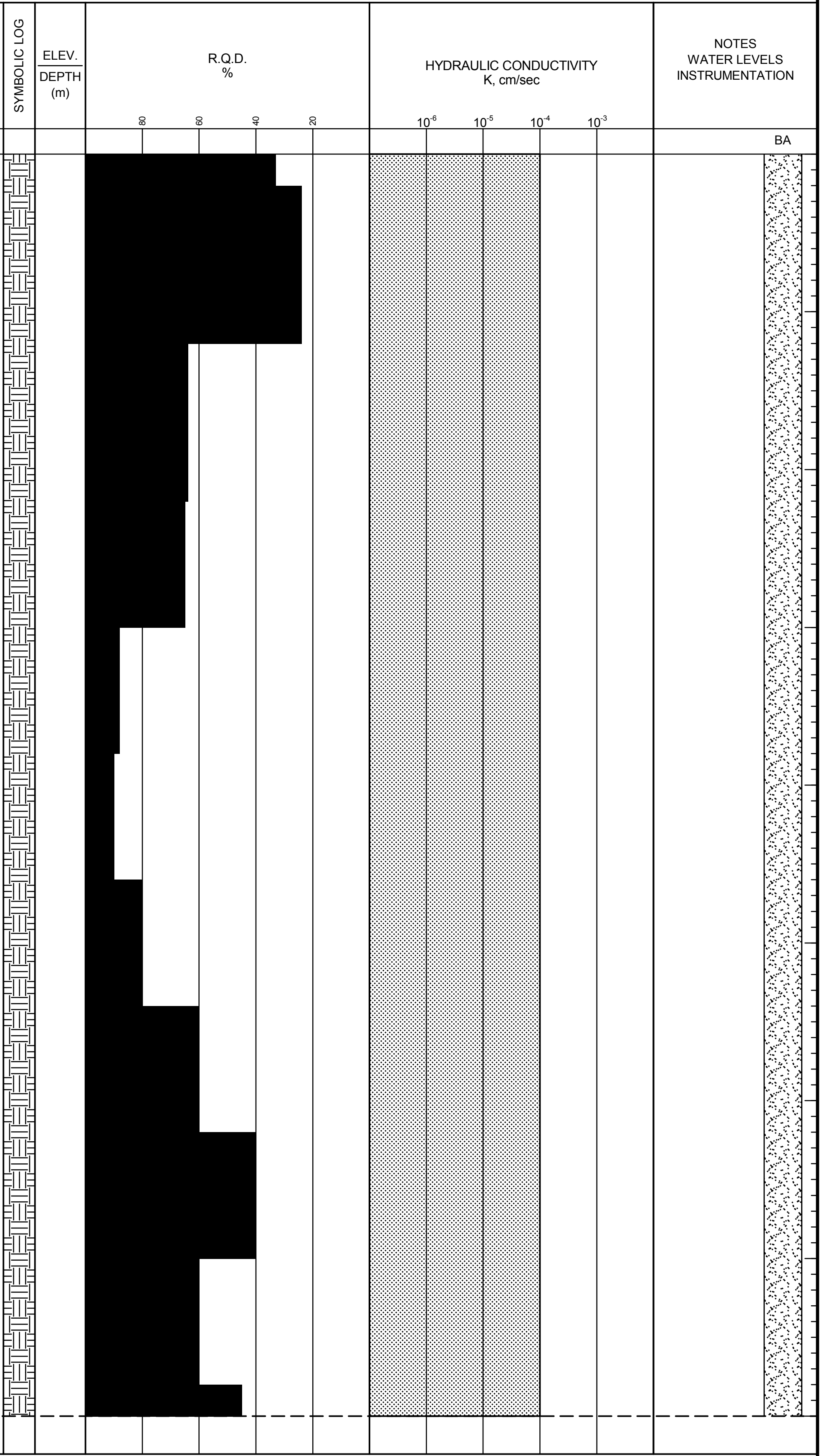
180

185

190

195

200



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DEPTH SCALE

1 : 200

LOGGED: WS

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-76 (P-16)

SHEET 6 OF 6

LOCATION: N 5872478.0 ;E 638615.7

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES | DESCRIPTION

--- CONTINUED FROM PREVIOUS PAGE ---

200

QUARTZ-SPECULARITE SCHIST, High alteration gives this unit a reddish colouration. Core is often friable and sandy. Rainbow tarnish on joints from 176.4-177m. Grain size and ore quality decreases downhole. Trace pyrolusite. Becomes a lean quartz-specularite ore, possible better described as a quartz-magnetite-carbonate gneiss quality rock. Reddish colouration seen in bands throughout. Banding is highly deformed and often brecciated. Moderate to strong alteration throughout creates broken zones and occasional friable zones. Localized coarse grained intervals. Highly limonitic through whole rock. Moderate to intense alteration. Primary texture is often obscured. Locally sandy and friable. Banded and jointed. 1-2 foliation fractures per meter from 183-191m. Becomes moderate to localized high alteration creates broken and friable zones. Occasional red colouration in specularite bands. Moderate vuggin

205

210

END OF DRILLHOLE

215

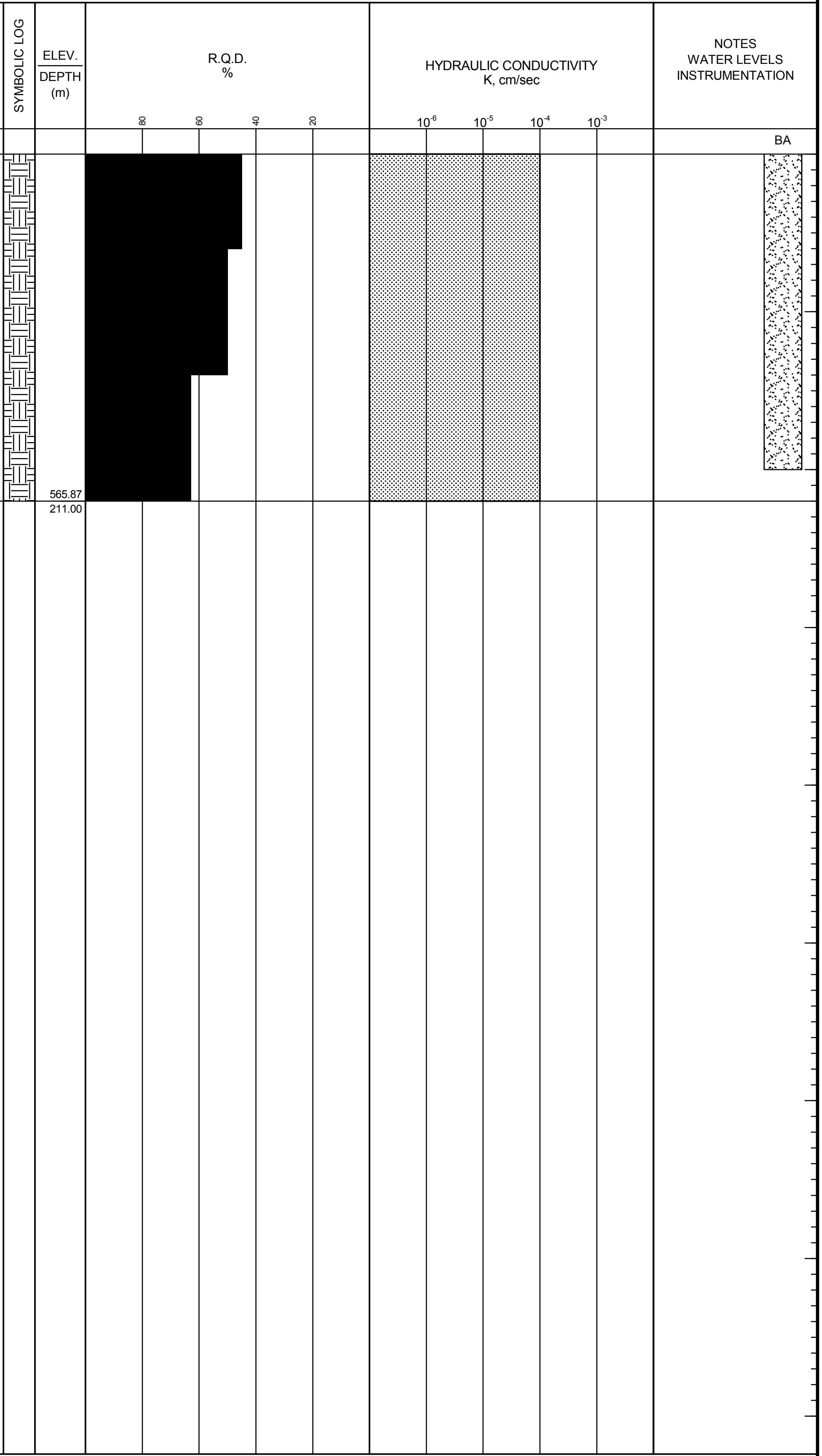
220

225

230

235

240



DEPTH SCALE

1 : 200

LOGGED: WS

CHECKED: PMMC

GTA-RCK 033 11-1152-0116.GPJ GAL-MISS.GDT 5/14/12 MV

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

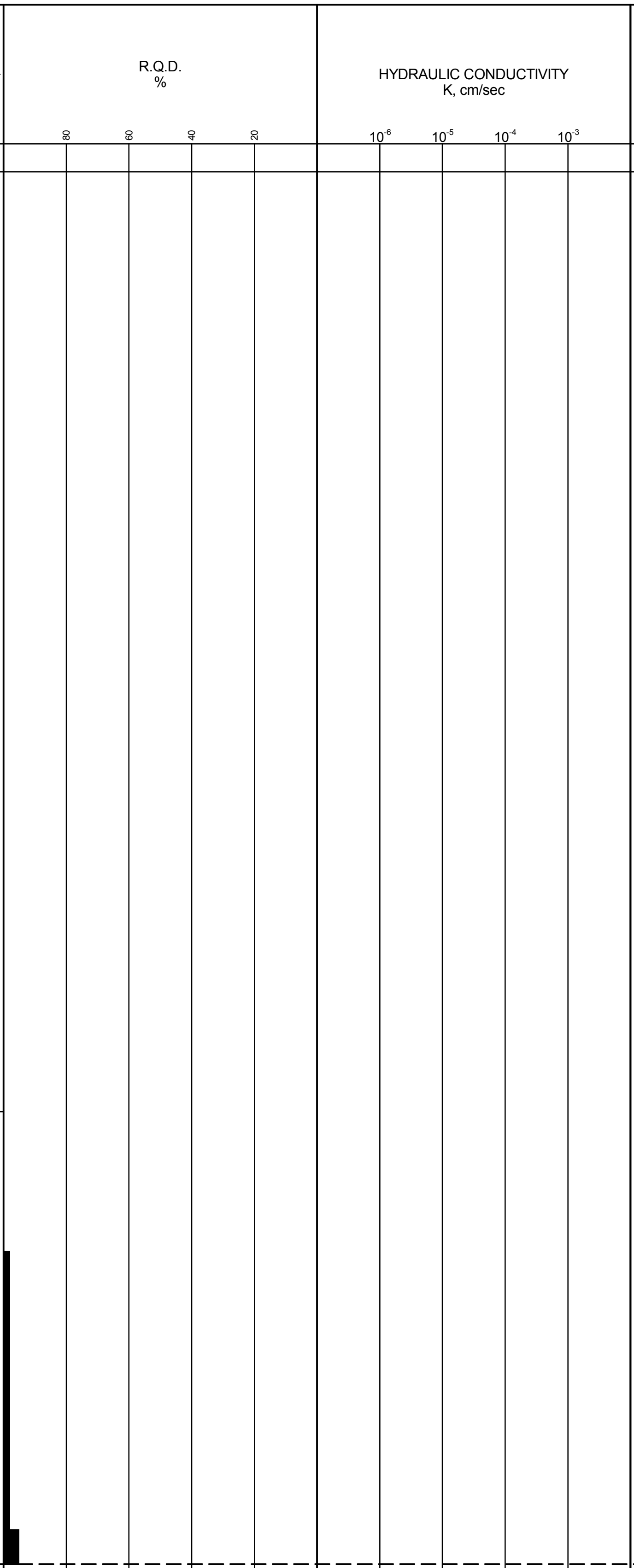
SHEET 1 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	NOTES WATER LEVELS INSTRUMENTATION
	GROUND SURFACE	798.60 0.00	
5	QUARTZ-MAGNETITE-GRUNERITE GNEISS, no banding, light foliation, sub-parallel to core axis, irregular and undulating [grunerite- green minerals(mostly different then chlorite)-magnetite] who gives a general vuggy texture, the granurite is mostly not under a fiber form, disseminated magnetite throughout.		
17.3			17.3 m
20			Open hole
27	QUARTZ-MAGNETITE, no banding, light foliation sub-parallel to core axis, irregular and undulating [green mineral(not chlorite) - magnetite] intrusions throughout, disseminated magnetite throughout	775.22 27.00	
40	*CONTINUED NEXT PAGE*		



DEPTH SCALE
1 : 200

LOGGED: SDR
CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

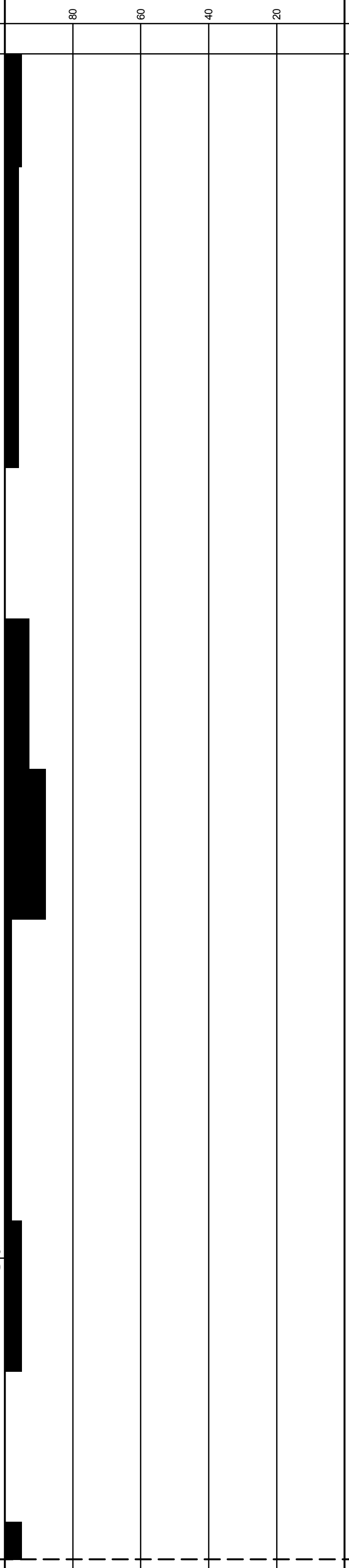
SHEET 2 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	R.Q.D. %	HYDRAULIC CONDUCTIVITY K, cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
40	QUARTZ-MAGNETITE, no banding, light foliation sub-parallel to core axis, irregular and undulating [green mineral(not chlorite) - magnetite] intrusions throughout, disseminated magnetite throughout					
45						
50						
55						
60						Open hole
65						
70						
	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.		736.25 72.00			
75						
80						
	CONTINUED NEXT PAGE					



HYDRAULIC CONDUCTIVITY K, cm/sec: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

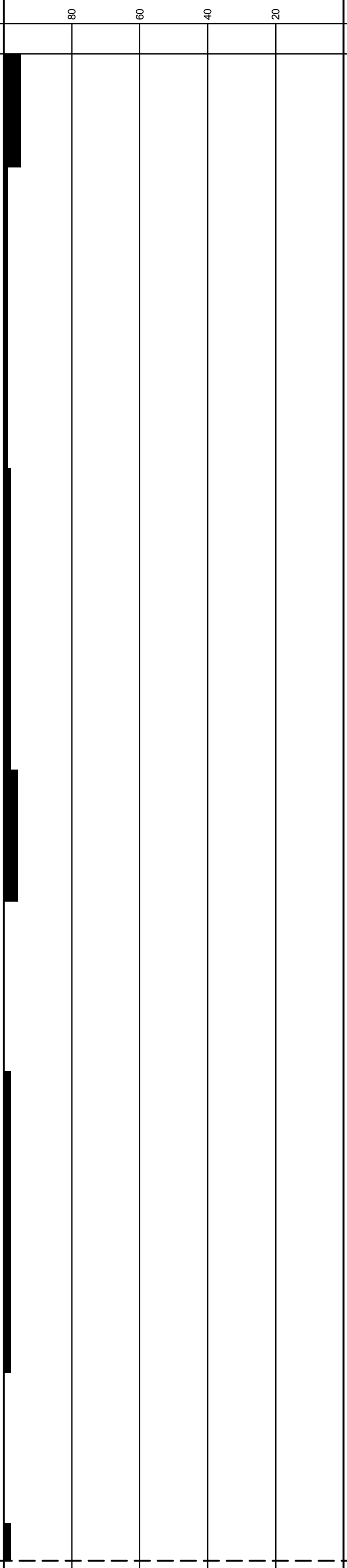
SHEET 3 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	R.Q.D. %	HYDRAULIC CONDUCTIVITY K, cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
80	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.					
85						
90						
95						
100						Open hole
105						
110						
115						
120	*CONTINUED NEXT PAGE*					



HYDRAULIC CONDUCTIVITY scale: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

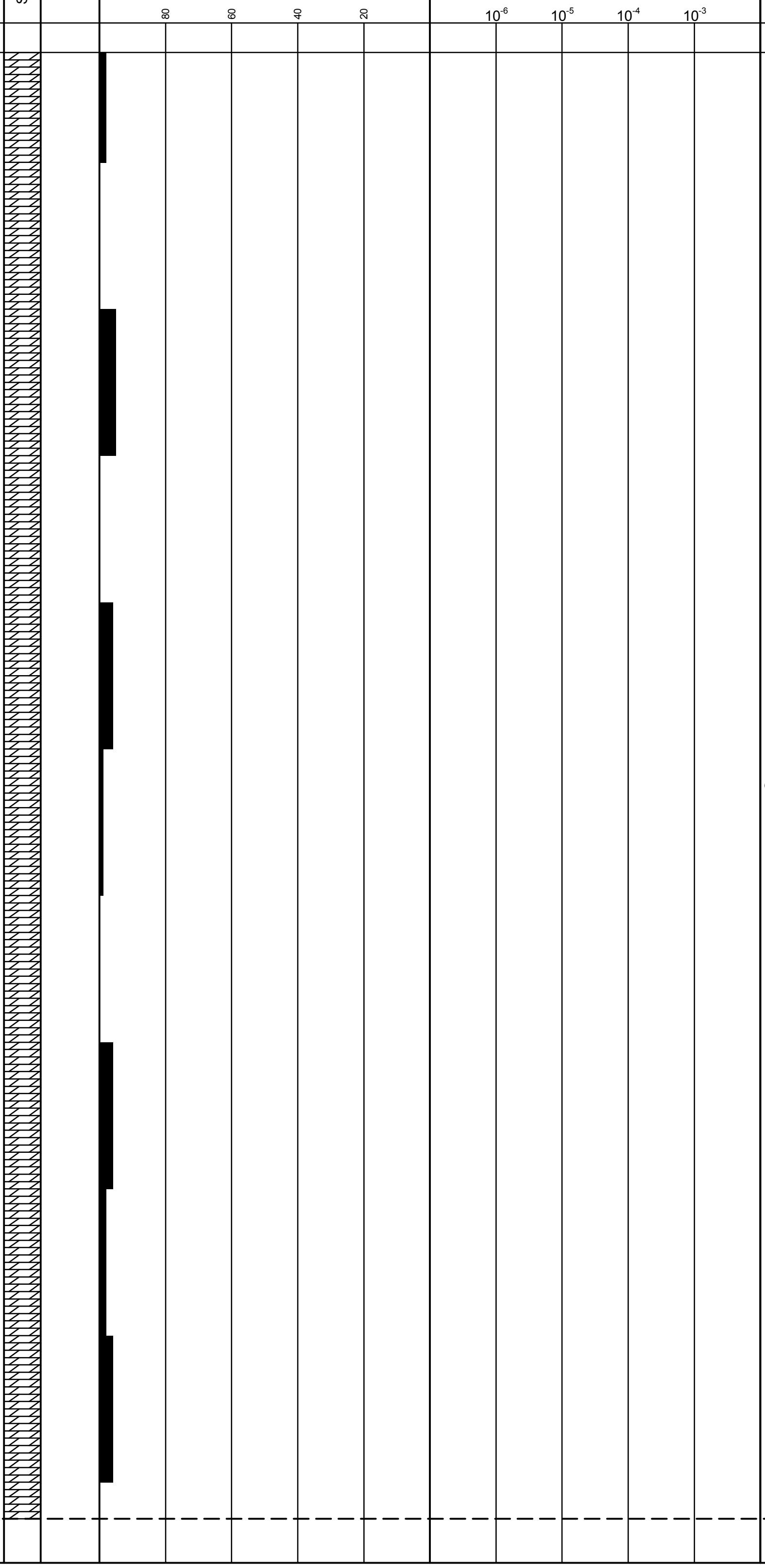
SHEET 4 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	R.Q.D. %	HYDRAULIC CONDUCTIVITY K, cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
120	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.					
125						
130						
135						
140						Open hole
145						
150						
155						
160						
	CONTINUED NEXT PAGE					



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

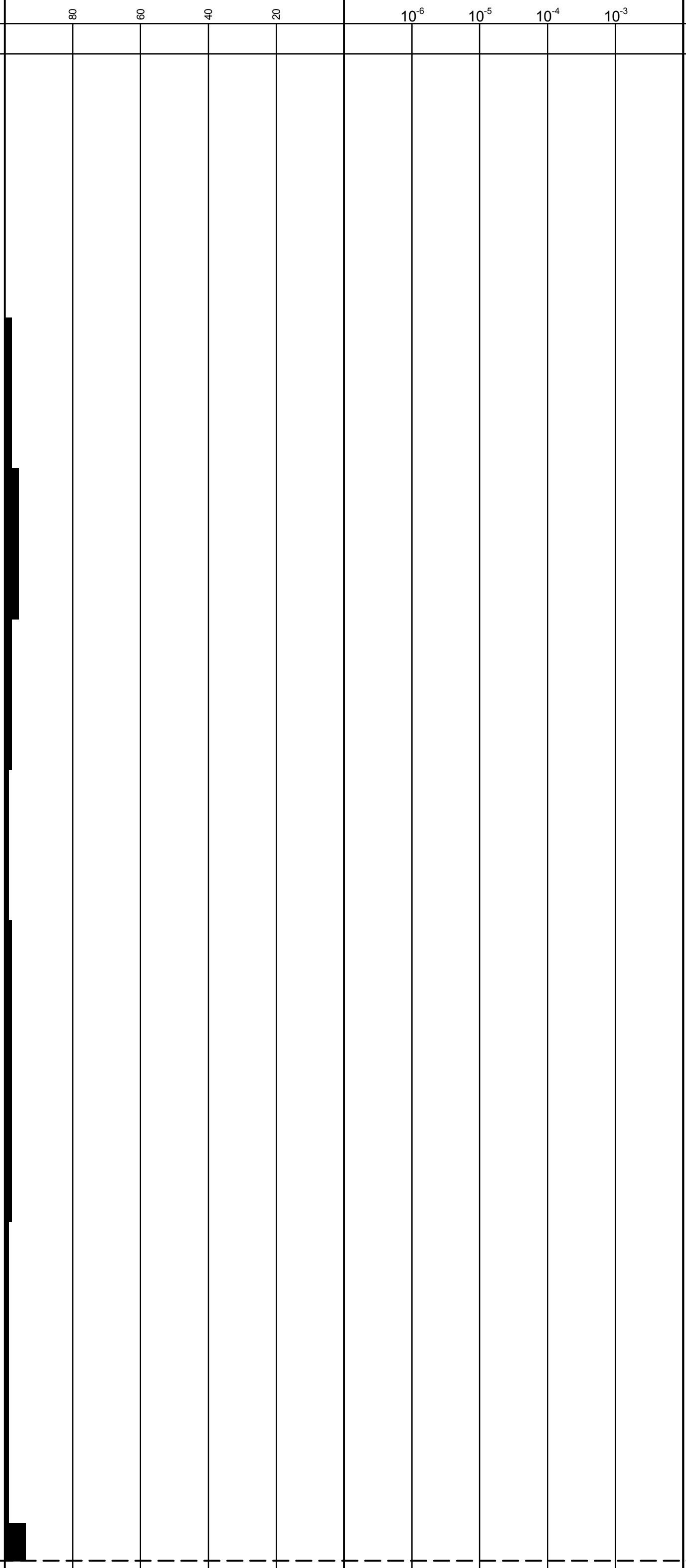
RECORD OF Drillhole: W3-11-81 (P-64)

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	R.Q.D. %	HYDRAULIC CONDUCTIVITY K, cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
160	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.					
165						
170						
175						
180						Open hole
185						
190						
195						
200	*CONTINUED NEXT PAGE*					



DEPTH SCALE
1 : 200

Golder Associates

LOGGED: SDR
CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

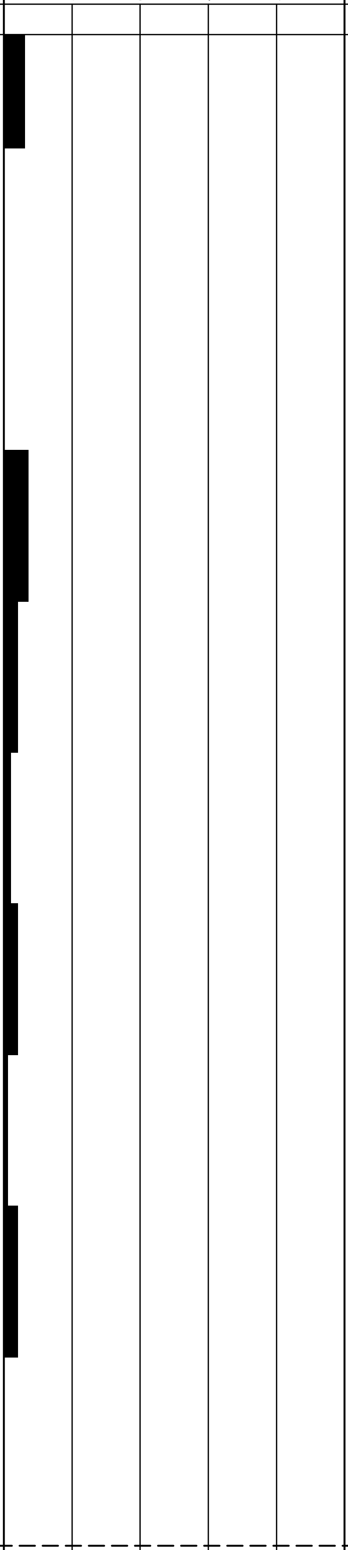
SHEET 6 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	R.Q.D. %	HYDRAULIC CONDUCTIVITY K, cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---			80 60 40 20	10^{-6} 10^{-5} 10^{-4} 10^{-3}	
200	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.					
205						
210						
215						
220						Open hole
225						
230						
235						
240	*CONTINUED NEXT PAGE*					



DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

SHEET 7 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	R.Q.D. %	HYDRAULIC CONDUCTIVITY K, cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
240	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.					
260						Open hole
	CONTINUED NEXT PAGE					

DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

GTA-RCK 033 11-1152-0116.GPJ GAL-MISS.GDT 5/14/12 MV

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

SHEET 8 OF 12

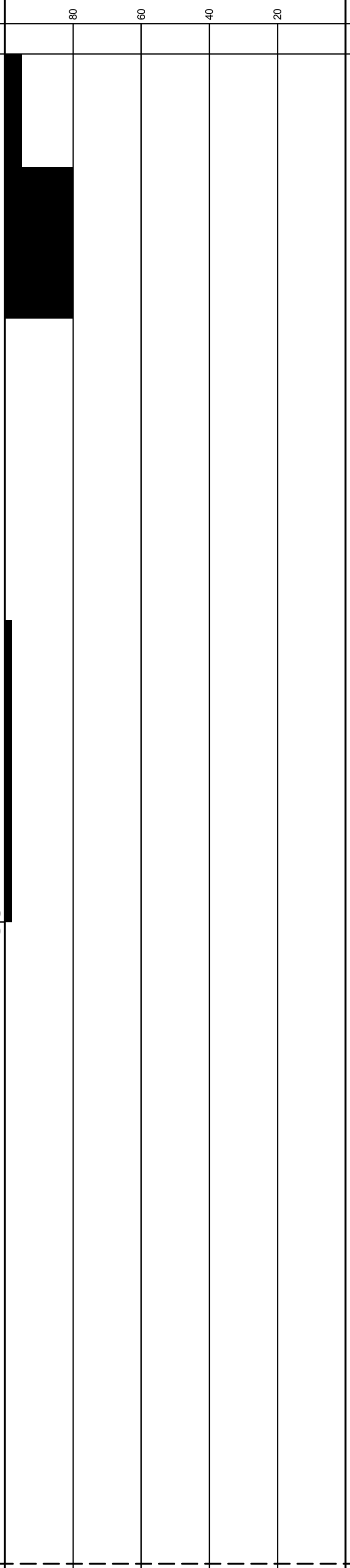
LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	NOTES WATER LEVELS INSTRUMENTATION
	--- *CONTINUED FROM PREVIOUS PAGE* ---		
280	QUARTZ-MAGNETITE-SPECULARITE, very similar to previous unit - with specularite, no grunerite found but a lot of chlorite intrusions(garnet rich) following the irregular intrusions - same vuggy texture, no apparent banding, foliation sub-parallel to core axis, actinolite locally observed at 125m. Highly weathered zone 214-215m, chlorite present in this zone. Calcite and undifferentiated carbonates 250-251m. highly weathered zone (lost core) 283-285m.		
285			
290			
295			
300			Open hole
	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, very similar to previous run - with fibers minerals, specularite dominant, same vuggy texture, undulating foliation with magnetite bands throughout (no apparent banding). Moderately weathered at joint surfaces with appearance of talc on the joint surface, fibrous from 330m to 357.5m	536.19 303.00	
305			
310			
315			
320	*CONTINUED NEXT PAGE*		

R.Q.D. %



HYDRAULIC CONDUCTIVITY K, cm/sec

10^{-6} 10^{-5} 10^{-4} 10^{-3}

DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

GTA-RCK 033 11-1152-0116.GPJ GAL-MISS.GDT 5/14/12 MV

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

SHEET 9 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	R.Q.D. % (80, 60, 40, 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3})	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
320	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, very similar to previous run - with fibers minerals, specularite dominant, same vuggy texture, undulating foliation with magnetite bands throughout (no apparent banding). Moderately weathered at joint surfaces with appearance of talc on the joint surface, fibrous from 330m to 357.5m					
325						
330						
335						
340						Open hole
345						
350						
355						
360						
	CONTINUED NEXT PAGE					

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

SHEET 10 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	R.Q.D. % (80, 60, 40, 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3})	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---				
360	QUARTZ-SPECULARITE-ANTHOPHYLLITE +/- TALC SCHIST, very similar to previous run - with fibers minerals, specularite dominant, same vuggy texture, undulating foliation with magnetite bands throughout (no apparent banding). Moderately weathered at joint surfaces with appearance of talc on the joint surface, fibrous from 330m to 357.5m				
365					
370					
375					
380					Open hole
385					
390					
395					
	QUARTZ-MAGNETITE-GRUNERITE GNEISS, well defined banding with magnetite bands throughout, high magnetism, felsic intrusions from 434 to 434.7m and from 437.5 to 438m	455.65 396.00			
400					
	CONTINUED NEXT PAGE				

DEPTH SCALE

1 : 200

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

SHEET 11 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	R.Q.D. % 80 60 40 20	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-6} 10^{-5} 10^{-4} 10^{-3}	NOTES WATER LEVELS INSTRUMENTATION
	--- CONTINUED FROM PREVIOUS PAGE ---					
400	QUARTZ-MAGNETITE-GRUNERITE GNEISS, well defined banding with magnetite bands throughout, high magnetism, felsic intrusions from 434 to 434.7m and from 437.5 to 438m					
405						
410						
415						
420						Open hole
425						
430						
435						
440						
	CONTINUED NEXT PAGE					

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

CHECKED: PMMC

PROJECT: 11-1152-0116

RECORD OF Drillhole: W3-11-81 (P-64)

SHEET 12 OF 12

LOCATION: N 5871459.6 ;E 637834.2

DATUM: NAD83

INCLINATION: -60° AZIMUTH: 90°

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	NOTES WATER LEVELS INSTRUMENTATION
440	QUARTZ-MAGNETITE-GRUNERITE GNEISS, well defined banding with magnetite bands throughout, high magnetism, felsic intrusions from 434 to 434.7m and from 437.5 to 438m		
445			
450			
		406.29 453.00	
455	QUARTZ-GRUNERITE-MAGNETITE SCHIST, low magnetite unit, typical schist texture, abundant grunerite minerals throughout, garnet and well crystallized pyrite minerals seen, irregular and undulating foliation, a few magnetite bands throughout. Moderately weathered at joint surfaces, with oxidation at joint surfaces.		
			Open hole
460			
465			
470			
475			
		385.51 477.00	
	END OF DRILLHOLE		
480			

R.Q.D. %: 80, 60, 40, 20

HYDRAULIC CONDUCTIVITY K, cm/sec: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

DEPTH SCALE

1 : 200

Golder Associates

LOGGED: SDR

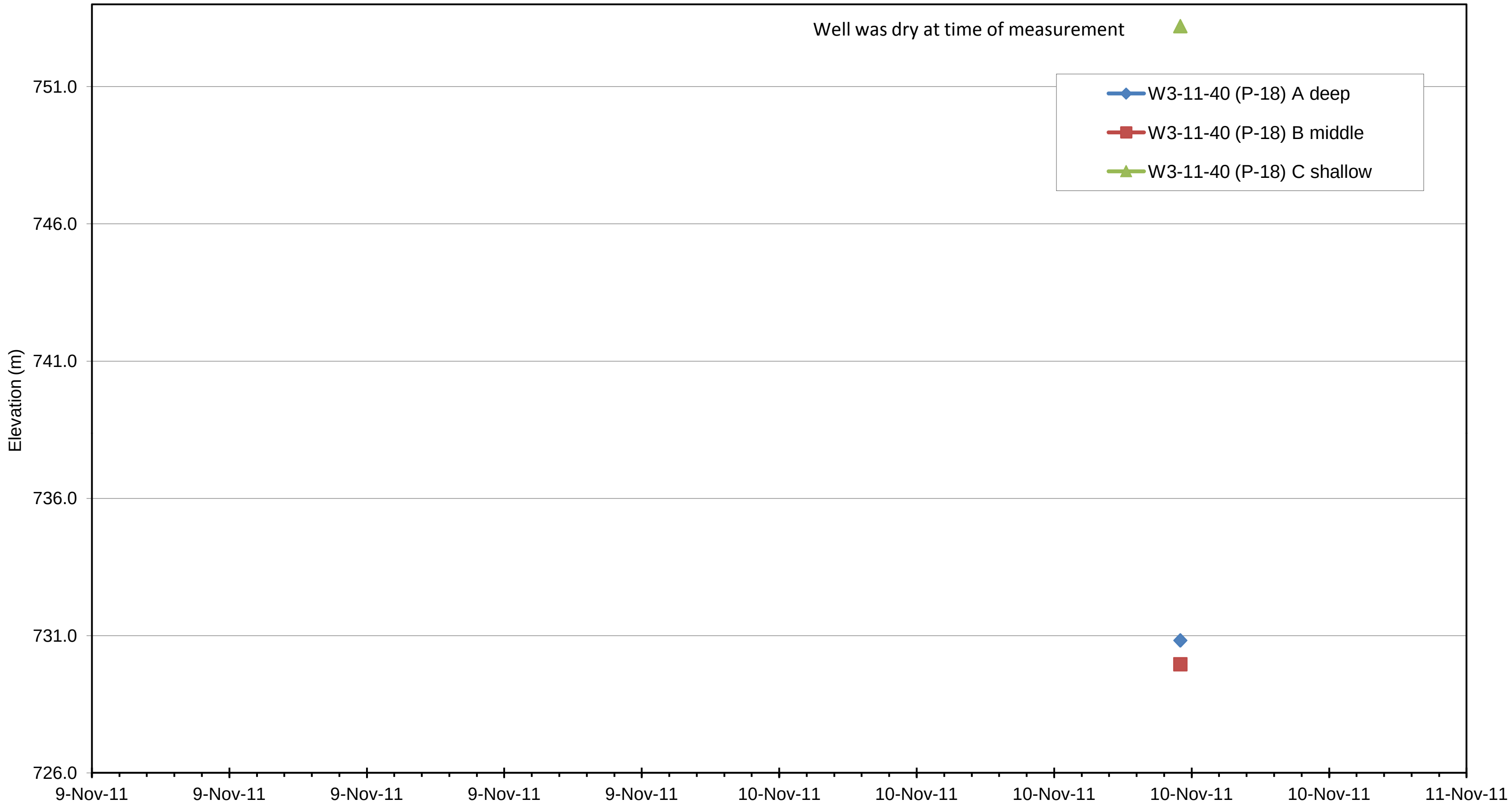
CHECKED: PMMC

ATTACHMENT 3

Groundwater Hydrographs

HYDROGRAPH OF MONITORING WELL W3-11-40 (P-18) GROUNDWATER ELEVATIONS (2011)

FIGURE A.3.1



DATE: December 2011

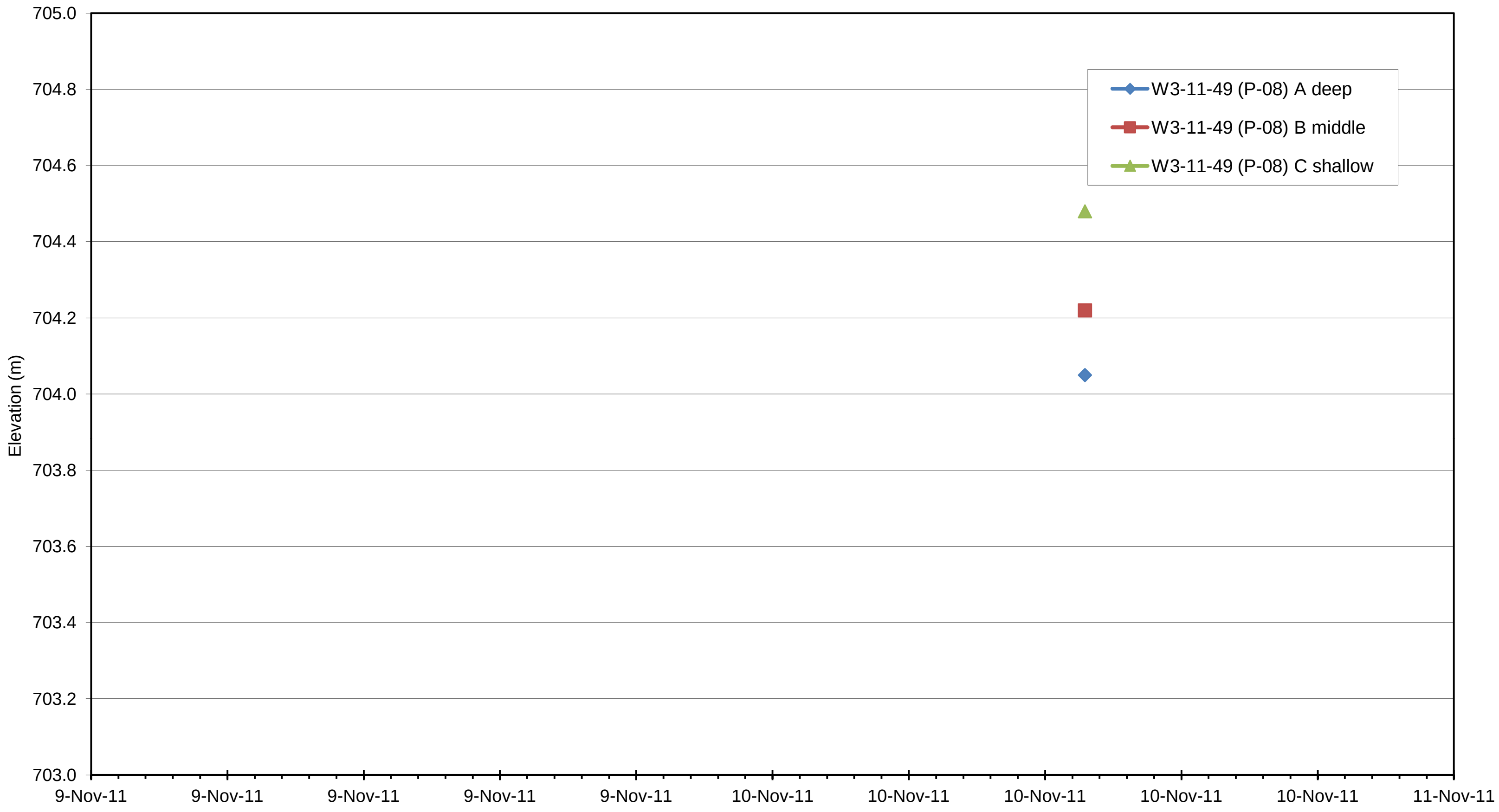
PROJECT: 11-1152-0116

CAD: KS

CHK: PMMC

HYDROGRAPH OF MONITORING WELL W3-11-49 (P-08) GROUNDWATER ELEVATIONS (2011)

FIGURE A.3.2



DATE: December 2011

PROJECT: 11-1152-0116

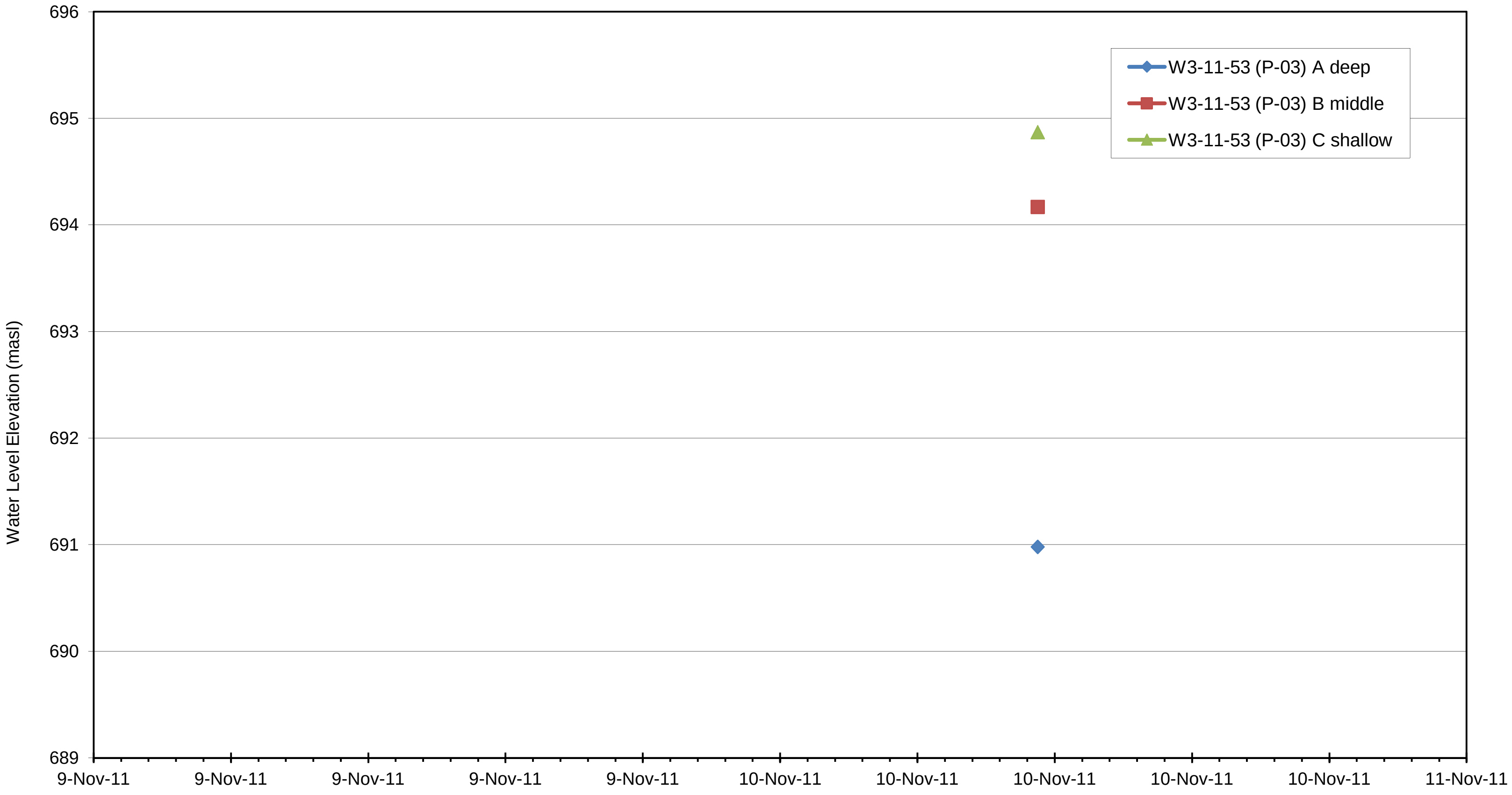
Golder Associates

CAD: KS

CHK: PMMC

HYDROGRAPH OF MONITORING WELL W3-11-53 (P-03) GROUNDWATER ELEVATIONS (2011)

FIGURE A.3.3



DATE: December 2011

PROJECT: 11-1152-0116

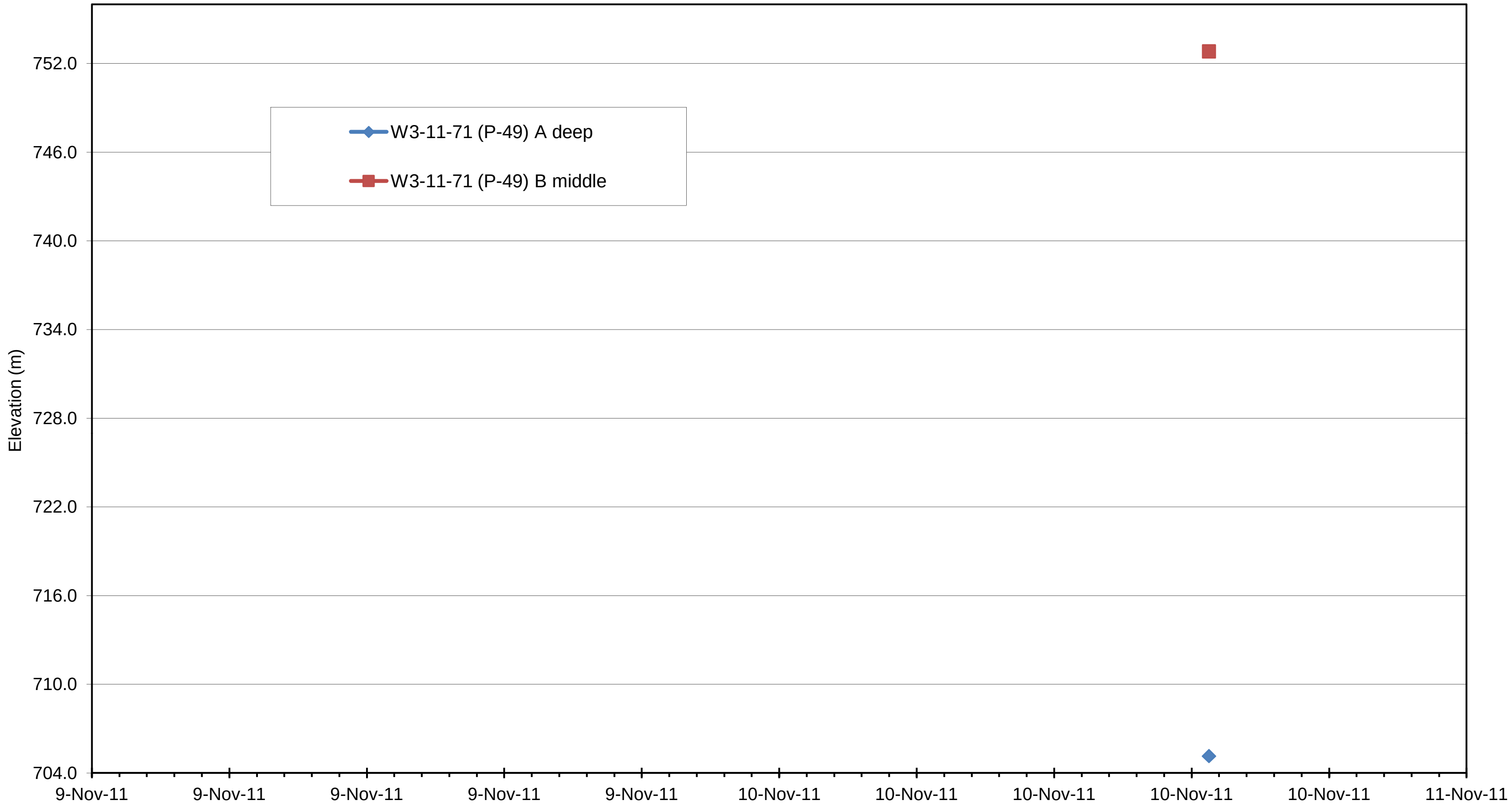
Golder Associates

CAD: KS

CHK: PMMC

HYDROGRAPH OF MONITORING WELL W3-11-71 (P-49) GROUNDWATER ELEVATIONS (2011)

FIGURE A.3.4



DATE: December 2011

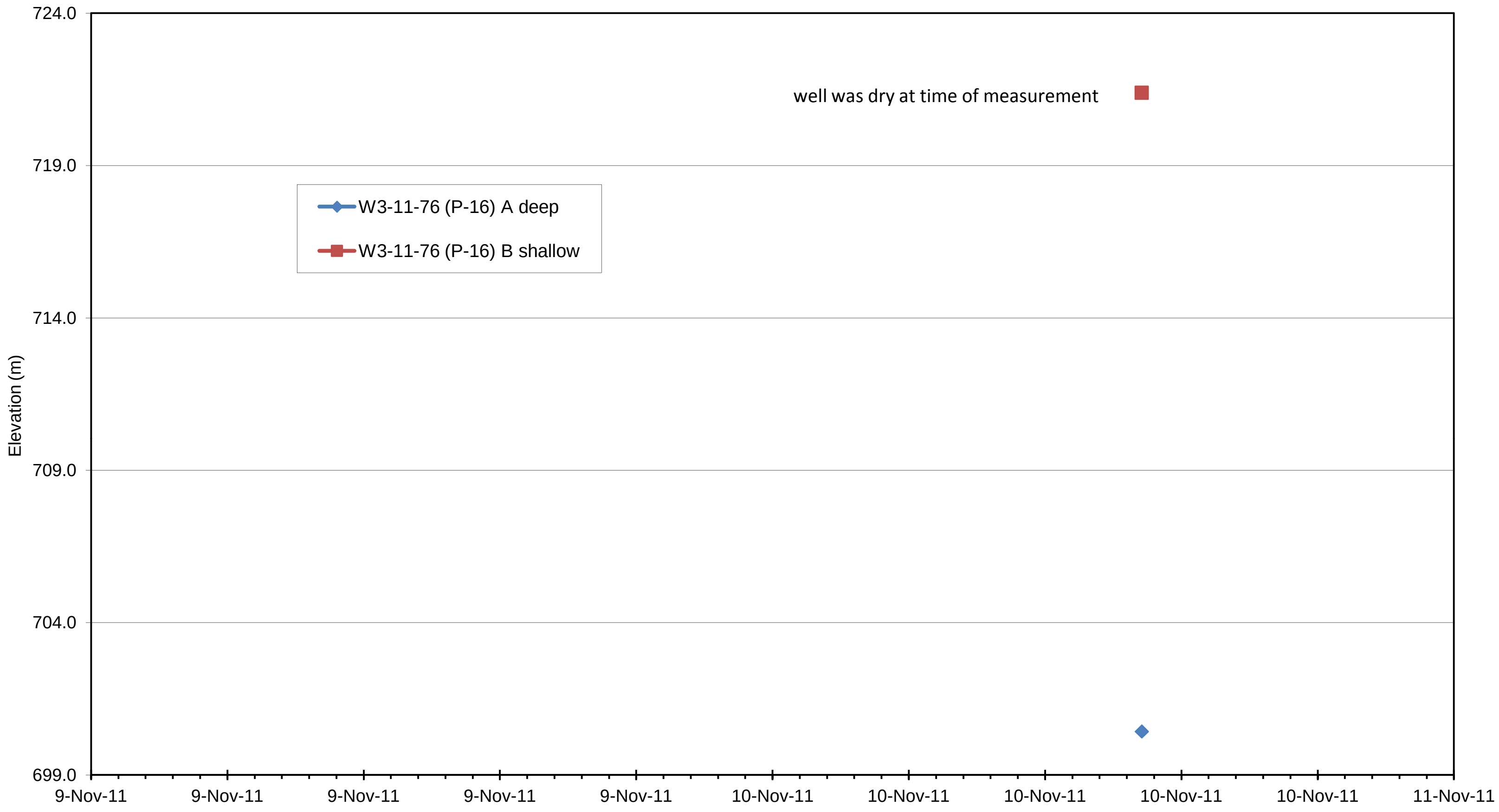
PROJECT: 11-1152-0116

CAD: KS

CHK: PMMC

HYDROGRAPH OF MONITORING WELL W3-11-76 (P-16)
GROUNDWATER ELEVATIONS (2011)

FIGURE A.3.5



DATE: December 2011

PROJECT: 11-1152-0116

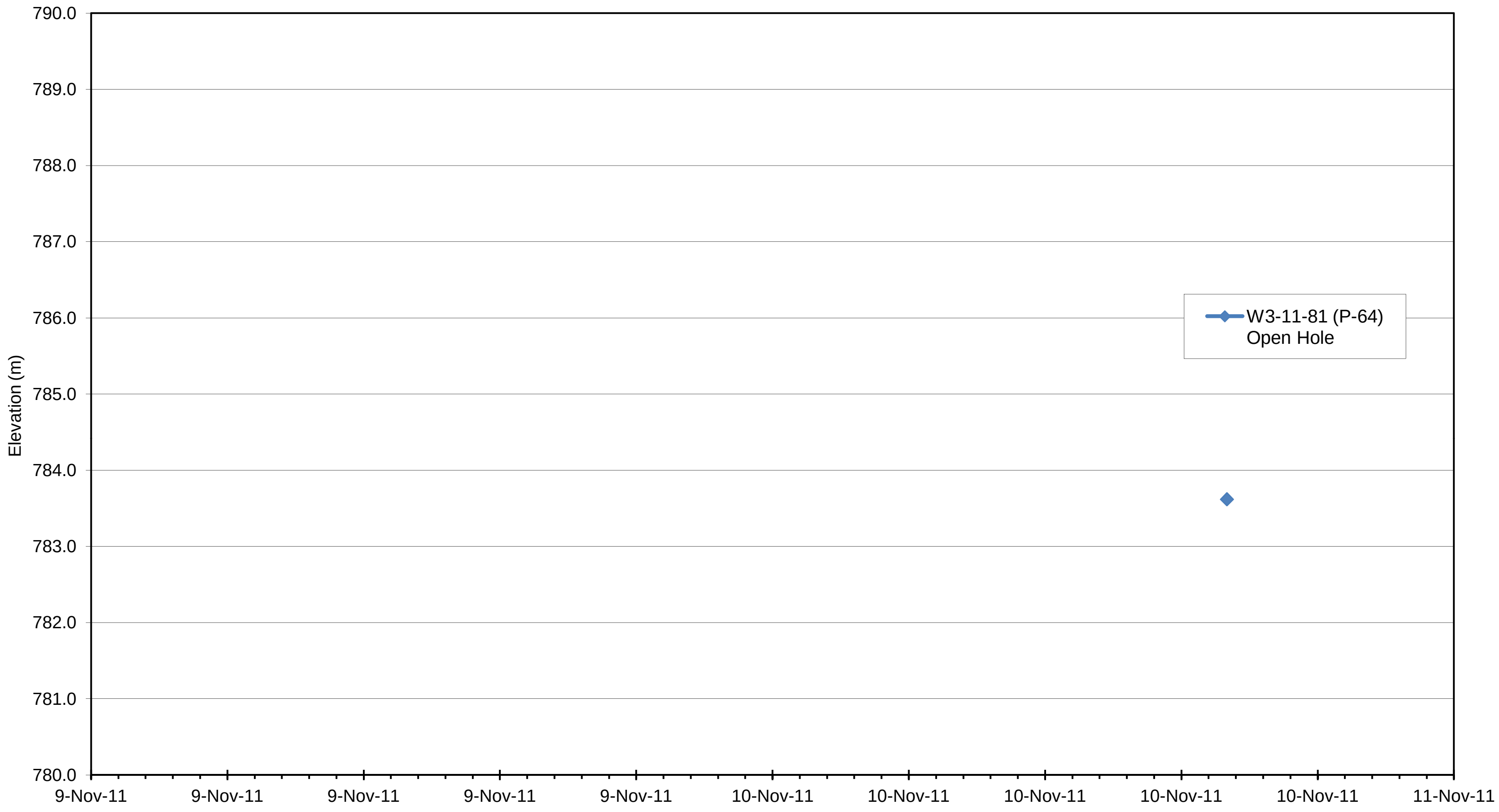
Golder Associates

CAD: KS

CHK: PMMC

HYDROGRAPH OF MONITORING WELL W3-11-81 (P-64) GROUNDWATER ELEVATIONS (2011)

FIGURE A.3.6



DATE: December 2011

PROJECT: 11-1152-0116

Golder Associates

CAD: KS

CHK: PMMC

APPENDIX B

PACKER TESTING SUMMARY SHEETS (10kPa = 1 m of Water)

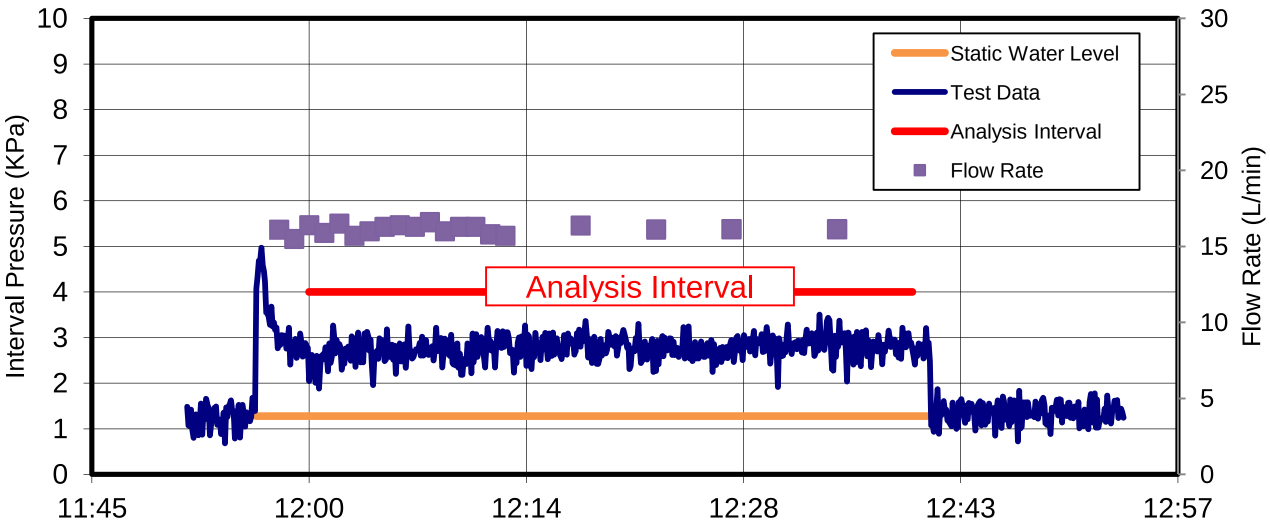
In-Situ Hydraulic Conductivity Test Report

Figure B.1

Constant Rate Test

W3-11-40 (P-18): 44.5m - 61.5m

Packer Test Interval	44.5 to 61.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	19-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	16.13 L/min
Average Change in Head	0.2 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.6E-03
Packer Interval	17 m
Hydraulic Conductivity (cm/sec)	9.E-03

Thiem Equation (1906)

$$T = Q \left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2 \Pi \Delta H} \right)$$

DATE: November 11, 2011

PROJECT: 11-1152-0116

prepared by: KS

CHK: PMMC

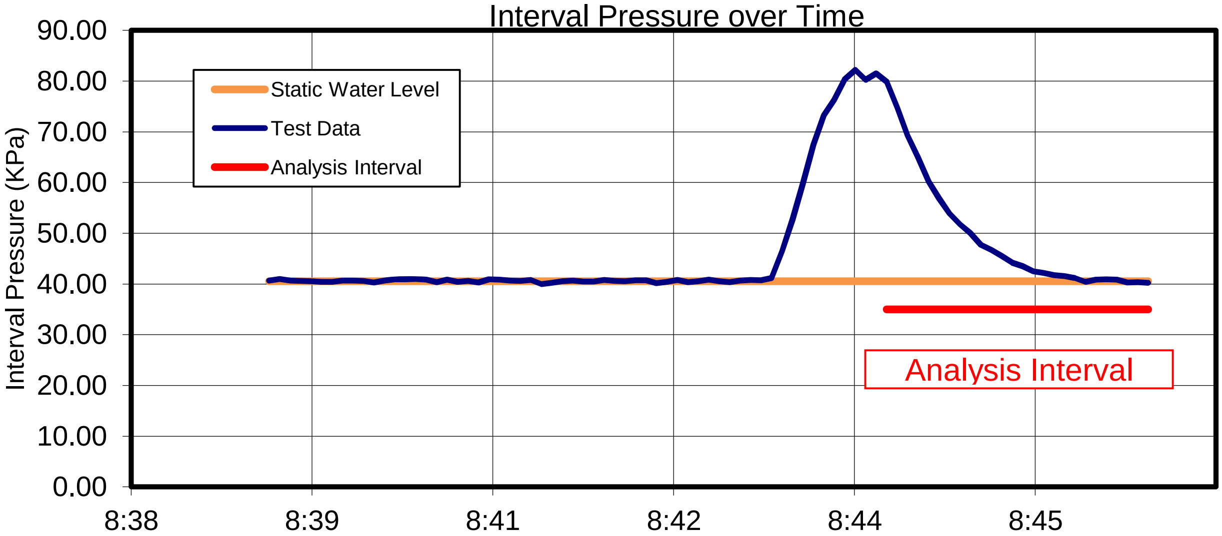
Golder Associates

In-Situ Hydraulic Conductivity Test Report

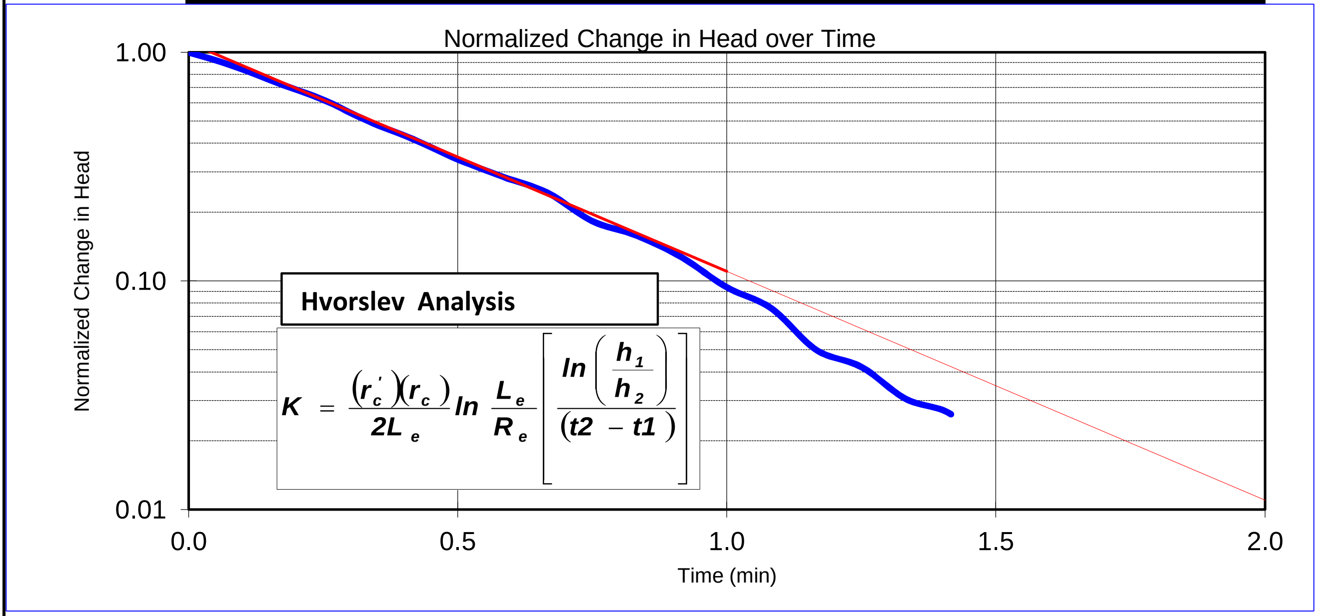
Falling Head Test W3-11-40 (P-18): 59.5m to 76.5m

Figure B.2

Packer Test Interval	59.5 to 76.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	19-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	2.303
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	2.E-04



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 11, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

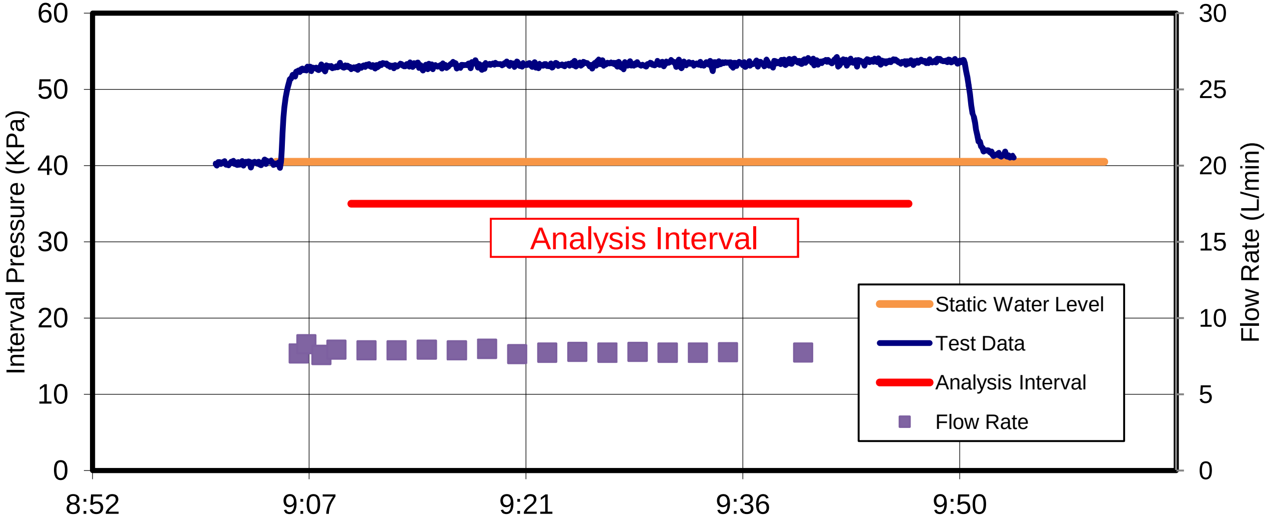
In-Situ Hydraulic Conductivity Test Report

Figure B.3

Constant Rate Test

W3-11-40 (P-18): 59.5m - 76.5m

Packer Test Interval	59.5 to 76.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	19-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	7.83 L/min
Average Change in Head	1.3 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	8.9E-05
Packer Interval	17 m
Hydraulic Conductivity (cm/sec)	5.E-04

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\ \Pi\ \Delta H}\right)$$

Notes:

DATE: November 11, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

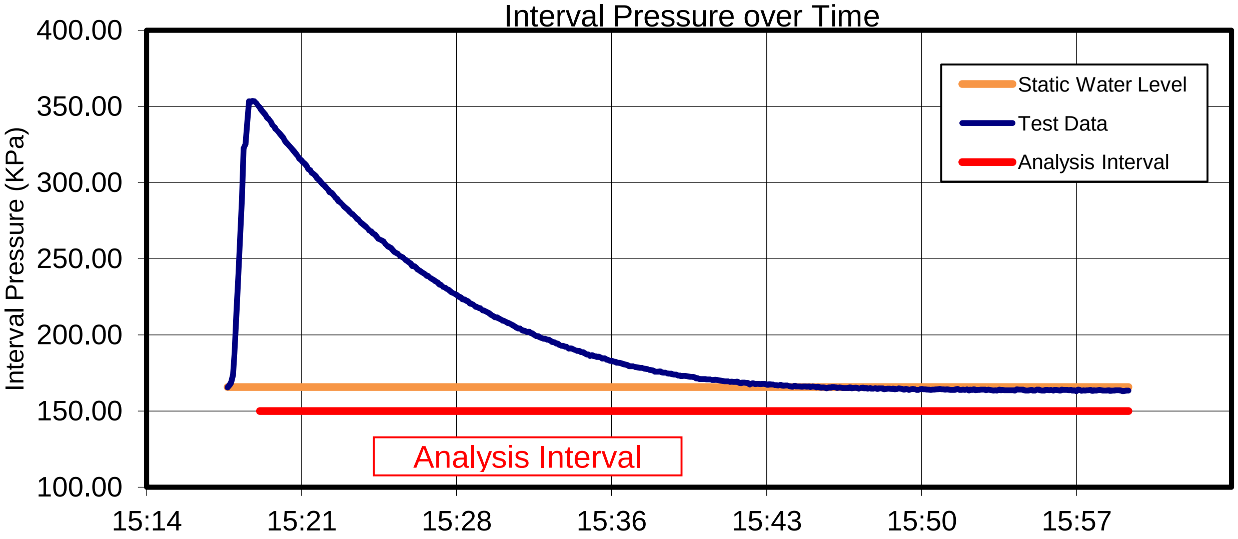
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

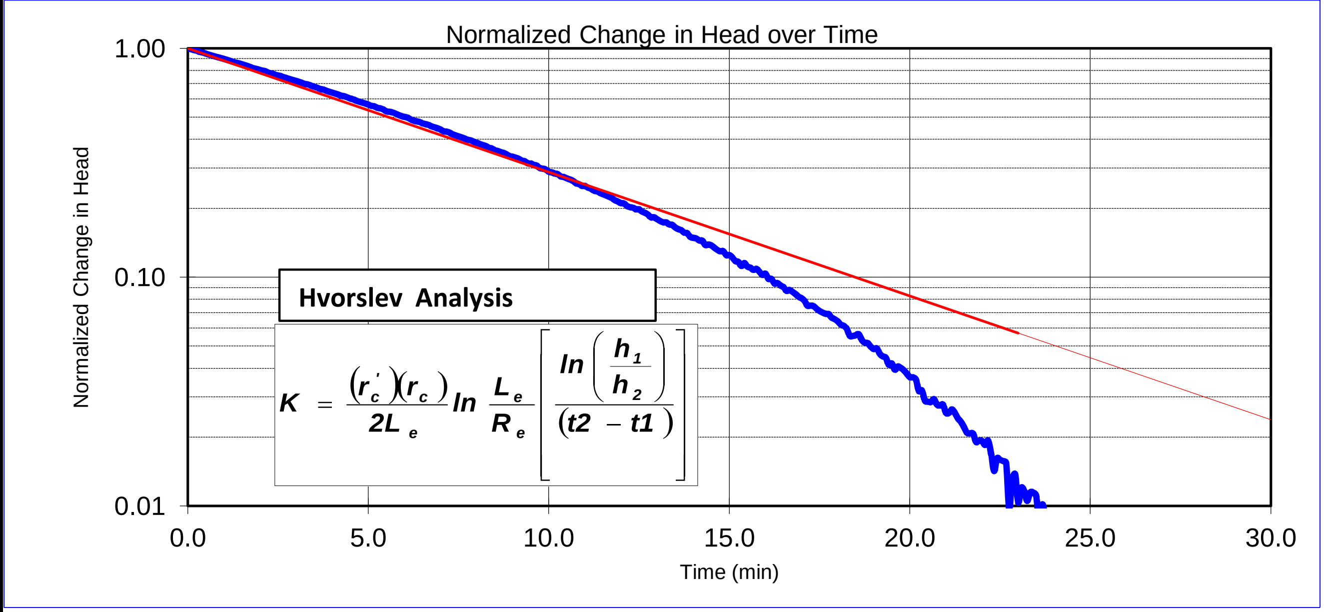
W3-11-40 (P-18): 74.5m to 91.5m

Figure B.4

Packer Test Interval	74.5 to 91.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	18-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	0.125
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	1.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 9, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

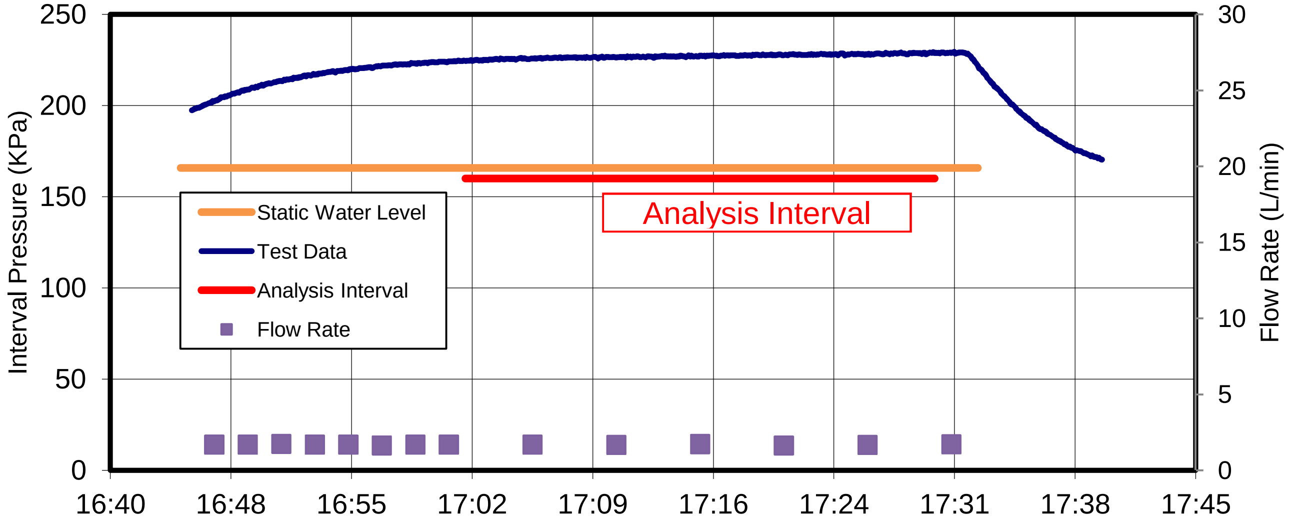
In-Situ Hydraulic Conductivity Test Report

Figure B.5

Constant Rate Test

W3-11-40 (P-18): 74.5m - 91.5m

Packer Test Interval	74.5 to 91.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	18-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	1.7 L/min
Average Change in Head	6.3 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	4.0E-06
Packer Interval	17 m
Hydraulic Conductivity (cm/sec)	2.E-05

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\,\Pi\,\Delta H}\right)$$

Notes:

DATE: November 7, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

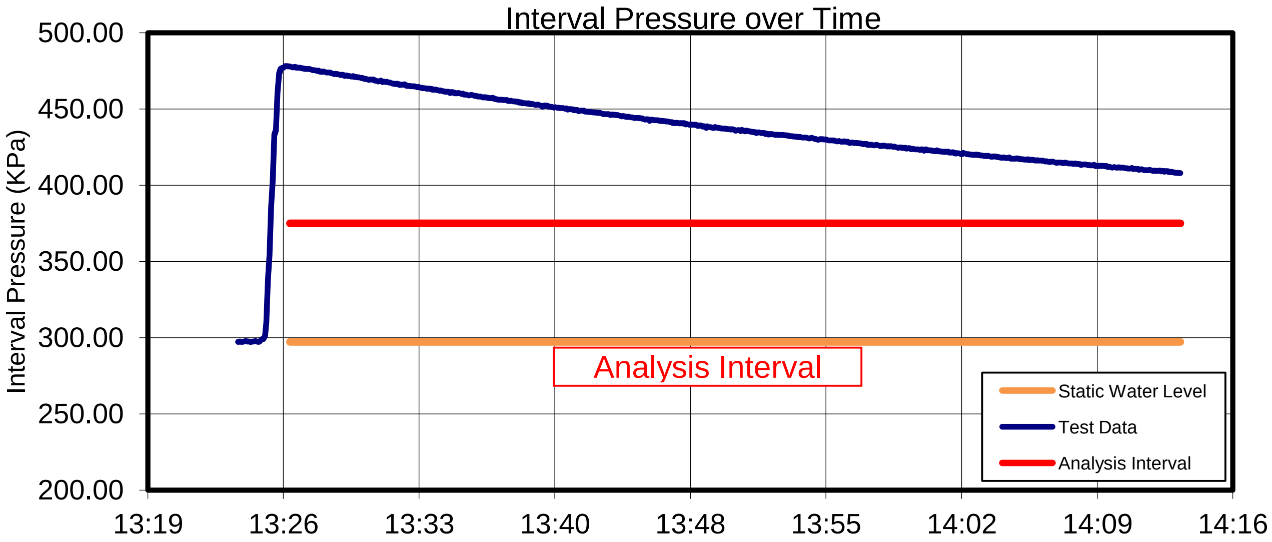
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

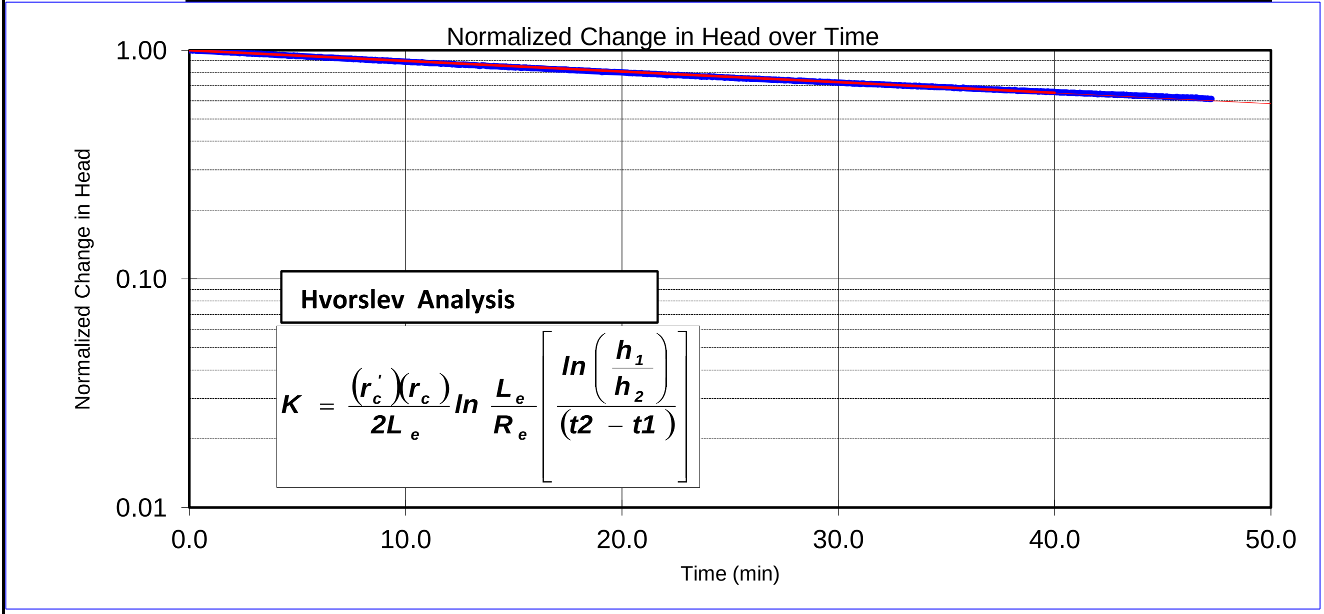
Figure B.6

Falling Head Test W3-11-40 (P-18): 89.5m to 106.5m

Packer Test Interval	89.5 to 106.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	18-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	0.011
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	1.E-06



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 9, 2011

PROJECT: 11-1152-0116

prepared by: KS

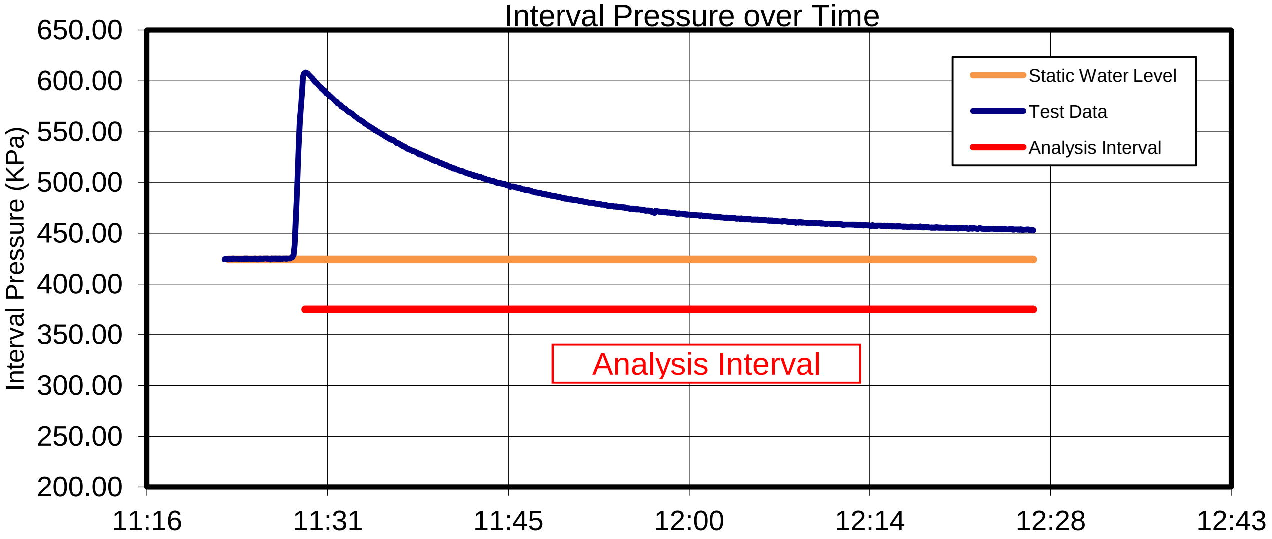
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

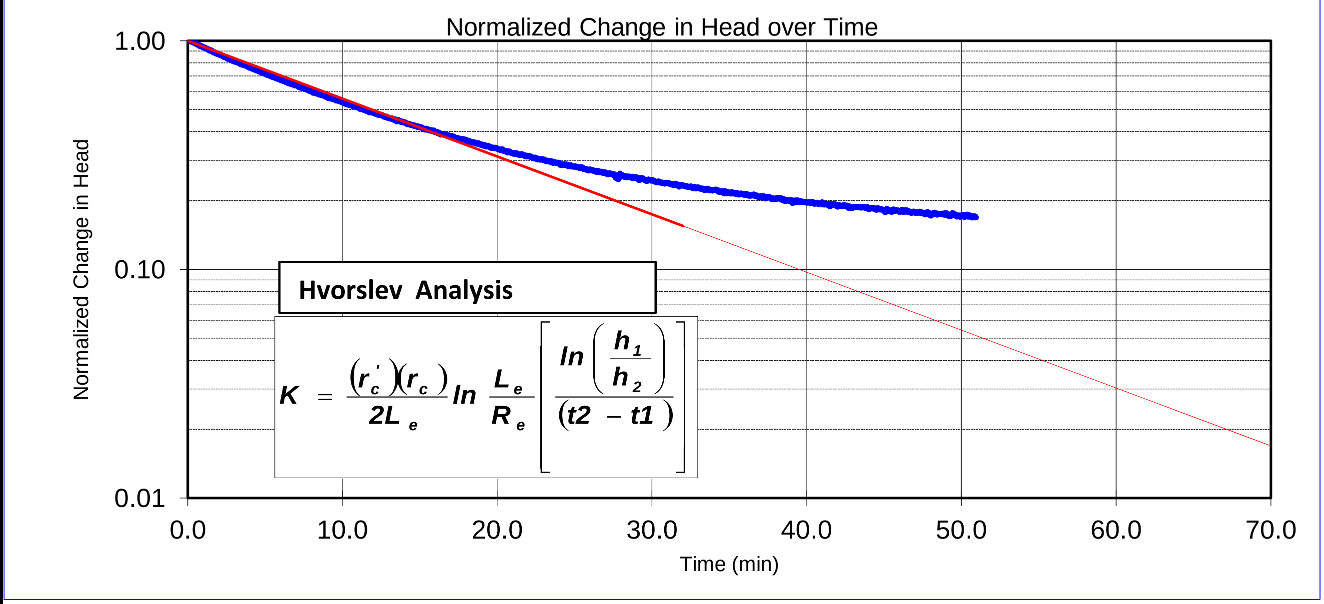
Falling Head Test W3-11-40 (P-18): 104.5 m to 121.5m

Figure B.7

Packer Test Interval	104.5 to 121.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	18-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	0.058
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	6.E-06



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 9, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

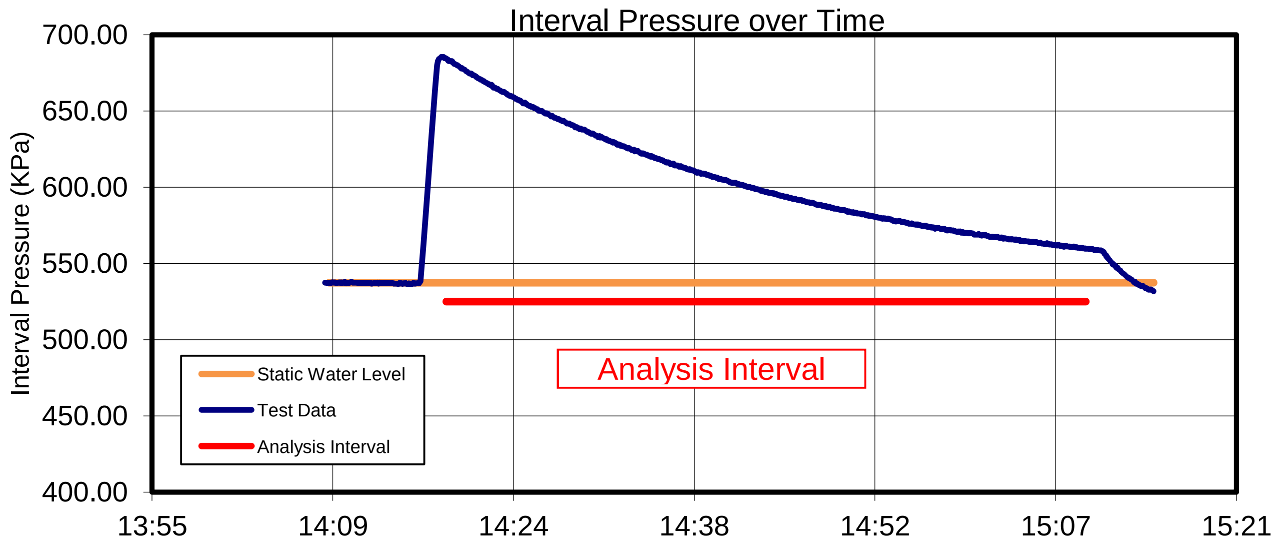
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

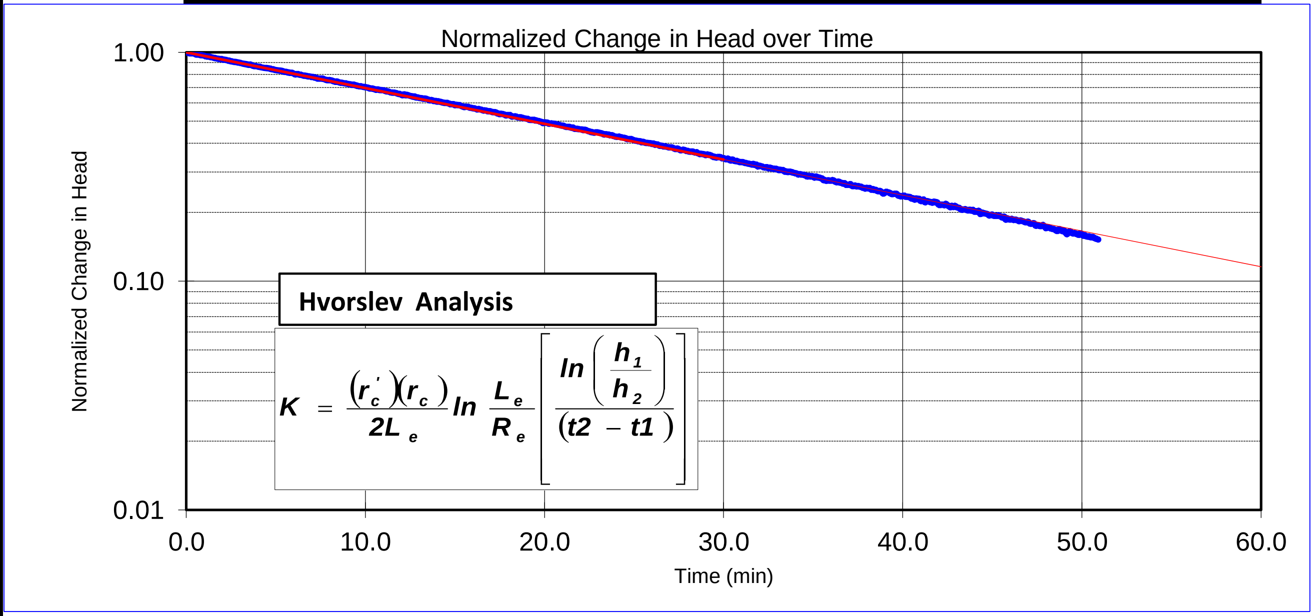
Falling Head Test W3-11-40 (P-18): 116.35 m to 140m

Figure B.8

Packer Test Interval	116.35 to 140 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	17-Oct-2011	Testing Rod Size	NQ



Borehole Radius	0.038 m	Packer Interval	23.65 m
Testing Rod Radius	0.03 m	Line of Best fit	0.036
Effective Testing RodRadius	0.035 m	Hy. Conductivity (cm/s)	9.E-06



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 9, 2011

PROJECT: 11-1152-0116

prepared by: KS

CHK: PMMC

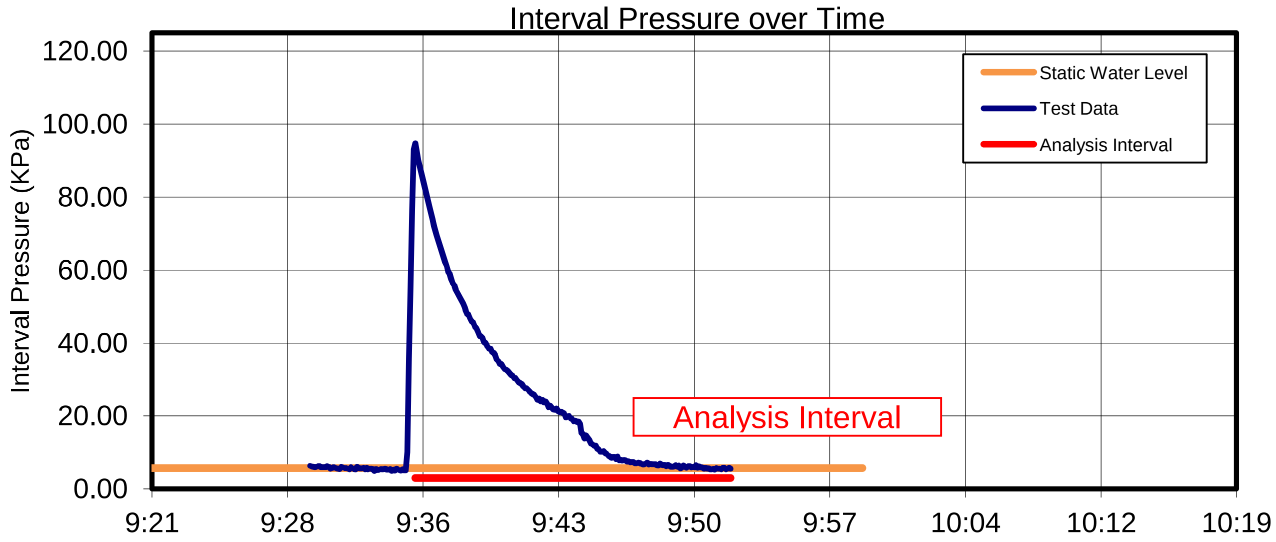
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

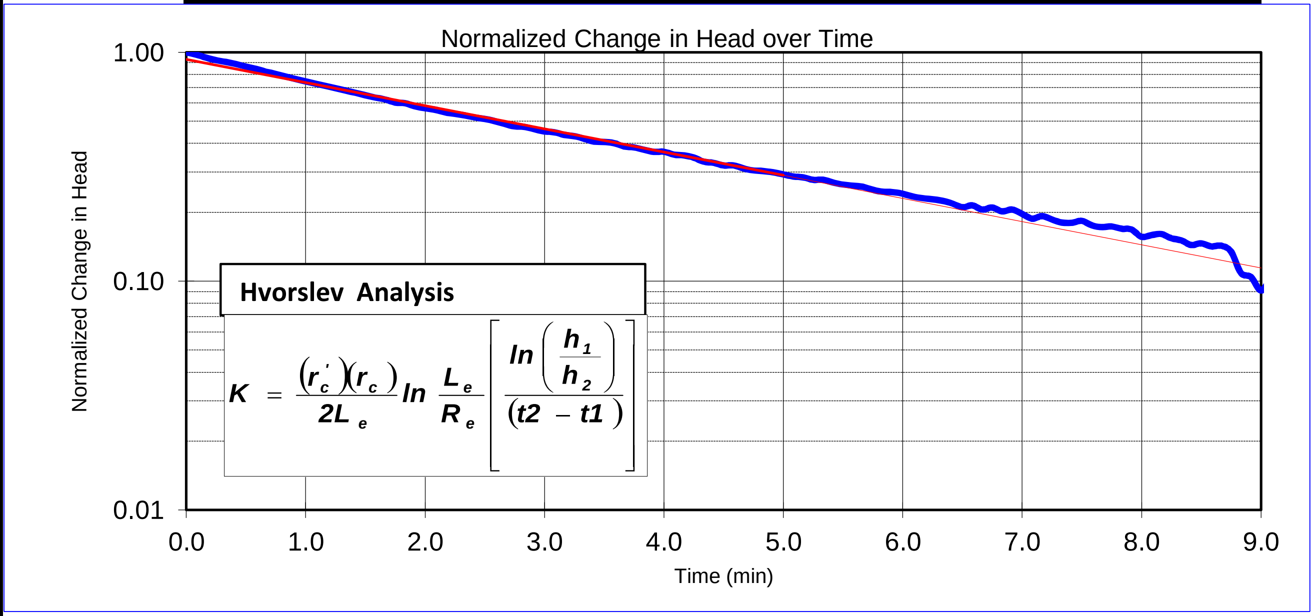
W3-11-49 (P-08): 11.5-25.7 m

Figure B.9

Packer Test Interval	11.5 to 25.7 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	14-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	14.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.233
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	3.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 14, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

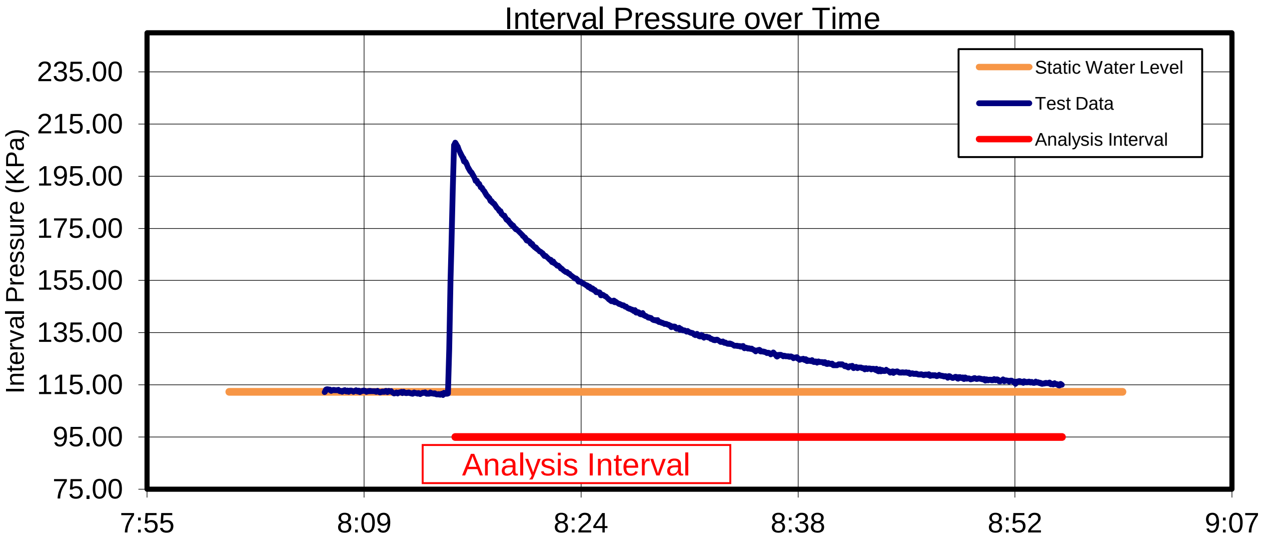
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

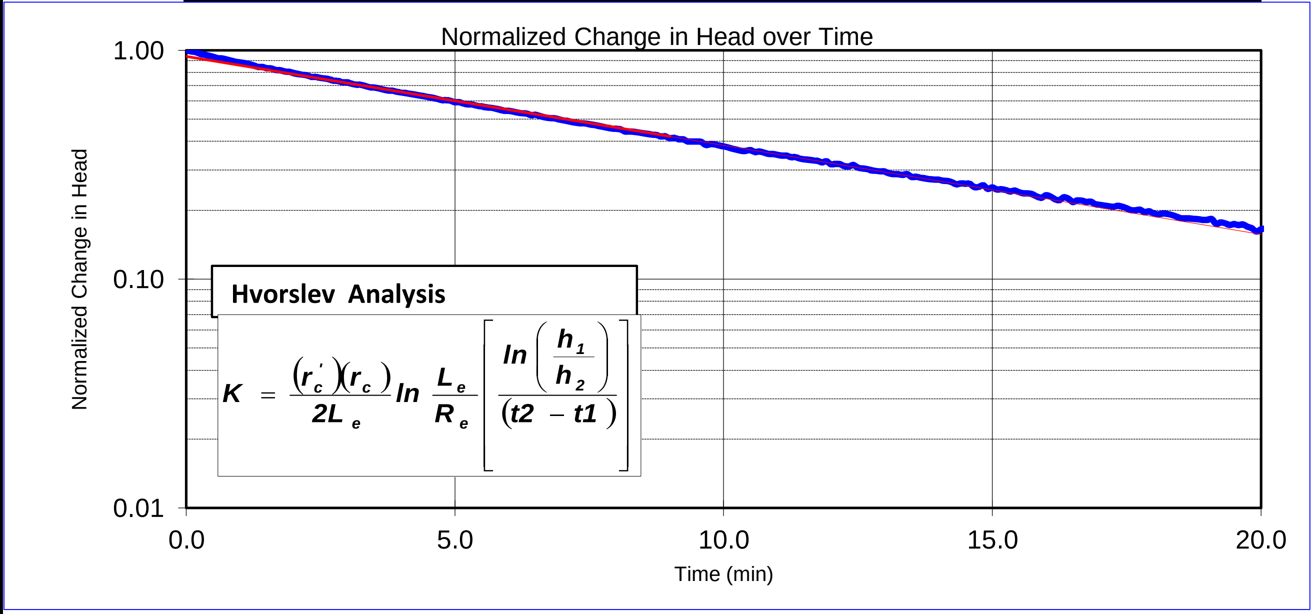
Figure B.10

Falling Head Test W3-11-49 (P-08): 23.5-37.7 m

Packer Test Interval	23.5 to 37.7 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	14-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	14.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.09
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	1.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 14, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

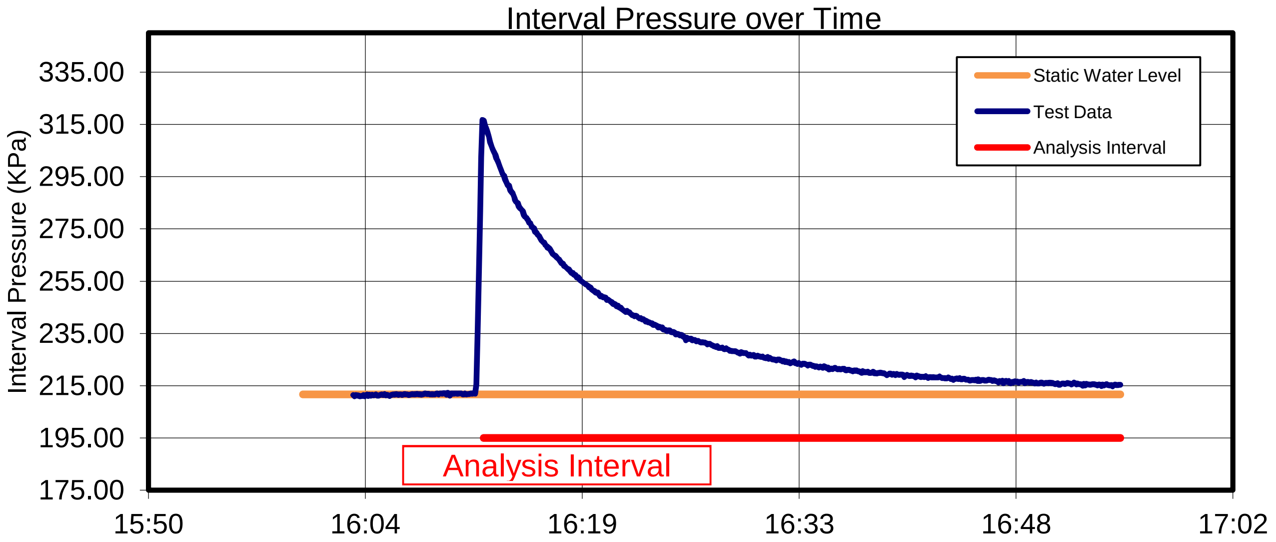
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

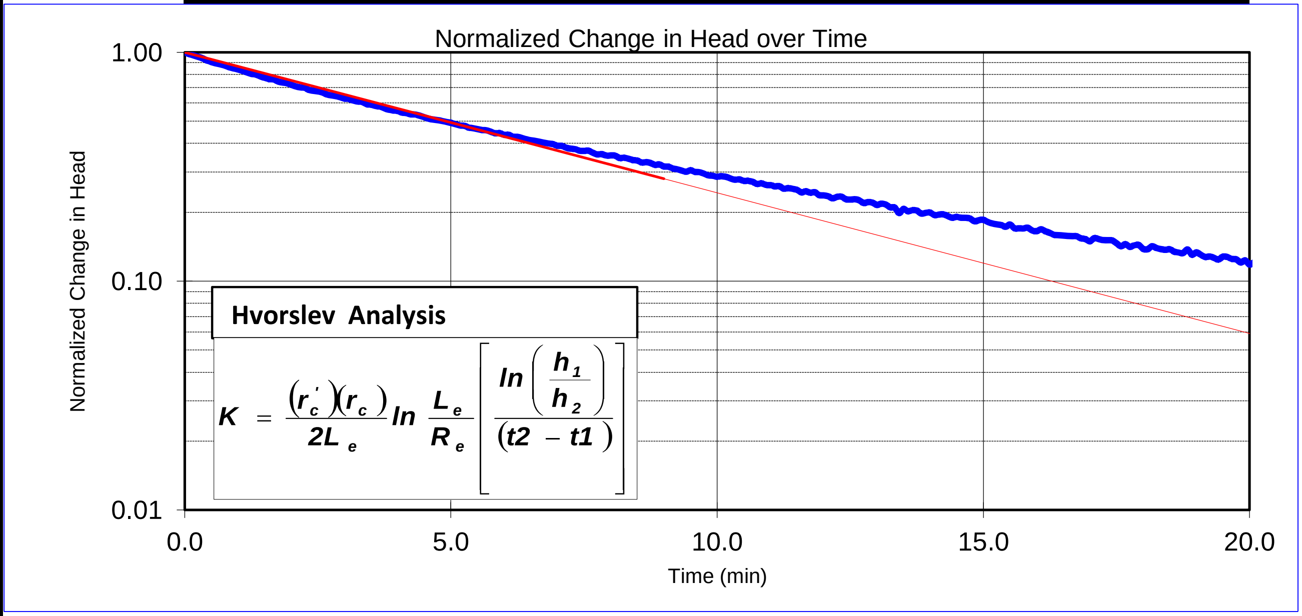
Falling Head Test W3-11-49(P-08): 35.5-49.7 m

Figure B.11

Packer Test Interval	35.5 to 49.7 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	13-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	14.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.141
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	2.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 14, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

checked by: PMMC

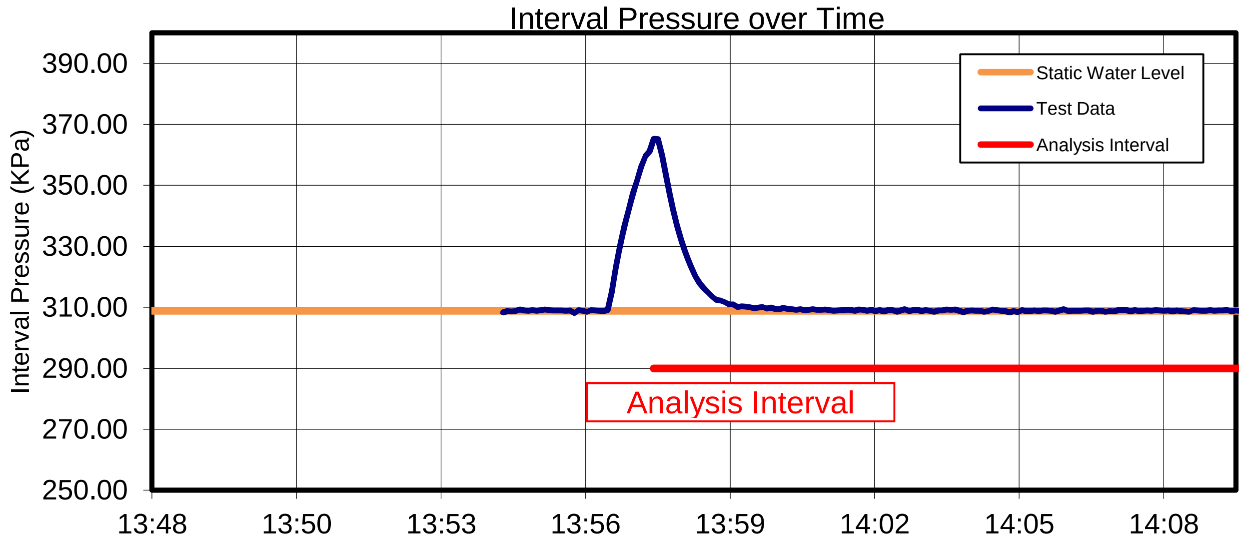
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

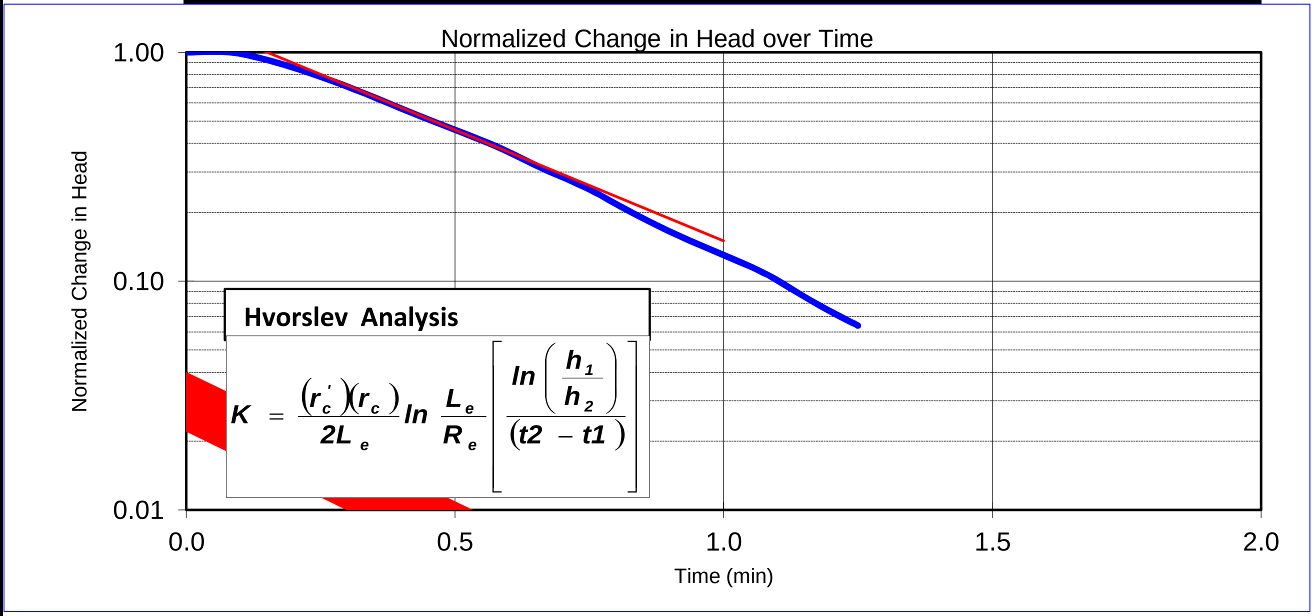
W3-11-49 (P-08): 47.5-61.7 m

Figure B.12

Packer Test Interval	47.5 to 61.7 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	13-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	14.2 m
Testing Rod Radius	0.017 m	Line of Best fit	2.234
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	3.E-04



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 14, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

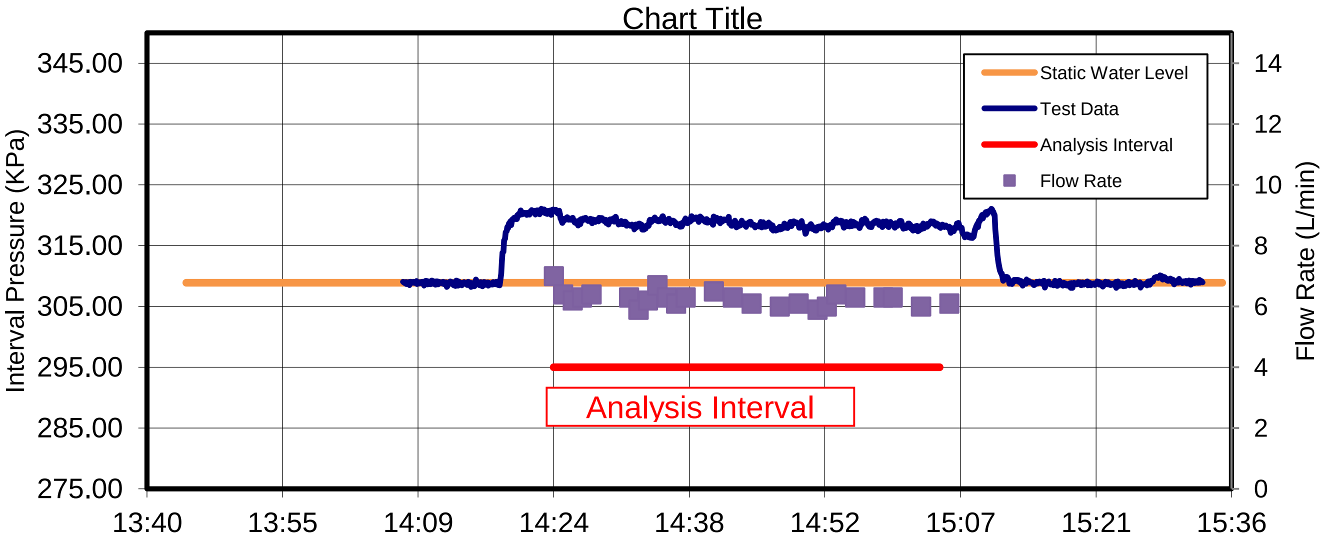
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

Figure B.13

Constant Rate Test W3-11-49 (P-08): 47.5-61.7 m

Packer Test Interval	47.5 to 61.7 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	13-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	6.26 L/min
Average Change in Head	1 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	9.3E-05
Packer Interval	14.2 m
Hy. Conductivity (cm/sec)	7.E-04

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\prod \Delta H}\right)$$

Notes:

DATE: November 14, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

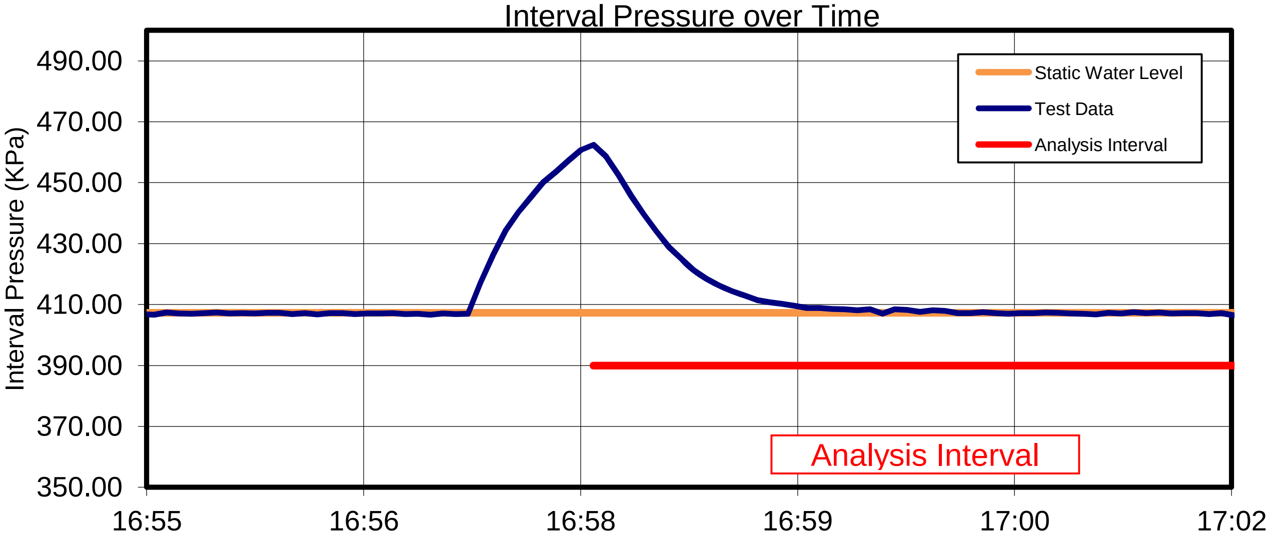
Figure B.14

Falling Head Test

W3-11-49 (P-08): 59.15-76.35 m

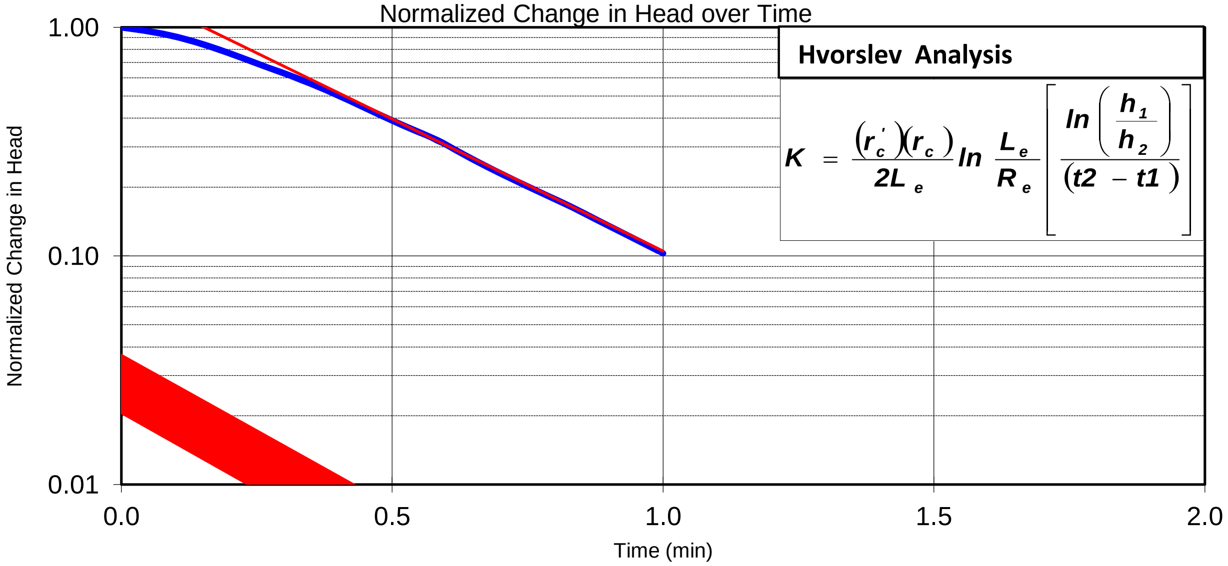
Packer Test Interval	59.15 to 76.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	12-Oct-2011	Testing Rod Size	AQ

Interval Pressure over Time



Borehole Radius	0.038 m	Packer Interval	17.2 m
Testing Rod Radius	0.017 m	Line of Best fit	2.659
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	3.E-04

Normalized Change in Head over Time



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 12, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

checked by: PMMC

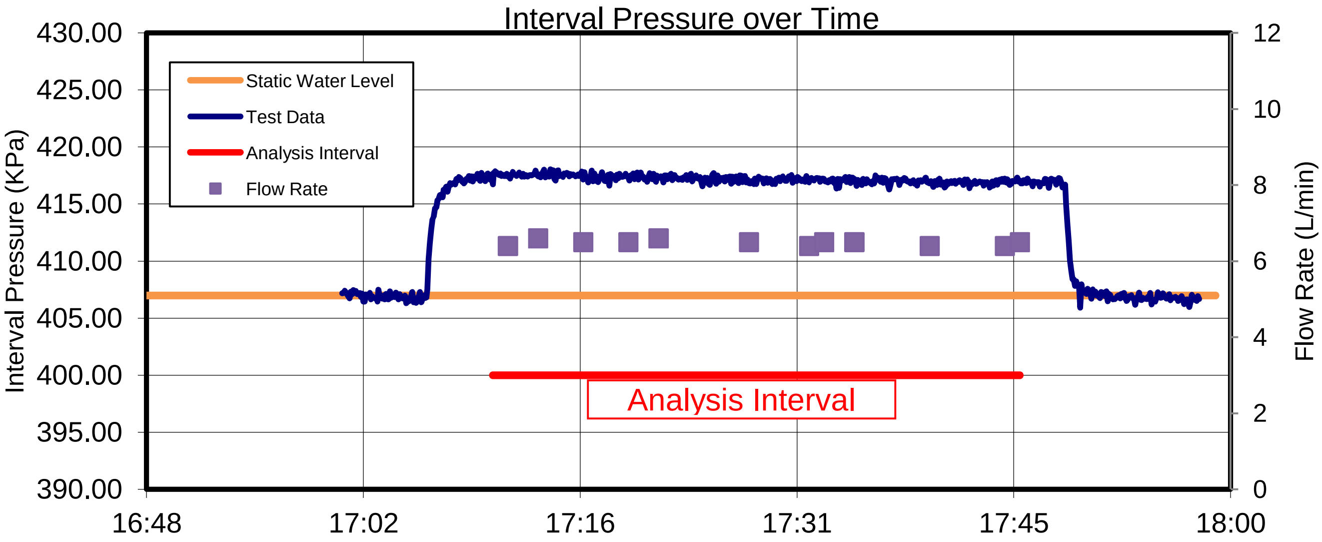
In-Situ Hydraulic Conductivity Test Report

Figure B.15

Constant Rate Test

W3-11-49 (P-08): 59.15-76.35 m

Packer Test Interval	59.15 to 76.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	12-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	6.48 L/min
Average Change in Head	1 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	9.2E-05
Packer Interval	17.2 m
Hy. Conductivity (cm/sec)	5.E-04

Thiem Equation (1906)

$$T = Q \left(\frac{\ln \left(\frac{R_i}{R_{ew}} \right)}{2 \Pi \Delta H} \right)$$

Notes:

DATE: November 12, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

checked by: PMMC

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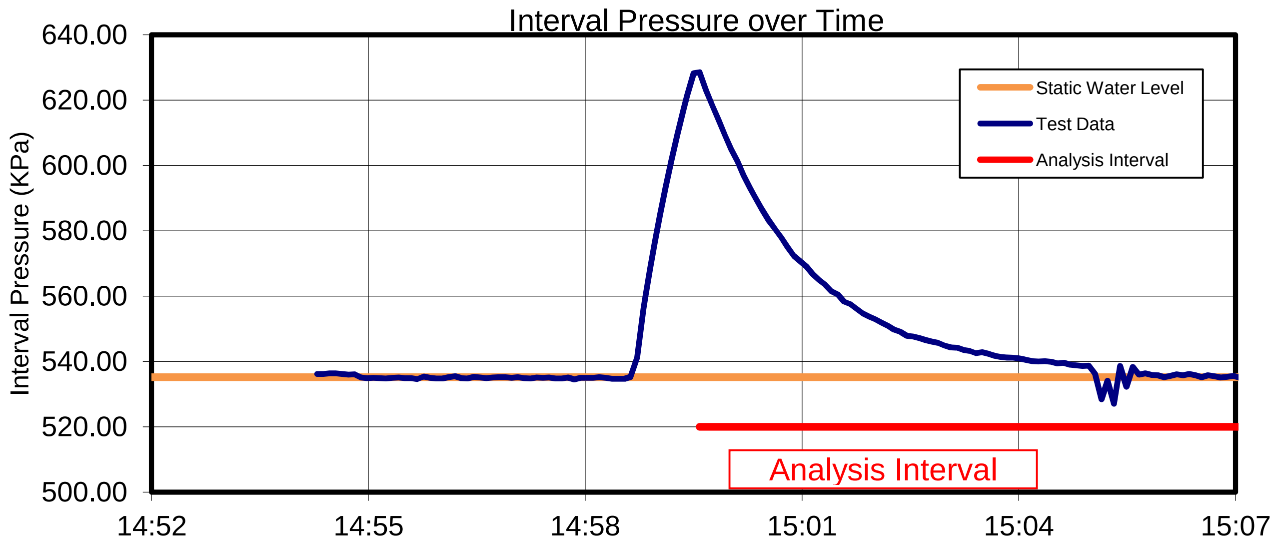
In-Situ Hydraulic Conductivity Test Report

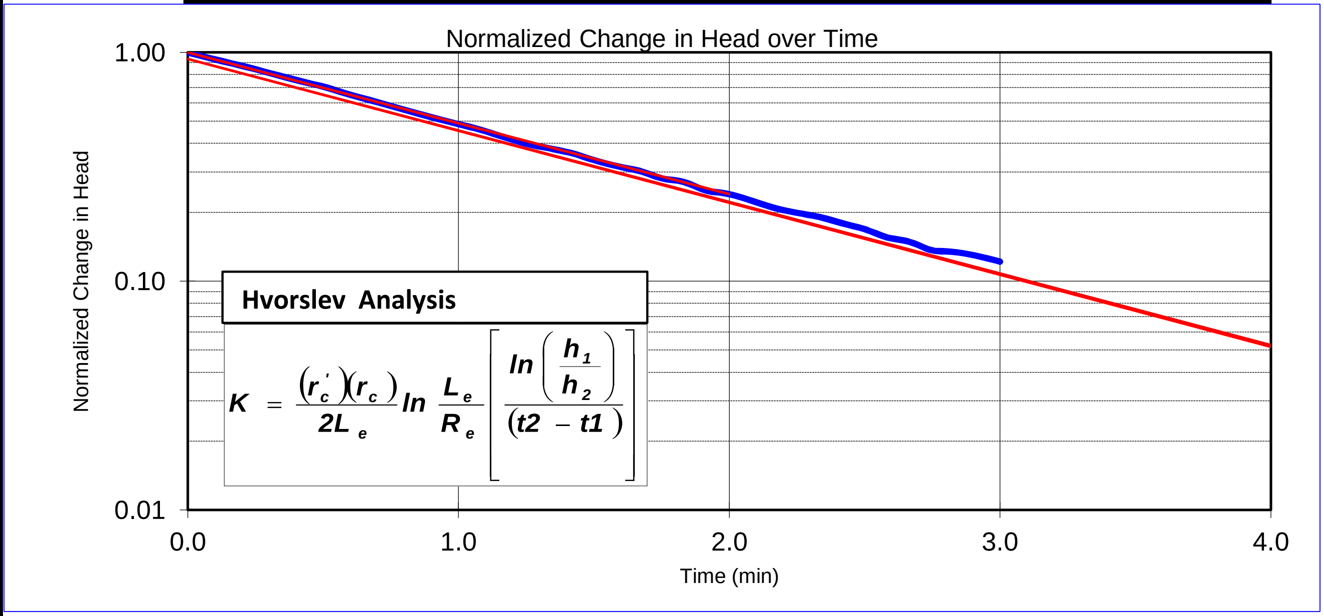
Falling Head Test W3-11-49 (P-08): 74.15-91.35 m

Figure B.16

Packer Test Interval	74.15 to 91.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	12-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.714
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	7.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 12, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

checked by: PMMC

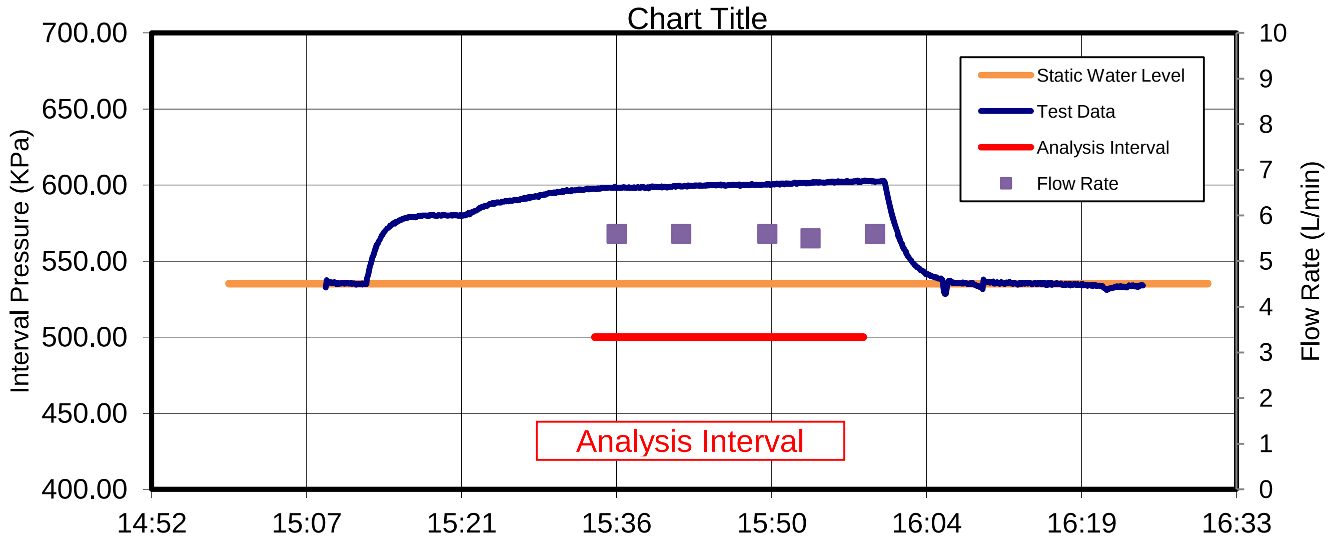
In-Situ Hydraulic Conductivity Test Report

Constant Rate Test

W3-11-49 (P-08): 74.15-91.35 m

Figure B.17

Packer Test Interval	74.15 to 91.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	12-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	5.58 L/min
Average Change in Head	6.6 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.2E-05
Packer Interval	17.2 m
Hy. Conductivity (cm/sec)	7.E-05

Thiem Equation (1906)

$$T = Q \left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2 \prod \Delta H} \right)$$

Notes:

DATE: November 12, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

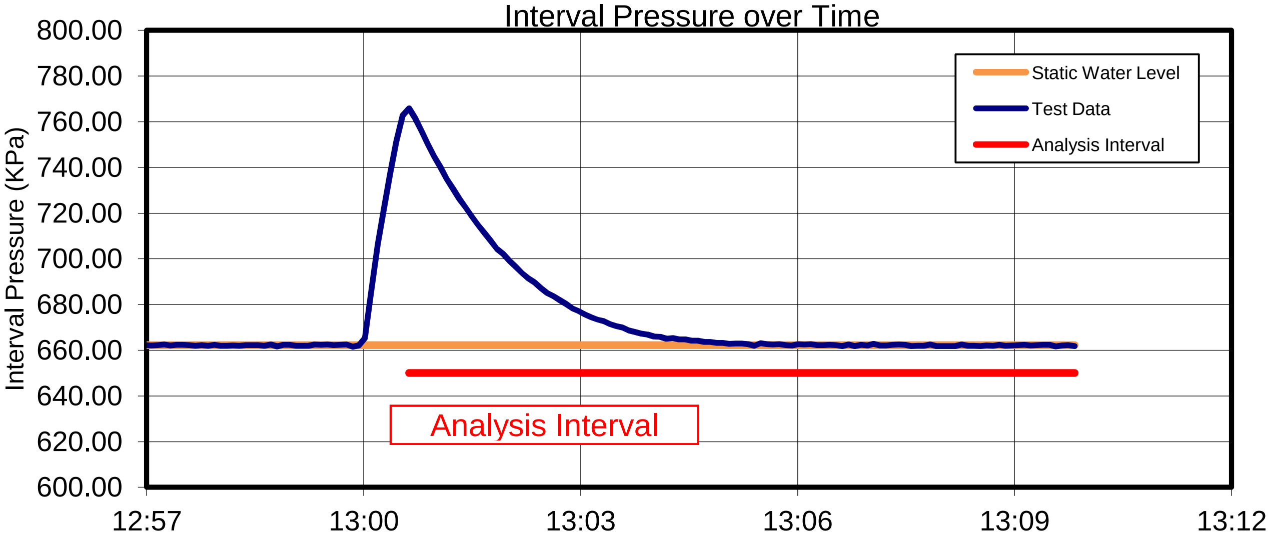
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

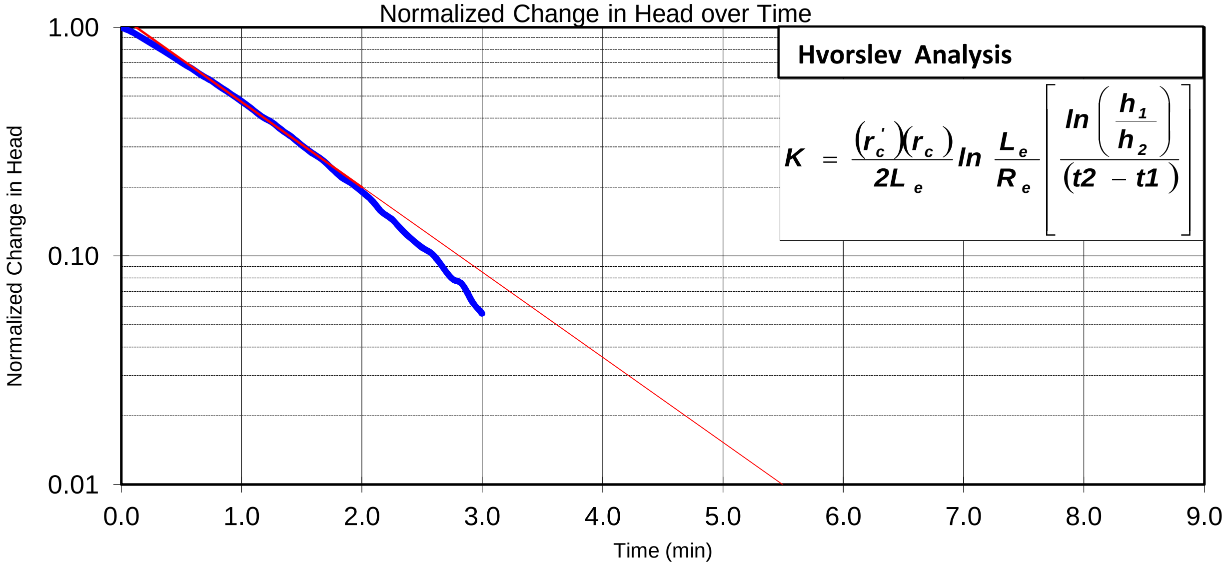
Falling Head Test W3-11-49 (P-08): 89.15 - 106.35 m

Figure B.18

Packer Test Interval	89.15 to 106.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	12-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.857
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	9.E-05



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)}\right]$$

DATE: November 12, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

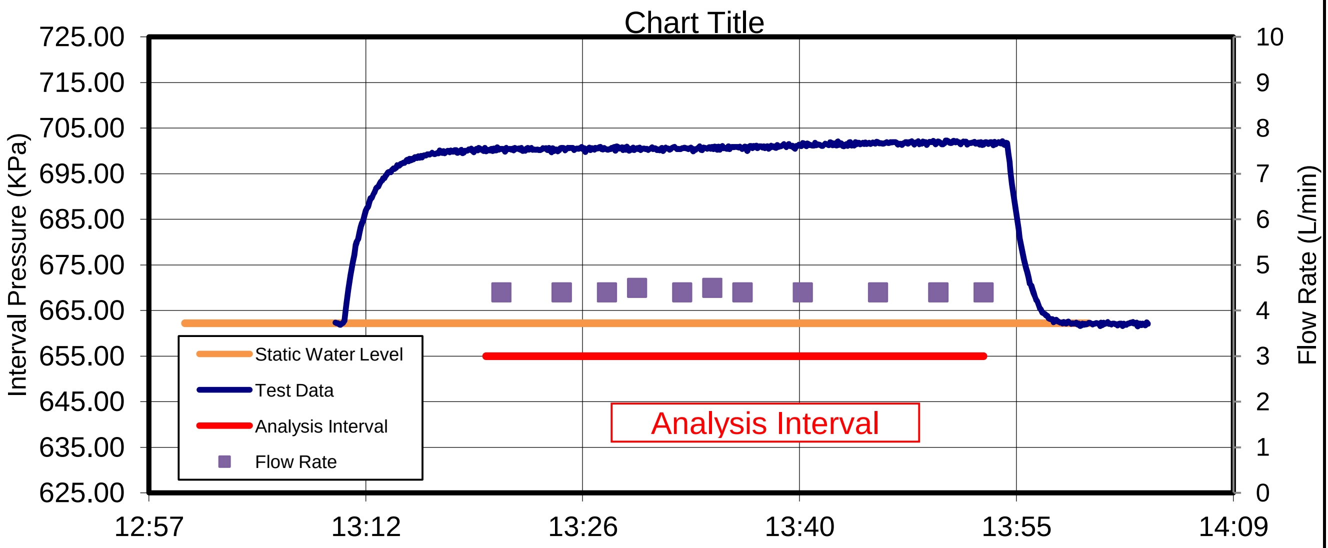
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

Figure B.19

Constant Rate Test W3-11-49 (P-08): 89.15 - 106.35 m

Packer Test Interval	89.15 to 106.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	12-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	4.42 L/min
Average Change in Head	4 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.7E-05
Packer Interval	17.2 m
Hy. Conductivity (cm/sec)	1.E-04

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\prod\Delta H}\right)$$

Notes:

DATE: November 12, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

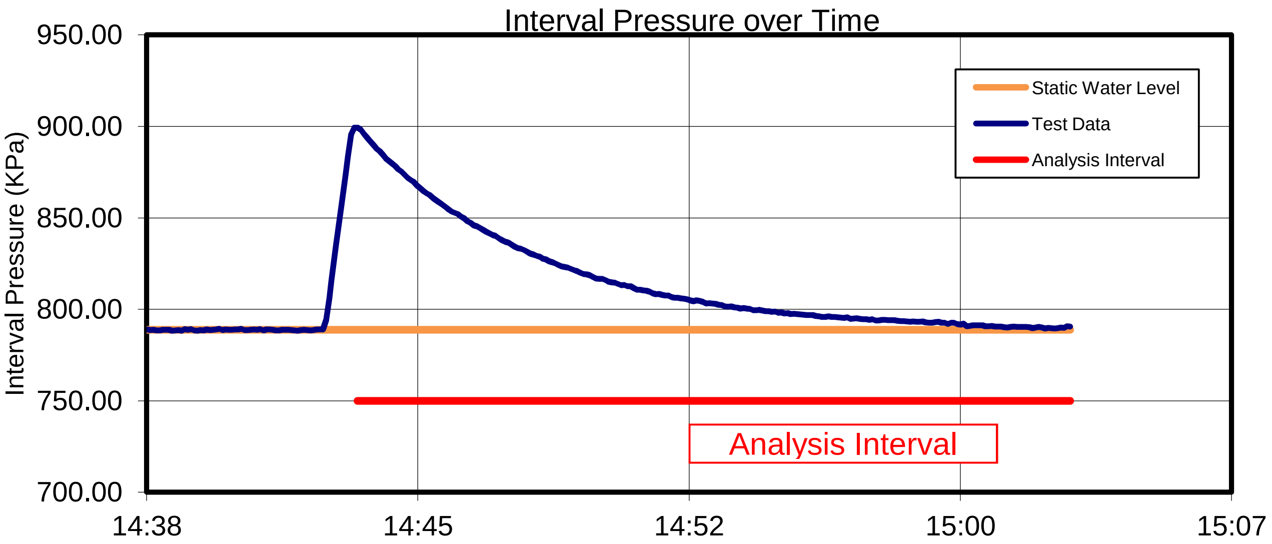
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

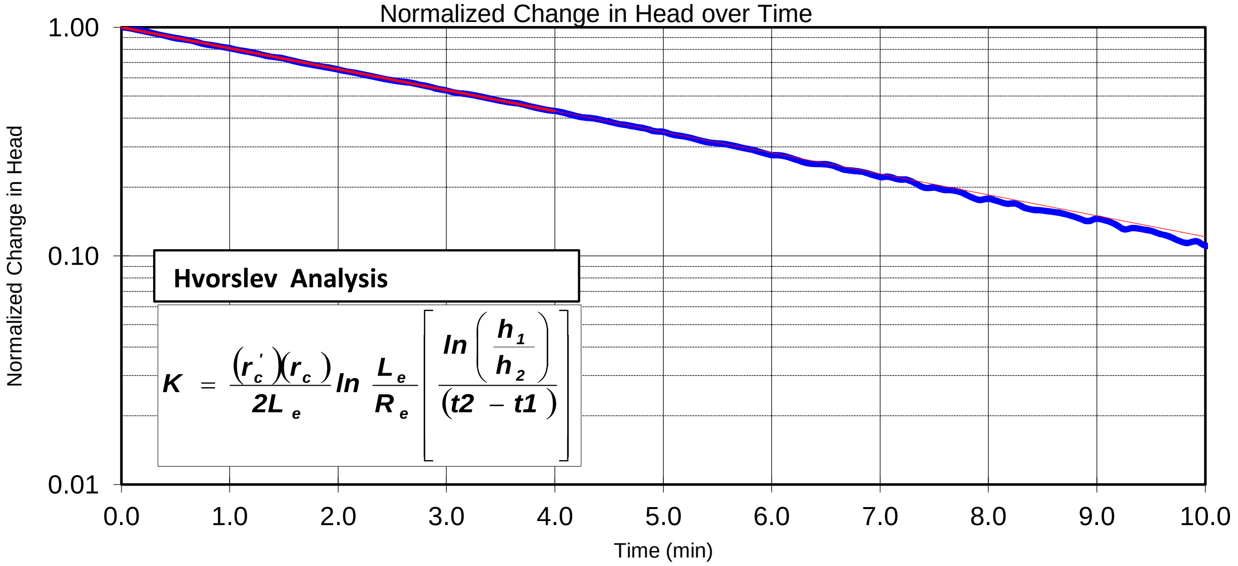
Falling Head Test W3-11-49 (P-08): 104.15-121.35 m

Figure B.20

Packer Test Interval	104.15 to 121.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	11-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.211
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	2.E-05



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 12, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

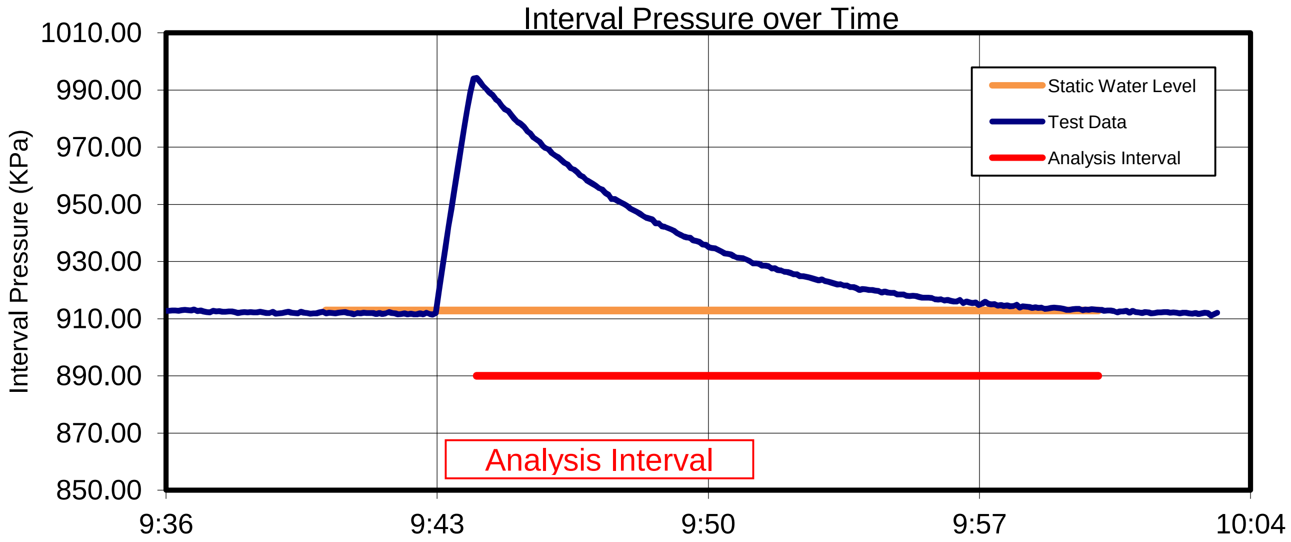
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

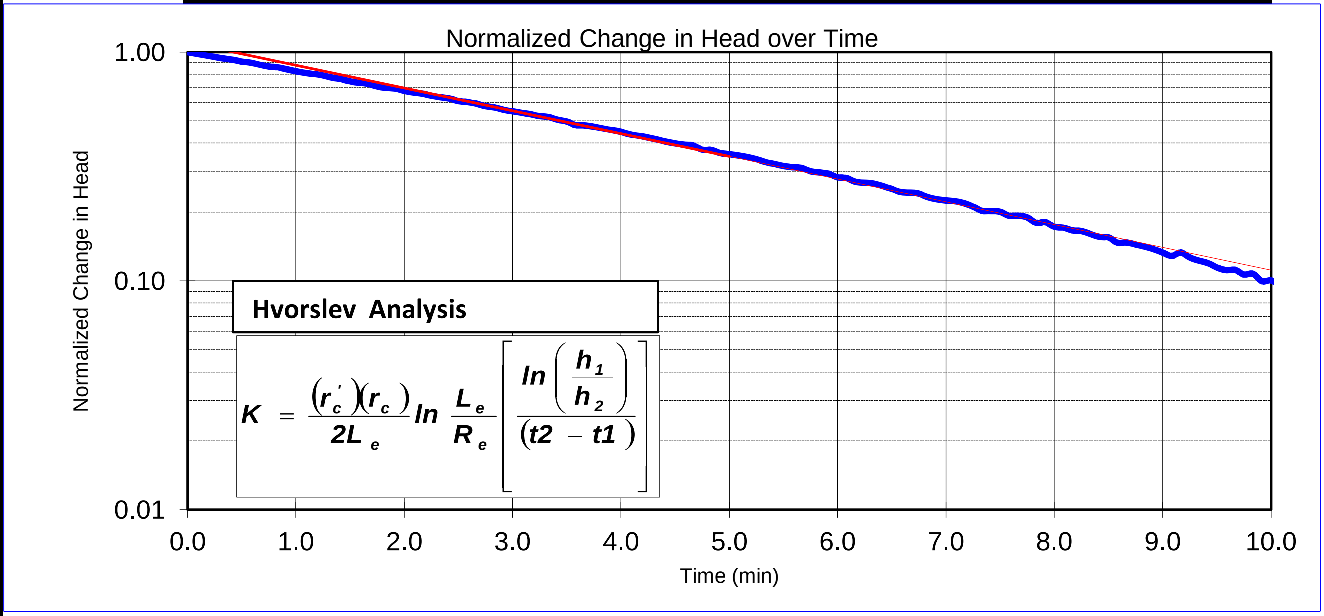
Falling Head Test W3-11-49 (P-08): 119.15 - 136.35 m

Figure B.21

Packer Test Interval	119.15 to 136.35 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	11-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17.2 m
Testing Rod Radius	0.017 m	Line of Best fit	0.229
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	2.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 11, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

checked by: PMMC

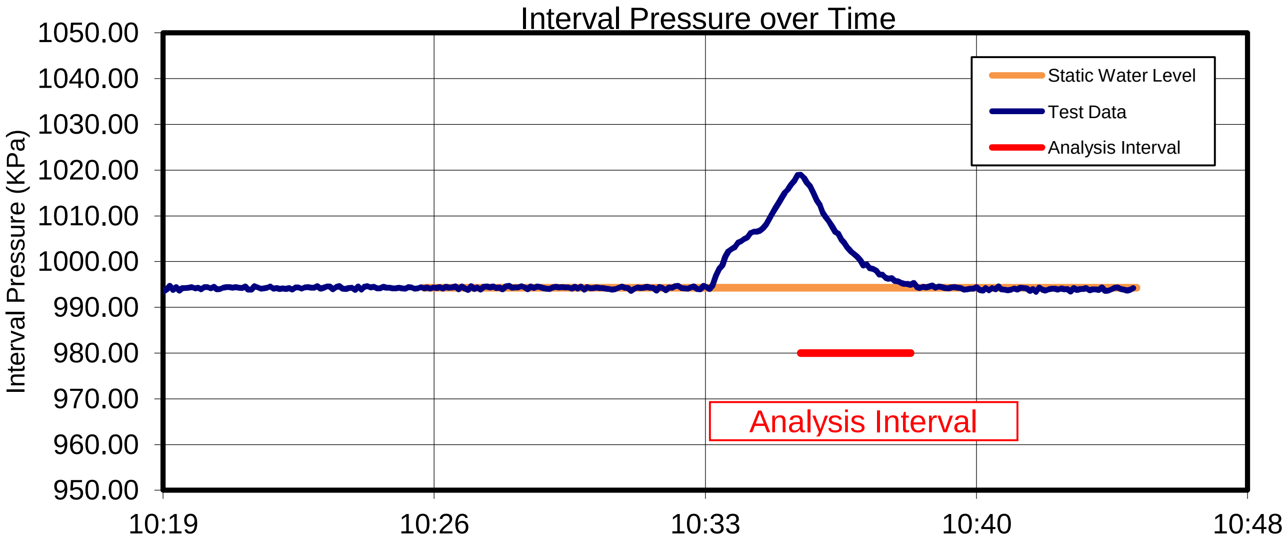
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

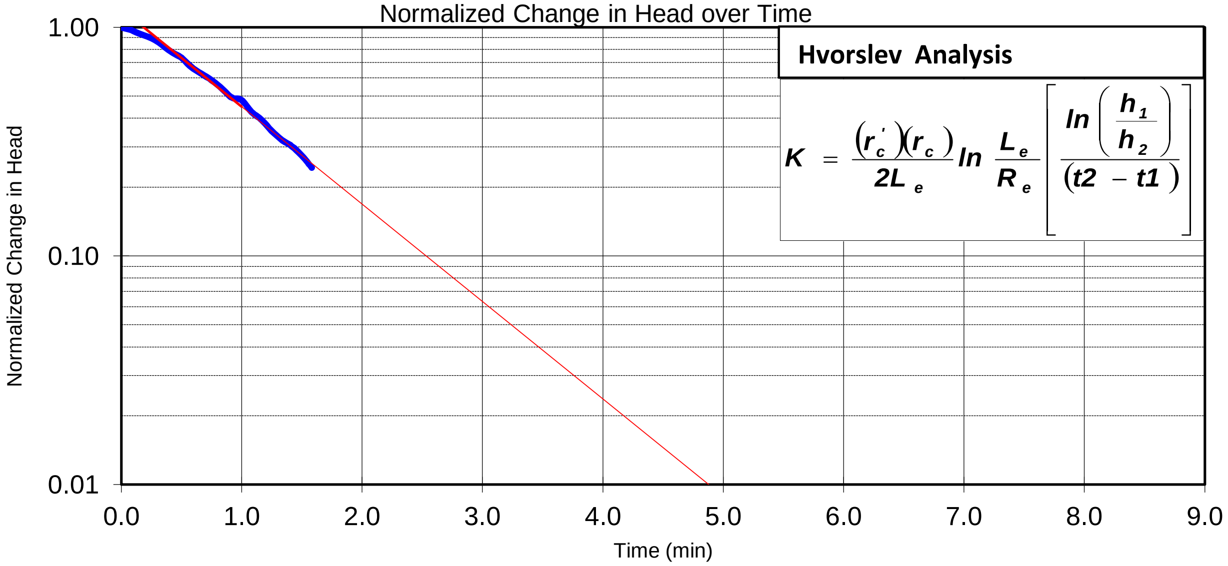
W3-11-49(P-08): 135 to 199m

Figure B.22

Packer Test Interval	135 to 199 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	10-Oct-2011	Testing Rod Size	NQ



Borehole Radius	0.038 m	Packer Interval	64 m
Testing Rod Radius	0.03 m	Line of Best fit	0.981
Effective Testing RodRadius	0.035 m	Hy. Conductivity (cm/s)	1.E-04



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 11, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

checked by: PMMC

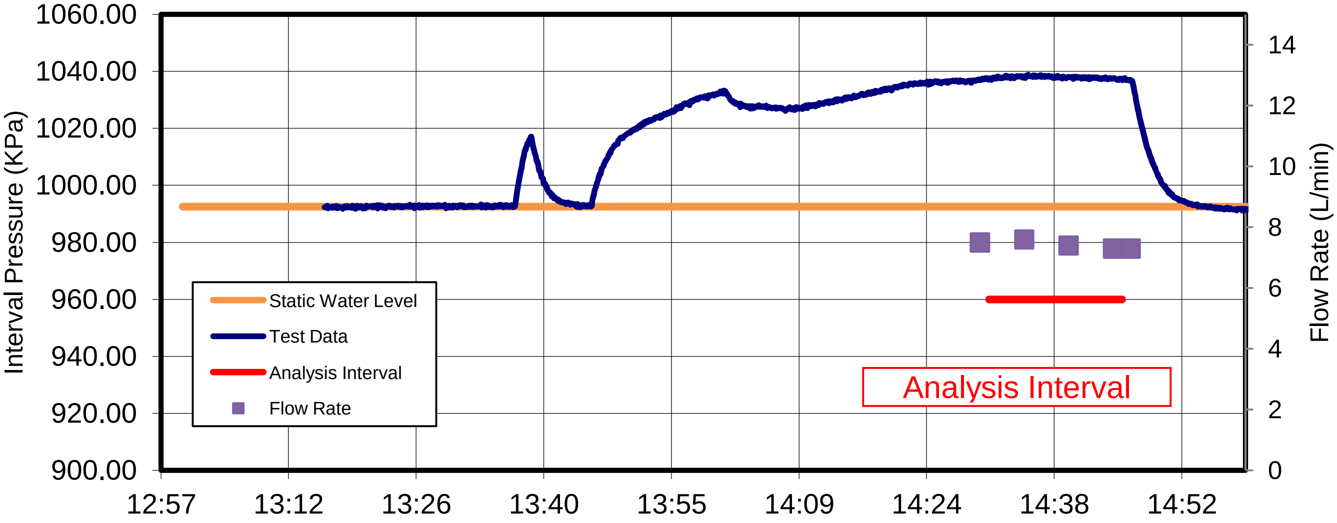
In-Situ Hydraulic Conductivity Test Report

Constant Rate Test

W3-11-53 (P-03): 135 -199m

Figure B.23

Packer Test Interval	135 to 199 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	10-Oct-2011	Testing Rod Size	NQ



Average Flow Rate	7.42 L/min
Average Change in Head	4.6 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	2.4E-05
Packer Interval	64 m
Hy. Conductivity (cm/sec)	4.E-05

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\,\Pi\,\Delta H}\right)$$

Notes:

DATE: November 11, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

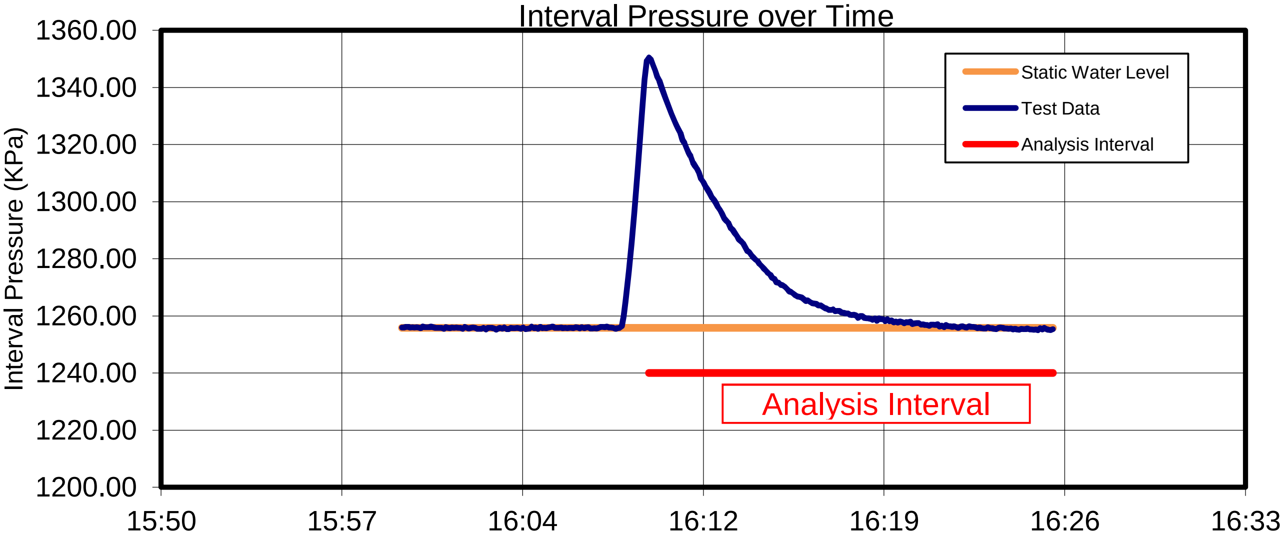
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

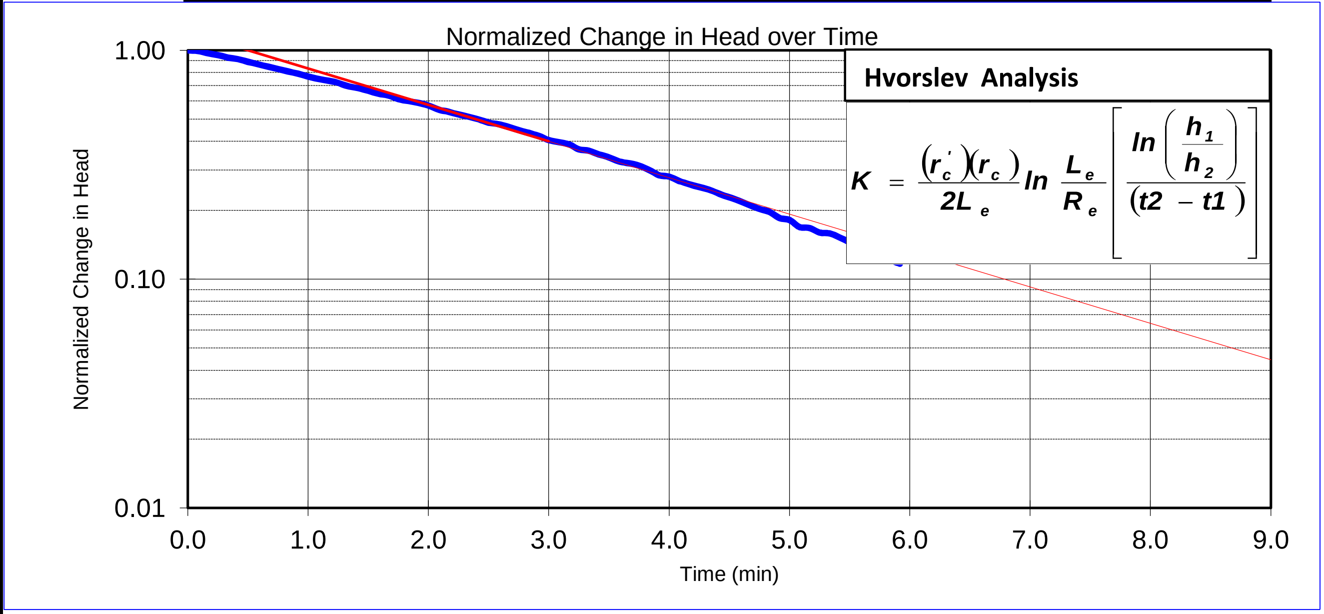
Falling Head Test W3-11-49 (P-08): 162.12m to 199m

Figure B.24

Packer Test Interval	162.12 to 199 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	9-Oct-2011	Testing Rod Size	NQ



Borehole Radius	0.038 m	Packer Interval	36.88 m
Testing Rod Radius	0.03 m	Line of Best fit	0.366
Effective Testing RodRadius	0.035 m	Hy. Conductivity (cm/s)	6.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)}\right]$$

DATE: November 11, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

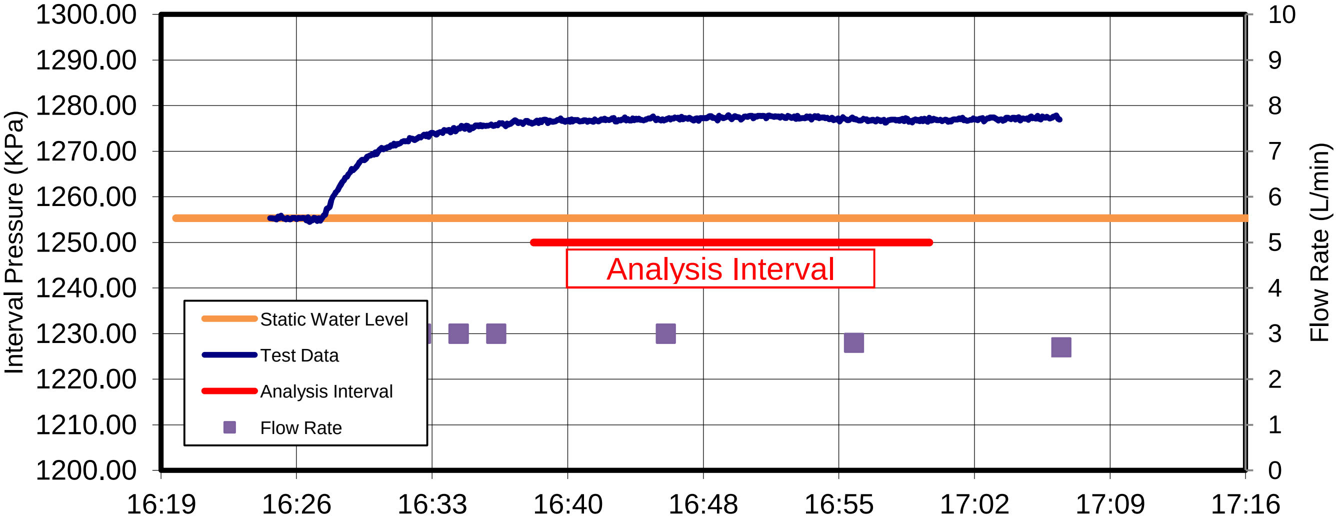
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

Constant Rate Test W3-11-49 (P-08): 162.12m-199m

Figure B.25

Packer Test Interval	162.12 to 199 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	9-Oct-2011	Testing Rod Size	NQ



Average Flow Rate	2.96 L/min
Average Change in Head	2.2 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	2.0E-05
Packer Interval	36.88 m
Hy. Conductivity (cm/sec)	5.E-05

Thiem Equation (1906)

$$T = Q \left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2 \Pi \Delta H} \right)$$

Notes:

DATE: November 11, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

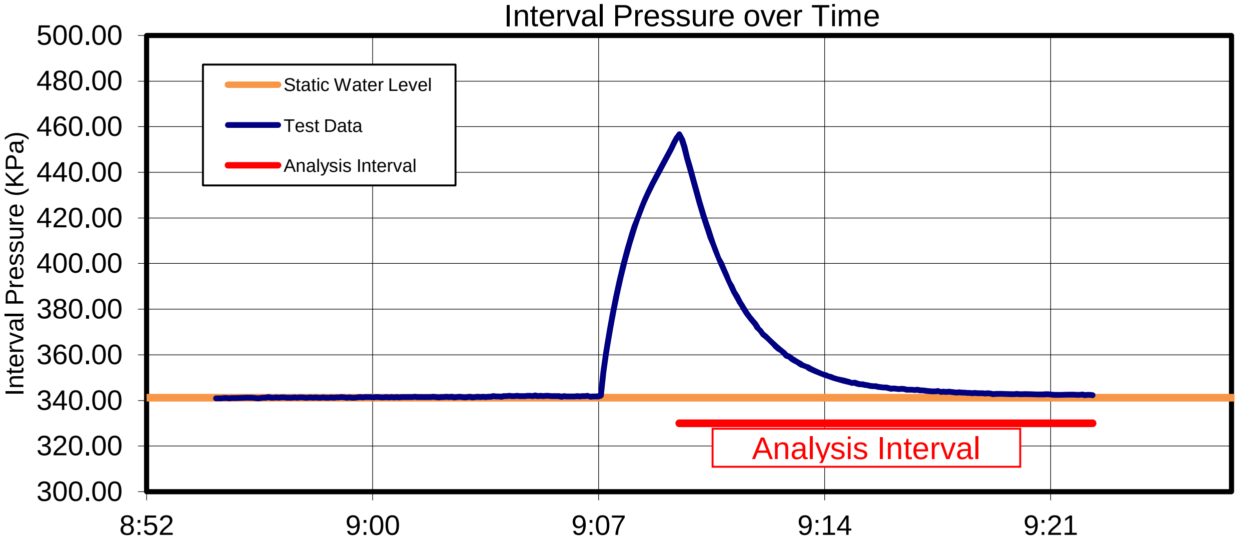
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

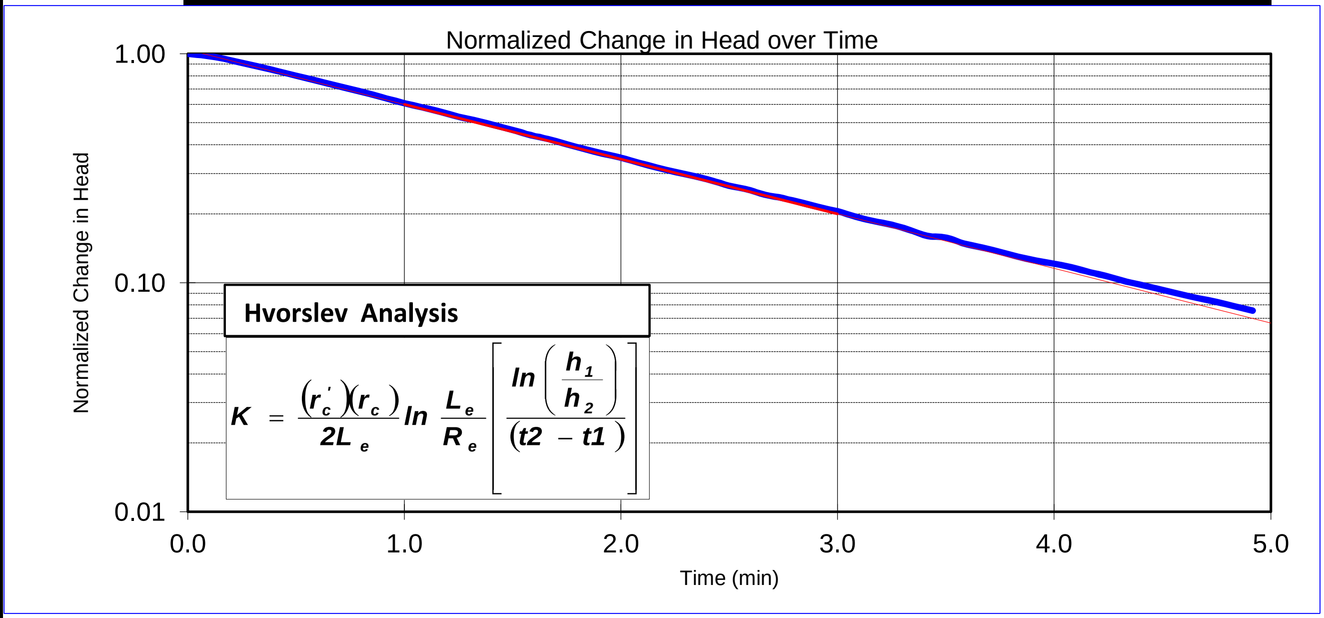
Falling Head Test W3-11-53 (P-03): 65.33-81.03 m

Figure B.26

Packer Test Interval	65.33 to 81.03 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Test Date	3-Oct-2011	Testing Rod Size	BQ



Borehole Radius	0.038 m	Packer Interval	15.7 m
Testing Rod Radius	0.023 m	Line of Best fit	0.549
Effective Testing RodRadius	0.023 m	Hy. Conductivity (cm/s)	9.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 23, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

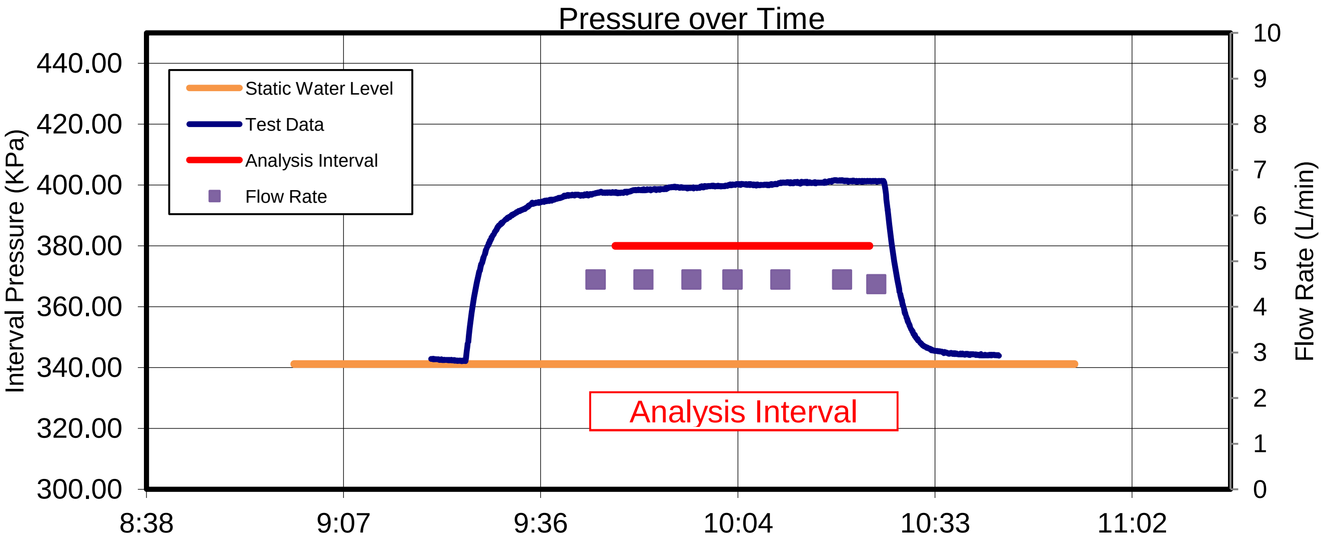
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

Constant Rate Test W3-11-53 (P-03): 65.33-81.03 m

Figure B.27

Packer Test Interval	65.33 to 81.03 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Date Time of Test	3-Oct-2011	Testing Rod Size	BQ



Average Flow Rate	4.59 L/min
Average Change in Head	6 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.1E-05
Packer Interval	15.7 m
Hy. Conductivity (cm/sec)	7.E-05

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\prod\Delta H}\right)$$

Notes:

DATE: November 15, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

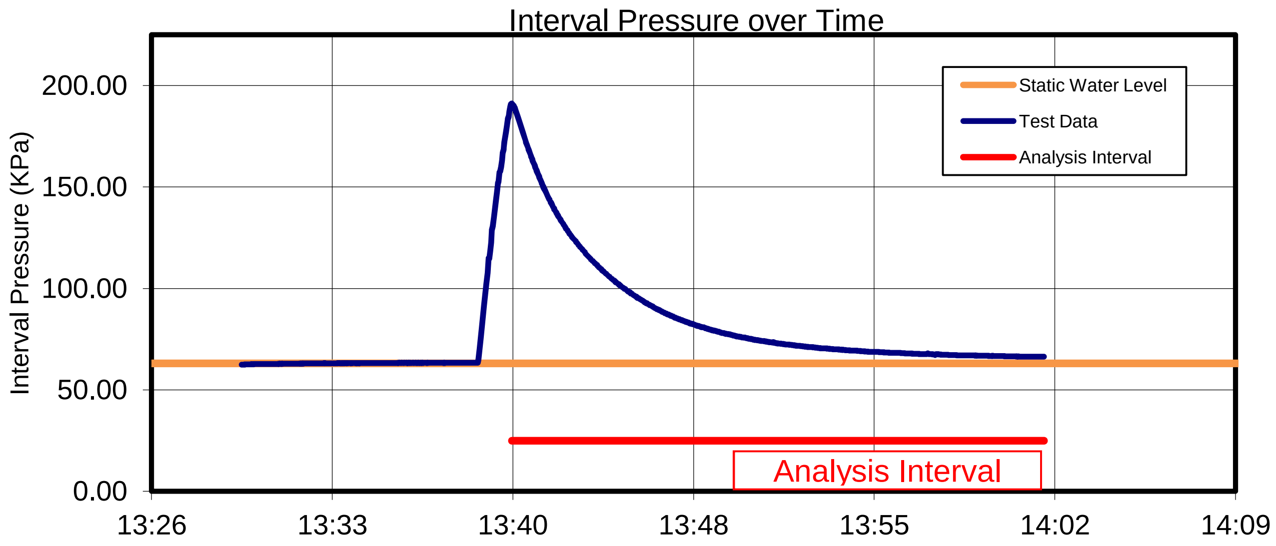
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

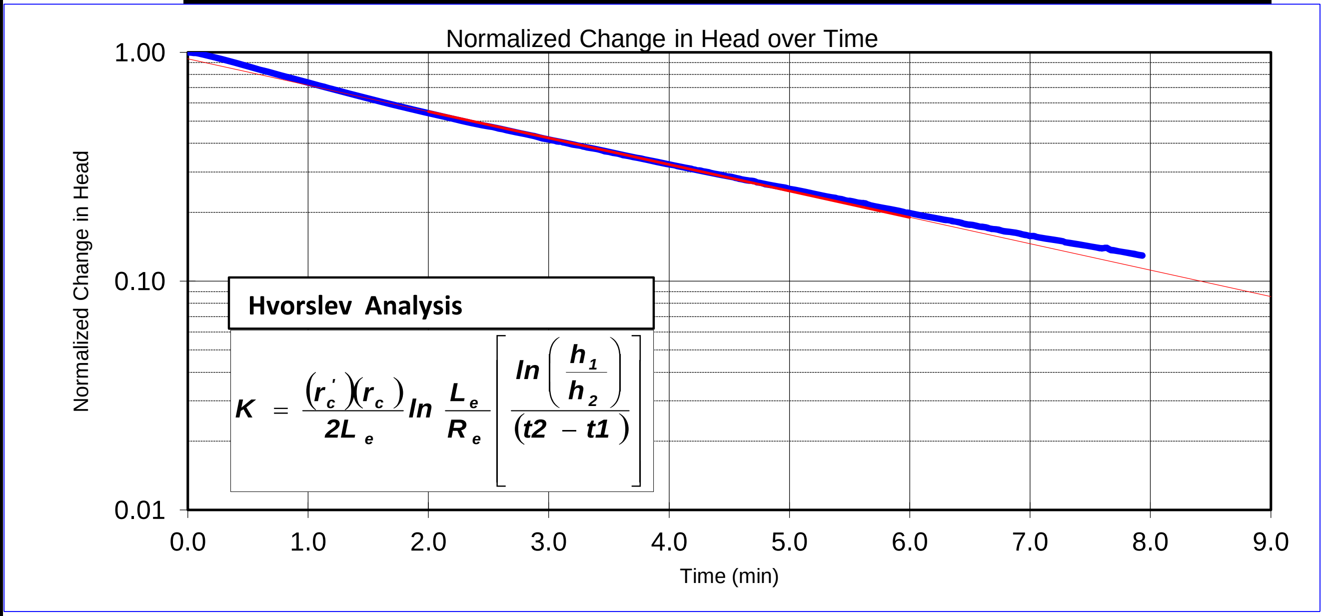
Falling Head Test W3-11-53 (P-03): 77.13-92.83 m

Figure B.28

Packer Test Interval	77.13 to 92.83 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Test Date	2-Oct-2011	Testing Rod Size	BQ



Borehole Radius	0.038 m	Packer Interval	15.7 m
Testing Rod Radius	0.023 m	Line of Best fit	0.266
Effective Testing RodRadius	0.023 m	Hy. Conductivity (cm/s)	5.E-05



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)}\right]$$

DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

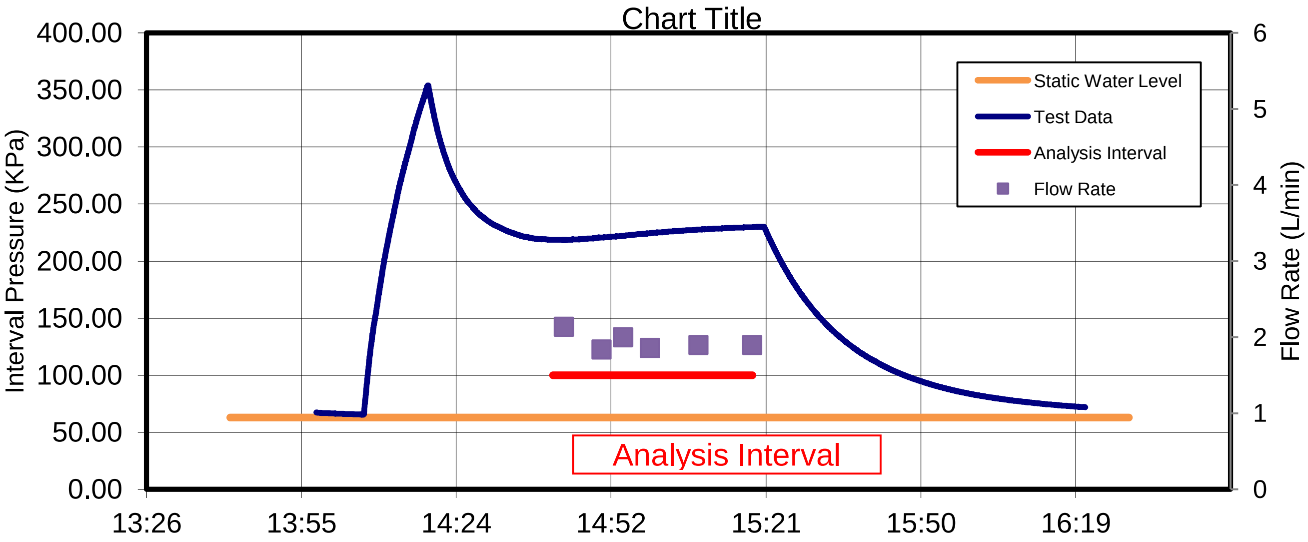
checked by: PMMC

In-Situ Hydraulic Conductivity Test Report

Constant Rate Test W3-11-53 (P-03): 77.13-92.83 m

Figure B.29

Packer Test Interval	77.13 to 92.83 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Date Time of Test	2-Oct-2011	Testing Rod Size	BQ



Average Flow Rate	1.94 L/min
Average Change in Head	16.4 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.7E-06
Packer Interval	15.7 m
Hy. Conductivity (cm/sec)	1.E-05

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\Pi\Delta H}\right)$$

Notes:

DATE: November 15, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

checked by: PMMC

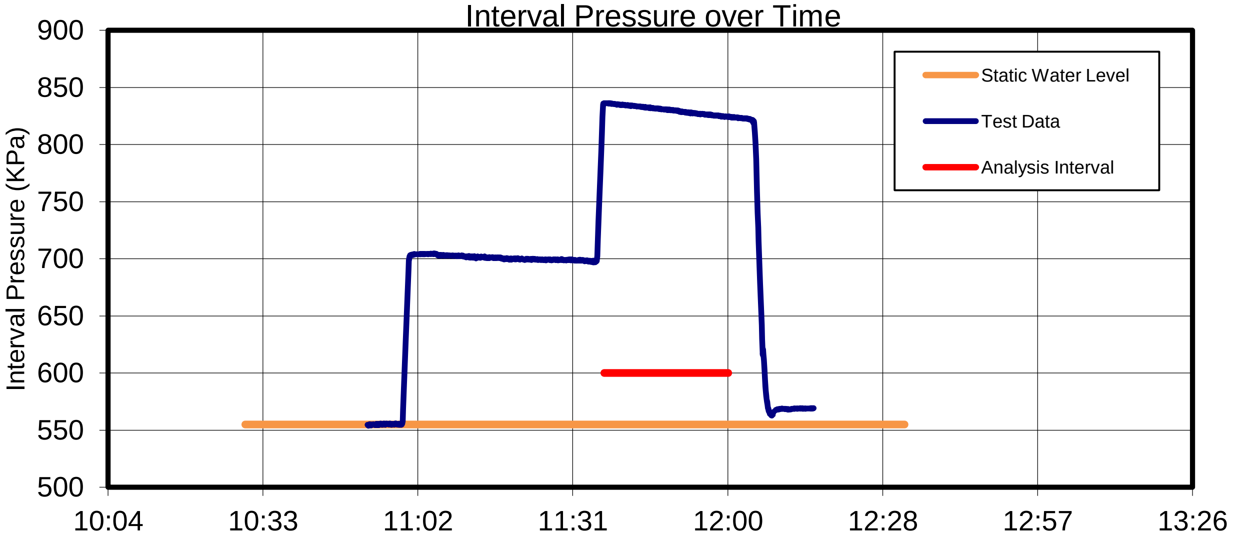
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

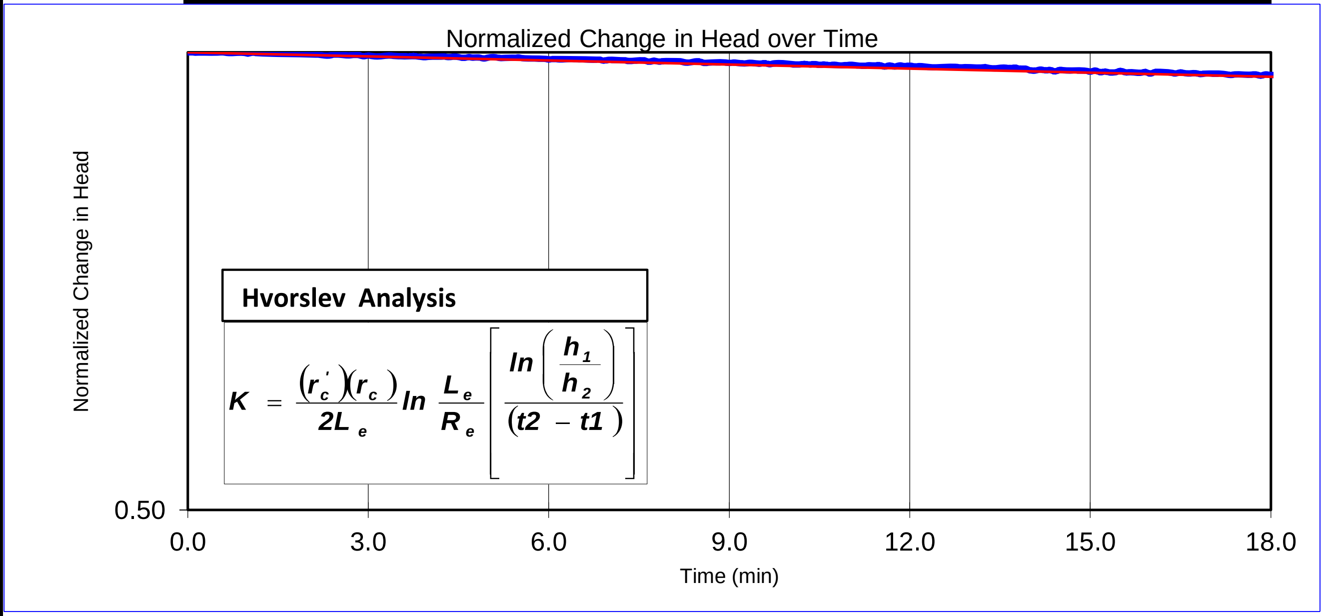
W3-11-53(P-03): 89.17-104.87 m

Figure B.30

Packer Test Interval	89.17 to 104.87 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Test Date	2-Oct-2011	Testing Rod Size	BQ



Borehole Radius	0.038 m	Packer Interval	15.7 m
Testing Rod Radius	0.023 m	Line of Best fit	0.002
Effective Testing RodRadius	0.023 m	Hy. Conductivity (cm/s)	3.E-07



Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 14, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

checked by: PMMC

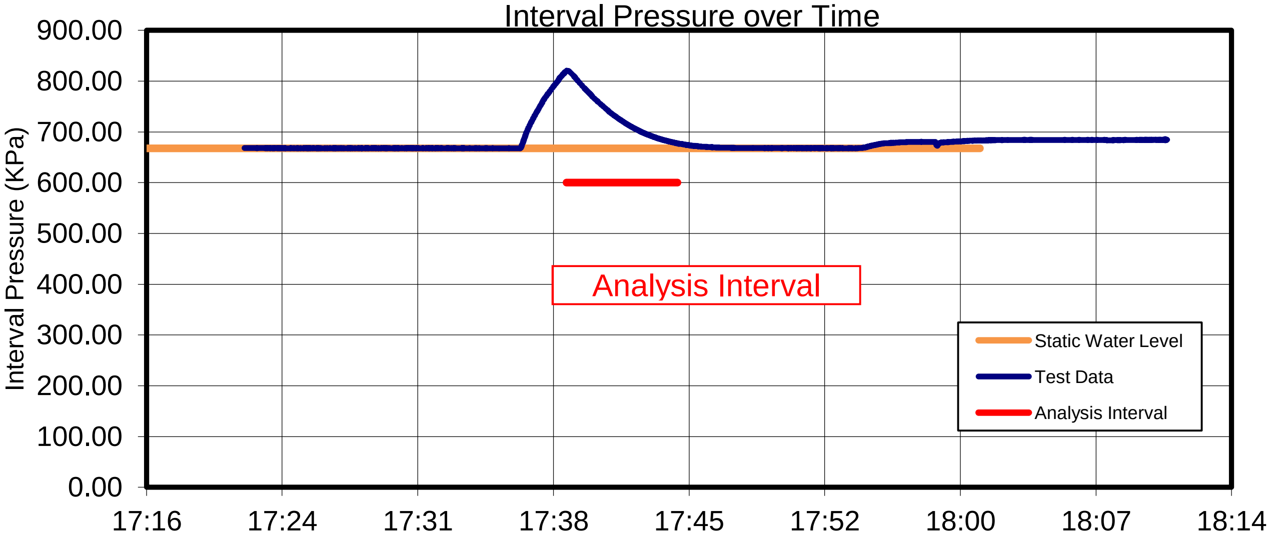
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

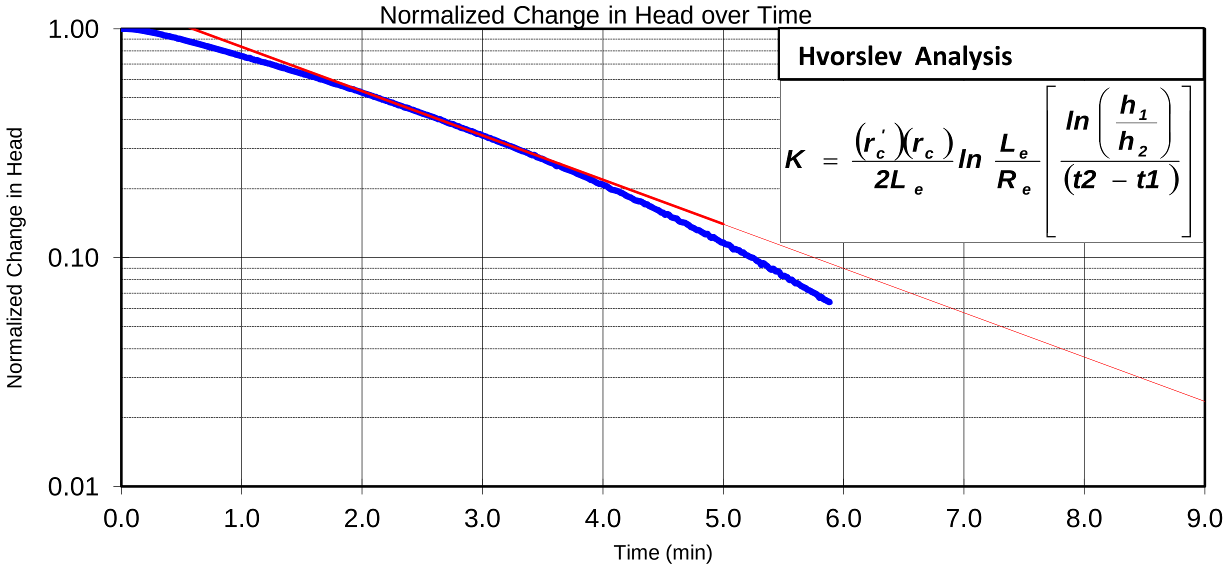
W3-11-53 (P-03): 103.79 m to EOH

Figure B.31

Packer Test Interval	103.79 to 138 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Test Date	29-Sep-2011	Testing Rod Size	NQ


Interval Pressure over Time

Borehole Radius	0.038 m	Packer Interval	34.21 m
Testing Rod Radius	0.03 m	Line of Best fit	0.446
Effective Testing RodRadius	0.03 m	Hy. Conductivity (cm/s)	7.E-05


Normalized Change in Head over Time

Hvorslev Analysis

$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 7, 2011

PROJECT: 11-1152-0116

prepared by: WRZ

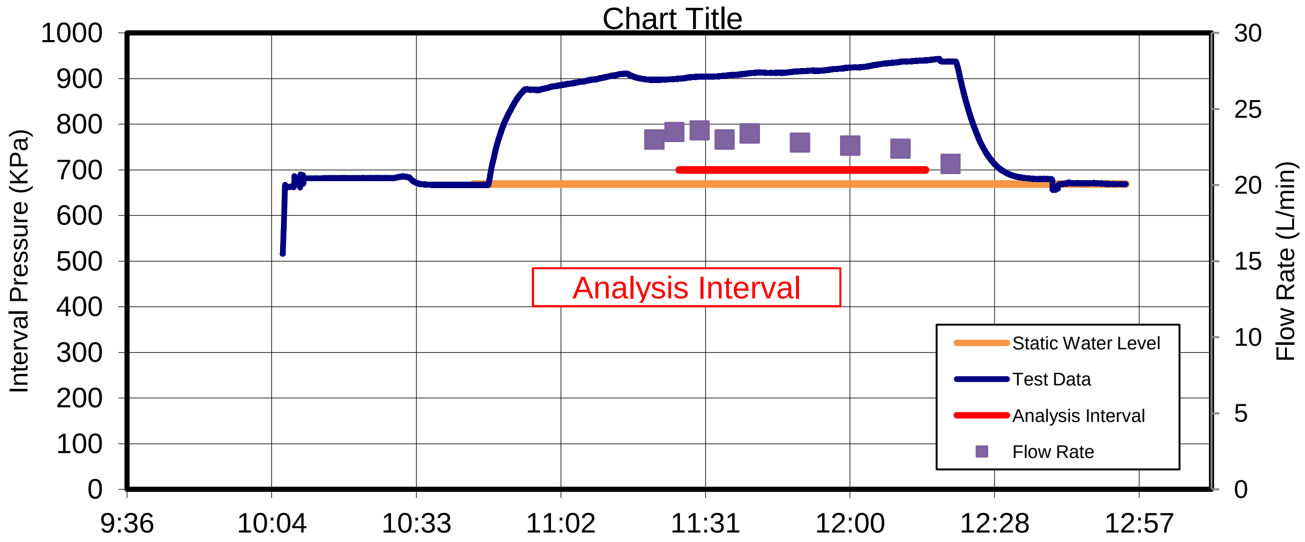
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

Figure B.32

Constant Rate Test W3-11-53 (P-03): 103.79 m - EOH

Packer Test Interval	103.79 to 138 m	Borehole Inclination	85 degrees
		Borehole Size	NQ
Date Time of Test	30-Sep-2011	Testing Rod Size	NQ



Average Flow Rate	23.04 L/min
Average Change in Head	25.4 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.3E-05
Packer Interval	34.21 m
Hy. Conductivity (cm/sec)	4.E-05

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\,\Pi\,\Delta H}\right)$$

Notes:

DATE: November 7, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: WRZ

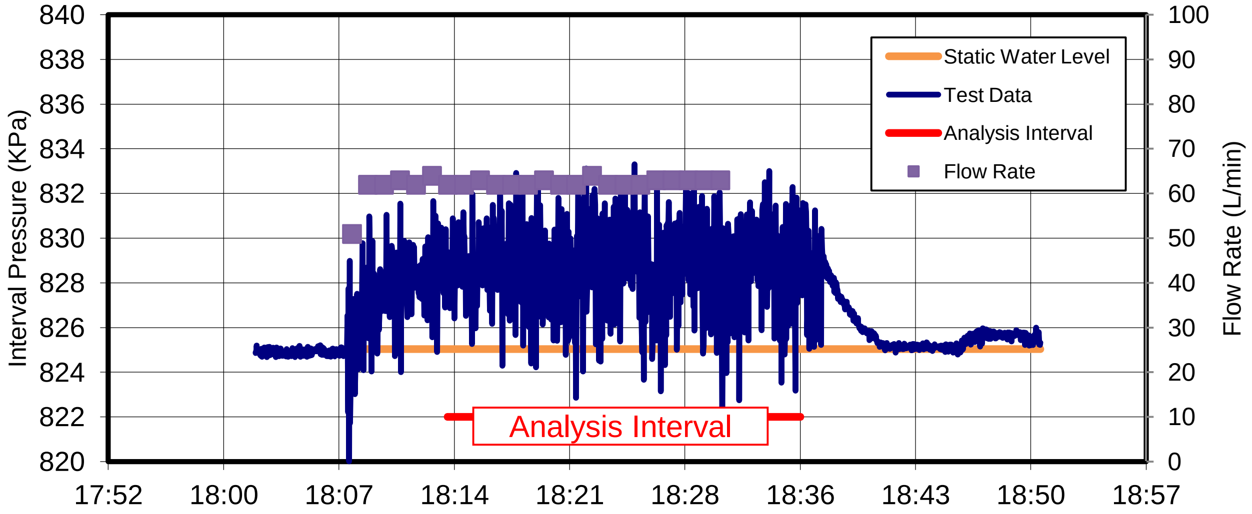
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

Constant Rate Test W3-11-71 (P-49): 179.95 to 306m

Figure B.33

Packer Test Interval	179.95 to 306 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	2-Nov-2011	Testing Rod Size	NQ



Average Flow Rate	62.5 L/min
Average Change in Head	0.4 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	2.4E-03
Packer Interval	126.05 m
Hydraulic Conductivity (cm/sec)	2.E-03

Thiem Equation (1906)

$$T = Q \left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2 \Pi \Delta H} \right)$$

Notes:

DATE: November 16, 2011

PROJECT: 11-1152-0116

prepared by: KS

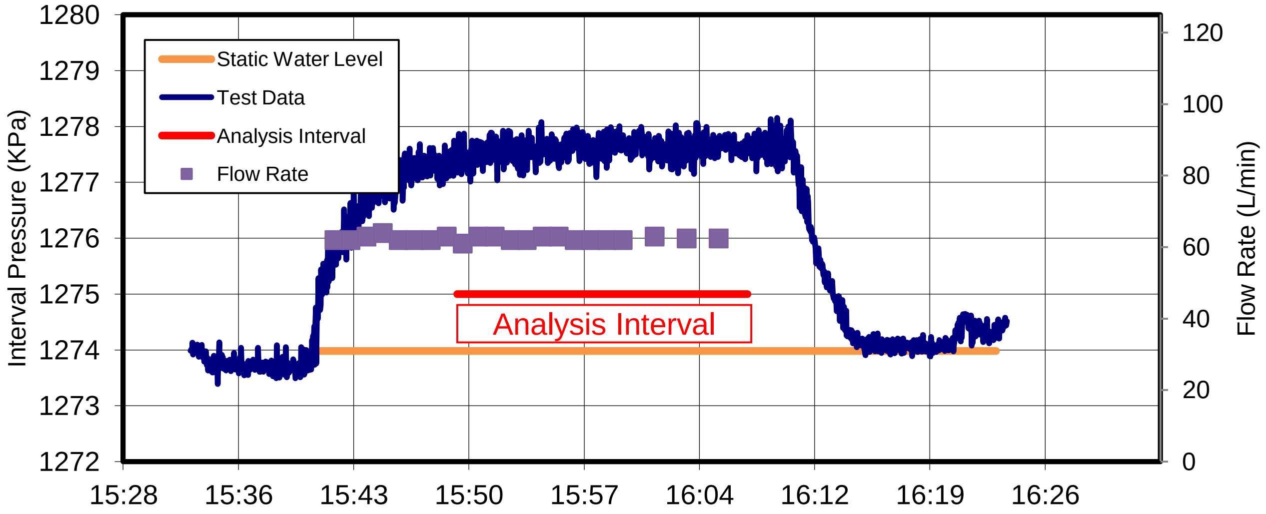
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

Constant Rate Test W3-11-71 (P-49): 230.75 to 306m

Figure B.34

Packer Test Interval	230.75 to 306 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	2-Nov-2011	Testing Rod Size	NQ



Average Flow Rate	62.41 L/min
Average Change in Head	0.4 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	2.5E-03
Packer Interval	75.25 m
Hydraulic Conductivity (cm/sec)	3.E-03

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\Pi\Delta H}\right)$$

Notes:

DATE: November 16, 2011

PROJECT: 11-1152-0116

prepared by: KS

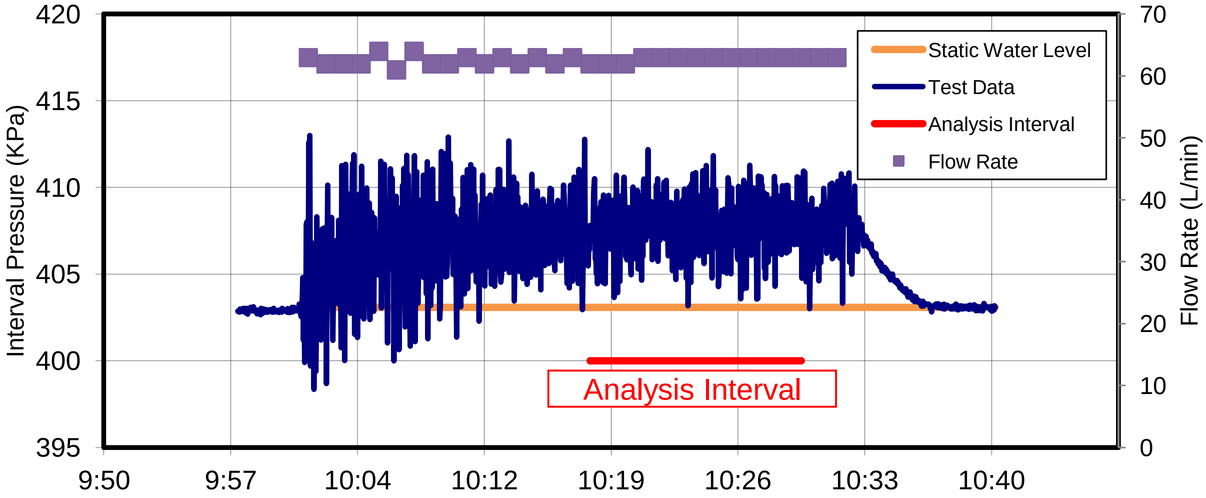
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

Constant Rate Test W3-11-71 (P-49): 136.18 to 306m

Figure B.35

Packer Test Interval	136.18 to 306 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	3-Nov-2011	Testing Rod Size	NQ



Average Flow Rate	62.75 L/min
Average Change in Head	0.5 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.9E-03
Packer Interval	169.82 m
Hydraulic Conductivity (cm/sec)	1.E-03

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\,\Pi\,\Delta H}\right)$$

Notes:

DATE: November 16, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

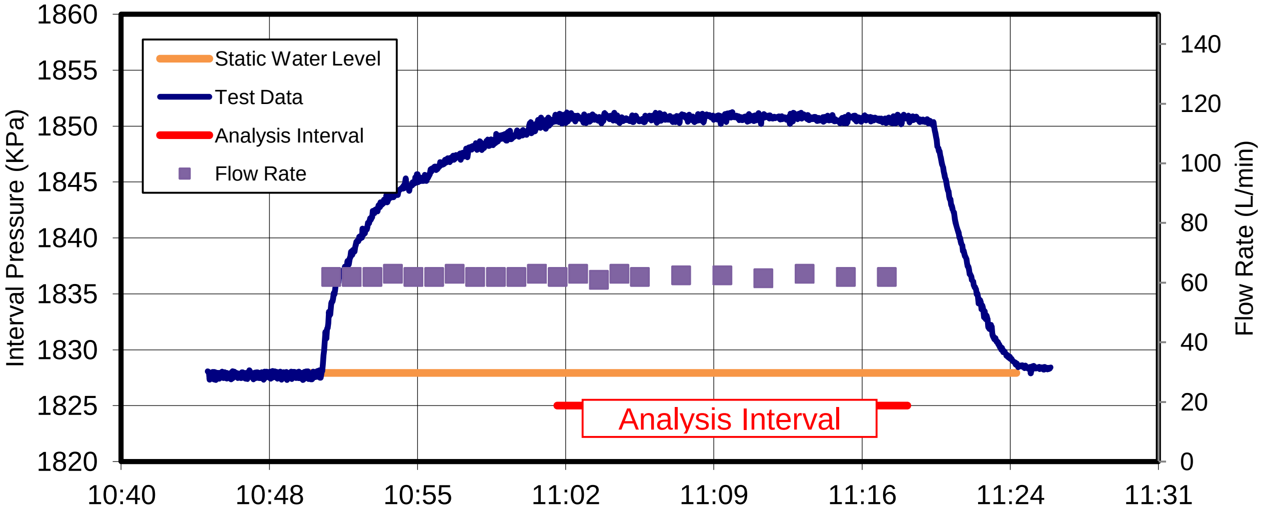
In-Situ Hydraulic Conductivity Test Report

Figure B.36

Constant Rate Test

W3-11-71 (P-49): 303.98m to 306m

Packer Test Interval	303.98 to 306 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	2-Nov-2011	Testing Rod Size	NQ



Average Flow Rate	62.23 L/min
Average Change in Head	2.3 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	4.0E-04
Packer Interval	2.02 m
Hydraulic Conductivity (cm/sec)	2.E-02

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\,\Pi\,\Delta H}\right)$$

Notes:

DATE: November 24, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

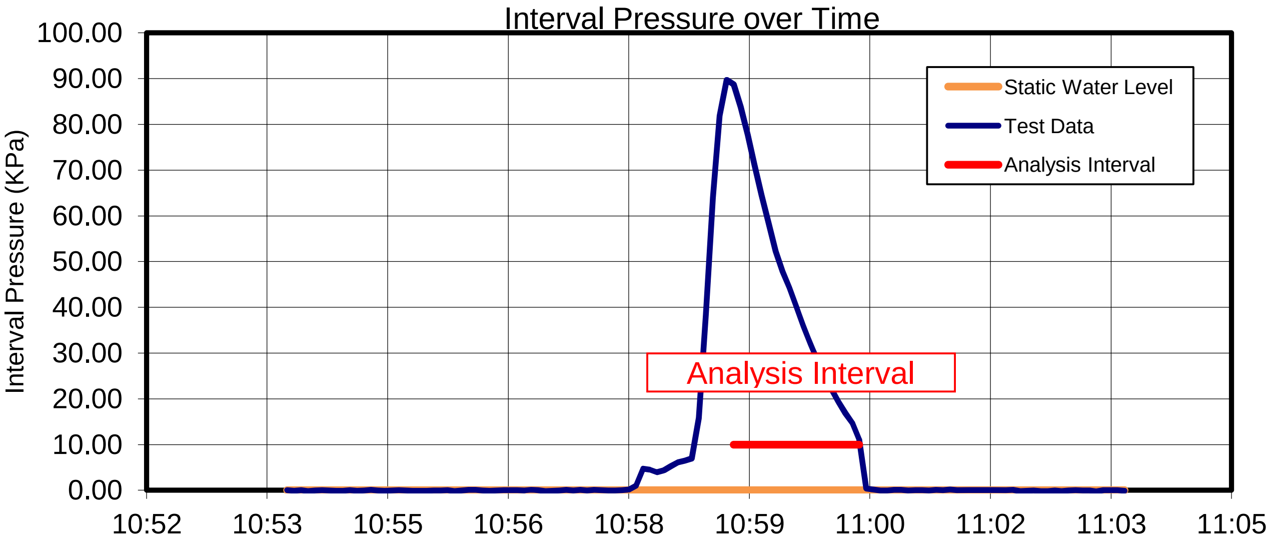
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

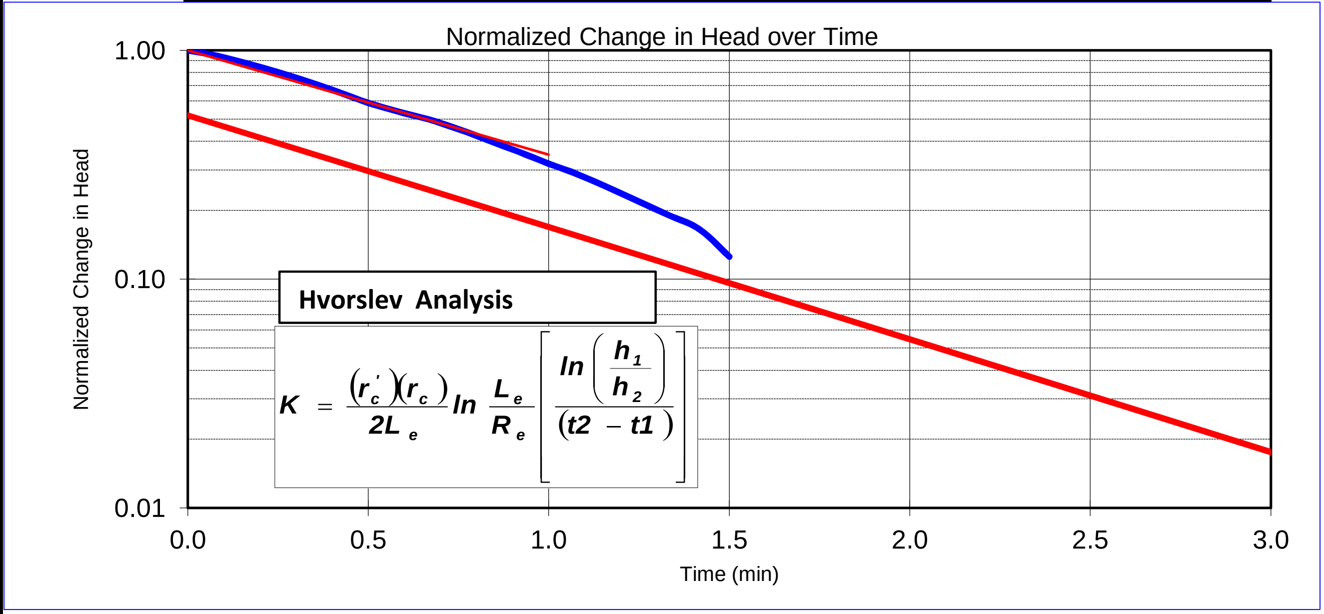
Falling Head Test W3-11-76 (P-16): 41.5m to 58.5m

Figure B.37

Packer Test Interval	41.5 to 58.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	26-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	1.05
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	1.E-04



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

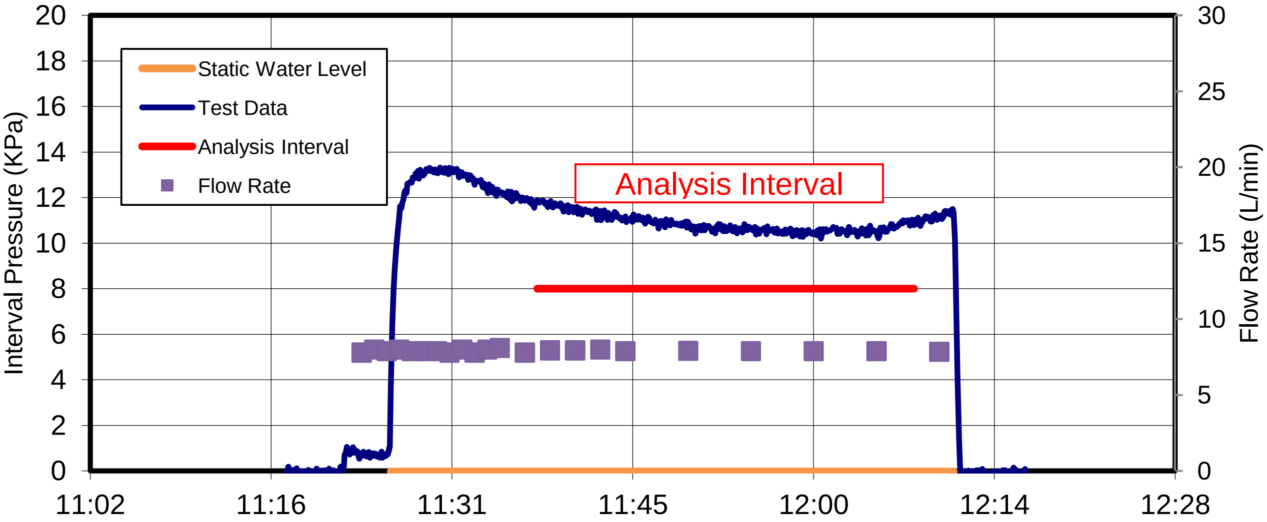
In-Situ Hydraulic Conductivity Test Report

Constant Rate Test

W3-11-76 (P-16): 41.5m to 58.5m

Figure B.38

Packer Test Interval	41.5 to 58.5 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	26-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	7.93 L/min
Average Change in Head	1.1 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.1E-04
Packer Interval	17 m
Hydraulic Conductivity (cm/sec)	6.E-04

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\Pi\Delta H}\right)$$

Notes:

DATE: November 15, 2011

PROJECT: 11-1152-0116

prepared by: KS

CHK: PMMC

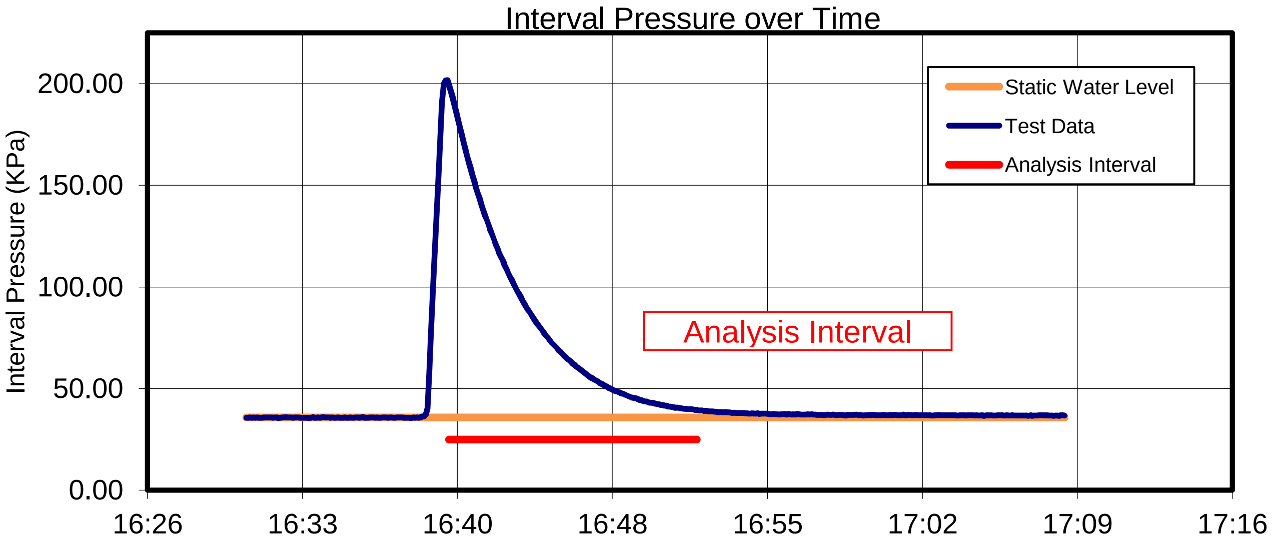
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

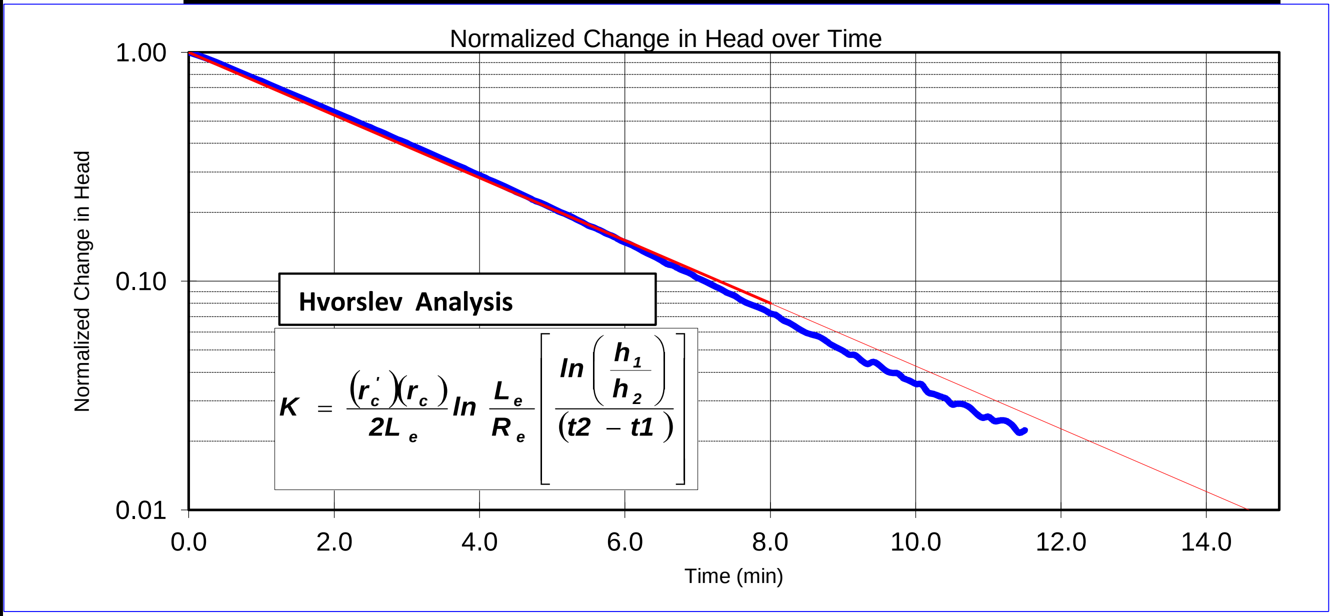
W3-11-76 (P-16): 56.8m to 73.8m

Figure B.39

Packer Test Interval	56.8 to 73.8 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	24-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	0.316
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	3.E-05



$$K = \frac{(r_c')(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

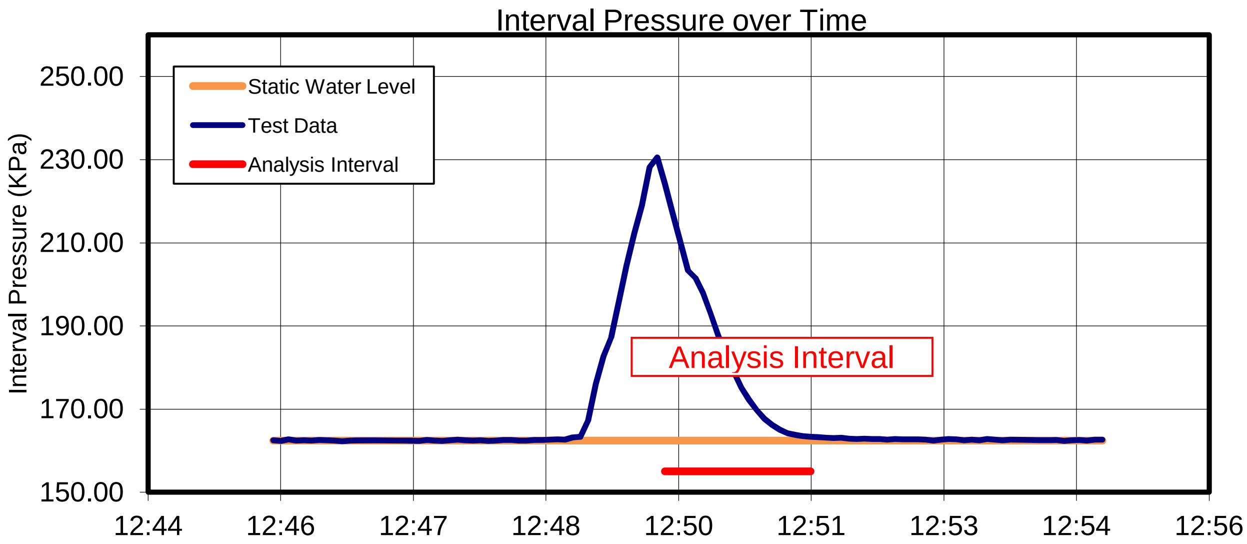
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

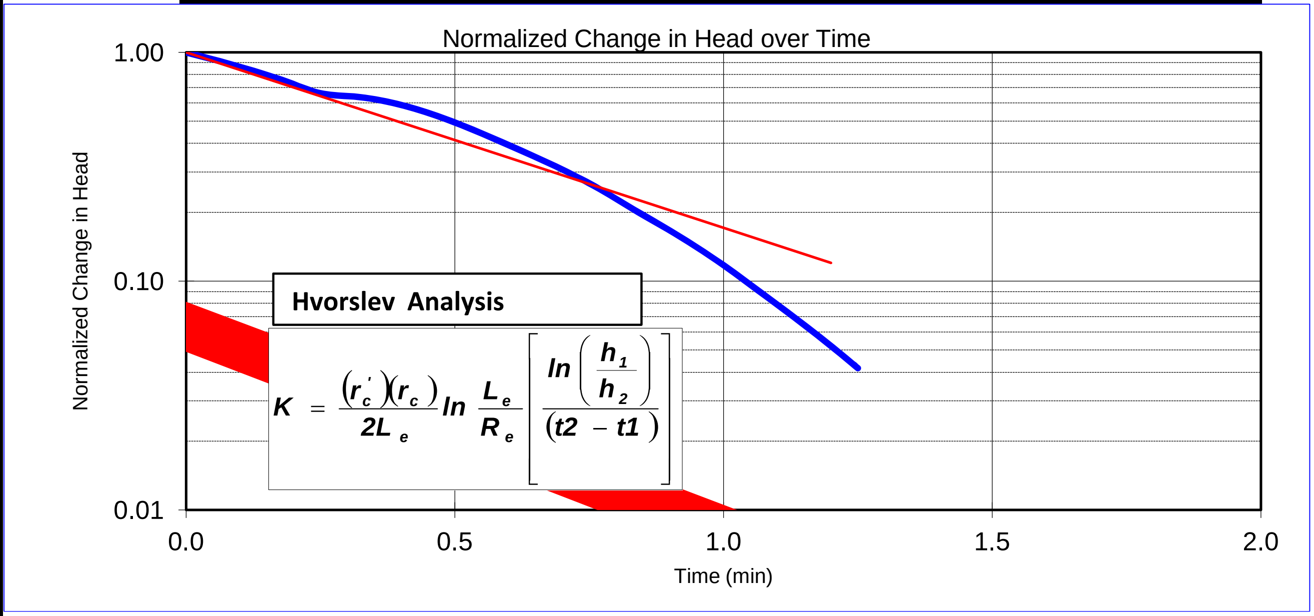
Falling Head Test W3-11-76 (P-16): 71.82m to 88.82m

Figure B.40

Packer Test Interval	71.82 to 88.82 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	24-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	1.767
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	2.E-04



DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

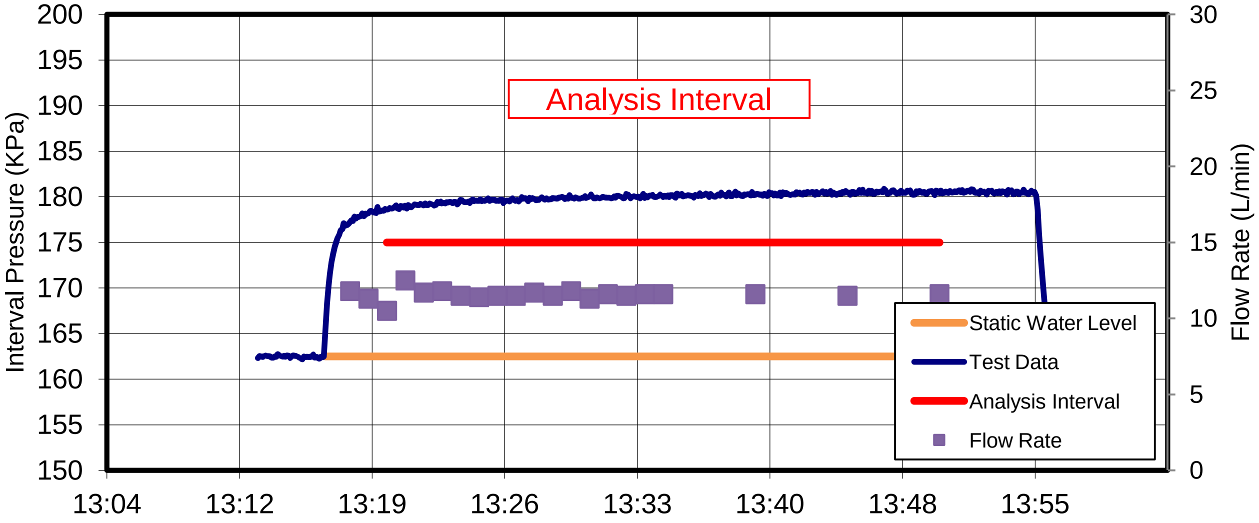
In-Situ Hydraulic Conductivity Test Report

Figure B.41

Constant Rate Test

W3-11-76 (P-16): 71.5m to 88.5m

Paker Test Interval	71.5 to 88.5 m	Borehole Inclination	60 degrees
Static Water Level	54.61 m TOC	Borehole Size	NQ
Date Time of Test	24-Oct-2011	Testing Rod Size	AQ



Average Flow Rate	11.56 L/min
Average Change in Head	1.8 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	9.6E-05
Packer Interval	17 m
Hydraulic Conductivity (cm/sec)	6.E-04

Thiem Equation (1906)

$$T = Q \left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2 \Pi \Delta H} \right)$$

Notes:

DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

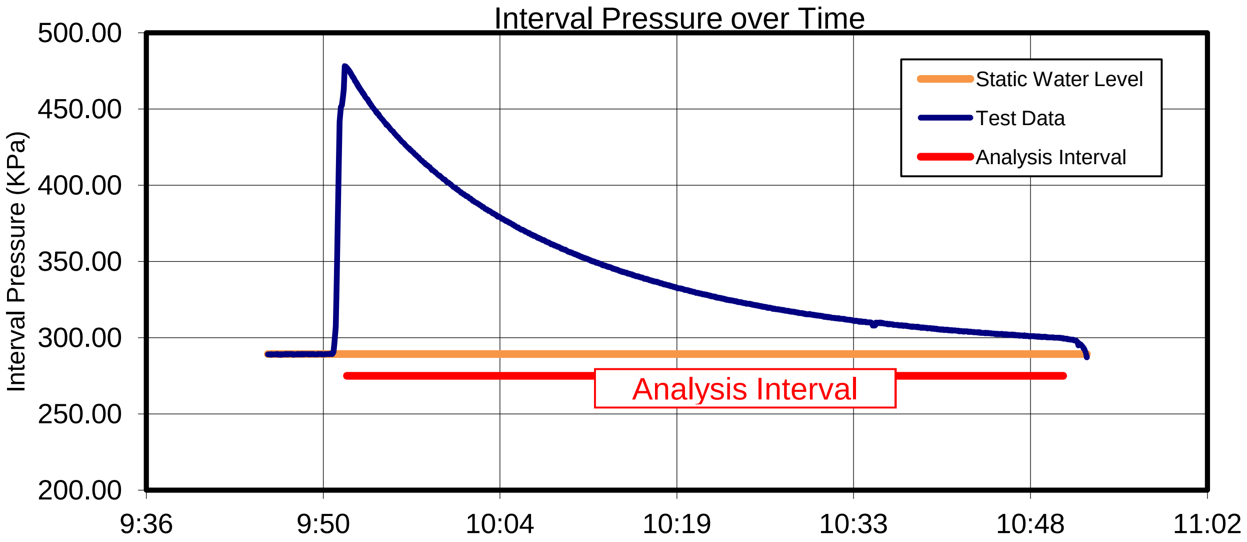
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

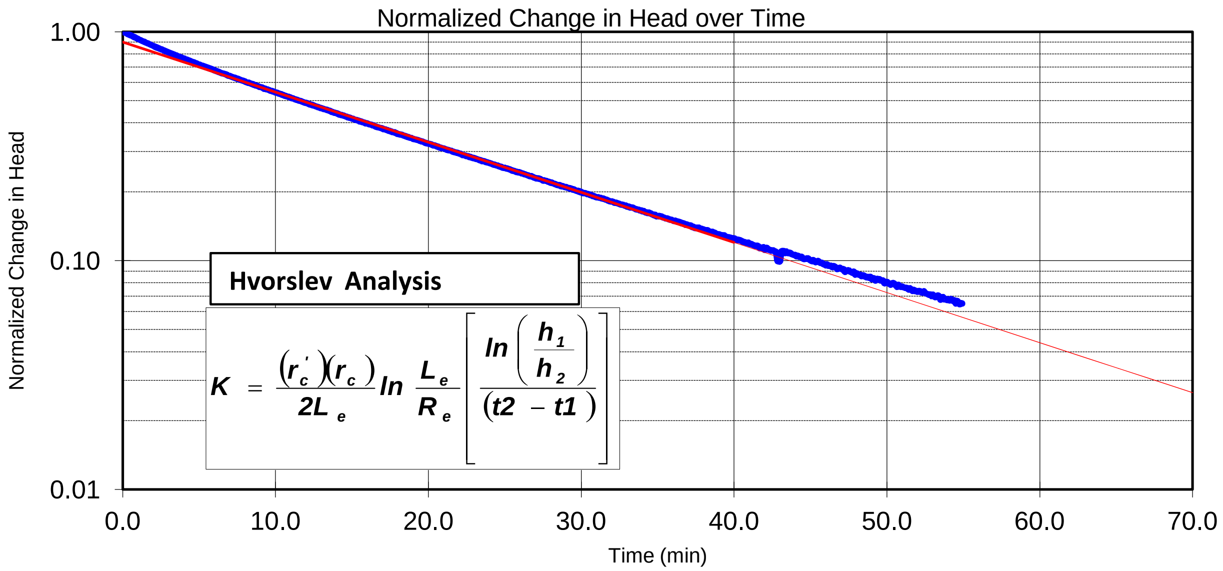
Falling Head Test W3-11-76 (P-16): 86.85m to 103.85m

Figure B.42

Packer Test Interval	86.85 to 103.85 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	24-Oct-2011	Testing Rod Size	AQ



Borehole Radius	0.038 m	Packer Interval	17 m
Testing Rod Radius	0.017 m	Line of Best fit	0.05
Effective Testing RodRadius	0.02 m	Hy. Conductivity (cm/s)	5.E-06



$$K = \frac{(r_c')(r_c)}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)}\right]$$

DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

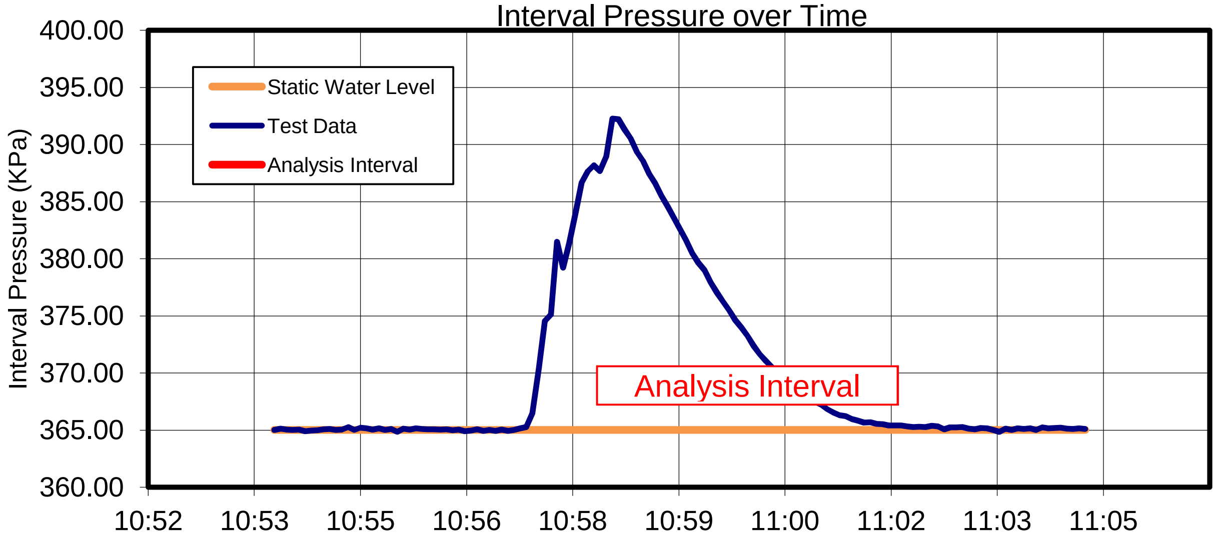
In-Situ Hydraulic Conductivity Test Report

Falling Head Test

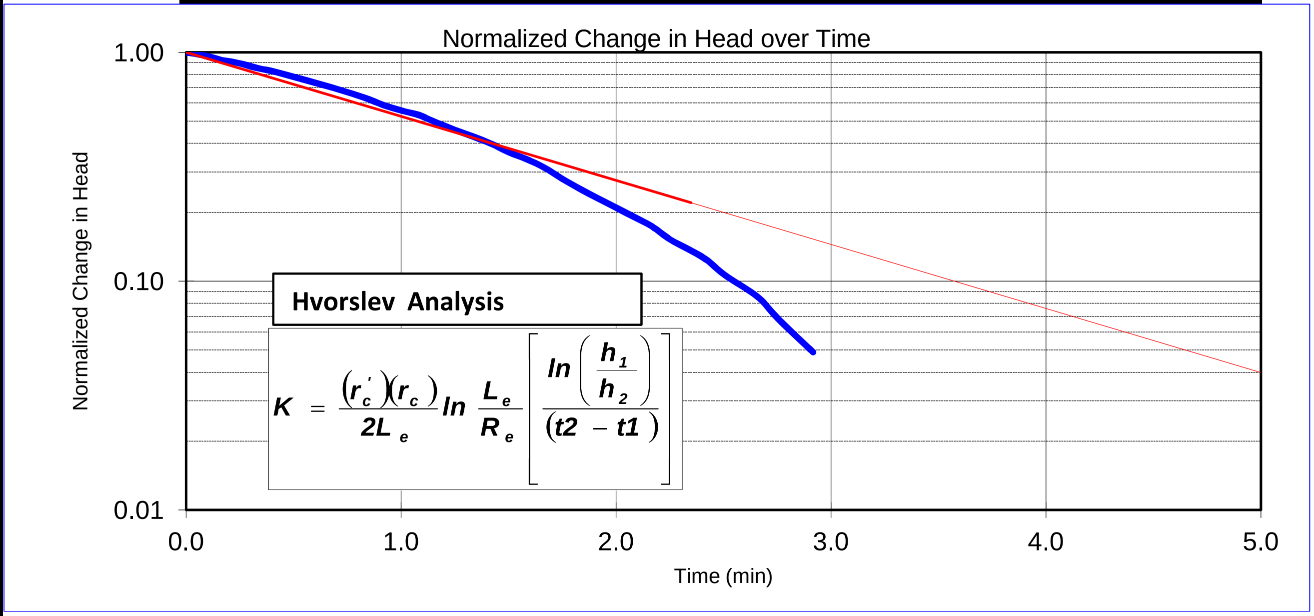
W3-11-76 (P-16): 98.19m to 211m

Figure B.43

Packer Test Interval	98.19 to 211 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Test Date	23-Oct-2011	Testing Rod Size	NQ



Borehole Radius	0.038 m	Packer Interval	112.81 m
Testing Rod Radius	0.03 m	Line of Best fit	0.644
Effective Testing RodRadius	0.035 m	Hy. Conductivity (cm/s)	4.E-05



$$K = \frac{(r_c^{'})(r_c)}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right]$$

DATE: November 15, 2011

PROJECT: 11-1152-0116

prepared by: KS

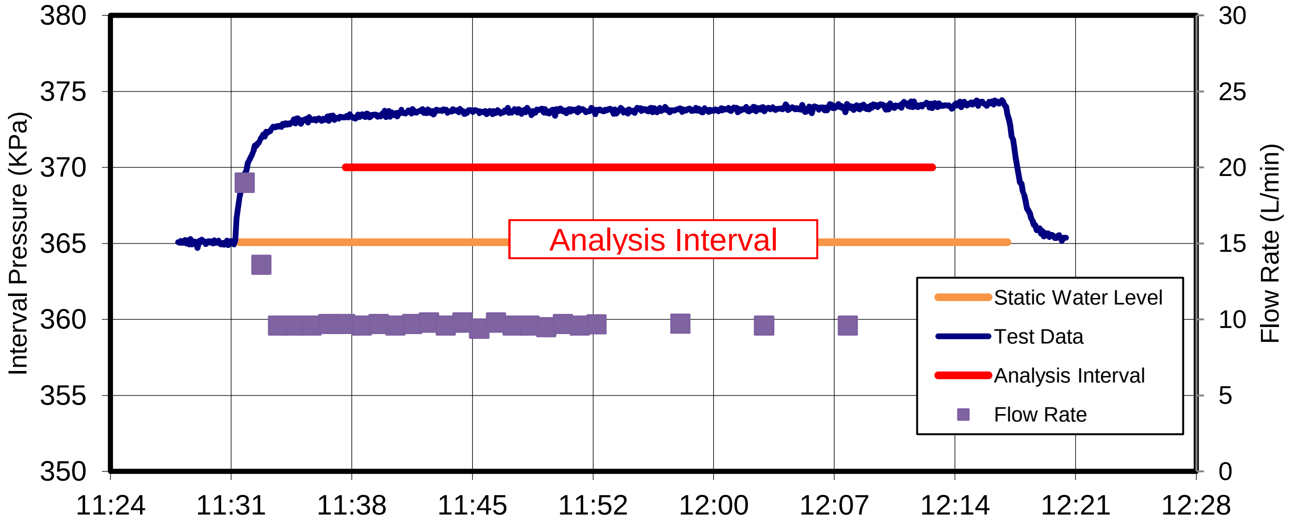
CHK: PMMC

In-Situ Hydraulic Conductivity Test Report

Figure B.44

Constant Rate Test W3-11-76 (P-16): 98.19m to 211m

Packer Test Interval	98.19 to 211 m	Borehole Inclination	60 degrees
		Borehole Size	NQ
Date Time of Test	23-Oct-2011	Testing Rod Size	NQ



Average Flow Rate	9.65 L/min
Average Change in Head	0.9 m
Radius of Well	0.038 m
Radius of Influence	10 m
Transmissivity (m^2/sec)	1.6E-04
Packer Interval	112.81 m
Hydraulic Conductivity (cm/sec)	1.E-04

Thiem Equation (1906)

$$T = Q\left(\frac{\ln\left(\frac{R_i}{R_{ew}}\right)}{2\Pi\Delta H}\right)$$

Notes:

DATE: November 15, 2011

PROJECT: 11-1152-0116

Golder Associates

prepared by: KS

CHK: PMMC

APPENDIX C

GROUNDWATER AND SURFACE WATER QUALITY SAMPLING RESULTS

ATTACHMENT 1

Groundwater Quality Sampling Results

Your P.O. #: 11-183
Your Project #: 11-1152-0116 PHASE 1006
Site Location: LABRADOR CITY
Your C.O.C. #: N/A

Attention: Phyllis McCrindle
Golder Associates
8 Elm Street
Apartment #3
Labrador City, NL
CANADA A2V 1Y3

Report Date: 2011/11/16
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1H2535
Received: 2011/11/02, 13:44

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Carbonate, Bicarbonate and Hydroxide	3	N/A	2011/11/09	CAM SOP-00102	APHA 4500-CO2 D
Alkalinity	3	N/A	2011/11/15	ATL SOP 00013	Based on EPA310.2
Anions (1)	3	N/A	2011/11/09	CAM SOP-00435	SM 4110B
Chloride	3	N/A	2011/11/09	ATL SOP 00014	Based on SM4500-Cl-
Colour	3	N/A	2011/11/09	ATL SOP 00020	Based on SM2120C
Conductance - water	3	N/A	2011/11/10	ATL SOP 00004/00006	Based on SM2510B
Fluoride	3	N/A	2011/11/04	ATL SOP 00043	Based on SM4500F-C
Hardness (calculated as CaCO3)	3	N/A	2011/11/09	ATL SOP 00048	Based on SM2340B
Mercury - Total (CVAA,LL)	3	2011/11/09	2011/11/10	ATL SOP 00026	Based on EPA245.1
Metals Water Total MS	3	2011/11/04	2011/11/07	ATL SOP 00059	Based on EPA6020A
Ion Balance (% Difference)	3	N/A	2011/11/15		
Anion and Cation Sum	3	N/A	2011/11/10		
Nitrogen Ammonia - water	3	N/A	2011/11/09	ATL SOP 00015	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	3	N/A	2011/11/10	ATL SOP 00016	Based on USGS - Enz.
Nitrogen - Nitrite	3	N/A	2011/11/10	ATL SOP 00017	Based on SM4500-NO2B
Nitrogen - Nitrate (as N)	3	N/A	2011/11/10	ATL SOP 00018	Based on ASTMD3867
pH	3	N/A	2011/11/09	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho	3	N/A	2011/11/10	ATL SOP 00021	Based on USEPA 365.1
Sat. pH and Langelier Index (@ 20C)	3	N/A	2011/11/15		
Sat. pH and Langelier Index (@ 4C)	3	N/A	2011/11/15		
Reactive Silica	3	N/A	2011/11/09	ATL SOP 00022	Based on EPA 366.0
Sulphate	3	N/A	2011/11/10	ATL SOP 00023	Based on EPA 375.4
Total Dissolved Solids (TDS calc)	3	N/A	2011/11/15		
Organic carbon - Total (TOC)	3	N/A	2011/11/10	ATL SOP 00037	Based on SM5310C
Total Suspended Solids	2	N/A	2011/11/07	ATL SOP 00007	based on EPA 160.2
Total Suspended Solids	1	N/A	2011/11/08	ATL SOP 00007	based on EPA 160.2
Turbidity	3	N/A	2011/11/10	ATL SOP 00011	based on EPA 180.1

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

../2

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARI KENNY, Project Manager
Email: MKenny@maxxam.ca
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

Maxxam Job #: B1H2535
Report Date: 2011/11/16

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: LABRADOR CITY
Your P.O. #: 11-183

RESULTS OF ANALYSES OF WATER

Maxxam ID				LM4517		LM4550			LM4551		
Sampling Date				2011/11/01		2011/10/31			2011/11/01		
	Units	**Criteria A**	**Criteria C**	**W-3-11-49 (P-08)-DEEP**	**RDL**	**W-3-11-49 (P-08))-MIDDLE**	**RDL**	**QC Batch**	**W-3-11-49 (P-08)-SHALLOW**	**RDL**	**QC Batch**
Calculated Parameters											
Anion Sum	me/L			1.93	N/A	1.20	N/A	2669632	1.05	N/A	2669632
Bicarb. Alkalinity (calc. as CaCO3)	mg/L			96	1	60	1	2669628	50	1	2669628
Calculated TDS	mg/L		500	104	1	68	1	2669637	61	1	2669637
Carb. Alkalinity (calc. as CaCO3)	mg/L			ND	1	ND	1	2669628	ND	1	2669628
Cation Sum	me/L			1.90	N/A	1.16	N/A	2669632	1.07	N/A	2669632
Hardness (CaCO3)	mg/L			70	1	32	1	2669629	21	1	2669629
Ion Balance (% Difference)	%			0.780	N/A	1.69	N/A	2669630	0.940	N/A	2669630
Langelier Index (@ 20C)	N/A			-0.700		-1.63		2669635	-1.56		2669635
Langelier Index (@ 4C)	N/A			-0.951		-1.88		2669636	-1.81		2669636
Nitrate (N)	mg/L	**10**		ND	0.05	ND	0.05	2669509	ND	0.05	2669509
Saturation pH (@ 20C)	N/A			8.14		8.62		2669635	8.84		2669635
Saturation pH (@ 4C)	N/A			8.39		8.87		2669636	9.09		2669636

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

C= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. If a concentration is well above an AO, then there is a possibility of a health hazard.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

Maxxam Job #: B1H2535
Report Date: 2011/11/16

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: LABRADOR CITY
Your P.O. #: 11-183

RESULTS OF ANALYSES OF WATER

Maxxam ID				LM4517		LM4550			LM4551		
Sampling Date				2011/11/01		2011/10/31			2011/11/01		
	Units	**Criteria A**	**Criteria C**	**W-3-11-49 (P-08)-DEEP**	**RDL**	**W-3-11-49 (P-08))-MIDDLE**	**RDL**	**QC Batch**	**W-3-11-49 (P-08)-SHALLOW**	**RDL**	**QC Batch**
Inorganics											
Total Alkalinity (Total as CaCO3)	mg/L			96	5	60	5	2675281	50	5	2675281
Dissolved Chloride (Cl)	mg/L		250	ND	1	ND	1	2675283	ND	1	2675283
Colour	TCU		15	ND	5	ND	5	2675286	ND	5	2675286
Dissolved Fluoride (F-)	mg/L	**1.5**		ND	0.1	ND	0.1	2671552	ND	0.1	2671552
Nitrate + Nitrite	mg/L			ND	0.05	ND	0.05	2675288	ND	0.05	2675288
Nitrite (N)	mg/L	**1**		ND	0.01	ND	0.01	2675289	ND	0.01	2675289
Nitrogen (Ammonia Nitrogen)	mg/L			ND	0.05	ND	0.05	2676137	ND	0.05	2676137
Total Organic Carbon (C)	mg/L			22	5	55	5	2678095	27	5	2678095
Orthophosphate (P)	mg/L			ND	0.01	ND	0.01	2675287	ND	0.01	2675287
pH	pH		6.5 : 8.5	7.44	N/A	6.99	N/A	2676002	7.28	N/A	2676002
Reactive Silica (SiO2)	mg/L			6.7	0.5	4.7	0.5	2675285	4.5	0.5	2675285
Total Suspended Solids	mg/L			80	20	240	50	2673017	160	50	2674492
Dissolved Sulphate (SO4)	mg/L		500	ND	2	ND	2	2675284	2	2	2675284
Turbidity	NTU	**0.3**		**31**	0.1	**160**	0.5	2677796	**74**	0.3	2677796
Conductivity	uS/cm			160	1	110	1	2677524	92	1	2677524
Dissolved Bromide (Br-)	mg/L			ND	1	ND	1	2675833	ND	1	2675833

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

MERCURY BY COLD VAPOUR AA (WATER)

Maxxam ID			LM4517	LM4550	LM4551		
Sampling Date			2011/11/01	2011/10/31	2011/11/01		
	Units	**Criteria A**	**W-3-11-49 (P-08)-DEEP**	**W-3-11-49 (P-08))-MIDDLE**	**W-3-11-49 (P-08)-SHALLOW**	**RDL**	**QC Batch**
Metals							
Total Mercury (Hg)	ug/L	**1**	ND	ND	ND	0.013	2677685

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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C= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. If a concentration is well above an AO, then there is a possibility of a health hazard.

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Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

Maxxam Job #: B1H2535
Report Date: 2011/11/16

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: LABRADOR CITY
Your P.O. #: 11-183

ELEMENTS BY ICP/MS (WATER)

Maxxam ID				LM4517	LM4550	LM4551		
Sampling Date				2011/11/01	2011/10/31	2011/11/01		
	Units	**Criteria A**	**Criteria C**	**W-3-11-49 (P-08)-DEEP**	**W-3-11-49 (P-08))-MIDDLE**	**W-3-11-49 (P-08)-SHALLOW**	**RDL**	**QC Batch**
Metals								
Total Aluminum (Al)	ug/L		100	13.8	40.1	223	5.0	2673124
Total Antimony (Sb)	ug/L	**6**		2.3	2.2	2.3	1.0	2673124
Total Arsenic (As)	ug/L	**10**		ND	ND	ND	1.0	2673124
Total Barium (Ba)	ug/L	**1000**		7.0	11.4	61.8	1.0	2673124
Total Beryllium (Be)	ug/L			ND	ND	ND	1.0	2673124
Total Bismuth (Bi)	ug/L			ND	ND	ND	2.0	2673124
Total Boron (B)	ug/L	**5000**		ND	ND	ND	50	2673124
Total Cadmium (Cd)	ug/L	**5**		0.030	0.048	0.047	0.017	2673124
Total Calcium (Ca)	ug/L			16600	8330	5960	100	2673124
Total Chromium (Cr)	ug/L	**50**		1.2	3.4	1.2	1.0	2673124
Total Cobalt (Co)	ug/L			27.2	34.9	23.9	0.40	2673124
Total Copper (Cu)	ug/L		1000	ND	8.4	5.5	2.0	2673124
Total Iron (Fe)	ug/L		300	ND	142	432	50	2673124
Total Lead (Pb)	ug/L	**10**		ND	ND	0.81	0.50	2673124
Total Magnesium (Mg)	ug/L			6800	2640	1530	100	2673124
Total Manganese (Mn)	ug/L		50	3850	4040	2110	2.0	2673124
Total Molybdenum (Mo)	ug/L			ND	ND	ND	2.0	2673124
Total Nickel (Ni)	ug/L			4.0	7.6	5.5	2.0	2673124
Total Phosphorus (P)	ug/L			ND	ND	ND	100	2673124
Total Potassium (K)	ug/L			1210	913	749	100	2673124

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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ELEMENTS BY ICP/MS (WATER)

Maxxam ID				LM4517	LM4550	LM4551		
Sampling Date				2011/11/01	2011/10/31	2011/11/01		
	Units	**Criteria A**	**Criteria C**	**W-3-11-49 (P-08)-DEEP**	**W-3-11-49 (P-08))-MIDDLE**	**W-3-11-49 (P-08)-SHALLOW**	**RDL**	**QC Batch**
Total Selenium (Se)	ug/L	**10**		ND	ND	ND	1.0	2673124
Total Silver (Ag)	ug/L			ND	0.21	0.46	0.10	2673124
Total Sodium (Na)	ug/L		200000	11000	11500	14000	100	2673124
Total Strontium (Sr)	ug/L			22.5	15.9	23.2	2.0	2673124
Total Thallium (Tl)	ug/L			ND	ND	ND	0.10	2673124
Total Tin (Sn)	ug/L			ND	ND	ND	2.0	2673124
Total Titanium (Ti)	ug/L			ND	ND	4.1	2.0	2673124
Total Uranium (U)	ug/L	**20**		ND	ND	0.16	0.10	2673124
Total Vanadium (V)	ug/L			ND	ND	ND	2.0	2673124
Total Zinc (Zn)	ug/L		5000	37.0	36.9	63.7	5.0	2673124

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

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Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

Package 1	1.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Report re-issued to include the Canadian Drinking Water Guidelines.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2671552	Dissolved Fluoride (F-)	2011/11/04	102	80 - 120	101	80 - 120	ND, RDL=0.1	mg/L	NC	25	98	80 - 120
2673017	Total Suspended Solids	2011/11/07					ND, RDL=1	mg/L	6.8	25	98	80 - 120
2673124	Total Aluminum (Al)	2011/11/07	100	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
2673124	Total Antimony (Sb)	2011/11/07	109	80 - 120	111	80 - 120	ND, RDL=1.0	ug/L				
2673124	Total Arsenic (As)	2011/11/07	99	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L				
2673124	Total Barium (Ba)	2011/11/07	100	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L				
2673124	Total Beryllium (Be)	2011/11/07	99	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L				
2673124	Total Bismuth (Bi)	2011/11/07	102	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Boron (B)	2011/11/07	96	80 - 120	100	80 - 120	ND, RDL=50	ug/L				
2673124	Total Cadmium (Cd)	2011/11/07	99	80 - 120	101	80 - 120	ND, RDL=0.017	ug/L				
2673124	Total Calcium (Ca)	2011/11/07	100	80 - 120	103	80 - 120	ND, RDL=100	ug/L				
2673124	Total Chromium (Cr)	2011/11/07	97	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L				
2673124	Total Cobalt (Co)	2011/11/07	96	80 - 120	100	80 - 120	ND, RDL=0.40	ug/L				
2673124	Total Copper (Cu)	2011/11/07	95	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Iron (Fe)	2011/11/07	101	80 - 120	105	80 - 120	ND, RDL=50	ug/L				
2673124	Total Lead (Pb)	2011/11/07	99	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L				
2673124	Total Magnesium (Mg)	2011/11/07	101	80 - 120	105	80 - 120	ND, RDL=100	ug/L				
2673124	Total Manganese (Mn)	2011/11/07	98	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Molybdenum (Mo)	2011/11/07	102	80 - 120	105	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Nickel (Ni)	2011/11/07	95	80 - 120	99	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Phosphorus (P)	2011/11/07	103	80 - 120	107	80 - 120	ND, RDL=100	ug/L				
2673124	Total Potassium (K)	2011/11/07	103	80 - 120	108	80 - 120	ND, RDL=100	ug/L				
2673124	Total Selenium (Se)	2011/11/07	101	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2673124	Total Silver (Ag)	2011/11/07	101	80 - 120	102	80 - 120	ND, RDL=0.10	ug/L				
2673124	Total Sodium (Na)	2011/11/07	94	80 - 120	98	80 - 120	ND, RDL=100	ug/L				
2673124	Total Strontium (Sr)	2011/11/07	97	80 - 120	100	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Thallium (Tl)	2011/11/07	101	80 - 120	103	80 - 120	ND, RDL=0.10	ug/L				
2673124	Total Tin (Sn)	2011/11/07	103	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Titanium (Ti)	2011/11/07	100	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Uranium (U)	2011/11/07	109	80 - 120	110	80 - 120	ND, RDL=0.10	ug/L				
2673124	Total Vanadium (V)	2011/11/07	99	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L				
2673124	Total Zinc (Zn)	2011/11/07	98	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
2674492	Total Suspended Solids	2011/11/08					ND, RDL=1	mg/L	6.7	25	101	80 - 120
2675281	Total Alkalinity (Total as CaCO3)	2011/11/15	113	80 - 120	115	80 - 120	ND, RDL=5	mg/L	NC	25	102	80 - 120
2675283	Dissolved Chloride (Cl)	2011/11/09	99	80 - 120	101	80 - 120	ND, RDL=1	mg/L	0.7	25	100	80 - 120
2675284	Dissolved Sulphate (SO4)	2011/11/10	112	80 - 120	111	80 - 120	ND, RDL=2	mg/L	NC	25	105	80 - 120
2675285	Reactive Silica (SiO2)	2011/11/09	NC	80 - 120	101	80 - 120	ND, RDL=0.5	mg/L	0.1	25	95	75 - 125
2675286	Colour	2011/11/09					ND, RDL=5	TCU	NC	25	101	80 - 120
2675287	Orthophosphate (P)	2011/11/10	51 (1, 2)	80 - 120	100	80 - 120	ND, RDL=0.01	mg/L	NC	25	103	80 - 120

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2675288	Nitrate + Nitrite	2011/11/10	101	80 - 120	100	80 - 120	ND, RDL=0.05	mg/L	NC	25	104	80 - 120
2675289	Nitrite (N)	2011/11/10	103	80 - 120	96	80 - 120	ND, RDL=0.01	mg/L	NC	25	93	80 - 120
2675833	Dissolved Bromide (Br-)	2011/11/09	93	80 - 120	94	80 - 120	ND, RDL=1	mg/L	NC	20		
2676002	pH	2011/11/09							0.1	25	102	80 - 120
2676137	Nitrogen (Ammonia Nitrogen)	2011/11/10	NC	80 - 120	106	80 - 120	ND, RDL=0.05	mg/L	9.2	25	104	80 - 120
2677524	Conductivity	2011/11/10			100	80 - 120	ND, RDL=1	uS/cm	0.07	25		
2677685	Total Mercury (Hg)	2011/11/10	119	80 - 120	108	80 - 120	ND, RDL=0.013	ug/L	NC	25	92	80 - 120
2677796	Turbidity	2011/11/10					ND, RDL=0.1	NTU	NC	25	99	80 - 120
2678095	Total Organic Carbon (C)	2011/11/10	96	80 - 120	95	80 - 120	ND, RDL=0.5	mg/L	NC	25	96	80 - 120

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - Poor spike recovery due to sample matrix, recovery confirmed by repeat analysis.

Validation Signature Page

Maxxam Job #: B1H2535

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CAcker

COLLEEN ACKER

Cristina Carriere

CRISTINA CARRIERE, Scientific Services

Kevin A. MacDonald

KEVIN MACDONALD, Inorganics Supervisor

===

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics Inc
200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax902-420-8612 Toll Free 1-800-565-7227
www.maxxamanalytics.com E-mail: customerservicebedford@maxxamanalytics.com

Chain of Custody Record

Use yyyy/mm/dd clients initials

INVOICE INFORMATION:
Company Name: Golder Associates
Contact Name: Nathalie Germain
Address: 690 Boul. Laure, Suite 112
Sept-Iles, Quebec G4R4N8
Email: ngermain@golder.com
Ph: 418 968-6111 Fax: (418) 968-6107

REPORT INFORMATION (if differs from Invoice):
Company Name: Golder Associates
Contact Name: Keith Connolly
Address: 118 Humphrey dr, Labrador City, NL, A2V 2J8
Email: phyllis_mccrindle@golder.ca
Ph: 1 (905) 567 6100 Ext. 1323 Fax:

PO#: 11-183
Project #: 11-1152-0116 phase 1006
Proj. Name: Wabush 3 Hydrogeo Ass.
Location: Labrador City
Quotation #:
Submitted By: Lisseth Benavente
Site Task #

MAXXAM JOB NUMBER: B1H2535
ENTERED BY, Init: AL
Client Code: 17441

Specify Guideline Requirements;

Nitric acid added to 50 ml bottles, potassium dichromate to 100 ml amber bottles

* Specify Matrix; Surface/Salt/Ground/Tapwater/Sewage/Effluent/Seawater Potable/NonPotable/Tissue/Soil/Sludge/Metal

DUE DATE:
STANDARD: ☒
RUSH Due Date:
For extra cost rush,specify Due Date. Rush analysis must be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

Sample Identification	Matrix *	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAp-30 Choose total or Diss Metals	RCAp-MS Choose total or Diss Metals	Metals Water: Total Digest (Default Method)	Metals Water: Dissolved	Mercury: Mercury is not included in soil or water metals scan	Metals Soil: Available Metals Digest Default Method (HNO3/H2O2)	Metals Soil: Total Digest - for sediments (HNO3/HF/HCLO4)	Metals Soil: Tin (required for CCME soils)	Metals Soil: Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Metals Soil: Hot Water soluble Boron (required for CCME Agricultural)	TPH MUST (BTEX, C6-C32)	Soil(Potable),TPH MUST,NS Fuel Oil Spill Policy Low Level BTEX & C6-C32	NB Potable Water BTEX, VPH, Low Level TEH	TPH Fractionation	PAH's	PCB's	VOC's EPA 624,8260	Other Analysis or Comments/Hazards
W-3-11-49 (P-08) - deep	groundwater	1-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																TSS, Mercury, Bromide, Fluoride COMMENT: samples contain drilling mud after purged 469 L
W-3-11-49 (P-08) - middle	groundwater	31-Oct	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																TSS, Mercury, Bromide, Fluoride COMMENT: samples contain drilling mud after purged 420 L
W-3-11-49 (P-08) - shallow	groundwater	1-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																TSS, Mercury, Bromide, Fluoride COMMENT: samples contain drilling mud after purged 40 L

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	DATE / TIME	PURPOSE OF CHANGE / REMARKS
Lisseth Benavente		1-Nov-11	

TEMP @ Maxxam Receipt: 2, 2, 1
INTEGRITY Init:
Yes [✓ No]

2011 NOV 2 PM 1:44

Your P.O. #: 11-191
Your Project #: 11-1152-0116.1006
Site Location: LABRADOR CITY
Your C.O.C. #: N/A

Attention: Phyllis McCrindle
Golder Associates
8 Elm Street
Apartment #3
Labrador City, NL
CANADA A2V 1Y3

Report Date: 2011/11/24

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1H9201
Received: 2011/11/15, 9:09

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Carbonate, Bicarbonate and Hydroxide	2	N/A	2011/11/21	CAM SOP-00102	APHA 4500-CO2 D
Alkalinity	2	N/A	2011/11/23	ATL SOP 00013	Based on EPA310.2
Anions (1)	2	N/A	2011/11/23	CAM SOP-00435	SM 4110B
Chloride	2	N/A	2011/11/23	ATL SOP 00014	Based on SM4500-Cl-
Colour	2	N/A	2011/11/23	ATL SOP 00020	Based on SM2120C
Conductance - water	2	N/A	2011/11/21	ATL SOP 00004/00006	Based on SM2510B
Fluoride	2	N/A	2011/11/15	ATL SOP 00043	Based on SM4500F-C
Hardness (calculated as CaCO3)	2	N/A	2011/11/21	ATL SOP 00048	Based on SM2340B
Mercury - Total (CVAA,LL)	2	2011/11/16	2011/11/17	ATL SOP 00026	Based on EPA245.1
Metals Water Total MS	2	2011/11/16	2011/11/16	ATL SOP 00059	Based on EPA6020A
Ion Balance (% Difference)	2	N/A	2011/11/24		
Anion and Cation Sum	2	N/A	2011/11/21		
Nitrogen Ammonia - water	2	N/A	2011/11/19	ATL SOP 00015	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	2	N/A	2011/11/23	ATL SOP 00016	Based on USGS - Enz.
Nitrogen - Nitrite	2	N/A	2011/11/24	ATL SOP 00017	Based on SM4500-NO2B
Nitrogen - Nitrate (as N)	2	N/A	2011/11/24	ATL SOP 00018	Based on ASTMD3867
pH	2	N/A	2011/11/21	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho	2	N/A	2011/11/23	ATL SOP 00021	Based on USEPA 365.1
Sat. pH and Langelier Index (@ 20C)	2	N/A	2011/11/24		
Sat. pH and Langelier Index (@ 4C)	2	N/A	2011/11/24		
Reactive Silica	2	N/A	2011/11/23	ATL SOP 00022	Based on EPA 366.0
Sulphate	2	N/A	2011/11/23	ATL SOP 00023	Based on EPA 375.4
Total Dissolved Solids (TDS calc)	2	N/A	2011/11/24		
Organic carbon - Total (TOC)	2	N/A	2011/11/23	ATL SOP 00037	Based on SM5310C
Total Suspended Solids	2	N/A	2011/11/16	ATL SOP 00007	based on EPA 160.2
Turbidity	2	N/A	2011/11/22	ATL SOP 00011	based on EPA 180.1

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

../2

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARI KENNY, Project Manager
Email: MKenny@maxxam.ca
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

RESULTS OF ANALYSES OF WATER

Maxxam ID				LP8638		LP8737		
Sampling Date				2011/11/08		2011/11/08		
	Units	**Criteria A**	**Criteria C**	**W3-11-71(P-49)-DEEP**	**RDL**	**W3-11-76(P-16)-DEEP**	**RDL**	**QC Batch**
Calculated Parameters								
Anion Sum	me/L			0.870	N/A	1.20	N/A	2682057
Bicarb. Alkalinity (calc. as CaCO3)	mg/L			43	1	60	1	2682054
Calculated TDS	mg/L		500	50	1	64	1	2682060
Carb. Alkalinity (calc. as CaCO3)	mg/L			ND	1	ND	1	2682054
Cation Sum	me/L			0.920	N/A	1.27	N/A	2682057
Hardness (CaCO3)	mg/L			41	1	59	1	2682055
Ion Balance (% Difference)	%			2.79	N/A	2.83	N/A	2682056
Langelier Index (@ 20C)	N/A			-0.816		-0.453		2682058
Langelier Index (@ 4C)	N/A			-1.07		-0.704		2682059
Nitrate (N)	mg/L	**10**		ND	0.05	ND	0.05	2682089
Saturation pH (@ 20C)	N/A			8.61		8.46		2682058
Saturation pH (@ 4C)	N/A			8.86		8.71		2682059

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

C= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. If a concentration is well above an AO, then there is a possibility of a health hazard.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

RESULTS OF ANALYSES OF WATER

Maxxam ID				LP8638		LP8737		
Sampling Date				2011/11/08		2011/11/08		
	Units	**Criteria A**	**Criteria C**	**W3-11-71(P-49)-DEEP**	**RDL**	**W3-11-76(P-16)-DEEP**	**RDL**	**QC Batch**
Inorganics								
Total Alkalinity (Total as CaCO3)	mg/L			43	5	60	5	2689371
Dissolved Chloride (Cl)	mg/L		250	ND	1	ND	1	2689374
Colour	TCU		15	ND	5	ND	5	2689377
Dissolved Fluoride (F-)	mg/L	**1.5**		ND	0.1	ND	0.1	2682452
Nitrate + Nitrite	mg/L			ND	0.05	ND	0.05	2689379
Nitrite (N)	mg/L	**1**		ND	0.01	ND	0.01	2689380
Nitrogen (Ammonia Nitrogen)	mg/L			ND	0.05	ND	0.05	2686586
Total Organic Carbon (C)	mg/L			0.8	0.5	0.7	0.5	2690917
Orthophosphate (P)	mg/L			ND	0.01	ND	0.01	2689378
pH	pH		6.5 : 8.5	7.79	N/A	8.01	N/A	2688035
Reactive Silica (SiO2)	mg/L			7.1	0.5	6.1	0.5	2689376
Total Suspended Solids	mg/L			21	5	8	2	2682564
Dissolved Sulphate (SO4)	mg/L		500	ND	2	ND	2	2689375
Turbidity	NTU	**0.3**		**4.2**	0.1	**0.5**	0.1	2689588
Conductivity	uS/cm			80	1	110	1	2688041
Dissolved Bromide (Br-)	mg/L			ND	1	ND	1	2685164

N/A = Not Applicable
ND = Not detected
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Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

MERCURY BY COLD VAPOUR AA (WATER)

Maxxam ID			LP8638	LP8737		
Sampling Date			2011/11/08	2011/11/08		
	Units	**Criteria A**	**W3-11-71(P-49)-DEEP**	**W3-11-76(P-16)-DEEP**	**RDL**	**QC Batch**
Metals						
Total Mercury (Hg)	ug/L	**1**	ND	ND	0.013	2684946

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ELEMENTS BY ICP/MS (WATER)

Maxxam ID				LP8638	LP8638	LP8737		
Sampling Date				2011/11/08	2011/11/08	2011/11/08		
	Units	**Criteria A**	**Criteria C**	**W3-11-71(P-49)-DEEP**	**W3-11-71(P-49)-DEEP Lab-Dup**	**W3-11-76(P-16)-DEEP**	**RDL**	**QC Batch**
Metals								
Total Aluminum (Al)	ug/L		100	15.8	12.9	12.4	5.0	2683958
Total Antimony (Sb)	ug/L	**6**		ND	ND	ND	1.0	2683958
Total Arsenic (As)	ug/L	**10**		ND	ND	ND	1.0	2683958
Total Barium (Ba)	ug/L	**1000**		26.8	25.8	72.9	1.0	2683958
Total Beryllium (Be)	ug/L			ND	ND	ND	1.0	2683958
Total Bismuth (Bi)	ug/L			ND	ND	ND	2.0	2683958
Total Boron (B)	ug/L	**5000**		66	ND	ND	50	2683958
Total Cadmium (Cd)	ug/L	**5**		ND	ND	ND	0.017	2683958
Total Calcium (Ca)	ug/L			11700	11900	12100	100	2683958
Total Chromium (Cr)	ug/L	**50**		ND	ND	ND	1.0	2683958
Total Cobalt (Co)	ug/L			6.51	6.22	10.1	0.40	2683958
Total Copper (Cu)	ug/L		1000	ND	ND	ND	2.0	2683958
Total Iron (Fe)	ug/L		300	ND	ND	ND	50	2683958
Total Lead (Pb)	ug/L	**10**		ND	ND	ND	0.50	2683958
Total Magnesium (Mg)	ug/L			2810	2730	7090	100	2683958
Total Manganese (Mn)	ug/L		50	115	112	130	2.0	2683958
Total Molybdenum (Mo)	ug/L			ND	ND	ND	2.0	2683958
Total Nickel (Ni)	ug/L			ND	ND	2.1	2.0	2683958
Total Phosphorus (P)	ug/L			ND	ND	ND	100	2683958
Total Potassium (K)	ug/L			762	701	958	100	2683958

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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ELEMENTS BY ICP/MS (WATER)

Maxxam ID				LP8638	LP8638	LP8737		
Sampling Date				2011/11/08	2011/11/08	2011/11/08		
	Units	**Criteria A**	**Criteria C**	**W3-11-71(P-49)-DEEP**	**W3-11-71(P-49)-DEEP Lab-Dup**	**W3-11-76(P-16)-DEEP**	**RDL**	**QC Batch**
Total Selenium (Se)	ug/L	**10**		ND	ND	ND	1.0	2683958
Total Silver (Ag)	ug/L			ND	ND	ND	0.10	2683958
Total Sodium (Na)	ug/L		200000	1910	1850	1340	100	2683958
Total Strontium (Sr)	ug/L			21.3	20.4	22.7	2.0	2683958
Total Thallium (Tl)	ug/L			ND	ND	ND	0.10	2683958
Total Tin (Sn)	ug/L			ND	ND	ND	2.0	2683958
Total Titanium (Ti)	ug/L			ND	ND	ND	2.0	2683958
Total Uranium (U)	ug/L	**20**		ND	ND	ND	0.10	2683958
Total Vanadium (V)	ug/L			ND	ND	ND	2.0	2683958
Total Zinc (Zn)	ug/L		5000	23.8	21.7	34.8	5.0	2683958

ND = Not detected
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QC Batch = Quality Control Batch
Criteria A, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Package 1	7.0°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Maxxam Job #: B1H9201
Report Date: 2011/11/24

Golder Associates
Client Project #: 11-1152-0116.1006
Site Location: LABRADOR CITY
Your P.O. #: 11-191

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2682452	Dissolved Fluoride (F-)	2011/11/15	102	80 - 120	101	80 - 120	ND, RDL=0.1	mg/L	NC	25	100	80 - 120
2682564	Total Suspended Solids	2011/11/16					ND, RDL=1	mg/L	NC	25	98	80 - 120
2683958	Total Aluminum (Al)	2011/11/16	99	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L	NC	25		
2683958	Total Antimony (Sb)	2011/11/16	109	80 - 120	108	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2683958	Total Arsenic (As)	2011/11/16	103	80 - 120	103	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2683958	Total Barium (Ba)	2011/11/16	NC	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L	3.6	25		
2683958	Total Beryllium (Be)	2011/11/16	101	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2683958	Total Bismuth (Bi)	2011/11/16	101	80 - 120	102	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Boron (B)	2011/11/16	103	80 - 120	102	80 - 120	ND, RDL=50	ug/L	NC	25		
2683958	Total Cadmium (Cd)	2011/11/16	105	80 - 120	105	80 - 120	ND, RDL=0.017	ug/L	NC	25		
2683958	Total Calcium (Ca)	2011/11/16	96	80 - 120	101	80 - 120	ND, RDL=100	ug/L	1.7	25		
2683958	Total Chromium (Cr)	2011/11/16	101	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2683958	Total Cobalt (Co)	2011/11/16	102	80 - 120	104	80 - 120	ND, RDL=0.40	ug/L	4.6	25		
2683958	Total Copper (Cu)	2011/11/16	101	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Iron (Fe)	2011/11/16	104	80 - 120	105	80 - 120	ND, RDL=50	ug/L	NC	25		
2683958	Total Lead (Pb)	2011/11/16	102	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L	NC	25		
2683958	Total Magnesium (Mg)	2011/11/16	NC	80 - 120	104	80 - 120	ND, RDL=100	ug/L	3.1	25		
2683958	Total Manganese (Mn)	2011/11/16	NC	80 - 120	100	80 - 120	ND, RDL=2.0	ug/L	3.1	25		
2683958	Total Molybdenum (Mo)	2011/11/16	106	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Nickel (Ni)	2011/11/16	103	80 - 120	104	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Phosphorus (P)	2011/11/16	108	80 - 120	109	80 - 120	ND, RDL=100	ug/L	NC	25		
2683958	Total Potassium (K)	2011/11/16	100	80 - 120	103	80 - 120	ND, RDL=100	ug/L	8.3	25		
2683958	Total Selenium (Se)	2011/11/16	101	80 - 120	102	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2683958	Total Silver (Ag)	2011/11/16	104	80 - 120	103	80 - 120	ND, RDL=0.10	ug/L	NC	25		
2683958	Total Sodium (Na)	2011/11/16	95	80 - 120	96	80 - 120	ND, RDL=100	ug/L	2.9	25		
2683958	Total Strontium (Sr)	2011/11/16	103	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L	4.0	25		
2683958	Total Thallium (Tl)	2011/11/16	102	80 - 120	103	80 - 120	ND, RDL=0.10	ug/L	NC	25		
2683958	Total Tin (Sn)	2011/11/16	104	80 - 120	104	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Titanium (Ti)	2011/11/16	104	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Uranium (U)	2011/11/16	109	80 - 120	109	80 - 120	ND, RDL=0.10	ug/L	NC	25		
2683958	Total Vanadium (V)	2011/11/16	102	80 - 120	102	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2683958	Total Zinc (Zn)	2011/11/16	100	80 - 120	102	80 - 120	ND, RDL=5.0	ug/L	NC	25		
2684946	Total Mercury (Hg)	2011/11/17	82	80 - 120	89	80 - 120	ND, RDL=0.013	ug/L	NC	25	87	80 - 120
2685164	Dissolved Bromide (Br-)	2011/11/23	101	80 - 120	104	80 - 120	ND, RDL=1	mg/L	NC	20		
2686586	Nitrogen (Ammonia Nitrogen)	2011/11/19	101	80 - 120	92	80 - 120	ND, RDL=0.05	mg/L	NC	25	104	80 - 120
2688035	pH	2011/11/21							1.2	25	102	80 - 120
2688041	Conductivity	2011/11/21			100	80 - 120	ND, RDL=1	uS/cm	0.4	25		
2689371	Total Alkalinity (Total as CaCO3)	2011/11/23	NC	80 - 120	114	80 - 120	ND, RDL=5	mg/L	1.4	25	107	80 - 120
2689374	Dissolved Chloride (Cl)	2011/11/23	98	80 - 120	102	80 - 120	ND, RDL=1	mg/L	2.1	25	101	80 - 120

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2689375	Dissolved Sulphate (SO4)	2011/11/23	NC	80 - 120	100	80 - 120	ND, RDL=2	mg/L	3.5	25	96	80 - 120
2689376	Reactive Silica (SiO2)	2011/11/23	NC	80 - 120	105	80 - 120	ND, RDL=0.5	mg/L	2.6	25	99	75 - 125
2689377	Colour	2011/11/23					ND, RDL=5	TCU	NC	25	108	80 - 120
2689378	Orthophosphate (P)	2011/11/23	95	80 - 120	101	80 - 120	ND, RDL=0.01	mg/L	NC	25	99	80 - 120
2689379	Nitrate + Nitrite	2011/11/23	100	80 - 120	102	80 - 120	ND, RDL=0.05	mg/L	NC	25	106	80 - 120
2689380	Nitrite (N)	2011/11/24	96	80 - 120	110	80 - 120	ND, RDL=0.01	mg/L	NC	25	103	80 - 120
2689588	Turbidity	2011/11/22					ND, RDL=0.1	NTU	NC	25	102	80 - 120
2690917	Total Organic Carbon (C)	2011/11/23	98	80 - 120	105	80 - 120	ND, RDL=0.5	mg/L	NC	25	99	80 - 120

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B1H9201

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

BRAD NEWMAN, Scientific Specialist

C Acker

COLLEEN ACKER

Kevin A. MacDonald

KEVIN MACDONALD, Inorganics Supervisor

===

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Chain of Custody Record
Use yyyy/mm/dd clients initials

INVOICE INFORMATION:
Company Name: Golder Associates
Contact Name: Nathalie Germain
Address: 690 Boul. Laure, Suite 112
Sept-Iles, Quebec G4R4N8
Email: ngermain@golder.com
Ph: 418 968-6111 Fax: (418) 968-6107

REPORT INFORMATION (if differs from invoice):
Company Name: Golder Associates
Contact Name: Phyllis McCrindle
Address: 2390 Argentia Road, Mississauga, On, L5N 5Z7
Email: phyllis_mccrindle@golder.ca
Ph: 1 (905) 567 6100 Ext. 1323 Fax:

PO#: 11-191
Project #: 11-1152-0116 phase 1006
Proj. Name: Wabush 3 Hydrogeo Ass.
Location: Labrador City
Quotation #:
Submitted By: Lisseth Benavente
Site Task #

MAXXAM JOB NUMBER: B1H9201
ENTERED BY, Init: TS
Client Code: 17441

Specify Guideline Requirements;
Nitric acid added to 50 ml bottles, potassium dichromate to 100 ml amber bottles

* Specify Matrix; Surface/Salt/Ground/Tapwater/Sewage/Effluent/Seawater Potable/NonPotable/Tissue/Soil/Sludge/Metal

DUE DATE:
STANDARD: ☒
RUSH Due Date:
For extra cost rush,specify Due Date. Rush analysis must be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

Sample Identification	Matrix *	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAp-30 Choose total or Diss Metals	RCAp-MS Choose total or Diss Metals	Metals Water		Mercury	Metals Soil					TPH MUST (BTEX, C6-C32)	Soil(Potable),TPH MUST,NS Fuel Oil Spill Policy Low Level BTEX & C6-C32	NB Potable Water BTEX, VPH, Low Level TEH	TPH Fractionation	PAH's	PCB's	VOC's EPA 624,8260	Other Analysis or Comments/Hazards
								Total Digest (Default Method)	Dissolved	Mercury is not included in soil or water metals scan	Available Metals Digest Default Method (HNO3/H2O2)	Total Digest - for sediments (HNO3/HF/HCLO4)	Tin (required for CCME soils)	Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Hot Water soluble Boron (required for CCME Agricultural)								
W3-11-71 (P-49) - deep	groundwater	8-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																TSS, Mercury, Bromide, Fluoride COMMENT: samples contain drilling mud after purged 469 L
W3-11-76 (P-16) - deep	groundwater	9-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																TSS, Mercury, Bromide, Fluoride COMMENT: samples contain drilling mud after purged 420 L

SHIPPED FROM
14-11-2011
MAXXAM NL

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	DATE / TIME	PURPOSE OF CHANGE / REMARKS
Lisseth Benavente		10-Nov-11	
		2011/11/14 9:10 AM	

TEMP @ Maxxam Receipt 7,6,5
INTEGRITY Init:
Yes [✓ No]

2011 NOV 15 AM

Your P.O. #: 11-193
Your Project #: 11-1152-0116 PHASE 1006
Site Location: WABUSH 3 HYDROGEO ASS. LABRADOR CITY
Your C.O.C. #: N/A

Attention: Phyllis McCrindle
Golder Associates
8 Elm Street
Apartment #3
Labrador City, NL
CANADA A2V 1Y3

Report Date: 2011/11/23

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1I0091
Received: 2011/11/16, 10:01

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Carbonate, Bicarbonate and Hydroxide	4	N/A	2011/11/22	CAM SOP-00102	APHA 4500-CO2 D
Alkalinity	1	N/A	2011/11/21	ATL SOP 00013	Based on EPA310.2
Alkalinity	3	N/A	2011/11/22	ATL SOP 00013	Based on EPA310.2
Anions (1)	4	N/A	2011/11/22	CAM SOP-00435	SM 4110B
Chloride	4	N/A	2011/11/22	ATL SOP 00014	Based on SM4500-Cl-
Colour	4	N/A	2011/11/21	ATL SOP 00020	Based on SM2120C
Conductance - water	4	N/A	2011/11/22	ATL SOP 00004/00006	Based on SM2510B
Fluoride	4	N/A	2011/11/22	ATL SOP 00043	Based on SM4500F-C
Hardness (calculated as CaCO3)	4	N/A	2011/11/21	ATL SOP 00048	Based on SM2340B
Mercury - Total (CVAA,LL)	4	2011/11/16	2011/11/17	ATL SOP 00026	Based on EPA245.1
Metals Water Total MS	4	2011/11/17	2011/11/17	ATL SOP 00059	Based on EPA6020A
Ion Balance (% Difference)	4	N/A	2011/11/22		
Anion and Cation Sum	4	N/A	2011/11/22		
Nitrogen Ammonia - water	4	N/A	2011/11/18	ATL SOP 00015	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	4	N/A	2011/11/22	ATL SOP 00016	Based on USGS - Enz.
Nitrogen - Nitrite	4	N/A	2011/11/21	ATL SOP 00017	Based on SM4500-NO2B
Nitrogen - Nitrate (as N)	4	N/A	2011/11/22	ATL SOP 00018	Based on ASTMD3867
pH	4	N/A	2011/11/22	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho	4	N/A	2011/11/22	ATL SOP 00021	Based on USEPA 365.1
Sat. pH and Langelier Index (@ 20C)	4	N/A	2011/11/22		
Sat. pH and Langelier Index (@ 4C)	4	N/A	2011/11/22		
Reactive Silica	4	N/A	2011/11/22	ATL SOP 00022	Based on EPA 366.0
Sulphate	4	N/A	2011/11/21	ATL SOP 00023	Based on EPA 375.4
Total Dissolved Solids (TDS calc)	4	N/A	2011/11/22		
Organic carbon - Total (TOC)	4	N/A	2011/11/23	ATL SOP 00037	Based on SM5310C
Total Suspended Solids	4	N/A	2011/11/17	ATL SOP 00007	based on EPA 160.2
Turbidity	4	N/A	2011/11/21	ATL SOP 00011	based on EPA 180.1

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

../2

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARI KENNY, Project Manager
Email: MKenny@maxxam.ca
Phone# (902) 420-0203

==

Total cover pages: 2

Maxxam Job #: B1I0091
Report Date: 2011/11/23

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: WABUSH 3 HYDROGEO ASS. LABRADOR CITY
Your P.O. #: 11-193

RESULTS OF ANALYSES OF WATER

Maxxam ID				LQ3074		LQ3112		LQ3113		
Sampling Date				2011/11/10		2011/11/10		2011/11/10		
	Units	**Criteria A**	**Criteria C**	**W3-11-53(P-03)-DEEP**	**RDL**	**W3-11-53(P-03)-MIDDLE**	**RDL**	**DUP1**	**RDL**	**QC Batch**
Calculated Parameters										
Anion Sum	me/L			1.32	N/A	0.970	N/A	1.32	N/A	2683612
Bicarb. Alkalinity (calc. as CaCO3)	mg/L			65	1	48	1	65	1	2683609
Calculated TDS	mg/L		500	70	1	54	1	71	1	2683617
Carb. Alkalinity (calc. as CaCO3)	mg/L			ND	1	ND	1	ND	1	2683609
Cation Sum	me/L			1.35	N/A	0.960	N/A	1.37	N/A	2683612
Hardness (CaCO3)	mg/L			64	1	31	1	65	1	2683610
Ion Balance (% Difference)	%			1.12	N/A	0.520	N/A	1.86	N/A	2683611
Langelier Index (@ 20C)	N/A			-0.470		-0.999		-0.475		2683615
Langelier Index (@ 4C)	N/A			-0.721		-1.25		-0.727		2683616
Nitrate (N)	mg/L	**10**		0.12	0.05	ND	0.05	0.13	0.05	2683604
Saturation pH (@ 20C)	N/A			8.32		8.73		8.32		2683615
Saturation pH (@ 4C)	N/A			8.57		8.98		8.57		2683616

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

C= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. If a concentration is well above an AO, then there is a possibility of a health hazard.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

RESULTS OF ANALYSES OF WATER

Maxxam ID				LQ3074		LQ3112		LQ3113		
Sampling Date				2011/11/10		2011/11/10		2011/11/10		
	Units	**Criteria A**	**Criteria C**	**W3-11-53(P-03)-DEEP**	**RDL**	**W3-11-53(P-03)-MIDDLE**	**RDL**	**DUP1**	**RDL**	**QC Batch**
Inorganics										
Total Alkalinity (Total as CaCO3)	mg/L			65	5	48	5	65	5	2686983
Dissolved Chloride (Cl)	mg/L		250	ND	1	ND	1	ND	1	2686988
Colour	TCU		15	ND	5	ND	5	ND	5	2686992
Dissolved Fluoride (F-)	mg/L	**1.5**		ND	0.1	ND	0.1	ND	0.1	2689825
Nitrate + Nitrite	mg/L			0.12	0.05	ND	0.05	0.13	0.05	2686994
Nitrite (N)	mg/L	**1**		ND	0.01	ND	0.01	ND	0.01	2686995
Nitrogen (Ammonia Nitrogen)	mg/L			ND	0.05	ND	0.05	ND	0.05	2686581
Total Organic Carbon (C)	mg/L			2.8	0.5	5.1	0.5	3.2	0.5	2690917
Orthophosphate (P)	mg/L			ND	0.01	ND	0.01	ND	0.01	2686993
pH	pH		6.5 : 8.5	7.85	N/A	7.73	N/A	7.84	N/A	2689341
Reactive Silica (SiO2)	mg/L			6.9	0.5	5.6	0.5	6.9	0.5	2686991
Total Suspended Solids	mg/L			4	2	43	5	5	2	2684818
Dissolved Sulphate (SO4)	mg/L		500	ND	2	ND	2	ND	2	2686990
Turbidity	NTU	**0.3**		**2.6**	0.1	**13**	0.1	**2.6**	0.1	2688442
Conductivity	uS/cm			110	1	84	1	110	1	2689343
Dissolved Bromide (Br-)	mg/L			ND	1	ND	1	ND	1	2686583

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

Maxxam Job #: B1I0091
Report Date: 2011/11/23

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: WABUSH 3 HYDROGEO ASS. LABRADOR CITY
Your P.O. #: 11-193

RESULTS OF ANALYSES OF WATER

Maxxam ID				LQ3114	LQ3114		
Sampling Date				2011/11/11	2011/11/11		
	Units	**Criteria A**	**Criteria C**	**W3-11-40(P-18)-DEEP**	**W3-11-40(P-18)-DEEP Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters							
Anion Sum	me/L			2.91		N/A	2683612
Bicarb. Alkalinity (calc. as CaCO3)	mg/L			135		1	2683609
Calculated TDS	mg/L		500	151		1	2683617
Carb. Alkalinity (calc. as CaCO3)	mg/L			4		1	2683609
Cation Sum	me/L			3.16		N/A	2683612
Hardness (CaCO3)	mg/L			150		1	2683610
Ion Balance (% Difference)	%			4.12		N/A	2683611
Langelier Index (@ 20C)	N/A			0.627			2683615
Langelier Index (@ 4C)	N/A			0.377			2683616
Nitrate (N)	mg/L	**10**		ND		0.05	2683604
Saturation pH (@ 20C)	N/A			7.83			2683615
Saturation pH (@ 4C)	N/A			8.08			2683616

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

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Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

Maxxam Job #: B1I0091
Report Date: 2011/11/23

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: WABUSH 3 HYDROGEO ASS. LABRADOR CITY
Your P.O. #: 11-193

RESULTS OF ANALYSES OF WATER

Maxxam ID				LQ3114	LQ3114		
Sampling Date				2011/11/11	2011/11/11		
	Units	**Criteria A**	**Criteria C**	**W3-11-40(P-18)-DEEP**	**W3-11-40(P-18)-DEEP Lab-Dup**	**RDL**	**QC Batch**
Inorganics							
Total Alkalinity (Total as CaCO3)	mg/L			140		30	2686874
Dissolved Chloride (Cl)	mg/L		250	ND		1	2686876
Colour	TCU		15	ND		5	2686880
Dissolved Fluoride (F-)	mg/L	**1.5**		ND		0.1	2689825
Nitrate + Nitrite	mg/L			ND		0.05	2686885
Nitrite (N)	mg/L	**1**		ND		0.01	2686886
Nitrogen (Ammonia Nitrogen)	mg/L			ND	ND	0.05	2686581
Total Organic Carbon (C)	mg/L			ND		5	2690917
Orthophosphate (P)	mg/L			ND		0.01	2686881
pH	pH		6.5 : 8.5	8.46	8.36	N/A	2689341
Reactive Silica (SiO2)	mg/L			10		0.5	2686879
Total Suspended Solids	mg/L			260		10	2684818
Dissolved Sulphate (SO4)	mg/L		500	7		2	2686877
Turbidity	NTU	**0.3**		**81**		0.5	2688442
Conductivity	uS/cm			260	260	1	2689343
Dissolved Bromide (Br-)	mg/L			ND		1	2686583

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: WABUSH 3 HYDROGEO ASS. LABRADOR CITY
Your P.O. #: 11-193

Maxxam Job #: B1I0091
Report Date: 2011/11/23

MERCURY BY COLD VAPOUR AA (WATER)

Maxxam ID			LQ3074	LQ3112	LQ3113	LQ3114		
Sampling Date			2011/11/10	2011/11/10	2011/11/10	2011/11/11		
	Units	**Criteria A**	**W3-11-53(P-03)-DEEP**	**W3-11-53(P-03)-MIDDLE**	**DUP1**	**W3-11-40(P-18)-DEEP**	**RDL**	**QC Batch**
Metals								
Total Mercury (Hg)	ug/L	**1**	ND	ND	ND	ND	0.013	2684946

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

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Maxxam Job #: B1I0091
Report Date: 2011/11/23

Golder Associates
Client Project #: 11-1152-0116 PHASE 1006
Site Location: WABUSH 3 HYDROGEO ASS. LABRADOR CITY
Your P.O. #: 11-193

ELEMENTS BY ICP/MS (WATER)

Maxxam ID				LQ3074	LQ3112	LQ3113	LQ3114		
Sampling Date				2011/11/10	2011/11/10	2011/11/10	2011/11/11		
	Units	**Criteria A**	**Criteria C**	**W3-11-53(P-03)-DEEP**	**W3-11-53(P-03)-MIDDLE**	**DUP1**	**W3-11-40(P-18)-DEEP**	**RDL**	**QC Batch**
Metals									
Total Aluminum (Al)	ug/L		100	8.4	24.5	12.1	141	5.0	2685172
Total Antimony (Sb)	ug/L	**6**		1.2	1.7	1.5	ND	1.0	2685172
Total Arsenic (As)	ug/L	**10**		ND	ND	ND	ND	1.0	2685172
Total Barium (Ba)	ug/L	**1000**		2.9	8.6	2.6	34.1	1.0	2685172
Total Beryllium (Be)	ug/L			ND	ND	ND	ND	1.0	2685172
Total Bismuth (Bi)	ug/L			ND	ND	ND	ND	2.0	2685172
Total Boron (B)	ug/L	**5000**		ND	ND	ND	ND	50	2685172
Total Cadmium (Cd)	ug/L	**5**		ND	ND	ND	0.057	0.017	2685172
Total Calcium (Ca)	ug/L			15500	7950	15700	25400	100	2685172
Total Chromium (Cr)	ug/L	**50**		ND	1.2	ND	ND	1.0	2685172
Total Cobalt (Co)	ug/L			19.3	12.5	12.0	6.56	0.40	2685172
Total Copper (Cu)	ug/L		1000	ND	ND	ND	ND	2.0	2685172
Total Iron (Fe)	ug/L		300	ND	ND	59	97	50	2685172
Total Lead (Pb)	ug/L	**10**		ND	ND	ND	ND	0.50	2685172
Total Magnesium (Mg)	ug/L			6190	2660	6270	21100	100	2685172
Total Manganese (Mn)	ug/L		50	305	824	306	87.2	2.0	2685172
Total Molybdenum (Mo)	ug/L			ND	ND	ND	ND	2.0	2685172
Total Nickel (Ni)	ug/L			2.7	3.3	ND	ND	2.0	2685172
Total Phosphorus (P)	ug/L			ND	ND	ND	ND	100	2685172
Total Potassium (K)	ug/L			784	452	803	2420	100	2685172
Total Selenium (Se)	ug/L	**10**		ND	ND	ND	ND	1.0	2685172

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

C= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. If a concentration is well above an AO, then there is a possibility of a health hazard.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ELEMENTS BY ICP/MS (WATER)

Maxxam ID				LQ3074	LQ3112	LQ3113	LQ3114		
Sampling Date				2011/11/10	2011/11/10	2011/11/10	2011/11/11		
	Units	**Criteria A**	**Criteria C**	**W3-11-53(P-03)-DEEP**	**W3-11-53(P-03)-MIDDLE**	**DUP1**	**W3-11-40(P-18)-DEEP**	**RDL**	**QC Batch**
Total Silver (Ag)	ug/L			ND	ND	ND	ND	0.10	2685172
Total Sodium (Na)	ug/L		200000	984	7660	1010	2010	100	2685172
Total Strontium (Sr)	ug/L			15.8	33.4	15.9	53.1	2.0	2685172
Total Thallium (Tl)	ug/L			ND	ND	ND	ND	0.10	2685172
Total Tin (Sn)	ug/L			ND	ND	ND	ND	2.0	2685172
Total Titanium (Ti)	ug/L			ND	ND	ND	ND	2.0	2685172
Total Uranium (U)	ug/L	**20**		ND	ND	ND	0.25	0.10	2685172
Total Vanadium (V)	ug/L			ND	ND	ND	ND	2.0	2685172
Total Zinc (Zn)	ug/L		5000	46.7	31.3	32.5	33.5	5.0	2685172

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria A, Criteria B, Criteria C: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Dec. 2010.

A= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health. When exceeded, minimum action required is immediate resampling. If continuous exceedance occurs, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

C= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water. If a concentration is well above an AO, then there is a possibility of a health hazard.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

Package 1	8.0°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Sample LQ3114-01: TOC: Elevated detection limit due to sample turbidity.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2684818	Total Suspended Solids	2011/11/17					ND, RDL=1	mg/L	NC	25	97	80 - 120
2684946	Total Mercury (Hg)	2011/11/17	82	80 - 120	89	80 - 120	ND, RDL=0.013	ug/L	NC	25	87	80 - 120
2685172	Total Aluminum (Al)	2011/11/17	105	80 - 120	109	80 - 120	ND, RDL=5.0	ug/L				
2685172	Total Antimony (Sb)	2011/11/17	114	80 - 120	113	80 - 120	ND, RDL=1.0	ug/L				
2685172	Total Arsenic (As)	2011/11/17	104	80 - 120	104	80 - 120	ND, RDL=1.0	ug/L	NC	25		
2685172	Total Barium (Ba)	2011/11/17	103	80 - 120	104	80 - 120	ND, RDL=1.0	ug/L				
2685172	Total Beryllium (Be)	2011/11/17	107	80 - 120	108	80 - 120	ND, RDL=1.0	ug/L				
2685172	Total Bismuth (Bi)	2011/11/17	105	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Boron (B)	2011/11/17	106	80 - 120	109	80 - 120	ND, RDL=50	ug/L				
2685172	Total Cadmium (Cd)	2011/11/17	104	80 - 120	102	80 - 120	ND, RDL=0.017	ug/L				
2685172	Total Calcium (Ca)	2011/11/17	102	80 - 120	103	80 - 120	ND, RDL=100	ug/L				
2685172	Total Chromium (Cr)	2011/11/17	95	80 - 120	103	80 - 120	ND, RDL=1.0	ug/L				
2685172	Total Cobalt (Co)	2011/11/17	103	80 - 120	104	80 - 120	ND, RDL=0.40	ug/L				
2685172	Total Copper (Cu)	2011/11/17	NC	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Iron (Fe)	2011/11/17	104	80 - 120	107	80 - 120	ND, RDL=50	ug/L				
2685172	Total Lead (Pb)	2011/11/17	103	80 - 120	104	80 - 120	ND, RDL=0.50	ug/L				
2685172	Total Magnesium (Mg)	2011/11/17	107	80 - 120	111	80 - 120	ND, RDL=100	ug/L				
2685172	Total Manganese (Mn)	2011/11/17	103	80 - 120	105	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Molybdenum (Mo)	2011/11/17	109	80 - 120	107	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Nickel (Ni)	2011/11/17	102	80 - 120	104	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Phosphorus (P)	2011/11/17	109	80 - 120	109	80 - 120	ND, RDL=100	ug/L				
2685172	Total Potassium (K)	2011/11/17	107	80 - 120	107	80 - 120	ND, RDL=100	ug/L				
2685172	Total Selenium (Se)	2011/11/17	105	80 - 120	105	80 - 120	ND, RDL=1.0	ug/L				
2685172	Total Silver (Ag)	2011/11/17	104	80 - 120	106	80 - 120	ND, RDL=0.10	ug/L				
2685172	Total Sodium (Na)	2011/11/17	100	80 - 120	104	80 - 120	ND, RDL=100	ug/L				
2685172	Total Strontium (Sr)	2011/11/17	105	80 - 120	103	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Thallium (Tl)	2011/11/17	104	80 - 120	105	80 - 120	ND, RDL=0.10	ug/L				
2685172	Total Tin (Sn)	2011/11/17	106	80 - 120	107	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Titanium (Ti)	2011/11/17	108	80 - 120	108	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Uranium (U)	2011/11/17	114	80 - 120	113	80 - 120	ND, RDL=0.10	ug/L				
2685172	Total Vanadium (V)	2011/11/17	103	80 - 120	104	80 - 120	ND, RDL=2.0	ug/L				
2685172	Total Zinc (Zn)	2011/11/17	103	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
2686581	Nitrogen (Ammonia Nitrogen)	2011/11/19	90	80 - 120	98	80 - 120	ND, RDL=0.05	mg/L	NC	25	112	80 - 120
2686583	Dissolved Bromide (Br-)	2011/11/22	104	80 - 120	94	80 - 120	ND, RDL=1	mg/L	NC	20		
2686874	Total Alkalinity (Total as CaCO3)	2011/11/21	NC	80 - 120	109	80 - 120	ND, RDL=5	mg/L	0.9	25	106	80 - 120
2686876	Dissolved Chloride (Cl)	2011/11/22	94	80 - 120	96	80 - 120	ND, RDL=1	mg/L	1.7	25	96	80 - 120
2686877	Dissolved Sulphate (SO4)	2011/11/21	105	80 - 120	102	80 - 120	ND, RDL=2	mg/L	NC	25	100	80 - 120
2686879	Reactive Silica (SiO2)	2011/11/22	NC	80 - 120	108	80 - 120	ND, RDL=0.5	mg/L	0.4	25	99	75 - 125
2686880	Colour	2011/11/21					ND, RDL=5	TCU	NC	25	105	80 - 120

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2686881	Orthophosphate (P)	2011/11/22	97	80 - 120	104	80 - 120	ND, RDL=0.01	mg/L	NC	25	100	80 - 120
2686885	Nitrate + Nitrite	2011/11/22	NC	80 - 120	107	80 - 120	ND, RDL=0.05	mg/L	2.0	25	105	80 - 120
2686886	Nitrite (N)	2011/11/21	101	80 - 120	82	80 - 120	ND, RDL=0.01	mg/L	NC	25	89	80 - 120
2686983	Total Alkalinity (Total as CaCO3)	2011/11/21	NC	80 - 120	107	80 - 120	ND, RDL=5	mg/L	2.8	25	103	80 - 120
2686988	Dissolved Chloride (Cl)	2011/11/22	NC	80 - 120	97	80 - 120	ND, RDL=1	mg/L	0.5	25	97	80 - 120
2686990	Dissolved Sulphate (SO4)	2011/11/21	NC	80 - 120	103	80 - 120	ND, RDL=2	mg/L	0.3	25	97	80 - 120
2686991	Reactive Silica (SiO2)	2011/11/22	NC	80 - 120	108	80 - 120	ND, RDL=0.5	mg/L	4.1	25	99	75 - 125
2686992	Colour	2011/11/21					ND, RDL=5	TCU	NC	25	107	80 - 120
2686993	Orthophosphate (P)	2011/11/22	100	80 - 120	104	80 - 120	ND, RDL=0.01	mg/L	NC	25	100	80 - 120
2686994	Nitrate + Nitrite	2011/11/22	104	80 - 120	106	80 - 120	ND, RDL=0.05	mg/L	NC	25	105	80 - 120
2686995	Nitrite (N)	2011/11/21	101	80 - 120	107	80 - 120	ND, RDL=0.01	mg/L	NC	25	102	80 - 120
2688442	Turbidity	2011/11/21					ND, RDL=0.1	NTU	16.9	25	98	80 - 120
2689341	pH	2011/11/22							1.2	25	102	80 - 120
2689343	Conductivity	2011/11/22			101	80 - 120	ND, RDL=1	uS/cm	0.4	25		
2689825	Dissolved Fluoride (F-)	2011/11/22	98	80 - 120	101	80 - 120	ND, RDL=0.1	mg/L	NC	25	98	80 - 120
2690917	Total Organic Carbon (C)	2011/11/23	98	80 - 120	105	80 - 120	ND, RDL=0.5	mg/L	NC	25	99	80 - 120

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B1I0091

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CAcker

COLLEEN ACKER

Eva Pr

CHARTERED
Eva Pranjic
CHEMIST

EWA PRANJIC, M.Sc., C.Chem, Scientific Specialist

Kevin A. MacDonald

KEVIN MACDONALD, Inorganics Supervisor

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics Inc

200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax902-420-8612 Toll Free 1-800-565-7227
www.maxxamanalytics.com E-mail: customerservicebedford@maxxamanalytics.com

Chain of Custody Record
Use yyyy/mm/dd clients initials

INVOICE INFORMATION:
Company Name: Golder Associates
Contact Name: Nathalie Germain
Address: 690 Boul. Laure, Suite 112
Sept-Iles, Quebec G4R4N8
Email: ngermain@golder.com
Ph: 418 968-6111 Fax: (418) 968-6107

REPORT INFORMATION (if differs from invoice):
Company Name: Golder Associates
Contact Name: Phyllis McCrindle
Address: 2390 Argentia Road, Mississauga, On, L5N 5Z7
Email: phyllis_mccrindle@golder.ca
Ph: 1 (905) 567 6100 Ext. 1323 Fax:

PO#: 11-193
Project # : 11-1152-0116 phase 1006
Proj. Name: Wabush 3 Hydrogeo Ass.
Location: Labrador City
Quotation #:
Submitted By: Lisseth Benavente
Site Task #

MAXXAM JOB NUMBER: BII0091
ENTERED BY, Init: 17441
Client Code:

Specify Guideline Requirements;

Nitric acid added to 50 ml bottles, potassium dichromate to 100 ml amber bottles

* Specify Matrix; Surface/Salt/Ground/Tapwater/Sewage/Effluent/Seawater Potable/NonPotable/Tissue/Soil/Sludge/Metal

DUE DATE:
STANDARD: ☒
RUSH Due Date:
For extra cost rush,specify Due Date. Rush analysis must be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

Sample Identification	Matrix *	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAp-30 Choose total or Diss Metals	RCAp-MS Choose total or Diss Metals	Metals Water		Mercury	Metals Soil						TPH MUST (BTEX, C6-C32)	Soil(Potable),TPH MUST,NS Fuel Oil Spill Policy Low Level BTEX & C6-C32	NB Potable Water BTEX, VPH, Low Level TEH	TPH Fractionation	PAH's	PCB's	VOC's EPA 624,8260	Other Analysis or Comments/Hazards
								Total Digest (Default Method)	Dissolved	Mercury is not included in soil or water metals scan	Available Metals Digest Default Method (HNO3/H2O2)	Total Digest - for sediments (HNO3/HF/HCLO4)	Tin (required for CCME soils)	Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Hot Water soluble Boron (required for CCME Agricultural)									
W3-11-53 (P-03) - deep	groundwater	10-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																	TSS, Mercury, Bromide, Fluoride
W3-11-53 (P-03) - middle	groundwater	10-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																	TSS, Mercury, Bromide, Fluoride
Dup 1	groundwater	10-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																	TSS, Mercury, Bromide, Fluoride
W3-11-40 (P-18) - deep	groundwater	11-Nov	2*200 ml, 1*50 ml, 1*100 ml, 1*500 ml				X																	TSS, Mercury, Bromide, Fluoride

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	DATE / TIME	PURPOSE OF CHANGE / REMARKS
Lisseth Benavente		14-Nov-11	
		20 11/15	8:45PM

TEMP @ Maxxam Receipt 8,8,8,
INTEGRITY Init: Gk
Yes [✓ No]

SHIPPED FROM
15 -11- 2011
MAXXAM NL

2011 NOV 16 AM 10:01

ATTACHMENT 2

Surface Water Quality Sampling Results

Maxxam

Success Through Science®

Your Project #: 11-1152-0116
Site Location: WABUSH
Your C.O.C. #: 28924

Attention: Melanie Kennedy
Golder Associates Ltd
Mississauga - Standing Offer
2390 Argentia Rd
Mississauga, ON
L5N 5Z7

Report Date: 2011/09/29

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1E4673
Received: 2011/09/20, 13:52

Sample Matrix: Water
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Carbonate, Bicarbonate and Hydroxide	3	N/A	2011/09/22	CAM SOP-00102	APHA 4500-CO2 D
Carbonate, Bicarbonate and Hydroxide	5	N/A	2011/09/23	CAM SOP-00102	APHA 4500-CO2 D
Alkalinity	7	N/A	2011/09/27	ATL SOP 00013 R4	Based on EPA310.2
Alkalinity	1	N/A	2011/09/28	ATL SOP 00013 R4	Based on EPA310.2
Anions (1)	8	N/A	2011/09/29	CAM SOP-00435	SM 4110B
Chloride	8	N/A	2011/09/28	ATL SOP 00014 R6	Based on SM4500-Cl-
Colour	8	N/A	2011/09/28	ATL SOP 00020 R3.	Based on SM2120C
Conductance - water	7	N/A	2011/09/21	ATL SOP 00004 R5/00006 R4	Based on SM2510B
Conductance - water	1	N/A	2011/09/22	ATL SOP 00004 R5/00006 R4	Based on SM2510B
Fluoride	8	N/A	2011/09/23	ATL SOP 00043 R3	Based on SM4500F-C
Hardness (calculated as CaCO3)	4	N/A	2011/09/22	ATL SOP 00048	Based on SM2340B
Hardness (calculated as CaCO3)	4	N/A	2011/09/23	ATL SOP 00048	Based on SM2340B
Mercury - Total (CVAA,LL)	6	2011/09/23	2011/09/26	ATL SOP 00026 R6	Based on EPA245.1
Mercury - Total (CVAA,LL)	2	2011/09/28	2011/09/29	ATL SOP 00026 R6	Based on EPA245.1
Metals Water Diss. MS	8	N/A	2011/09/21	ATL SOP 00059 R1	Based on EPA6020A
Metals Water Total MS	8	2011/09/21	2011/09/22	ATL SOP 00059 R1	Based on EPA6020A
Ion Balance (% Difference)	8	N/A	2011/09/29		
Anion and Cation Sum	8	N/A	2011/09/28		
Nitrogen Ammonia - water	8	N/A	2011/09/28	ATL SOP 00015 R5	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	8	N/A	2011/09/28	ATL SOP 00016 R4	Based on USGS - Enz.
Nitrogen - Nitrite	8	N/A	2011/09/28	ATL SOP 00017 R4	Based on SM4500-NO2B
Nitrogen - Nitrate (as N)	8	N/A	2011/09/29	ATL SOP 00018 R3	Based on ASTMD3867
pH	7	N/A	2011/09/21	ATL SOP 00003 R5/00005 R7	Based on SM4500H+B
pH	1	N/A	2011/09/22	ATL SOP 00003 R5/00005 R7	Based on SM4500H+B
Phosphorus - ortho	8	N/A	2011/09/28	ATL SOP 00021 R3	Based on USEPA 365.1
Sat. pH and Langelier Index (@ 20C)	8	N/A	2011/09/29		
Sat. pH and Langelier Index (@ 4C)	8	N/A	2011/09/29		
Reactive Silica	8	N/A	2011/09/28	ATL SOP 00022 R3	Based on EPA 366.0
Sulphate	8	N/A	2011/09/28	ATL SOP 00023 R3	Based on EPA 375.4
Total Dissolved Solids (TDS calc)	8	N/A	2011/09/29		
Organic carbon - Total (TOC)	8	N/A	2011/09/27	ATL SOP 00037 R4	Based on SM5310C
Total Suspended Solids	8	N/A	2011/09/22	ATL SOP 00007 R3	based on EPA 160.2
Turbidity	8	N/A	2011/09/27	ATL SOP 00011 R5	based on EPA 180.1

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons. The extraction date for samples field preserved with methanol for F1 and Volatile Organic Compounds is considered to be the date sampled.

Maxxam Analytics is accredited by SCC (Lab ID 97) for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARI KENNY, Project Manager
Email: MKenny@maxxam.ca
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

Maxxam Job #: B1E4673
Report Date: 2011/09/29

Golder Associates Ltd
Client Project #: 11-1152-0116
Site Location: WABUSH

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Maxxam ID		KY5294	KY5329	KY5330	KY5331		KY5332		
Sampling Date		2011/09/15	2011/09/15	2011/09/15	2011/09/15		2011/09/16		
	Units	**SW-8**	**SW-7**	**SW-10**	**SW-9**	**RDL**	**SW-6**	**RDL**	**QC Batch**
Calculated Parameters									
Anion Sum	me/L	0.710	0.830	0.600	0.880	N/A	3.42	N/A	2619995
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	33	41	30	43	1	98	1	2619992
Calculated TDS	mg/L	38	42	33	46	1	189	1	2619998
Carb. Alkalinity (calc. as CaCO3)	mg/L	<1	<1	<1	<1	1	2	1	2619992
Cation Sum	me/L	0.700	0.810	0.620	0.850	N/A	3.41	N/A	2619995
Hardness (CaCO3)	mg/L	33	39	29	41	1	140	1	2619993
Ion Balance (% Difference)	%	0.710	1.22	1.64	1.73	N/A	0.150	N/A	2619994
Langelier Index (@ 20C)	N/A	-1.12	-0.838	-1.25	-0.738		0.278		2619996
Langelier Index (@ 4C)	N/A	-1.37	-1.09	-1.50	-0.990		0.0280		2619997
Nitrate (N)	mg/L	<0.05	<0.05	<0.05	0.11	0.05	7.5	0.3	2621502
Saturation pH (@ 20C)	N/A	8.87	8.68	8.96	8.66		7.96		2619996
Saturation pH (@ 4C)	N/A	9.12	8.93	9.21	8.91		8.21		2619997
Inorganics									
Total Alkalinity (Total as CaCO3)	mg/L	33	41	30	44	5	100	5	2628103
Dissolved Chloride (Cl)	mg/L	<1	<1	<1	<1	1	23	1	2628106
Colour	TCU	12	18	12	5	5	6	5	2628110
Nitrate + Nitrite	mg/L	<0.05	<0.05	<0.05	0.11	0.05	7.6	0.3	2628112
Nitrite (N)	mg/L	<0.01	<0.01	<0.01	<0.01	0.01	0.08	0.01	2628113
Nitrogen (Ammonia Nitrogen)	mg/L	<0.05	<0.05	<0.05	<0.05	0.05	0.22	0.05	2628055
Total Organic Carbon (C)	mg/L	2.3	3.4	1.9	1.0	0.5	1.4	0.5	2628615
Orthophosphate (P)	mg/L	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	2628111
pH	pH	7.75	7.84	7.71	7.92	N/A	8.24	N/A	2621551
Reactive Silica (SiO2)	mg/L	3.6	2.6	3.9	4.6	0.5	2.7	0.5	2628109
Dissolved Sulphate (SO4)	mg/L	2	<2	<2	<2	2	11	2	2628107
Turbidity	NTU	0.3	0.3	0.9	0.2	0.1	0.3	0.1	2628065
Conductivity	uS/cm	65	78	61	82	1	330	1	2621555

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Maxxam ID		KY5294	KY5329	KY5330	KY5331		KY5332		
Sampling Date		2011/09/15	2011/09/15	2011/09/15	2011/09/15		2011/09/16		
	Units	**SW-8**	**SW-7**	**SW-10**	**SW-9**	**RDL**	**SW-6**	**RDL**	**QC Batch**
Metals									
Total Aluminum (Al)	ug/L	26.9	107	77.8	18.5	5.0	22.3	5.0	2623051
Total Antimony (Sb)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	<1.0	1.0	2623051
Total Arsenic (As)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	<1.0	1.0	2623051
Total Barium (Ba)	ug/L	7.3	9.2	7.1	5.2	1.0	8.0	1.0	2623051
Total Beryllium (Be)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	<1.0	1.0	2623051
Total Bismuth (Bi)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	2.0	2623051
Total Boron (B)	ug/L	<50	<50	<50	<50	50	<50	50	2623051
Total Cadmium (Cd)	ug/L	<0.017	<0.017	<0.017	<0.017	0.017	<0.017	0.017	2623051
Total Calcium (Ca)	ug/L	8220	10200	7270	10300	100	26800	100	2623051
Total Chromium (Cr)	ug/L	<1.0	6.6	<1.0	1.7	1.0	<1.0	1.0	2623051
Total Cobalt (Co)	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	<0.40	0.40	2623051
Total Copper (Cu)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	2.0	2623051
Total Iron (Fe)	ug/L	<50	322	192	<50	50	112	50	2623051
Total Lead (Pb)	ug/L	<0.50	<0.50	0.70	<0.50	0.50	<0.50	0.50	2623051
Total Magnesium (Mg)	ug/L	3020	4000	2820	3790	100	18000	100	2623051
Total Manganese (Mn)	ug/L	3.8	91.1	22.4	4.2	2.0	33.5	2.0	2623051
Total Molybdenum (Mo)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	2.0	2623051
Total Nickel (Ni)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	2.0	2623051
Total Phosphorus (P)	ug/L	<100	<100	<100	<100	100	<100	100	2623051
Total Potassium (K)	ug/L	741	638	793	759	100	2070	100	2623051
Total Selenium (Se)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	<1.0	1.0	2623051
Total Silver (Ag)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	0.10	2623051
Total Sodium (Na)	ug/L	517	472	767	447	100	11100	100	2623051
Total Strontium (Sr)	ug/L	9.7	9.1	10.0	10.5	2.0	28.5	2.0	2623051
Total Thallium (Tl)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	0.10	2623051
Total Tin (Sn)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	2.0	2623051
Total Titanium (Ti)	ug/L	<2.0	3.9	4.3	<2.0	2.0	<2.0	2.0	2623051
Total Uranium (U)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	0.24	0.10	2623051
Total Vanadium (V)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	2.0	2623051
Total Zinc (Zn)	ug/L	<5.0	10.0	8.1	<5.0	5.0	<5.0	5.0	2623051

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Maxxam ID		KY5333		KY5334	KY5334			KY5335		
Sampling Date		2011/09/16		2011/09/16	2011/09/16			2011/09/16		
	Units	**SW-4**	**RDL**	**SW-2**	**SW-2 Lab-Dup**	**RDL**	**QC Batch**	**DUP**	**RDL**	**QC Batch**
Calculated Parameters										
Anion Sum	me/L	4.23	N/A	0.770		N/A	2619995	3.23	N/A	2619995
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	109	1	38		1	2619992	89	1	2619992
Calculated TDS	mg/L	238	1	41		1	2619998	181	1	2619998
Carb. Alkalinity (calc. as CaCO3)	mg/L	2	1	<1		1	2619992	1	1	2619992
Cation Sum	me/L	4.21	N/A	0.720		N/A	2619995	3.23	N/A	2619995
Hardness (CaCO3)	mg/L	170	1	34		1	2619993	140	1	2619993
Ion Balance (% Difference)	%	0.240	N/A	3.36		N/A	2619994	0.00	N/A	2619994
Langelier Index (@ 20C)	N/A	0.513		-0.949			2619996	0.223		2619996
Langelier Index (@ 4C)	N/A	0.263		-1.20			2619997	-0.0270		2619997
Nitrate (N)	mg/L	11	0.3	0.14		0.05	2621502	7.4	0.3	2621502
Saturation pH (@ 20C)	N/A	7.84		8.82			2619996	8.01		2619996
Saturation pH (@ 4C)	N/A	8.09		9.07			2619997	8.26		2619997
Inorganics										
Total Alkalinity (Total as CaCO3)	mg/L	110	30	38		5	2628103	90	10	2628103
Dissolved Chloride (Cl)	mg/L	33	1	<1		1	2628106	23	1	2628106
Colour	TCU	<5	5	<5		5	2628110	5	5	2628110
Nitrate + Nitrite	mg/L	11	0.3	0.14		0.05	2628112	7.5	0.3	2628112
Nitrite (N)	mg/L	0.12	0.01	<0.01		0.01	2628113	0.08	0.01	2628113
Nitrogen (Ammonia Nitrogen)	mg/L	0.43	0.05	<0.05		0.05	2628055	0.19	0.05	2628055
Total Organic Carbon (C)	mg/L	1.1	0.5	<0.5		0.5	2628615	1.7	0.5	2628615
Orthophosphate (P)	mg/L	<0.01	0.01	<0.01		0.01	2628111	<0.01	0.01	2628111
pH	pH	8.35	N/A	7.87	7.86	N/A	2621551	8.23	N/A	2623147
Reactive Silica (SiO2)	mg/L	2.8	0.5	5.2		0.5	2628109	2.7	0.5	2628109
Dissolved Sulphate (SO4)	mg/L	14	2	<2		2	2628107	11	2	2628107
Turbidity	NTU	0.3	0.1	<0.1		0.1	2628065	0.3	0.1	2628065
Conductivity	uS/cm	430	1	71	70	1	2621555	330	1	2623148

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Maxxam ID		KY5333		KY5334	KY5334			KY5335		
Sampling Date		2011/09/16		2011/09/16	2011/09/16			2011/09/16		
	Units	**SW-4**	**RDL**	**SW-2**	**SW-2 Lab-Dup**	**RDL**	**QC Batch**	**DUP**	**RDL**	**QC Batch**
Metals										
Total Aluminum (Al)	ug/L	26.3	5.0	14.7		5.0	2623051	20.1	5.0	2623051
Total Antimony (Sb)	ug/L	<1.0	1.0	<1.0		1.0	2623051	<1.0	1.0	2623051
Total Arsenic (As)	ug/L	<1.0	1.0	<1.0		1.0	2623051	<1.0	1.0	2623051
Total Barium (Ba)	ug/L	7.3	1.0	2.5		1.0	2623051	8.2	1.0	2623051
Total Beryllium (Be)	ug/L	<1.0	1.0	<1.0		1.0	2623051	<1.0	1.0	2623051
Total Bismuth (Bi)	ug/L	<2.0	2.0	<2.0		2.0	2623051	<2.0	2.0	2623051
Total Boron (B)	ug/L	<50	50	<50		50	2623051	<50	50	2623051
Total Cadmium (Cd)	ug/L	<0.017	0.017	<0.017		0.017	2623051	<0.017	0.017	2623051
Total Calcium (Ca)	ug/L	33400	100	8040		100	2623051	26500	100	2623051
Total Chromium (Cr)	ug/L	<1.0	1.0	<1.0		1.0	2623051	<1.0	1.0	2623051
Total Cobalt (Co)	ug/L	<0.40	0.40	<0.40		0.40	2623051	<0.40	0.40	2623051
Total Copper (Cu)	ug/L	<2.0	2.0	<2.0		2.0	2623051	<2.0	2.0	2623051
Total Iron (Fe)	ug/L	141	50	<50		50	2623051	100	50	2623051
Total Lead (Pb)	ug/L	<0.50	0.50	<0.50		0.50	2623051	<0.50	0.50	2623051
Total Magnesium (Mg)	ug/L	23300	100	3610		100	2623051	17200	100	2623051
Total Manganese (Mn)	ug/L	27.8	2.0	<2.0		2.0	2623051	31.4	2.0	2623051
Total Molybdenum (Mo)	ug/L	<2.0	2.0	<2.0		2.0	2623051	<2.0	2.0	2623051
Total Nickel (Ni)	ug/L	<2.0	2.0	<2.0		2.0	2623051	<2.0	2.0	2623051
Total Phosphorus (P)	ug/L	<100	100	<100		100	2623051	<100	100	2623051
Total Potassium (K)	ug/L	2360	100	617		100	2623051	1960	100	2623051
Total Selenium (Se)	ug/L	<1.0	1.0	<1.0		1.0	2623051	<1.0	1.0	2623051
Total Silver (Ag)	ug/L	<0.10	0.10	<0.10		0.10	2623051	<0.10	0.10	2623051
Total Sodium (Na)	ug/L	15400	100	452		100	2623051	10700	100	2623051
Total Strontium (Sr)	ug/L	33.5	2.0	9.4		2.0	2623051	27.4	2.0	2623051
Total Thallium (Tl)	ug/L	<0.10	0.10	<0.10		0.10	2623051	<0.10	0.10	2623051
Total Tin (Sn)	ug/L	<2.0	2.0	<2.0		2.0	2623051	<2.0	2.0	2623051
Total Titanium (Ti)	ug/L	2.3	2.0	<2.0		2.0	2623051	2.1	2.0	2623051
Total Uranium (U)	ug/L	0.31	0.10	<0.10		0.10	2623051	0.22	0.10	2623051
Total Vanadium (V)	ug/L	<2.0	2.0	<2.0		2.0	2623051	<2.0	2.0	2623051
Total Zinc (Zn)	ug/L	<5.0	5.0	<5.0		5.0	2623051	<5.0	5.0	2623051

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RESULTS OF ANALYSES OF WATER

Maxxam ID		KY5294		KY5329		KY5330		KY5331		
Sampling Date		2011/09/15		2011/09/15		2011/09/15		2011/09/15		
	Units	**SW-8**	**RDL**	**SW-7**	**RDL**	**SW-10**	**QC Batch**	**SW-9**	**RDL**	**QC Batch**
Inorganics										
Dissolved Fluoride (F-)	mg/L	<0.1	0.1	<0.1	0.1	<0.1	2624794	<0.1	0.1	2624794
Total Suspended Solids	mg/L	1	1	8	2	4	2621149	1	1	2621151
Dissolved Bromide (Br-)	mg/L	<1	1	<1	1	<1	2627408	<1	1	2627408

Maxxam ID		KY5332	KY5333		KY5334	KY5334		KY5335		
Sampling Date		2011/09/16	2011/09/16		2011/09/16	2011/09/16		2011/09/16		
	Units	**SW-6**	**SW-4**	**RDL**	**SW-2**	**SW-2 Lab-Dup**	**RDL**	**DUP**	**RDL**	**QC Batch**
Inorganics										
Dissolved Fluoride (F-)	mg/L	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1	2624794
Total Suspended Solids	mg/L	1	1	1	<2		2	2	1	2621148
Dissolved Bromide (Br-)	mg/L	<1	<1	1	<1		1	<1	1	2627408

MERCURY BY COLD VAPOUR AA (WATER)

Maxxam ID		KY5294	KY5329	KY5330	KY5331	KY5332	KY5333		KY5334	KY5334	KY5335		
Sampling Date		2011/09/15	2011/09/15	2011/09/15	2011/09/15	2011/09/16	2011/09/16		2011/09/16	2011/09/16	2011/09/16		
	Units	**SW-8**	**SW-7**	**SW-10**	**SW-9**	**SW-6**	**SW-4**	**QC Batch**	**SW-2**	**SW-2 Lab-Dup**	**DUP**	**RDL**	**QC Batch**
Metals													
Total Mercury (Hg)	ug/L	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	2626596	<0.013	<0.013	<0.013	0.013	2631115

ELEMENTS BY ICP/MS (WATER)

Maxxam ID		KY5294	KY5329	KY5330	KY5331	KY5332	KY5333	KY5334	KY5335		
Sampling Date		2011/09/15	2011/09/15	2011/09/15	2011/09/15	2011/09/16	2011/09/16	2011/09/16	2011/09/16		
	Units	**SW-8**	**SW-7**	**SW-10**	**SW-9**	**SW-6**	**SW-4**	**SW-2**	**DUP**	**RDL**	**QC Batch**
Metals											
Dissolved Aluminum (Al)	ug/L	15.1	18.9	9.7	5.3	<5.0	<5.0	6.5	6.6	5.0	2621461

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Test Summary

Maxxam ID KY5294
Sample ID SW-8
Matrix Water

Collected 2011/09/15
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/23	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/23	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2626596	2011/09/23	2011/09/26	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621149	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5329
Sample ID SW-7
Matrix Water

Collected 2011/09/15
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/23	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/23	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2626596	2011/09/23	2011/09/26	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621149	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5330
Sample ID SW-10
Matrix Water

Collected 2011/09/15
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/23	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/23	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2626596	2011/09/23	2011/09/26	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621149	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5331
Sample ID SW-9
Matrix Water

Collected 2011/09/15
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/23	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/23	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2626596	2011/09/23	2011/09/26	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621151	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5332
Sample ID SW-6
Matrix Water

Collected 2011/09/16
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/22	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/22	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2626596	2011/09/23	2011/09/26	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621148	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5333
Sample ID SW-4
Matrix Water

Collected 2011/09/16
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/22	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/22	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2626596	2011/09/23	2011/09/26	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621148	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5334
Sample ID SW-2
Matrix Water

Collected 2011/09/16
Shipped
Received 2011/09/20

Test Description	**Instrumentation**	**Batch**	**Extracted**	**Analyzed**	**Analyst**
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/22	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/27	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/22	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2631115	2011/09/28	2011/09/29	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY
Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621148	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

Test Summary

Maxxam ID KY5334 Dup
Sample ID SW-2
Matrix Water

Collected 2011/09/16
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Conductance - water	AT	2621555	N/A	2011/09/21	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Mercury - Total (CVAA,LL)	CVAA	2631115	2011/09/28	2011/09/29	JOSH RICHARD
pH	PHEL	2621551	N/A	2011/09/21	MORGAN JOLLIMORE

Maxxam ID KY5335
Sample ID DUP
Matrix Water

Collected 2011/09/16
Shipped
Received 2011/09/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	2619992	N/A	2011/09/23	AUTOMATED STATCHK
Alkalinity	AC	2628103	N/A	2011/09/28	ARLENE ROSSITER
Anions	IC	2627408	N/A	2011/09/29	SALLY COUGHLIN
Chloride	AC	2628106	N/A	2011/09/28	MARY CLANCEY
Colour	AC	2628110	N/A	2011/09/28	MARY CLANCEY
Conductance - water	AT	2623148	N/A	2011/09/22	MORGAN JOLLIMORE
Fluoride	ISE	2624794	N/A	2011/09/23	TAMMY PETERS
Hardness (calculated as CaCO3)		2619993	N/A	2011/09/22	AUTOMATED STATCHK
Mercury - Total (CVAA,LL)	CVAA	2631115	2011/09/28	2011/09/29	JOSH RICHARD
Metals Water Diss. MS	CICP/MS	2621461	N/A	2011/09/21	DAREN LEBLANC
Metals Water Total MS	CICP/MS	2623051	2011/09/21	2011/09/22	DAREN LEBLANC
Ion Balance (% Difference)	CALC	2619994	N/A	2011/09/29	AUTOMATED STATCHK
Anion and Cation Sum	CALC	2619995	N/A	2011/09/28	AUTOMATED STATCHK
Nitrogen Ammonia - water	AC	2628055	N/A	2011/09/28	ARLENE ROSSITER
Nitrogen - Nitrate + Nitrite	AC	2628112	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrite	AC	2628113	N/A	2011/09/28	MARY CLANCEY
Nitrogen - Nitrate (as N)	CALC	2621502	N/A	2011/09/29	AUTOMATED STATCHK
pH	PHEL	2623147	N/A	2011/09/22	MORGAN JOLLIMORE
Phosphorus - ortho	AC	2628111	N/A	2011/09/28	MARY CLANCEY
Sat. pH and Langelier Index (@ 20C)	CALC	2619996	N/A	2011/09/29	AUTOMATED STATCHK
Sat. pH and Langelier Index (@ 4C)	CALC	2619997	N/A	2011/09/29	AUTOMATED STATCHK
Reactive Silica	AC	2628109	N/A	2011/09/28	ARLENE ROSSITER
Sulphate	AC	2628107	N/A	2011/09/28	MARY CLANCEY

Test Summary

Total Dissolved Solids (TDS calc)	CALC	2619998	N/A	2011/09/29	AUTOMATED STATCHK
Organic carbon - Total (TOC)	TECH	2628615	N/A	2011/09/27	CLIFF RAYMOND
Total Suspended Solids	SLDS	2621148	N/A	2011/09/22	COLLEEN ACKER
Turbidity	TURB	2628065	N/A	2011/09/27	MORGAN JOLLIMORE

GENERAL COMMENTS

Sample KY5334-01: Total Suspended Solids: Used all of the sample provided, DL raised.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2621148	Total Suspended Solids	2011/09/22					<1	mg/L	10.0	25	98	80 - 120
2621149	Total Suspended Solids	2011/09/22					<1	mg/L	NC	25	99	80 - 120
2621151	Total Suspended Solids	2011/09/22					<1	mg/L	3.5	25	98	80 - 120
2621461	Dissolved Aluminum (Al)	2011/09/21	107	80 - 120	104	80 - 120	<5.0	ug/L	0.2	25		
2621551	pH	2011/09/21							0.1	25	101	80 - 120
2621555	Conductivity	2011/09/21			100	80 - 120	<1	uS/cm	0.4	25		
2623051	Total Aluminum (Al)	2011/09/22	97	80 - 120	99	80 - 120	6.0, RDL=5.0(1)	ug/L	NC	25		
2623051	Total Antimony (Sb)	2011/09/22	101	80 - 120	101	80 - 120	<1.0	ug/L	NC	25		
2623051	Total Arsenic (As)	2011/09/22	100	80 - 120	101	80 - 120	<1.0	ug/L	1.5	25		
2623051	Total Barium (Ba)	2011/09/22	95	80 - 120	96	80 - 120	<1.0	ug/L	2.0	25		
2623051	Total Beryllium (Be)	2011/09/22	108	80 - 120	108	80 - 120	<1.0	ug/L	NC	25		
2623051	Total Bismuth (Bi)	2011/09/22	100	80 - 120	100	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Boron (B)	2011/09/22	106	80 - 120	106	80 - 120	<50	ug/L	NC	25		
2623051	Total Cadmium (Cd)	2011/09/22	99	80 - 120	98	80 - 120	<0.017	ug/L	NC	25		
2623051	Total Calcium (Ca)	2011/09/22	NC	80 - 120	102	80 - 120	<100	ug/L	0.8	25		
2623051	Total Chromium (Cr)	2011/09/22	99	80 - 120	100	80 - 120	<1.0	ug/L	NC	25		
2623051	Total Cobalt (Co)	2011/09/22	98	80 - 120	99	80 - 120	<0.40	ug/L	NC	25		
2623051	Total Copper (Cu)	2011/09/22	97	80 - 120	100	80 - 120	<2.0	ug/L	0.3	25		
2623051	Total Iron (Fe)	2011/09/22	104	80 - 120	104	80 - 120	<50	ug/L	NC	25		
2623051	Total Lead (Pb)	2011/09/22	96	80 - 120	97	80 - 120	<0.50	ug/L	NC	25		
2623051	Total Magnesium (Mg)	2011/09/22	104	80 - 120	105	80 - 120	<100	ug/L	0.9	25		
2623051	Total Manganese (Mn)	2011/09/22	100	80 - 120	101	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Molybdenum (Mo)	2011/09/22	104	80 - 120	104	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Nickel (Ni)	2011/09/22	99	80 - 120	101	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Phosphorus (P)	2011/09/22	107	80 - 120	105	80 - 120	<100	ug/L	NC	25		
2623051	Total Potassium (K)	2011/09/22	105	80 - 120	105	80 - 120	<100	ug/L	1.5	25		
2623051	Total Selenium (Se)	2011/09/22	101	80 - 120	103	80 - 120	<1.0	ug/L	NC	25		
2623051	Total Silver (Ag)	2011/09/22	101	80 - 120	100	80 - 120	<0.10	ug/L	NC	25		
2623051	Total Sodium (Na)	2011/09/22	NC	80 - 120	98	80 - 120	<100	ug/L	0.2	25		
2623051	Total Strontium (Sr)	2011/09/22	NC	80 - 120	100	80 - 120	<2.0	ug/L	0.8	25		
2623051	Total Thallium (Tl)	2011/09/22	98	80 - 120	101	80 - 120	<0.10	ug/L	NC	25		
2623051	Total Tin (Sn)	2011/09/22	100	80 - 120	102	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Titanium (Ti)	2011/09/22	102	80 - 120	104	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Uranium (U)	2011/09/22	108	80 - 120	109	80 - 120	<0.10	ug/L	NC	25		
2623051	Total Vanadium (V)	2011/09/22	99	80 - 120	101	80 - 120	<2.0	ug/L	NC	25		
2623051	Total Zinc (Zn)	2011/09/22	99	80 - 120	100	80 - 120	<5.0	ug/L	NC	25		
2623147	pH	2011/09/22							0.1	25	102	80 - 120
2623148	Conductivity	2011/09/22			101	80 - 120	<1	uS/cm	0.1	25		
2624794	Dissolved Fluoride (F-)	2011/09/23	106	80 - 120	100	80 - 120	<0.1	mg/L	NC	25	98	80 - 120
2626596	Total Mercury (Hg)	2011/09/26	NC	80 - 120	93	80 - 120	<0.013	ug/L	NC	25	96	80 - 120

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2627408	Dissolved Bromide (Br-)	2011/09/29	97	80 - 120	102	80 - 120	<1	mg/L	NC	20		
2628055	Nitrogen (Ammonia Nitrogen)	2011/09/28	96	80 - 120	96	80 - 120	<0.05	mg/L	NC	25	103	80 - 120
2628065	Turbidity	2011/09/27					<0.1	NTU	NC	25	102	80 - 120
2628103	Total Alkalinity (Total as CaCO3)	2011/09/28	NC	80 - 120	102	80 - 120	<5	mg/L	2.2	25	107	80 - 120
2628106	Dissolved Chloride (Cl)	2011/09/28	NC	80 - 120	94	80 - 120	<1	mg/L	0.5	25	95	80 - 120
2628107	Dissolved Sulphate (SO4)	2011/09/28	100	80 - 120	109	80 - 120	<2	mg/L	NC	25	102	80 - 120
2628109	Reactive Silica (SiO2)	2011/09/28	NC	80 - 120	102	80 - 120	<0.5	mg/L	0.7	25	98	75 - 125
2628110	Colour	2011/09/28					<5	TCU	NC	25	109	80 - 120
2628111	Orthophosphate (P)	2011/09/28	108	80 - 120	103	80 - 120	<0.01	mg/L	NC	25	100	80 - 120
2628112	Nitrate + Nitrite	2011/09/28	107	80 - 120	107	80 - 120	<0.05	mg/L	0.1	25	108	80 - 120
2628113	Nitrite (N)	2011/09/28	95	80 - 120	96	80 - 120	<0.01	mg/L	NC	25	97	80 - 120
2628615	Total Organic Carbon (C)	2011/09/27	102	80 - 120	108	80 - 120	<0.5	mg/L	5.0	25	106	80 - 120
2631115	Total Mercury (Hg)	2011/09/29	106	80 - 120	104	80 - 120	<0.013	ug/L	NC	25	109	80 - 120

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

(1) - Low level lab contamination. Minimal impact on data quality.

Validation Signature Page

Maxxam Job #: B1E4673

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CAcker

COLLEEN ACKER,

Cristina Carriere

CRISTINA CARRIERE, Scientific Services

Kevin A. MacDonald

KEVIN MACDONALD, Inorganics Supervisor

===

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Client: Golder

COC# 28924

HOLD TIME :month Sep day 22

COC time stamped

RUSH(1,2,3Day,IOL,Chlorine, MICRO)

Urgent Stamp

Rush Okayed by:	For:	Date:

If no Maxxam COC - Sign&Print

If no Maxxam COC Temp °C

Critical Flag

_____ **Temp >10C** [2] Exceptions -Inorganic, Organic received sameday, Coliform <1hr old

_____ **No COC**[4] **or no analysis requested** [10]

_____ **Hold time Up** [13]

Sample #	**Coliform/Bacteria** 300/100mL (Sodium Thiosulfate)	**RCAp** 200mL plastic	**Metals** 50mL plastic	**Hg** 100mL KCr_2 & HNO_3	**TKN/PHENOL/COD/TP/AOX** 100mL H_2SO_4	**BOD / TSS** 500mL plastic	**Cyanide/Cr+6** 60mL NaOH	**Chlorine** 40mL no headspace	**Sulphide** 200mL ZnAcetate/HNO_3	**MUST/RBCA** 250mL $NaHSO_4$	**MUST /RBCA/ VOC** 40mL NaHSO4- no headspace	**TPH Fractionation** 1L $NaHSO_4$	**NBMUST** 500mL $NaHSO_4$	**PAH / PCB** 250mL glass	**Oil&Grease/Pesticides** 1L glass	**Soil** 250mL glass	**Soil** 60mL glass	**Other**
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Bottle Types & # Listed on COC are Correct- Initial _____ (No need to fill in table above)

Critical Flag

_____ **Incorrect preservation or headspace** [15]
(In all 40ml, in 60ml, in 250ml with no 60ml received)

_____ **Sample requiring filtration preserved** [19]

Flag Supervisor Init: _____

_____ Labelling issue [11] (bottle Ids & Project# don't match COC)

_____ Bottles/Samples listed on COC but not received [8]
(CS initials _____, Login Manager Initials _____)

_____ Broken Bottle[3]-Note if insufficient Packing or cooler/box damaged
(Internal Maxxam Shipment No FLAG,add info to Job Remark,notify PM to call&initial _____)

_____ Cap Missing or Cap Broken [20], Empty Bottle [21]

_____ Insufficient Volume [18],wrong bottle [14], insufficient bottles no flag[16]

_____ Bottles/Samples received but not listed on COC [9]

_____ >1cm sediment in Organic groundwater sample[23]

_____ Organic samples received >5d after sampling [12] ~~(not over~~ hold time)

Green Flag

_____ COC not current [7] or COC not complete [5] [✓ COC not signed/dated][6]

Sample Frozen[22]

FLAG Yes / [✓ No] Initials (Need to indicate Yes/No on COC too)

Resolution:

Barcode Label

Sticker/Stamp

Sticker/ Stamp

if IOL use IOL Checklist

if Heat treat place sticker on this sheet

if Prep Step Required place sticker on this sheet

Notes:

COC is not Signed

Some of the samples TDS are written with pencil

Required for Non Maxxam COC

Client#

Maxxam Job#

Login Date:

Login Initials:

Required for Non **Current** Maxxam COC

Labelled by:

WIF/DRY/[✓ RCAP]/Bin/CART

Temp Storage U8/E3

880

Maxxam Analytics Inc

49-55 Elizabeth Avenue, Suite 101A, St. John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
www.maxxamanalytics.com

CHAIN OF CUSTODY RECORD

28924

INVOICE INFORMATION:

Company Name: GOLDER ASSOC.
Contact Name: Melanie Kennedy
Address: 2390 Argentia
Mississauga Ontario
Email: makennedy@golder.com
Ph: (905) 567-4444 Fax: (905) 567-6561

REPORT INFORMATION (if differs from invoice):

Company Name:
Contact Name:
Address:
Email:
Ph: Fax:

PO #:
Project #: 11-1152-0116
Proj. Name: IOC Wabush
Location: Wabush
Quotation#:
Submitted By:
Site Task #:

MAXXAM JOB NUMBER: B1E4673

ENTERED BY, Init: 1326

Client Code:

Specify Guideline Requirements:

PWQO (Provincial Water Quality objectives)
CCME

*Specify Matrix: Surface/Salt/Ground/Tapwater/Sewage/Effluent/Seawater Potable/NonPotable/Tissue/Soil/Sludge/Metal

DUE DATE:

STANDARD: ☑

RUSH Due Date:

For extra cost rush, specify Due Date. Rush analysis must be scheduled prior to sample submission.

Client will be contacted if Rush date cannot be met.

Sample Identification	Matrix*	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAp-30 Choose Total or Diss Metals	RCAp-MS Choose [✓ Total] or Diss Metals	Metals Water		Mercury	Metals Soil						TPH MUST (BTEX, C_6-C_{32})	Soil (Potable), TPH MUST, NS Fuel Oil Spill Policy Low Level BTEX & C_6-C_{32}	NB Potable Water BTEX, VPH, Low Level TEH	TPH Fractionation	PAH's	PCB's	VOC's EPA 624,8260	Other Analysis or Comments/Hazards
								Total Digest (Default Method)	Dissolved	Mercury is not included in soil or water metals scan	Available Metals Digest Default Method (HNO_3/H_2O_2)	Total Digest - for sediments ($HNO_3/HF/HCLO_4$)	Tin (required for CCME soils)	Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Hot Water soluble Boron (required for CCME Agricultural)									
SW-8	SW	Sept 15/11	5	✓	✓		✓			✓														mercury and metals preserved
SW-7	SW	"	5	✓	✓		✓			✓														mercury field
SW-10	SW	"	5	✓	✓		✓			✓														Filtered
SW-9	SW	"	5	✓	✓		✓			✓														pH, conductivity
SW-6	SW	Sept 16/11	5	✓	✓		✓			✓														TSS, TDS, Alkalinity
SW-4	SW	"	5	✓	✓		✓			✓														Hardness, Nitrate (as N)
SW-2	SW	"	5	✓	✓		✓			✓														Nitrite, Ammonia,
Dup	SW	"	5	✓	✓		✓			✓														Sulphate, chloride, Bromide
																								Fluoride, Aluminum
																								Note: Aluminum to be lab filtered

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	DATE / TIME	PURPOSE OF CHANGE / REMARKS
	T Dawson		

TEMP @ Maxxam Receipt
9, 11, 10

2011 SEP 20 PM 1:52

INTEGRITY Init:
[✓ Yes] No

KEENVROCOC St.John's 05/05

APPENDIX D

SURFACE WATER MONITORING PHOTOGRAPHS

Appendix D
Surface Water Monitoring Photographs


SW1: Facing upstream


SW2: Facing upstream


SW2: Facing upstream


SW1: Facing downstream


SW2: Facing downstream

Appendix D
Surface Water Monitoring Photographs


SW3: Facing upstream


SW3: Facing upstream


SW3: Facing weir


SW3: Facing downstream

SW4: Facing upstream


SW4: Facing downstream

SW4: Culvert discharging to lake

SW4: Facing lake

SW5: Facing downstream

SW5: Facing downstream

SW5: Facing downstream

SW5: Downstream side of culvert

Appendix D
Surface Water Monitoring Photographs

SW6: Upstream of culvert, facing upstream

SW6: Facing upstream

SW6: Upstream side of culvert

SW6: Second culvert on upstream side

SW7: Facing upstream

SW7: Facing downstream

Appendix D
Surface Water Monitoring Photographs


SW7: Outlet into lake


SW7: Outlet into lake


SW8: Facing upstream


SW8: Upstream side of culvert


SW8: Downstream side of culvert


SW8: Facing downstream

Appendix D
Surface Water Monitoring Photographs


SW9: Upstream side of culvert


SW9: Facing upstream (water quality sampling)


SW9: Riffle section


SW10: Facing upstream


SW10: Facing downstream

APPENDIX E

SELECT GEOPHYSICAL TELEVIEWER RESULTS BY DGI GEOSCIENCE INC.
(Included on CD)

APPENDIX F

GROUNDWATER MODEL TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

DATE December 16, 2011 **PROJECT No.** 11-1152-0116 1000 1011

TO Iron Ore Company of Canada (IOC)

FROM Devin Hannan, P.Eng. **EMAIL** dhannan@golder.com

IOC WABUSH GROUNDWATER MODELLING

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has developed a 3D numerical MODFLOW groundwater model of the Wabush Mines operation and regional surroundings. The ultimate goal of the modelling is to estimate inflows to the proposed Wabush 3 and Wabush 6 pits.

Two scenarios are examined:

1) **Existing Conditions:** This scenario approximates the current mining layout and incorporates the present pits, namely: Spooks, Lorraine, Humphrey Main, Humphrey South and Luce pits.

2) **Proposed Conditions:** In addition to the existing pits, this scenario incorporates the proposed Wabush 3 and Wabush 6 pits at full excavation.

Both scenarios are run to steady-state conditions, and simulated inflow to each pit is evaluated.

A limited calibration is undertaken to approximate simulated groundwater inflows with measured groundwater inflows at Luce pit using the Existing Conditions model.

The approach utilized in this study is considered relatively high-level, with the intent to provide preliminary, “order-of-magnitude” estimates of potential pit inflows.

2.0 DATA SOURCES

The following data is utilized in the development of the model:

- Elevation data from IOC of the existing pits and site surrounds circa 2004.
- Elevation data from IOC of the areas around and including Wabush 3 and 6 circa 2011.
- Regional topographic mapping from government sources (NRCAN-Canvec).

- Estimated ultimate extraction contours of the proposed Wabush 3 and Wabush 6 pits, provided by IOC which are draft excavation plans based upon drilling by IOC up to 2007. This data is “stitched in” to the above noted topographic data to approximate future topography for the Proposed Conditions scenario.
- Site packer testing data from five wells; a total of 44 intervals were tested.
- Dewatering rates for Luce Pit sumps and dewatering wells and pond/flood elevation for Humphrey Main, Humphrey South, Spooks and Lorraine Pits, provided by IOC in 2011.
- Recharge estimates derived by Golder, as described in Section 6.4.1 of the main text.

It is important to note that the simulated inflows to the pits are, in part, dependent on the contours of the pits themselves (particularly when a pit is being drained to its bottom elevation). It is known that the pits have expanded and/or deepened somewhat since 2004; however, current topography is not available at the time of this analysis. Thus the use of the 2004 topographic data may tend to underestimate inflows to the pits under the Existing Conditions scenario.

Relatedly, external to the Wabush 3 and Wabush 6 pit footprints, the 2004 topography is also used for the Proposed Condition scenario. Golder understands that the present pits will likely be considerably larger than the 2004 data by the time Wabush 3 and Wabush 6 reach their ultimate extent; however, future contours for these pits are not available. Therefore the model results may tend to under predict future flows at Spooks, Lorraine, Humphrey Main, Humphrey South and Luce pits. Meanwhile, inflows at Wabush 3 and Wabush 6 may be over predicted (as the future additional depressurization from the surrounding pit expansions, particularly Luce, is unaccounted for).

3.0 MODEL DOMAIN, GRID AND LAYERING

The model domain is shown on Figure 1 and the model covers an area of 246 km^2. Due to the preliminary scoping nature of the modelling exercise, a large, simple rectangular domain is chosen. The regional extents are largely influenced by the desire to avoid undue boundary effects from pit dewatering.

Horizontally, the model is uniformly discretized with 100 m by 100 m finite-difference grid cells.

Vertically, the model is bounded at its top by topography and at its bottom by a constant elevation of -250 masl. A relatively deep bottom elevation of -250 masl was chosen to allow simulation of vertical gradients under the pits, and to avoid the underlying layers from “thinning out” in the area of the pits.

Under the Existing Conditions scenario, the topography ranges from a high of 877 masl along the central ridge to a low of 520 masl at Wabush Lake. Under the Proposed Conditions scenario, the topography ranges from 877 masl to a low of 235 masl at Wabush 6.

The model is subdivided into seven vertical layers. In general, the first four layers are 50 m thick, the fifth layer is 75 m thick, the sixth layer is 100 m thick, and the seventh layer has variable thickness. Multiple layers are utilized in part to allow an approximation of various lake depths during the assignment of boundary conditions (discussed below).

4.0 BOUNDARY CONDITIONS

The model boundary conditions are summarized as follows:

- Lakes are assigned as constant head boundaries with heads equal to topographic elevation. Lake depths are assumed to be 25% of their width and are roughly implemented in the model based on the closest model layer depth (the structure of the model layering accommodates depth intervals of 50 m, 100 m, 150 m etc.).
- Rivers and streams are assigned as constant head boundaries with elevations equal to topography. These features are present in the first model layer only.
- For the Proposed Conditions scenario, it is assumed that smaller lakes and drainage features around the Wabush 3 and Wabush 6 footprints would be re-routed. As such, these features are not included as constant heads as they may provide a false source of recharge to the pits.
- In both the Existing Conditions and Proposed Conditions scenarios, the pits are assigned as drain cells with heads set at topography. The one exception is Spooks Pit, which is assigned as a constant head of 608 masl, based on its measured flooded elevation provide by IOC.
- The edges of the model domain are no-flow, except where intersected by lake or stream boundary cells. This no-flow boundary does not necessarily reflect a hydrogeologic divide. Rather, the outer boundary of the model is simply chosen to be large enough to avoid boundary effects, and given the preliminary nature of this modelling exercise, an attempt to reconcile the far-field model extents with natural boundaries is deemed unwarranted. The single exception to this is the eastern border of the model, which is largely defined by Wabush Lake, the largest natural drainage feature in the area.

5.0 MODEL PARAMETERS

5.1 Hydraulic Conductivity

The assignment of hydraulic conductivity in the model is constrained in part by the packer testing data. The dataset, based on 44 tested intervals in five wells, shows a range of measured values from 3×10^{-9} m/s to 2×10^{-4} m/s, with a geometric mean of 8.03×10^{-7} m/sec and the arithmetic mean is 9.15×10^{-6} m/sec. The model calibration suggests that a hydraulic conductivity at the higher end of this measured range is required to approach groundwater inflow rates at Luce Pit. After several iterations during the calibration process the model was assigned a final bulk hydraulic conductivity of 5×10^{-6} m/s. Lastly, it was found that a Kxy : Kz anisotropy ratio of 1:1 produced the most reasonable match to inflows at Luce Pit.

5.2 Recharge

An infiltration rate of 20% (173 mm/yr) of total precipitation is applied model-wide.

6.0 CALIBRATION

The goal of the model calibration is to fine-tune a bulk hydraulic conductivity value such that a satisfactory match between simulated inflows and estimated groundwater inflows at Luce Pit is achieved. No other data constraints (well water levels, other pit inflows etc.) are considered for this exercise.

Based on the aforementioned pumping data analysis of Luce Pit, for March to October 2011 the estimated average daily groundwater inflow to Luce Pit is about 26,438 m^3/d (306 L/s). Using a bulk hydraulic conductivity of 5 x10^{-6} m/s, the simulated groundwater inflow to Luce Pit is 20,522 (238 L/s). While this value is approximately 20% less than the measured inflow, it is reasonable to assume that a significant amount of this discrepancy is due to the model using the 2004 pit elevations, which, to Golder's understanding, are significantly less expansive than the 2011 configuration and recycling of water from Luce Lake is thought to occur and the quantity of recirculation within the pumping records is unknown. Further, using a hydraulic conductivity much higher than 5 x 10^{-6} m/s is considered unrepresentative of bulk material properties.

7.0 MODEL RESULTS

The pit inflows for both existing and proposed scenarios are listed in Table 1 below.

Table 1; Simulated Groundwater Inflows to Pits

Pit Name	Existing Conditions		Proposed Conditions	
	Inflow (m^3/d)	Inflow (L/s)	Inflow (m^3/d)	Inflow (L/s)
Spooks	-1,250	-14	-1,954	-23
Lorraine	0	0	0	0
Humphrey Main	23,552	273	23,169	268
Humphrey South	0	0	0	0
Luce	20,522	238	3,651	42
Wabush 3	N/A	N/A	59,410	688
Wabush 6	N/A	N/A	138,940	1,608
TOTAL:	**42,824**	**496**	**223,216**	**2,584**

The following is noted:

- **Spooks:** This pit receives some groundwater discharge, but its overall flow budget indicates that the pit acts a groundwater recharge feature, supplying about 1,250 m^3/d to the groundwater system under the Existing Conditions scenario (hence the "-" negative symbol in Table 1). This would suggest that its flooded elevation of 608 masl (a constant head in the model) is at or above the water table for most of the ponded footprint. Under the Proposed Condition the seepage from this pit increases to 1,954 m^3/d.
- **Lorraine:** Under both Existing and Proposed scenarios this pit receives no groundwater discharge. In reality this pit is currently flooded; however, it is unclear if the source of this water is entirely surface water and/or pumpage transfer, or if groundwater seepage contributes significantly to the water balance.

- **Humphrey Main:** For the Existing Conditions scenario, this pit receives the majority of the groundwater discharge to the mines (23,552 m^3/d, or 55% of the total inflow to the IOC mines in the model domain). The addition of Wabush 3 and Wabush 6 pits under the Proposed Conditions scenario only slightly reduces the inflow to this pit. This would suggest that the Humphrey Main pit, at a distance of over 4 km northwest from Wabush 3 and Wabush 6, is bordering the zone of influence of these new pits.
- **Humphrey South:** Under both Existing and Proposed scenarios this pit receives no groundwater discharge. In reality this pit is flooded to 670 masl, but is not being dewatered. Again it is unclear if the source of this flooding is due to surface water alone or a combination of surface water and groundwater sources.
- **Luce:** As mentioned previously, under the Existing Conditions scenario the inflow to this pit is 20,522 m^3/d; this is considered reasonably similar to the actual estimated inflow of 26,438 m^3/d to Luce. During the Proposed Condition scenario, the relatively close proximity of Luce Pit to the deeper Wabush 3 and Wabush 6 pits results in a sizeable reduction in inflow, as the depressurization caused by the new pits serves to lower the water table in the Luce area.
- **Wabush 3:** This pit has a simulated inflow of 59,410 m^3/d under the Proposed Condition.
- **Wabush 6:** For the Proposed Condition scenario, this pit receives a considerable majority of the groundwater discharge (138,940 m^3/d). The high inflow to this pit is largely due to its depth and close proximity to Wabush Lake. With a pit bottom of about 235 masl, and the lake elevation at 520 masl, there is a 295 m decrease in head over a distance of less than 800 m. This high flow gradient (40%) results in the high inflows at Wabush 6.

8.0 RECOMMENDATIONS

If a more refined estimate of the results of pit dewatering is deemed necessary, several model enhancements may be pursued:

- Obtain and implement current topographic contours of the existing pits, and, where applicable, flooded elevations of the pits.
- For forecast simulations, obtain and implement the estimated pit extents for all pits (not just Wabush 3 and Wabush 6).
- Revise the model domain to be more reflective of natural hydrogeologic boundaries (major streams, groundwater divides, etc.)
- Expand the calibration dataset to include measured water levels and other pit inflows (if available). A more rigorous calibration may suggest that spatially varying hydraulic conductivity and recharge is necessary to satisfactorily match water levels and inflows at other pits.
- Obtain a more detailed layout of the proposed site drainage and implement model boundary conditions accordingly.

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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