REPORT ON

HYDROGEOLOGIC INVESTIGATIONS OF DEWATERING REQUIREMENTS FOR THE PROPOSED OPEN PIT MINAGO, MANITOBA

Version 2

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June 4, 2009 08-1428-0001/7000

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EXECUTIVE SUMMARY

Golder Associates (Golder) was retained by Victory Nickel Inc. (Victory Nickel) to undertake hydro geologic investigations of the Minago Site located in central Manitoba. These investigations were conducted to estimate the dewatering requirements for the proposed open-pit mine, in support of Victory's mine feasibility study and Environmental Impact Statement (EIS) and Environmental Act License Application.

The investigations included the implementation of a multi-well, long duration, pumping test program, the generation of a conceptual hydrogeological model of the Site, and the subsequent development of a groundwater flow model of the proposed open pit area. The pumping test program involved the pumping of four bedrock dewatering wells located along the perimeter of the proposed open pit mine, and monitoring the hydraulic response in these pumping wells and in twenty-four observation wells. The groundwater flow modeling included the development and calibration of a numerical model of the Site based on the conceptual model and on recorded pre-pumping groundwater levels and the pumping test response data. The calibrated model was used for the simulation of dewatering well operation during the development of the proposed open-pit mine.

The primary focus of the hydrogeological investigation was to estimate the configuration of the dewatering well system required for the operation of the proposed open pit mine; to estimate the total pumping rate required; and to estimate the extent of the drawdown cone created during mining operations. The study concluded that a total of 12 new dewatering wells completed in both the limestone and sandstone aquifers, at equally-spaced distances of approximately 300 m to 400 m along the crest of the ultimate pit, and operating simultaneously, will be required. The total quantity of groundwater likely to be generated by these wells is predicted to be 40,000 m^3/day (7,300 USgpm). The average pumping rate for an individual well is estimated to be 3,300 m^3/day (600 USgpm). Limestone dewatering was predicted to be relatively rapid such that the cone of depression created by dewatering would reach near-steady state conditions within several months after implementation of the full dewatering system. This relatively rapid response to pumping is primarily related to the low storage and high transmissive properties of the limestone.

Based on a sensitivity analysis, the actual dewatering rate for the entire wellfield could vary from 25,000 m^3/day (4,600 USgpm) to 90,000 m^3/day (16,500 USgpm). The parameter with the greatest affect on dewatering rates was the hydraulic conductivity of the limestone. This parameter was varied by +/- 2 times over the estimated hydraulic conductivity values. This variation in hydraulic conductivity accounted for nearly 90% of the minimum and maximum discharge rates calculated as part of the sensitivity analyses.

The hydrogeological investigation was successful in the collection of sufficient data and the completion of the necessary analyses to meet all of the project objectives. A summary of the findings of the investigation, as they relate to the objectives of the study are as follows:

- The hydraulic conductivity of the limestone unit at the Site was estimated to range between 1.0×10^{-5} m/s to 1.5×10^{-4} m/s, depending on location and depth. The shallow limestone (up to 40 m depth) was inferred as being more permeable than the deeper limestone due to the greater fracture density in the shallow limestone. A higher permeability zone in the limestone was identified in the vicinity of well HG-7 at the north end of the proposed open pit area. The hydraulic conductivities of the overburden, sandstone, and granite were estimated to be 1×10^{-8} m/s, 1×10^{-6} m/s and 1×10^{-8} m/s respectively. Representative storage parameters for these units were estimated to be a specific yield of 0.025 and specific storage of 2×10^{-6} 1/m;

- The influence of significant hydrogeologic boundaries was not identified during the pumping test program. This is likely because of the greater distance to the nearest surface water body in contact with the limestone aquifer (Minago River at approximately 10 km distant) relative to the radius of influence of the test (approximately 3 km). Oakley Creek, located approximately 1 km south of the dewatering wells is likely not in direct contact with the limestone aquifer (*i.e.*, the creek bed lies in the overburden); therefore, it was not observed to act as a significant hydrogeologic boundary. The key hydrogeologic (recharge) boundaries that may affect the dewatering system are the nearest lakes to the west and south of the Site (*i.e.*, William Lake and Lake Winnipeg), and the nearest rivers and creeks to the south-east and north (William River and Minago River). These recharge sources appear to be distributed relatively uniformly around the proposed pit perimeter;

- During the pumping test, the overburden was not significantly affected by pumping, except in the near vicinity of the North Pit Wall zone. This indicates that the overburden is an aquitard that is expected to provide some leakage to the limestone aquifer and some additional flow to the dewatering wells. The leakage would likely occur predominantly in the vicinity of the dewatering wells;

- A direct hydraulic connection between the limestone unit and the nearby creeks and rivers (*i.e.*, Oakley Creek and Minago River) was not identified during the pumping test. As indicated previously, this is likely because of the creek bed for Oakley Creek in the Site vicinity likely lies within the overburden unit, and the distance to Minago River is greater than the radius of influence of the pumping test; and,

- Based on the groundwater quality results, the groundwater depicts high background concentrations when compared with the CCME-EQG freshwater aquatic life standards for total aluminum, total iron, total zinc and total fluoride. If the groundwater is being considered a possible source of potable water for the mine camp, it may require settling or filtration to remove Total Suspended Solids and turbidity.

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1.0 INTRODUCTION

Golder Associates (Golder) was retained by Victory Nickel Inc. (Victory Nickel) to undertake hydrogeologic investigations of the Minago Site (the ‘Site’) located in central Manitoba (Figure 1). These investigations were conducted to estimate the dewatering requirements for the proposed open-pit mine, in support of Victory’s mine feasibility study and Environmental Impact Statement (EIS) and Environmental Act License Application.

The hydrogeologic investigations conducted by Golder included the implementation of a multi-well, long duration, pumping test program, the generation of a conceptual hydrogeological model of the Site, and the subsequent development of a groundwater flow model of the proposed open pit area. The pumping test program involved the pumping of four bedrock dewatering wells located along the perimeter of the proposed open pit mine, and monitoring the hydraulic response in these pumping wells and in twenty-four observation wells. The groundwater flow modeling included the development and calibration of a numerical model of the Site based on the conceptual model and on recorded pre-pumping groundwater levels and the pumping test response data. The calibrated model was used for the simulation of dewatering well operation during the development of the proposed open-pit mine.

This report describes the pumping test program and the groundwater model development, and presents the results of the hydrogeologic analyses and groundwater quality from these investigations. In addition, this report provides recommendations on the configuration of the dewatering well system that is required to provide sufficient dewatering for the development of the proposed open-pit mine.

2.0 OBJECTIVES

The main objective of the hydrogeologic investigations was to provide information required for a comprehensive hydrogeologic characterization of the Site. This characterization is necessary for the design of the dewatering system for the proposed open pit. The detailed objectives of the pumping test program were as follows:

- Estimate the hydrogeologic parameters for the main hydrostratigraphic units identified at the Site including transmissivity, storativity, and specific yield;
- Identify key hydrogeologic boundaries, if any, that may affect the dewatering system;
- Measure potential changes in shallow groundwater conditions as a result of pumping from the bedrock aquifers;
- Assess the potential hydraulic connection of the bedrock aquifers with nearby surface water bodies;
- Provide data for establishing the maximum yields for the planned dewatering wells; and,
- Collect groundwater quality data from the bedrock aquifers to assess the potential impact of discharging groundwater to surface water bodies during development of an open-pit mine.

The above information was used to develop and calibrate a numerical groundwater flow model for the Minago Project. This model was then used as a tool to estimate the pumping rates and configuration of the dewatering well system that is required to provide sufficient dewatering for the proposed open pit mine and to estimate the extent of the drawdown cone created by the dewatering system during mining operations. The overall objectives for the groundwater modelling study were to determine the number, location and depth of the dewatering wells and the total quantity of groundwater discharge that will likely be generated by the proposed open-pit dewatering system.

3.0 BACKGROUND

3.1 Site Location and Regional Setting

The Site is located in central Manitoba, about 100 kilometres north of Grand Rapids; 10 kilometres south of the Minago River Bridge; and about 2 kilometres west of Provincial Trunk Highway #6 (Figure 1). The site lies within the Manitoba Lowland, which comprises much of the southern and central portion of the province, and is situated at the boundary between the Nelson River Watershed and the Lake Winnipeg Basin (Betcher, *et al.*, 1995). Peat bog and boreal forest vegetation exists across the Site, and conditions at the surface remain frozen for approximately six months of the year. Bedrock is covered at much of the Site by Quaternary overburden which may be of glacial or lacustrine origin. Bedrock geology at the Site consists of Ordovician dolomitic limestone of the Red River formation and quartzose sandstone of the Winnipeg formation overlying Precambrian igneous and metamorphic rocks of the Canadian Shield (Betcher, *et al.*, 1995), which include mineralized zones of the Thompson Nickel Belt.

3.2 Climate

The Site is situated at an elevation of approximately 250 m above mean sea level. The mean annual precipitation at the Site is approximately 474 mm of which 77% falls as rain mostly over the period between June and September (Canadian Climate Normals 1971-2000, Grand Rapids Hydro Climate Station – Elevation 222.5 m above sea level). Temperatures range from 23.5°C in July to -24.4°C in January. Evaporation at the Site is estimated to be 110% of rainfall, based on research conducted in a wetland boreal forest environment approximately 200 km northeast of the Site (Lafleur, *et al.*, 1997).

3.3 Dewatering and Observation Wells

Figure 2 presents the locations of four dewatering wells and twenty-four observation wells that were utilized during the pumping test program. Dewatering wells were installed in February 2008 at two locations (HG-7 and HG-3) at the perimeter of the proposed open pit mine. Each dewatering well location consists of two wells (Figure 3): one that penetrated the full thickness of the limestone unit (*i.e.*, HG-7 LS) and one that penetrated the full thickness of the sandstone unit (*i.e.*, HG-7 SS). Observation wells were installed at a total of nine locations, at distances of approximately 40 m, 80 m, 300 m, and 2,000 m from each dewatering well, and at various depths within the four primary hydrostratigraphic units described in Section 3.4 below. The shallow limestone (SLS) wells were completed within the upper three meters of the limestone unit. The other limestone (LS) wells were completed within the remaining thickness of the limestone unit. Table 1 presents surveyed positions of each dewatering and observation well. Detailed well log information is provided in Golder (2008).

3.4 Hydrogeologic Units

Based on the drilling records for the dewatering and observation wells and the results of the draft initial hydrogeological assessment completed by Wardrop (2007), there are four primary hydrogeologic units at the Site, namely: overburden, limestone, sandstone, and granite. The overburden at the site consists of approximately 1 m (3 ft) of peat moss overlying approximately 5 m (16 ft) of clay (base of clay at approximately 6 m or 20 ft depth). The bedrock stratigraphy consists of approximately 55 m (180 ft) of dolomitic limestone (base of limestone at approximately 60 m or 200 ft depth) of which the upper 30 m (100 ft) contains water-bearing fractures (base of fractured zone at approximately 40 m or 130 ft depth). A hydrogeologic distinction is made between shallow limestone consisting of the upper zone of water bearing fractures (up to 40 m depth) and deep limestone underlying this zone. Underlying the limestone is approximately 10 m (30 ft) of sandstone (base of sandstone at approximately 70 m or 230 ft), followed by some shale and weathered granite of the Precambrian Shield. The maximum depth of the observation wells is 77 m (253 ft) below ground surface, which is 4.5 m (15 ft) within weathered granite.

4.0 METHODOLOGY - PUMPING TEST PROGRAM

The pumping test program was conducted by GAIA and directed by Golder over the period between July 30 and August 19, 2008. Throughout the pumping test program, groundwater level were recorded at each well location using both manually operated water level meters and pressure transducers equipped with data loggers (Solinst Gold Leveloggers) and direct-read cables.

The frequency of measurement for the pressure transducers ranged from 10 to 30 seconds for the step drawdown test and pumping test, depending on the proximity of the wells to the pumping wells and also the ease of accessibility of the wells (*i.e.*, soft, flooded ground surface conditions required long travel times to reach the more distant observation wells). The measurement frequency was reduced to 1 second in select wells that were later subjected to short duration, single-well response tests. The frequency of manual water level measurements, using water level probes, was approximately daily to weekly, depending on the well locations and measurement frequency, as each data logger was equipped to store up to 40,000 data points. Manual measurements were conducted to verify the functionality and accuracy of the pressure transducers and to assist with data evaluation and reduction at the end of the tests. A Barologger was also deployed at the Site (*i.e.*, it was placed within the above-ground protective steel casing of observation well MW-SS-5) to collect barometric pressure data throughout the program. This data was used to provide barometric correction to all the data generated by the pressure transducers.

Pumping rates during the step-drawdown tests and pumping test were measured at each dewatering well at a frequency of approximately three times per day using an inline paddlewheel flow gauge (model F-1000 Rate-Totalizer from Blue White Industries). Pumping rates were also measured manually on approximately a daily basis using a 205-litre barrel and a stopwatch, to calibrate the flow gauges and to verify the discharge measurements.

The pumping test program consisted of five primary activities which are described in the following sections.

4.1 Pre-pumping Water Levels and Pump Installations

Pre-pumping (baseline) water levels at each well location were recorded over the period between August 2 and August 9, 2008, using both manual water level probes and pressure transducers. Data output from the pressure transducers were checked against manual measurements to verify their functionality and accuracy prior to the start of testing.

Golder Associates Innovative Applications (GAIA) carried out the installation of pumps, construction of well-head assemblies, and the connection of generators. A 40 horsepower Grundvos pump (Figure 4), rated to 1,200 USgpm, was installed with a 6-inch PVC discharge pipe to a depth of 34.7 m (114 ft.) below the top of the well casing in HG-7 LS dewatering well. Similarly, a 40 horsepower Grundvos pump, rated to 800 USgpm, was installed with a 6-inch PVC discharge pipe to a depth of 34.7 m (114 ft.) below the top of HG-3 LS dewatering well. A 20 horsepower Grundvos pump, rated to 550 USgpm, was installed with a 4-inch PVC discharge pipe to a depth of 53.0 m (174 ft.) below the top of the well casing in each of the HG-7 SS and HG-3 SS dewatering wells.

4.2 Step-Drawdown Tests

A six-hour step-drawdown test was conducted at each of the four dewatering wells, on separate days, over the four-day period between August 6 and 9, 2008. The purpose of the tests was to determine the optimum pumping rate for each dewatering well for the multi-well pumping test. The test involved the pumping of the well at, initially, a low constant rate, until the drawdown within the well stabilized (*i.e.*, until a steady state was reached). The pumping rate was then increased to a higher constant rate until drawdown re-stabilized. This step was repeated once more, with each step having an approximately equal duration. During each step-drawdown test, the water levels in all the dewatering wells were monitored to assess the potential for interference effects during the multi-well pumping test.

4.3 Pumping Test

The pumping test was carried out over the period between August 11 and 18, 2008, and consisted of five days of pumping and two days of recovery. Pumping in the dewatering wells was initiated sequentially, on separate days, such that pumping at HG-7 LS began at the start of Day 1, at HG-3 LS at the start of Day 2, at HG-7 SS on Day 3, and at HG-3 SS on Day 4. On Days 4 and 5, all the wells were pumping simultaneously, at a combined rate of approximately 1,500 USgpm (8,300 m^3/d). At the start of Day-6, all the pumps were turned off and well recovery monitoring occurred over Days 6 and 7.

The quality of the pumped groundwater was monitored twice daily for pH, temperature, specific conductance, and oxidation-reduction potential, using a WTW pH/Cond 3400i multi-meter. Ferrous iron and dissolved oxygen were also monitored daily using colormetric methods (Chemets Kit K6201 and Chemets Kit K7512, respectively). On the last day of pumping (Day 5), groundwater samples were collected from each of the dewatering wells, the details of which are discussed in the following section (Section 4.4).

Although outside the scope of work for this project, the potential for ground subsidence in response to decreased pore pressure in the overburden, was monitored during the pumping test using rudimentary methods. It is understood that this data may be used by others at a later date to evaluate potential for ground subsidence in response to mine dewatering. The change in vertical distance between two arbitrary reference points on the well heads of the granite observation wells (see Figure 5), located approximately 80 m from the nearest dewatering wells, was used to determine whether subsidence had occurred as a result of the pumping test. The reference points consisted of a fixed point on the well pipe that was anchored into the granite, and a fixed point on the well casing (*i.e.,* the top of casing) that was anchored into the shallow overburden to a depth of 1 m or less. The distance between the overburden reference point and the granite reference point was monitored both prior to and during the pumping test at regular intervals.

4.4 Groundwater Sampling

As indicated above, a groundwater sample was collected from each of the four dewatering wells on the fifth day of the pumping test (August 15, 2008). Duplicate samples were taken from HG-7 LS and HG-3 SS for quality assurance/quality control (QA/QC) purposes. The samples were collected using an in-line sampling port constructed in the well head assembly. Samples were preserved as necessary and stored at approximately 4ºC until delivery on August 20, 2008, to the laboratory (ALS Laboratory Group) in Vancouver, British Columbia. The samples were analyzed for major anions, nutrients, cyanide, total organic carbon and total metals on August 21, 2008. The samples were re-analyzed by the laboratory on October 22, 2008 (67 days after sampling date) at the request of Victory Nickel for dissolved metals using ultra low detection limits and for Total Suspended Solids (TSS).

4.5 Single-Well Response Tests

Single-well response tests (slug tests) were carried out after completion of the pumping test, over the period from August 18 to 19, 2008. These tests were conducted to estimate the hydraulic properties of the lower permeability units, namely the overburden and the weathered granite. Six overburden observation wells (MW-OB-1, MW-OB-2, MW-OB-4, MW-OB-5, MW-OB-6, and MW-OB-7) and both granite observation wells (MW-GR-2, and MW-GR-5) were tested. The test was initiated by rapidly submerging a solid slug of a known volume in the well. The initial water level displacement and the rate in fall of the water level in the well were recorded using both a pressure transducer and a manually-operated water level tape. Following completion of a falling head test, the slug was rapidly removed and the rise in water level in the well was recorded as part of the rising head test.

5.0 PUMPING TEST PROGRAM RESULTS

5.1 Limestone Outcrops and Areas of Groundwater Recharge/Discharge

Limestone outcrops were observed on Site, approximately 2 km northwest of the proposed pit area at a topographic knob, and off-site, approximately 9 km south of the Site at a Highway 6 road cut, and approximately 10 km northeast of the Site in the vicinity of the Minago River. The latter two outcrops are identified in the surficial geology map by Matile and Keller (2006), as shown on Figure 6. The upper several meters of the limestone outcrops (Figure 7a and b) are weathered and contain planar apertures along horizontal bedding planes at intervals of about 10 cm, as well as numerous vertical joints and fractures. These types of features exist in the aquifer on a regional scale to a depth of about 30 m below ground surface, and provide pathways for much of the flow in the aquifer (Betcher, *et al.*, 1995). The limestone outcrop areas are likely recharge areas where precipitation may directly infiltrate the limestone aquifer.

Although the surficial geology map of Matile and Keller (2006) suggests that the streambeds of both the Minago River and Oakley Creek are largely contained within the overburden unit (see Figure 6), the Minago riverbed was observed to cut into the limestone aquifer near Highway 6, approximately 10 km north of the Site, as shown on Figure 7c. It is uncertain whether this area is a discharge or recharge area for the limestone aquifer.

Pre-pumping water levels in the limestone unit were above those in the overburden unit at all the well locations except those in the vicinity of HG-7 (including MW-1, MW-2, and MW-3). These conditions, which include flowing artesian wells (see Figure 7d), indicate that the overburden is an effective aquitard. These conditions create an upward hydraulic gradient across the overburden unit, such that surface water observed on the surficial peat that covers much of the Site likely does not contribute to groundwater recharge under non-pumping conditions.

5.2 Pre-pumping Hydraulic Heads and Groundwater Flow Directions

Figures 8a to 8d present the pre-pumping hydraulic head distribution in the overburden, limestone, sandstone, and granite units, respectively. The hydraulic heads are based on the water levels recorded over the period between August 2 and August 9, 2008, as listed in Table 2.

Based on the hydraulic head contours in Figure 8b, the inferred groundwater flow direction in the limestone unit is from west to east, with a horizontal hydraulic gradient of approximately 0.0018. Although there is an insufficient spacing of sandstone wells to determine the position of hydraulic head contours in the sandstone unit, the inferred direction of groundwater flow in this unit is also from west to east (Figure 8c). This inferred eastward flow direction in these aquifers generally agrees with the regional groundwater flow analysis by Betcher, *et al.* (1995) for the sandstone aquifer (*i.e.,* the Winnipeg Formation) and is consistent with the local ground surface topography. However, the interpreted flow direction by Betcher, *et al.* (1995) for the regional carbonate aquifer in the areas north of Lake Winnipeg is towards the southeast, toward Lake Winnipeg. The difference in the groundwater flow direction on Site may be a local phenomenon as a result of the direct hydraulic connection of the limestone and sandstone aquifers. According to Betcher et al. (1995), the two aquifers are regionally separated by an effective shale aquitard which thins out in the northern areas of the Western Canadian Sedimentary Basin, of which the Site location is situated. This shale aquitard was not observed during the well drilling program at the Site.

The hydraulic head contours in the overburden, presented in Figure 8a, indicate that a small component of groundwater flow in the overburden is also directed eastward, with a horizontal hydraulic gradient of approximately 0.0027. This horizontal hydraulic gradient is between 60 and 180 times lower than the vertical hydraulic gradient through the overburden, as is discussed further below.

Figures 9 and 10 present hydrogeologic cross-sections oriented north-south (Section A-A') and west-east (Section B-B') through the Site. Section B-B' (Figure 10) is aligned along the inferred direction of groundwater flow in the limestone and sandstone units. Based on the measurements of hydraulic head in each well, as shown in Section B-B' (Figure 10), the inferred direction of groundwater flow in the limestone and sandstone units at the Site is primarily horizontal (from west to east). A minor component of groundwater flow in the shallow limestone, except in the vicinity of HG-7, is inferred to be directed upward through the overburden, indicating that the ground surface is an area of groundwater discharge over much of the Site. Flowing artesian conditions prevail at all well locations except those in the vicinity of HG-7 (including MW-1, MW-2, and MW-3). The vertical hydraulic gradient through the overburden prior to pumping was estimated to be between 0.1 and 0.6 over much of the Site, such that flow is predominantly upward through the overburden. In the vicinity of HG-7, however, the vertical gradient was estimated to be between -0.2 and -0.4, such that flow is predominantly downward. The hydraulic head in the limestone is also comparatively lower in the vicinity of HG-7, relative to those directly south, in the vicinity of HG-3 (see Figure 8b). This difference in hydraulic conditions in the limestone in the vicinity of HG-7 suggests potential presence of a higher hydraulic conductivity zone within the limestone in this area.

Based on the hydraulic head contours in Section B-B'(Figure 10), the horizontal hydraulic gradient in the sandstone unit is approximately 0.003. A component of groundwater flow in the sandstone unit, in the vicinity of the proposed mine pit area, is directed upward across the sandstone-limestone contact, with an upward hydraulic gradient ranging from 0 to 0.02.

Due to the absence of a sufficient number and spacing of wells completed within the weathered granite, the groundwater flow direction in this unit cannot be confirmed. However, the hydraulic head contours shown in Section B-B' indicate that groundwater flow through the weathered granite is also likely horizontal with some upward vertical flow.

5.3 Time-Series Water-levels and Pumping Rates

The time series plots of hydraulic head recorded at each of the wells throughout the pumping test program - from August 2 to 20, 2008 are provided in Figures 11, 12, and 13. These figures also provide the recorded pumping rates for the dewatering wells over that time so that the hydraulic responses in the wells can be matched to the start of pumping in the dewatering wells. These plots show that prior to the start of testing, prior to the step-drawdown tests between August 6 and 9,, the dewatering wells underwent short periods of pumping (two hours or less), to test the operation of the pumps and generators, and also to further develop the limestone wells to remove debris that had accumulated in these open-hole wells prior to the start of the pumping test program.

5.4 Analysis of the Step-Drawdown Tests

The graphical plots of drawdown in the dewatering wells over time (plotted in a semi-log scale) during the step-drawdown tests are presented in Figure 14. The analysis of these plots includes projecting forward the drawdown slope at each constant-rate pumping step by several days based on the planned duration of pumping for the well during the pumping test. Based on an analysis of these plots, the optimum pumping rates for the dewatering wells were selected as following:

- HG-7LS at 900 US gallons per minute (gpm);
- HG-7SS at 100 US gpm;
- HG-3LS at 300 US gpm; and,
- HG-3SS at 100 US gpm.

These optimum pumping rates were derived from a consideration of the pumping rate that caused the water levels in the dewatering well to be below the top of limestone but without dropping below the level of the pressure transducer and pump intake. The optimum pumping rate also considered the additional drawdown in the pumping well that could be generated as a result of well interference. Well interference was estimated from the maximum drawdown observed in a given well as a result of step-drawdown tests for the other dewatering wells. The constant pumping rate steps applied, and the maximum drawdown observed, at each of the dewatering wells during the step-drawdown tests are presented in Table 3.

The step-drawdown test for HG-7 LS generated up to 1 m of drawdown in the southern dewatering wells, which are approximately 1.3 km distant (at HG-3). The step-drawdown test for HG-3 LS generated up to 0.5 m of drawdown in the northern dewatering wells (at HG-7). The step-drawdown tests for sandstone dewatering wells did not generate drawdown at the distant dewatering wells. All of the step-drawdown tests generated drawdown in the adjacent dewatering wells, as shown in Table 3.

Based on the pumping rate and pumping well drawdown data presented in Table 3, the specific capacity of the northern limestone well, HG-7 LS, ranged from approximately 24 to 46 USgpm/ft (422 to 818 m^3/d/m; 0.0049 to 0.0095 m^3/s/m). The specific capacity of the southern limestone well, HG-3 LS, ranged from approximately 4 to 14 USgpm/ft (77 to 249 m^3/d/m; 0.0009 to 0.0029 m^3/s/m). The north and south sandstone wells, HG-7 SS and HG-3 SS, respectively, had specific capacities that were relatively consistent, ranging from approximately 1.1 to 1.4 USgpm/ft (19 to 26 m^3/d/m; 0.0002 to 0.0003 m^3/s/m), as shown on Table 3.

5.5 Analysis of Pumping Test

5.5.1 Maximum Drawdown Observed during the Pumping Test

The maximum drawdown observed in each of the four hydrostratigraphic units, as recorded on the fifth day of the pumping test, is presented in plan view in Figures 15a to 15c, and in cross-section in Figures 16 and 17. The maximum drawdown recorded at each well is also listed in Table 2.

The maximum drawdown in the overburden ranged from 0.01 m to 0.06 m at the Site, except at MW-OB-1 (located approximately 30 m from HG-7), where the drawdown was 2.4 m (Figure 15a). During the pumping test, the ground surface remained saturated, even in the vicinity of MW-OB-1 (the water level in the peat was observed to be at the ground surface), possibly due to horizontal surface or subsurface flow in the peat. The inundated ground surface conditions are visible in the photo of HG-7 in Figure 3.

Figure 15b presents contours of the maximum drawdown in the limestone during the pumping test. These contours represent the inferred maximum extent of the cone of depression during the pumping test. The radius of influence of the pumping test is estimated to have been up to approximately 3 km around the proposed pit area based on these drawdown contours. The cone of depression in Figure 15b is considered an over-simplification, as the multi-well pumping test likely generated two cones of depression, one around each of the two pumping centers (*i.e.*, one cone of depression centered around HG-7 and the other around HG-3). These cones likely approached each other or merged in the central area of the proposed mine pit, the extent of which cannot be confirmed in the absence of limestone wells in between the two pumping centres.

The cross-sections presented in Figures 16 and 17 indicate that a cone of depression was generated within each of the hydrostratigraphic units. As a result, groundwater flow at the Site was directed towards the dewatering wells, and generally toward the pit area, in all hydrogeological units, during the pumping test.

5.5.2 Wide Area Analysis

The Copper and Jacob (1946) distance-drawdown method was selected as the primary method to analyze the pumping test data for the limestone aquifer because it provided wide-area estimates of the aquifer parameters useful for application to the groundwater flow model (see Section 7.0). Figure 18 presents the results of the distance-drawdown analysis, which was carried out separately for each limestone dewatering well (HG-7 LS and HG-3 LS) and was based on the drawdown observed in the limestone wells at a time of 4.6 days after the start of the pumping test (*i.e.*, at approximately the end of pumping). The drawdown observed at this time was considered representative of "late-time" data that is generally applicable to the distance-drawdown method.

Table 4 summarizes the results of the distance-drawdown analysis for transmissivity and storativity of the limestone. The region around HG-7 is referred to as the North Pit Wall zone and the region around HG-3 is referred to as the South Pit Wall zone. Transmissivity at the North Pit Wall (NPW) is estimated to be $6.9x10^{-3}$ m^2/s in the shallow limestone (T_{SLS}) and $2.7x10^{-3}$ m^2/s in the limestone unit (T_{LS}). Transmissivity at the South Pit Wall (SPW) is estimated to be $1.8x10^{-3}$ m^2/s in the shallow limestone (T_{SLS}) and $8.7x10^{-4}$ m^2/s in the limestone unit (T_{LS}). Storativity estimates range from $2.5x10^{-6}$ to $4.5x10^{-3}$. The limestone transmissivity values calculated using data from the LS wells are considered more representative as the LS wells generally experienced the greatest drawdown.

Well efficiency, which quantifies the variation between the water level in the well and the water level in the formation adjacent to the well, is estimated to be 90% at HG-7 LS and 93% at HG-3 LS. A well efficiency greater than 90% is considered to be an indication of a good well construction. As the limestone dewatering wells are open hole wells, these high efficiencies are generally expected.

5.5.3 Detailed Analyses

Groundwater flow to the dewatering wells at the Site during the pumping test caused water levels in the limestone aquifer to decline in a nonlinear fashion over time. As such, the time-varying drawdown data generated by the pumping test were also used to estimate the hydraulic properties of the limestone aquifer based on analytical solutions for non-steady flow to the pumping wells. The results of these analyses, presented in Table 5, generally support the distance-drawdown results presented above and also provide additional information regarding conditions in the aquifer and additional aquifer parameters of interest, such as specific yield. Plots of the analytical solution results are provided in Appendix I.

The results listed in Table 5 from Butler's (1988) solution indicate that a region of high transmissivity (T) exists within approximately 350 m of HG-7 (*i.e.,* North Pit Wall zone). This analysis accounted for pumping at all four dewatering wells by solving the groundwater flow equation at several time intervals during the pumping test and applying the principle of superposition. The associated transmissivity estimates from the Butler solution for the North Pit Wall zone (T_{SLS}: 1.4x10^{-2} m^2/s and T_{LS}: 7.5x10^{-3} m^2/s) are 2 to 3 times greater than those estimated using the distance-drawdown method presented previously. However, the storativity of the shallow limestone for the North Pit Wall zone is almost an order of magnitude greater than that estimated using the distance-drawdown method. As indicated previously, the limestone transmissivity values calculated using data from the LS wells are considered more representative as the LS wells generally experienced the greatest drawdown. In the region extending beyond 350 m from HG-7 (*i.e.,* including the South Pit Wall zone), the estimated transmissivity of the limestone based on the Butler solution (2.0x10^{-3} m^2/s) is similar to the range estimated using the distance-drawdown method. In the regions extending more than 2 km from HG-7 to the north and west, and more than 3 km from HG-7 to the south, the estimated transmissivity of the limestone (4.0x10^{-3} to 5.6x10^{-3} m^2/s) is within the range estimated for the near-pit zone (2.0x10^{3} m^2/s near South Pit Wall to 7.5x10^{-3} m^2/s at the North Pit Wall) based on the Butler solution.

To check the quality of the distance-drawdown results for the South Pit Wall zone presented previously, the Theis (1935) solution was used to estimate the hydraulic properties of the South Pit Wall zone. To enable this analysis, the drawdown data for the South Pit Wall zone was corrected for well interference from HG-7 LS (North Pit Wall Area) and the 1-day delay in the start of pumping at HG-3 LS during the pumping test (see Section 4.3 for pumping test methodology). The Theis analysis accounted for pumping from both the limestone and sandstone dewatering wells by applying the principal of superposition. The associated transmissivity estimates based on the Theis solution (T_{SLS}: 2.5x·10^{-3} m^2/s and T_{LS}: 1.3x10^{-3} m^2/s) are approximately 1.5 times greater than those estimated using the distance-drawdown method presented previously.

5.5.4 Heterogeneity of the Limestone

The heterogeneity of the limestone aquifer, based on the analyses of responses to the pumping test is approximated by the following ratios in transmissivity:

North Pit Wall vs. South Pit Wall

- T_{SLS} at North Pit Wall > T_{SLS} at South Pit Wall by a factor of: **4**
- T_{LS} at North Pit Wall > T_{LS} at South Pit Wall by a factor of: **3**

Neat Pit vs. Far Pit

- T_{LS} approx. 2 km from pit > T_{LS} at South Pit Wall by a factor of: **3**
- T_{LS} at North Pit Wall > T_{LS} approx. 2 km from pit by a factor of: **2**

5.5.5 Area Impacted by Pumping During the Pumping Test

Based on the distance-drawdown analysis using the LS wells, the radius of influence of the pumping test in the limestone is estimated to have been 3 km around HG-7 LS and 2.4 km around HG-3 LS, as shown in Figures 15b and 18. Figure 18 also implies that theoretically, the radius of influence in the uppermost portion of the limestone (using the SLS wells) is larger than that of the remaining limestone (using the LS wells which penetrate most of the remaining portions of the limestone). However, this extrapolation cannot be verified in the absence of SLS well data beyond 300 m from the dewatering wells. The drawdown in the SLS wells is consider to be largely the result of downward leakage from the uppermost portion of the limestone to underlying more permeable portions of the limestone. Therefore, it is expected that the drawdown in the uppermost portion of the limestone (represented by the SLS wells) beyond 300 m would be less than or equal to that of the remaining limestone (represented by the LS wells; Figure 18). Consequently, it is expected that the radius of influence in the uppermost portion of the limestone would be equal to or less than that determined using the LS wells.

5.5.6 Conversion to Unsaturated Conditions in the Shallow Limestone

During the pumping test, the water level dropped below the top of the limestone in the region within 75 to 300 m of HG-7 and the region within 40 m of HG-3. The Moench and Prickett (1972) method was used to assess the unconfined storage properties of the limestone aquifer for wells completed within these regions. This method solves the groundwater flow equation analytically, for flow to a pumping well in a confined aquifer that undergoes a conversion to unconfined conditions. The specific yield (S_y) of the shallow limestone unit was estimated to be between 0.01 and 0.02, as shown on Table 5. This estimate lies within the typical range of S_y for limestone, which has been reported to range from 0.005 to 0.05 (ASCE, 1996). It should be noted that this analysis yielded results for T and S for the limestone that are considered less accurate than the values reported above. This caveat is based on the assessment that the response of the aquifer to pumping was dominated by the zone of high transmissivity near HG-7, rather than the conversion to unsaturated conditions in the shallow limestone unit.

5.5.7 Assessment of Vertical Hydraulic Conductivity for the Overburden

The Hantush-Jacob (1955) steady state solution for leaky aquifers was used to estimate the vertical hydraulic conductivity of the overburden clay (*i.e.,* the overlying aquitard), from the measurements of drawdown made during the pumping test. Leakage and vertical hydraulic conductivity estimates determined from the maximum drawdown observed at six overburden wells are summarized in Appendix I. The vertical hydraulic conductivity estimates from the more distant observation wells are considered more representative because leakage generated by the aquitard becomes a larger portion of the well discharge with greater distance from the pumping wells. Based on the results from the overburden wells situated at least two kilometres from the pumping wells (MW7-OB, MW8-OB and MW9-OB), the vertical hydraulic conductivity (K_V) of the overburden is estimated to range from $4x10^{-9}$ m/s to $6x10^{-9}$ m/s.

5.6 Analysis of Single-Well Response Tests

The horizontal hydraulic conductivity estimates determined from the single-well response tests are summarized in Table III-1 in Appendix III. The horizontal hydraulic conductivity estimates for the overburden aquitard ranged from $6x10^{-6}$ m/s to $6x10^{-9}$ m/s, with a geometric mean of approximately $4x10^{-8}$ m/s. This mean is one order of magnitude greater than the mean vertical hydraulic conductivity estimate for the overburden based on the pumping test analyses ($K_V = 5x10^{-9}$ m/s, see Section 5.5), indicating an anisotropy ratio (K_H/K_V) of 10 for the overburden aquitard.

The horizontal conductivity for weathered granite was estimated to be $4x10^{-7}$ m/s on the north side of the proposed pit area (MW-2-GR) and $4x10^{-9}$ m/s on the south side of the proposed pit area. The geometric mean of these results is approximately $4x10^{-8}$ m/s.

5.7 Quality of Pumped Groundwater

The results of the chemical analyses of the groundwater samples collected from the four dewatering wells at the end of the pumping test, including two duplicate samples taken for quality assurance/quality control (QA/QC) purposes, are provided in Tables 6 and 7. The laboratory report is provided in Appendix III. Table 6 also includes field parameters that were measured immediately prior to sampling. Field parameters measured throughout the course of the pumping test (recorded between August 6 and August 16) are presented in Appendix IV.

Based on the field parameter results presented in Table 6, the groundwater in the limestone and sandstone aquifers is characterized by:

- Near-neutral pH (ranging between 7.4 and 7.7);
- Moderate specific conductance (ranging between 451 µS/cm and 504 µS/cm);
- Low redox potential (Eh ranging between 251 mV and 271 mV);
- Relatively low oxygen content (2 to 3 mg/L) except at HG-7 (8 mg/L); and,
- High ferrous iron concentrations relative to total iron concentrations (Fe^{2+} ranging from approximately 0.3 to 0.6 mg/L, compared to total iron concentrations ranging from 0.13 to 0.73 mg/L in Table 7).

These results are generally consistent with the time-series field parameter plots presented in Appendix IV. The dissolved oxygen content in groundwater was outside the Canadian Council of Ministers of the Environment - Environmental Quality Guidelines (CCME-EQG) for freshwater aquatic life (<5.5 mg/L) at all locations except HG-7-LS. In addition, the dissolved ferrous iron content at HG-3 LS (0.6 mg/L) exceeded the applicable CCME freshwater guideline (0.3 mg/L) and the GCDWQ criterion (0.3 mg/L)

The analytical results in Tables 6 and 7 indicate that groundwater discharged from all the dewatering wells had fluoride concentrations (0.24 to 0.70 mg/L) that exceeded the CCME freshwater aquatic life guideline (0.12 mg/L). In addition, HG-3 LS had concentrations of total aluminum (0.11 mg/L) and total iron (0.73 mg/L) that exceeded both the respective CCME freshwater aquatic life guidelines and the respective Guidelines for Canadian Drinking Water Quality (GCDWQ). Groundwater discharged from HG-7 LS had concentrations of total iron (0.34 or 0.36 mg/L) that exceeded both the CCME freshwater aquatic life guideline (0.3 mg/L) and the GCDWQ criterion (0.3 mg/L). HG-3 SS had a concentration of total zinc (0.073 mg/L) that exceeded the CCME freshwater aquatic life criterion (0.03 mg/L) in one of two duplicate samples, while the other duplicate had a zinc concentration below the method detection limit (<0.05 mg/L). None of the dissolved metals concentration exceeded the MWQSOG.

5.8 Quality Assurance/Quality Control Results

For quality assurance purposes, two field duplicate groundwater samples were collected and were analyzed to assess the variability in analytical results which could be related to the field sampling procedures and/or the laboratory analysis. The QA/QC results for the groundwater samples are presented in Table 8. The relative percent difference (RPD) was used to evaluate the sample result variability. The RPD is the absolute difference between two values (*i.e.*, the sample and its duplicate) divided by the mean. For water samples, an RPD of less than 20% represents a good correlation.

As shown in Table 8, the calculated RPDs ranged between 1 and 17 percent for total metals, anions, and nutrients, except for total zinc with an RPD of 37% and ammonia with an RPD of 25%, for the samples from HG-3 SS. Excluding zinc and ammonia, these results indicate acceptable sample correlation and analytical results of good quality in general. The RPD result for ammonia (25%) was not considered a significant concern because it was reasonably close to the data quality objective (DQO) of 20% and the ammonia concentrations did not exceed the applicable regulatory criteria. However, the RPD result for zinc (37%) was of concern because it caused an inconsistency in the interpretation of the zinc concentrations at HG-3SS when they were compared to the CCME aquatic life guideline for zinc (*i.e.,* only one of the two duplicate samples exceeded this regulatory criteria while the other sample had a zinc concentration which was below the detection limit). The cause of this RPD result for zinc is unknown but could be related to the presence of particulate matter in the one sample with the higher zinc concentration, as the groundwater samples for total metals analyses were not filtered. This result does not render unacceptable the water analyses as a whole.

The RDP values for several dissolved metals exceeded the DQO of 20% (*i.e.,* aluminum, arsenic, barium, calcium, copper, lead, manganese, nickel, selenium, vanadium and zinc). Several of the QAQC sample pairs for dissolved metals had non-detectable concentrations in one of the pairs. These results may be due to the delay in filtration and analysis of the groundwater samples for dissolved metals analysis (*i.e.,* delay of 67 days from the time the samples were collected, as discussed previously in Section 4.4) which potentially allowed some dissolved metals to precipitate out of solution while the samples were held in storage at the laboratory. Therefore, the dissolved metals concentrations may be underestimated (*i.e.,* the actual dissolved metals concentrations in groundwater may be higher).

The QA/QC procedures, and the results of internal QA/QC analyses conducted by the analytical laboratory, are documented in the Analysis Report prepared by the laboratory, and are provided in Appendix III. A review of the results of these QA/QC analyses indicates that the reproducibility of the analytical results is generally good, and that the reported results are considered acceptable for the assessment of chemical concentrations in water from the Site.

5.9 Summary

A summary of the hydrogeological parameters considered representative for each of the four main hydrostratigraphic units at the Site is presented in Table 9. These values are based on the results of the pumping test and single-well response tests and also consider the conceptual hydrogeological model of the Site outlined below (Section 6.0). In addition, the results of the pumping test program indicate the following:

1. The influence of significant hydrogeologic (recharge or zero-flux) boundaries were not identified in the hydraulic response to pumping during the pumping test program. This is likely because of the distance to the nearest surface water body in contact with the limestone aquifer (*i.e.*, the Minago River is approximately 10 km from the dewatering wells) and the limited duration of the pumping test. Oakley Creek, located approximately 1 km south of the dewatering wells is likely not in direct contact with the limestone aquifer (*i.e.*, its bed lies in the overburden); therefore, it was not observed to act as a significant hydrogeologic boundary. Under pre-pumping conditions, the Minago River may be an area of groundwater discharge. Under sustained groundwater pumping conditions, this river could convert to a source of groundwater recharge to the limestone aquifer. Limestone outcrops 2 km northwest and 9 km south of the Site are likely areas where recharge to the limestone aquifer occurs through net infiltration of precipitation.

2. The overburden was not significantly affected by pumping during the pumping test, except in the near vicinity (approximately 30 m) of the North Pit Wall zone (HG-7).

3. Based on the groundwater quality results, the groundwater depicts background concentrations of total aluminum, total iron, total zinc and total fluoride that exceed the applicable CCME-EQG freshwater aquatic life standards. If the groundwater is being considered a possible source of potable water for the mine camp, it may require filtration to meet the GCDWQ for turbidity and Total Suspended Solids (TSS)..

6.0 CONCEPTUAL MODEL

Based on the regional hydrogeological setting, the well logs, and the hydraulic response to pumping, a conceptual model is proposed for groundwater flow in the upper 75 m of the subsurface at the Site. The limestone aquifer forms the main aquifer at the Site. The limestone aquifer is confined by the overburden clay deposit: a 5 m-thick aquitard. The upper 20 to 30 m of the limestone unit is more permeable than the deeper limestone. The ambient groundwater flow direction in the limestone is from west to east. During pumping, the water level in the limestone was lowered below the top of the limestone (*i.e.,* below the bottom of the overburden unit) within about 100 m of the dewatering wells, under the pumping rates of the pumping test. In these regions, the limestone aquifer becomes unconfined, and groundwater is released through aquifer drainage. Some amount of leakage from the overburden aquitard into the limestone aquifer occurs, providing some additional flow to the dewatering wells. The sandstone aquifer is affected by pumping in the limestone, and experiences greater drawdown than in the limestone because of its comparatively lower hydraulic conductivity. The weathered granite that is in direct contact with the sandstone aquifer is likely more permeable than the underlying non-weathered granite. The non-weathered granite likely acts as a lower confining unit, or an aquitard, that provides minimal leakage to the sandstone unit, possibly through vertical fractures.

7.0 NUMERICAL GROUNDWATER MODEL

The conceptual hydrogeologic model presented in previous section was used as a basis for the construction of a numerical hydrogeologic model for the site. Following calibration this model was used to predict the dewatering requirements for limestone and sandstone units that will be intersected by the proposed open pit. The following sections present the details of model construction and calibration, whereas Section 8.0 presents the results of the predicted dewatering requirements.

7.1 Model Construction

7.1.1 Model Code Selection

The numerical code used for the construction of the groundwater model for the site must be able to adequately represent key characteristics of the hydrogeologic regime at the site. Considering this, FEFLOW, a finite element modelling code from WASY Institute in Germany (Diersch, 2008) was utilized. FEFLOW is capable of simulating transient groundwater flow in three-dimensions in heterogeneous porous media, and has the capability of representing highly-permeable features (*e.g.*, water-conductive faults, fractured rock zones) using specialized discrete feature elements. FEFLOW is superior to groundwater models that are based on a finite difference approach, such as MODFLOW, as the finite element mesh more accurately represent the site hydrostratigraphy while providing sufficient spatial resolution for accurate predictions in the area of interested (*i.e.*, near pumping wells).

7.1.2 Model Mesh

Figure 19 presents the extent of the model domain and the details of the finite element mesh. Horizontally, the model extends approximately 50 km in both the east-west and north-south directions, and is centered on the proposed open pit. Mesh spacing varies from approximately 30 m in the area of the proposed pit to about 500 m elsewhere in the model, which allows for steep hydraulic gradients that are expected to develop near the pit in response to pumping. Overall, the model spans an area of approximately 2,470 km^2.

Vertically, the model is divided into eight layers. The elevation of the model top was set to topographic elevation based on digital elevation model (DEM) obtained from the Manitoba Science, Technology, Energy and Mines website (http://www2.gov.mb.ca/itm-cat/freedownloads.htm). Layers one and two represent the overburden throughout most of the model domain, except for the area where the limestone outcrops are inferred to be present. At locations of these outcrops, the two topmost layers of the model are assigned limestone properties. Layers three and four represent the limestone unit, and layer five represents the sandstone unit. The elevation of the top and bottom of the overburden, limestone, and sandstone near the proposed open pit was based on elevation surfaces provided by Wardrop. At greater distances from the pit these three units were assumed to have similar thicknesses as those near the pit, and the limestone unit was assumed to dip gently towards the northeast in agreement with regional data presented in Betcher et al. (1995, pg 5). Layers six, seven, and eight were used to represent the underlying granite. The respective thickness of these layers was 10 m, 30 m, and 60 m. The base of the model was set at 100 m beneath the sandstone/granite contact.

7.1.3 Boundary Conditions

Three types of boundary conditions were used in the model: specified head, specified flux, and no-flow (zero flux). The location of these boundaries are presented on Figure 20

Specified head boundaries were used to simulate all major and minor lakes, including William Lake to the southwest from the site, Winnipeg Lake to the southeast, and Kiskit Lake to the northeast. Water level elevations in these water bodies were based on data provided by URS (2008), where available, and on the DEM data. It was assumed that all lakes are in direct hydraulic connection with the limestone unit. Specified heads were also used to represent rivers and creeks. The water elevations of all streams were based on the DEM data and, except for Minago River east of Highway 6, all streams were assumed to be underlain by overburden. Based on field observations discussed in Section 5.1, Minago River east of Highway 6 was considered to be in good hydraulic connection with the limestone unit. In addition, a specified head boundary was assigned along the portion of the west model edge to represent regional inflow of groundwater from limestone outcrops located west of the model domain. Finally, specified head boundaries, constrained to allow outflow of groundwater only, and set to ground elevation, were applied along the top of the model. These boundaries represented seepage faces and water-logged areas in portions of the model where artesian conditions in the limestone unit are expected.

Specified flux boundaries were used to represent groundwater recharge from precipitation. These boundaries were assigned everywhere in the top layer of the model, and it was assumed that recharge values would be higher in the areas of limestone outcrops southwest and west of the site, and lower in the areas underlain by the overburden. Recharge values were adjusted during model calibration, as discussed in Section 7.2.3. A specified flux boundary was also assigned along the bottom of the model to simulate upward hydraulic gradient between granite and limestone units. This flux value was also adjusted during model calibration. In addition, specified flux boundaries were used to represent pumping wells HG-3 and HG-7 during model calibration.

No-flow boundaries (zero flux) were applied along an inferred flowline north and south of the site. A no-flow boundary was also assigned to an area east of the site, between Kiskit Lake and Winnipeg Lake, in the direction where regional data suggest that the limestone unit may be pinching out. Because the locations of these no-flow boundaries were somewhat arbitrary, preliminary model simulations were completed to establish that these boundaries would not be intersected by the drawdown cone created during mine dewatering.

7.2 Model Calibration

The hydrogeologic model was calibrated to the drawdown response observed during the 5-day pumping test, to static hydraulic heads recorded prior to the test, and to baseflow measurements in the Minago River and Oakley Creek. Initial hydrogeologic parameters assigned to the model were based on the values calculated from field investigations, as discussed in Section 5.0.

7.2.1 Pumping Test

A local-scale model that utilized a portion of the finite element mesh presented in Figure 19 was used for transient calibration to the drawdown recorded during the 5-day pumping test. The rationale for using this local-scale model was that the drawdown cone created at the end of the test extended to a distance of less than approximately 3 km from the pumping wells; therefore, in the transient calibration it was not necessary to simulate groundwater flow at greater distances from the wells. This smaller model domain allowed a finer model thus permitting more accurate representation of hydraulic head changes during the test, while maintaining a relatively moderate number of mesh elements thereby limiting the run time of simulation trails during calibration. The mesh spacing graded from approximately 1.5 m near pumping wells HG-3 and HG-7 to 100 m away from these wells. Furthermore, based on the principle of superposition, only drawdown response was simulated in the local-scale model such that regional groundwater flow was not represented.

The 5-day pumping test was simulated by assigning specified flux boundaries at the locations of wells HG-3 and HG-7. These boundaries were assigned in the limestone and sandstone units, and the flux values were based on the pumping rates measured during the 5-day test. The model was run for a period of seven days (five days of pumping and two days of recovery) and the drawdowns predicted at all observation wells were compared to the measured drawdowns. Initially, several manual calibration runs were conducted, where individual model parameters were incrementally adjusted to improve the match between simulated and measured drawdown. The calibration was then refined using an automated procedure that utilized parameter estimation code PEST (Doherty, 1999).

Figure 21 presents the drawdown cone predicted for the limestone unit by the calibrated model at the end of the 5-day pumping period, whereas Appendix V shows a comparison of model predicted drawdown versus measured drawdown at each monitoring well. The spatial extent of the drawdown cone in limestone predicted by the calibrated model is in good agreement with field observations, although the model predicted drawdown in the shallow limestone is somewhat greater than the measured drawdown and the predicted drawdown at the nearby deep limestone locations is slightly less than measured. The model was also capable of accurately predicting drawdown response over time in the overburden, sandstone, and granite. Overall, the results of calibration to the 5-day pumping test are considered good. The hydrogeologic parameters estimated for the area near the pumping wells resulting from the calibration of this local-scale model were transferred to the original model for subsequent calibration to static hydraulic heads and baseflow.

7.2.2 Static Hydraulic Heads and Baseflow

The targets for the steady-state calibration that represented pre-pumping conditions consisted of hydraulic heads measured in monitoring wells before pumping begun (Section 5.2) and streamflow data summarized by URS (2008). Two streamflow gauging stations, MRW1 on the Minago River and OCW1 on the Oakley Creek, were selected because they had the longest data record and provided stream information for the catchments that were closest to the proposed open pit. At these two locations low flow conditions measured in August and September of 2007 were assumed to correspond to actual baseflow.

During model calibration, adjustments were made to the hydraulic conductivity of the limestone aquifer at distances greater than approximately 3 km from the pumping well, and to the flux values representing recharge to groundwater flow from precipitation and upward groundwater flow from the granite unit. Hydrogeologic parameters representing other hydrostratigraphic units, and the limestone aquifer in the vicinity of the 5-day pumping test were not changed from the ones arrived at during calibration to the pumping test.

Figure 22 presents the groundwater flow pattern in the limestone unit predicted by the calibrated model for the pre-pumping conditions. In agreement with the site conceptual model, the predicted groundwater flow direction near the proposed open pit is towards the east under relatively moderate horizontal hydraulic gradient of approximately 0.003. This flow is predicted to occur in response to groundwater recharge at the limestone outcrops located southwest and west of the site, and to a lesser degree, recharge to the overburden. Groundwater flowing through the area of the proposed pit is predicted to discharge to Oakley Creek east of the site and to Lake Winnipeg to the southeast. As presented on the cross-section in Figure 22, the calibrated model correctly reproduces upward groundwater flow through the overburden; artesian conditions in the limestone unit near the proposed pit; and upward hydraulic gradient between granite and limestone.

The baseflow predicted by the calibrated model for the Minago River at station MRW1 and for the Oakley Creek at station OCW1 was 1.5 L/s and 0.5 L/s, respectively. Both values fall within the range of streamflow measured during low flow periods at these stations, suggesting that hydrogeologic parameters assigned within the catchment of these two streams are reasonable.

Figure 23 provides a comparison of hydraulic heads calculated by the calibrated model and measured hydraulic heads for the pre-pumping conditions. The mean error and mean absolute error between predicted and measured values are -0.2 m and 0.5 m, respectively. This indicates that, on average, model predicted heads are 0.2 m lower than the measured values and that the model predictions are within +/- 0.5 m of the measured values. The weighted root-mean-square error is approximately 9%. Considering the scale of the model and the magnitude of drawdown expected during mine dewatering (approximately 70 m in the limestone and sandstone units), these calibration results are considered to be reasonable. Overall, the reasonably good calibration results for the pre-pumping hydraulic heads, baseflow, general groundwater flow patterns, and drawdown response during pumping indicate that the calibrated model can provide predictions of pit dewatering requirements with sufficient accuracy for the mine feasibility planning.

7.2.3 Calibrated Model Parameters

Figure 24 provides a summary of hydrogeologic parameters developed during model calibration. Vertical hydraulic conductivity of the overburden was set to 1×10^{-8} m/s, which is in good agreement with values estimated from the drawdown response in the overburden during the pumping test (Section 5.5.7) and from the single-well response testing (Section 5.6).

Limestone hydraulic conductivity in the vicinity of the open pit, except near wells HG-7, was set to 3.5×10^{-5} m/s. A higher permeability zone with a radius of approximately 350 m was implemented near well HG-7, and the hydraulic conductivity in this zone was set to 1.3×10^{-4} m/s. At greater distance from the proposed pit, two north-northwest – south-southeast trending hydraulic conductivity zones were assigned in the limestone. The hydraulic conductivity in the zone west of the pit was set to 1.5×10^{-4} m/s whereas in the zone to the east was set to 1.0×10^{-5} m/s. The regional permeability pattern adopted for limestone is in agreement with the general understanding of regional hydrostratigraphy (by Betcher et al., 1995), where the limestone units pinches out towards northeast of the site, and increases in thickness towards the southwest. The range of hydraulic conductivity used for limestone in the calibrated model agrees fairly well with values derived during the analysis of the pumping test (Section 5.10), and with values reported in the regional study (Betcher et al., 1995). Storage parameters consisting of a specific yield of 0.025 and specific storage of 2×10^{-6} 1/m are in agreement with values published in the literature (Maidment, 1990) for similar lithologies.

In the calibrated model, sandstone and granite were assigned respective hydraulic conductivities of 1.0 x 10^{-6} m/s and 1.0 x 10^{-8} m/s. As the calibration was based only on data from two monitoring wells completed in each unit, the resulting values are somewhat uncertain. Nevertheless, from the perspective of pit dewatering which will be primarily controlled by groundwater flow in the more permeable limestone, this uncertainty was considered to be not significant for the dewatering system design. It should also be mentioned that the calibrated hydraulic conductivity for the sandstone unit is within the range of values reported in the regional study (Betcher et al., 1995), and the hydraulic conductivity assigned to the granite is in agreement with published data (Maidment, 1990) and experience from other sites.

During calibration, fluxes assigned to specified head boundaries representing recharge from precipitation and upward groundwater flow in granite were varied to improve the match between predicted and measured hydraulic heads in all hydrostratigraphic units. The resulting flux values that were used in the calibrated model are presented on Figure 20. Groundwater recharge in the areas where the overburden is present was set to 110 mm/yr, or approximately 20% of the average annual precipitation at the Grand Rapids climate station. It should be noted that this recharge was automatically applied by the model only in areas where it was possible for recharge to occur (*i.e.*, where artesian groundwater conditions were not present) due to specified head boundaries assigned to the top of the model that were constrained to allow outflow only. A higher recharge value of 274 mm/yr (or approximately 50% of average annual precipitation) was applied in the areas of limestone outcrops southwest and west of the site. In these areas more rapid infiltration of precipitation is expected due to the relatively permeable nature of the limestone (see Section 5.1). Finally, a specified flux boundary that was applied along the bottom of the model was assigned a value of 18 mm/yr, which appears reasonable considering the low permeability of the granite and the vertical hydraulic gradient measured between granite and limestone units.

8.0 DEWATERING SYSTEM DESIGN

The calibrated groundwater model was used to simulate the pumping wells that will be necessary for dewatering of the limestone and sandstone units. The results from the numerical model were used to estimate the number, location, and pumping rates for these wells, and the total pumping rate for the entire wellfield. Based on this analysis typical well installation schematics were developed, and recommendations were provided with respect to the observation well network that will be required to monitoring dewatering progress during mine pit development.

8.1 Mine Dewatering Predictions and Uncertainty

Prior to the full-scale dewatering simulations, preliminary model simulations were conducted to assess the approximate amount of time required for the dewatering to occur once pumping is started. These preliminary simulations, together with the observations gathered during the 5-day pumping test, suggested that limestone dewatering is relatively rapid and that the cone of depression created by dewatering would reach a near-steady state configuration within several months after the full dewatering system is implemented. This relatively rapid response to pumping is primarily related to the low storage and high transmissive properties of the limestone unit. Consequently, it was decided that the model simulations representing the full-scale dewatering system could be conducted in steady-state without considering groundwater storage effects.

Several model runs were completed where the location and number of dewatering wells were varied in an attempt to essentially dewater the limestone unit within the pit area and depressurize the underlying sandstone unit. It is not practical to attempt full dewatering of the sandstone unit as it is of a lower permeability when compared to limestone; therefore it would receive steady recharge from above. Nevertheless, depressurization of the sandstone unit is considered to be sufficient because, due to its relatively low hydraulic conductivity it is not considered to be able to provide significant inflows to the pit. Instead, any localized and minor inflows from sandstone could be mitigated using sub-horizontal drain holes installed from the pit benches.

The dewatering wells considered in the analysis were simulated using specified head boundaries, constrained to allow outflow of groundwater only, that were assigned in model layers representing the limestone and sandstone. It was assumed that pumping from these wells would lower the water level in each well below the limestone/sandstone contact. With drawdown at each pumping well fixed, the model calculated the pumping rate at each well thus allowing rapid evaluation of various dewatering options without constant rate adjustments.

Figure 25 and Figure 26 present the hydrogeologic conditions predicted by the numerical model for a wellfield that provided the required dewatering of the limestone unit without excessive pumping and/or number of pumping wells. The design consists of 12 new dewatering wells evenly-spaced at a distance of approximately 300 m to 400 m along the crest of the ultimate pit, as close to the ultimate pit crest as reasonably possible, and pumping simultaneously from the limestone and sandstone units. The total pumping rate for the wellfield is predicted by the numerical model to be approximately 40,000 m^3/day (7,300 USgpm), and the average pumping rate for an individual well is estimated at about 3,300 m^3/day (600 USgpm). As presented on Figure 25, pumping at these rates is predicted to be sufficient to lower the water table to a depth of 70 m, which is near the sandstone/granite contact. The associated drawdown cone, defined using a 1 m drawdown contour, is predicted to extend laterally in the limestone to a distance of approximately 5,000 m to 6,000 m from the proposed open pit.

Although the groundwater model was developed using a comprehensive hydrogeologic dataset, and was successfully calibrated to the pre-pumping conditions and pumping test, uncertainty exists with respect to the predicted dewatering rates. This uncertainty is inherent in any hydrogeologic assessment, as it is simply not practical to drill boreholes at dense enough spacing that would allow identification and testing of all heterogeneities, discontinuities, etc. To address this uncertainty, a series of sensitivity analyses were conducted such that selected model parameters were varied over their uncertainty ranges, and their influence on the predicted dewatering rates was assessed. These parameters included the hydraulic conductivity of the limestone unit, the hydraulic conductivity of the overburden, and the recharge rate. The results of this analysis suggests that the actual dewatering rate for the entire wellfield could vary from 25,000 m^3/day (4,600 USgpm) to 90,000 m^3/day (16,500 USgpm).

The parameter that had the greatest affect on the dewatering rates was the hydraulic conductivity of the limestone unit. Other model parameters were found to have a relatively small influence on model predictions. Based on the pumping test results for the two limestone wells, the hydraulic conductivity was estimated at $1x10^{-4}$ m/s for the limestone intersected by well HG-3 LS, and $3x10^{-4}$ m/s for the limestone intersected by HG-7 LS (see Table 9). This means that the limestone hydraulic conductivity at HG-7 LS is 3 times that of HG-3 LS. If a third well were installed and tested, it is uncertain whether the hydraulic conductivity would be even higher than $3x10^{-4}$ m/s or even lower than $1x10^{-4}$ m/s. Therefore, in the sensitivity analyses, the hydraulic conductivity of the limestone was increased and decreased by a factor of 2. This change in hydraulic conductivity accounted for nearly 90% of the maximum and minimum mine dewatering rates calculated as part of the sensitivity analyses.

8.2 Dewatering Wells Construction

The recommended dewatering well design includes the following considerations:

- Each well should be drilled 10 m into the granite unit;
- A sump should be placed in the bottom 5 m of the well such that the sump lies within the granite unit;
- A well screen should be placed above the sump such that it is completed in at least 5 m of granite unit, the full extent of the sandstone unit (approximately 10 m), and the bottom 5 m of the limestone unit. The approximate screen length would be 20 m;
- The well casing in the limestone should be slotted throughout most of its length;
- The well annulus around the screened interval should be filled with an appropriate filter pack to minimize fines from entering the well;
- The well annulus that lies within the limestone unit should be filled with gravel to allow free downward drainage; and,
- The pump is installed in the sump in the bottom 5 m of each well.

The above design should allow well pumping to the extent that drawdown in the well will be near the bottom of the screen. This would effectively create a seepage face in the well screen/slotted casing that intersects the sandstone–limestone contact. A schematic of the recommended well design is presented in Figure 27.

Because the design of the existing dewatering wells, HG-7 and HG-3, will not permit dewatering of the full extent of the limestone, up to the limestone/sandstone contact (*i.e.*, the screen or open intervals for the existing wells are not at a sufficient length or depth), these wells may not be adequate for dewatering purposes at the later stage of pit development. Therefore 12 new wells are recommended for the dewatering system design, as outlined previously (see Section 8.1). Additional wells may need to be installed if individual wells within this system are installed in isolated relatively low or high permeable areas around the pit.

8.3 Monitoring Network

As a minimum, one standpipe piezometers will be required for up to two pumping wells, for a total of six standpipe piezometers. Theses piezometers would be screened throughout the entire thickness of limestone and sandstone for the purpose of monitoring the water table position during dewatering. A schematic of the recommended well design is presented in Figure 27.

9.0 SUMMARY AND CONCLUSIONS

The primary focus of the hydrogeological investigation was to estimate the configuration of the dewatering well system required for the operation of the proposed open pit mine; to estimate the total pumping rate required; and to estimate the extent of the drawdown cone created during mining operations. The study concluded that a total of 12 new dewatering wells completed in both the limestone and sandstone aquifers, at equally-spaced distances of approximately 300 m to 400 m along the crest of the ultimate pit, will be required to operate simultaneously. The total quantity of groundwater likely to be generated by these wells is predicted to be 40,000 m^3/day (7,300 USgpm). The average pumping rate for an individual well is estimated to be 3,300 m^3/day (600 USgpm). Limestone dewatering was predicted to be relatively rapid such that the cone of depression created by dewatering would reach near-steady state conditions within several months after implementation of the full dewatering system. This relatively rapid response to pumping is primarily related to the low storage and high transmissive properties of the limestone.

Based on a sensitivity analysis, the actual dewatering rate for the entire wellfield could vary from 25,000 m^3/day (4,600 USgpm) to 90,000 m^3/day (16,500 USgpm). The parameter with the greatest affect on dewatering rates was the hydraulic conductivity of the limestone. This parameter was varied by +/- 2 times over the estimated hydraulic conductivity values. This variation in hydraulic conductivity accounted for nearly 90% of the minimum and maximum discharge rates calculated as part of the sensitivity analyses.

The hydrogeological investigation was successful in the collection of sufficient data and the completion of the necessary analyses to meet all of the project objectives. A summary of the findings of the investigation, as they relate to the objectives of the study are as follows:

- The hydraulic conductivity of the limestone unit at the Site was estimated to range between 1.0×10^{-5} m/s to 1.5×10^{-4} m/s, depending on location and depth. The shallow limestone (up to 40 m depth) was inferred as being more permeable than the deeper limestone due to the greater fracture density in the shallow limestone. A higher permeability zone in the limestone was identified in the vicinity of well HG-7 at the north end of the proposed open pit area. The hydraulic conductivities of the overburden, sandstone, and granite were estimated to be 1×10^{-8} m/s, 1×10^{-6} m/s and 1×10^{-8} m/s respectively. Representative storage parameters for these units were estimated to be a specific yield of 0.025 and specific storage of 2×10^{-6} 1/m.

- The influence of significant hydrogeologic (recharge or zero-flux) boundaries were not identified during the pumping test program. This is likely because of the greater distance to the nearest surface water body in contact with the limestone aquifer (Minago River at approximately 10 km distant) relative to the radius of influence of the test (approximately 3 km). Oakley Creek, located approximately 1 km south of the dewatering wells is likely not in direct contact with the limestone aquifer (*i.e.*, the creekbed lies in the overburden); therefore, it was not observed to act as a significant hydrogeologic boundary. The key hydrogeologic (recharge) boundaries that may affect the dewatering system are the nearest lakes to the west and south of the Site (*i.e.*, William Lake and Lake Winnipeg), and the nearest rivers and creeks to the south-east and north (William River and Minago River). These recharge sources appear to be distributed relatively uniformly around the proposed pit perimeter.

- During the pumping test, the overburden was not significantly affected by pumping, except in the near vicinity of the North Pit Wall zone (HG-7). This indicates that the overburden is an aquitard that is expected to provide some leakage to the limestone aquifer and some additional flow to the dewatering wells. The leakage would likely occur predominantly in the vicinity of the dewatering wells.

- A direct hydraulic connection between the limestone unit and the nearby creeks and rivers (*i.e.*, Oakley Creek and Minago River) was not identified during the pumping test. As indicated previously, this is likely because the creek bed for Oakley Creek in the Site vicinity likely lies within the overburden unit, and the distance to Minago River is greater than the radius of influence of the pumping test.

- Based on the groundwater quality results, the groundwater depicts high background concentrations when compared with the CCME-EQG freshwater aquatic life standards for total aluminum, total iron, total zinc and total fluoride. If the groundwater is being considered a possible source of potable water for the mine camp, it may require settling or filtration to remove Total Suspended Solids and turbidity.

10.0 CLOSURE

We trust that this report on the pumping test program meets your requirements for planning purposes. Should you have any questions, please do not hesitate to contact us.

Yours very truly,

GOLDER ASSOCIATES LTD.

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Attachments

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Table 1: Location of Dewatering and Monitoring Wells

Well Name	NAD'83 ZONE 14 UTM NORTH	UTM EAST	Ground ELEV.	Top of Well	Stickup
	m	m	m.a.s.l.	m.a.s.l.	m
Pumping Wells:					
HG-3 LS	5992847.45	487656.77	245.89	246.89	1.00
HG-3 SS	5992857.95	487658.47	245.98	246.98	1.00
HG-7 LS	5993994.85	487056.57	247.21	248.26	1.05
HG-7 SS	5993984.75	487059.04	247.17	248.22	1.05
Observation Wells:					
MW-OB-1	5994026.08	487057.86	247.35	248.29	0.94
MW-OB-2	5994071.56	487050.07	247.16	248.20	1.04
MW-OB-3	5994103.21	487343.64	246.72	247.60	0.88
MW-OB-4	5992813.12	487681.64	245.71	246.84	1.13
MW-OB-5	5992782.12	487706.24	245.61	247.02	1.41
MW-OB-6	5992660.75	487430.95	246.13	247.33	1.21
MW-OB-7	5996197.10	487635.76	244.89	246.02	1.13
MW-OB-8	5993790.96	489383.37	240.82	241.95	1.13
MW-OB-9	5991490.11	488407.52	243.58	244.56	0.98
MW-SLS-1	5994027.41	487057.94	247.21	248.21	0.99
MW-SLS-2	5994066.57	487051.00	247.17	248.20	1.03
MW-SLS-3	5994103.97	487341.27	246.65	247.55	0.90
MW-SLS-4	5992815.51	487681.22	245.60	246.58	0.98
MW-SLS-5	5992779.40	487703.58	245.53	246.68	1.15
MW-SLS-6	5992663.53	487430.71	246.13	247.23	1.10
MW-LS-2	5994067.23	487038.93	247.22	248.27	1.04
MW-LS-5	5992774.04	487706.88	245.60	246.61	1.01
MW-LS-7	5996198.77	487632.33	244.99	246.64 *	1.64
MW-LS-8	5993791.16	489380.18	240.87	242.90 *	2.04
MW-LS-9	5991493.31	488409.36	243.54	244.91 *	1.38
MW-SS-2	5994070.24	487040.64	247.16	248.33	1.17
MW-SS-5	5992781.61	487699.45	245.67	246.56	0.88
MW-GR-2	5994070.48	487047.49	247.05	248.08	1.03
MW-GR-5	5992770.51	487697.33	245.67	246.64	0.96

Notes:
* Value includes pipe added to the well before the pumping test, due to artesian conditions.
m.a.s.l. - meters above sea level

Table 2: Pre-Pumping Water Levels and Maximum Drawdown Levels

Well Name	Pre-pumping Water Level August 2 to 9, 2008			Water Level at Maximum Drawdown August 16, 2008 11:00AM			Maximum Drawdown
	m.a.s.l.	mbgs	mbtp	m.a.s.l.	mbgs	mbtp	m
Pumping Wells:							
HG-3-LS	246.02	-0.13	0.87	228.74	17.14	18.14	17.27
HG-3-SS	246.23	-0.25	0.75	204.37	41.60	42.60	41.86
HG-7-LS	246.34	0.87	1.92	227.92	19.29	20.34	18.42
HG-7-SS	246.84	0.33	1.38	215.80	31.38	32.43	31.05
Observation Wells:							
MW-OB-1	246.58	0.77	1.72	244.17	3.18	4.12	2.41
MW-OB-2	247.00	0.16	1.20	246.94	0.22	1.26	0.06
MW-OB-3	246.61	0.11	0.99	246.59	0.13	1.02	0.02
MW-OB-4	245.57	0.14	1.27	245.53	0.18	1.31	0.04
MW-OB-5	245.47	0.14	1.55	245.41	0.20	1.61	0.06
MW-OB-6	246.15	-0.03	1.18	246.14	-0.01	1.19	0.01
MW-OB-7	244.72	0.17	1.30	244.71	0.18	1.31	0.01
MW-OB-8	240.77	0.05	1.18	240.71	0.11	1.24	0.06
MW-OB-9	243.53	0.04	1.03	243.50	0.07	1.06	0.03
MW-SLS-1	246.30	0.91	1.91	237.26	9.95	10.95	9.04
MW-SLS-2	246.39	0.78	1.81	237.10	10.07	11.10	9.29
MW-SLS-3	246.21	0.44	1.34	239.96	6.69	7.59	6.25
MW-SLS-4	245.76	-0.16	0.81	240.98	4.62	5.60	4.78
MW-SLS-5	246.05	-0.52	0.63	242.11	3.41	4.56	3.94
MW-SLS-6	246.38	-0.25	0.85	245.37	0.76	1.86	1.01
MW-LS-2	246.33	0.90	1.94	233.59	13.63	14.68	12.74
MW-LS-5	246.24	-0.65	0.36	232.93	12.67	13.68	13.31
MW-LS-7	246.45	-1.46	0.19	244.90	0.10	1.74	1.55
MW-LS-8	242.72	-1.85	0.18	242.15	-1.28	0.75	0.57
MW-LS-9	244.67	-1.13	0.24	243.39	0.15	1.52	1.28
MW-SS-2	246.90	0.26	1.43	233.81	13.36	14.52	13.09
MW-SS-5	246.18	-0.51	0.38	236.60	9.07	9.95	9.58
MW-GR-2	246.90	0.15	1.18	233.39	13.66	14.69	13.51
MW-GR-5	246.20	-0.52	0.44	236.92	8.75	9.72	9.28

Notes:
m.a.s.l. - meters above sea level
mbgs - meters below ground surface
mbtp - meters below top of pipe

Table 3: Step-Drawdown Tests

Pumping Well	Date	Step	Pumping Rate	Duration	Drawdown at Pumping Well	Drawdown Interference				Specific Capacity		
						HG-7 SS	HG-7 LS	HG-3 LS	HG-3 SS			
			USgpm	hours	m	m	m	m	m	USgpm/ft	$m^3/s/m$	$m^3/d/m$
HG-7 LS	August 7, 2008	1	420	1.3	2.8					46	9.5E-03	818
		2	705	2	6.3	14	-	1	1	34	7.1E-03	610
		3	1200	2.4	15.5					24	4.9E-03	422
HG-3 LS	August 8, 2008	1	180	2	3.9					14	2.9E-03	249
		2	280	2	10.4					8	1.7E-03	146
		3	480	2.1	34 (to pump)	0.5 ?	0.5 ?	-	2	4	8.9E-04	77
		4	350	0.75	15.2					7	1.5E-03	126
HG-7 SS	August 6, 2008	1	159	1.5	39					1.2	2.6E-04	22
		2	182	0.27	47.5	-	0.6			1.2	2.4E-04	21
		3	104	1.25	29.6					1.1	2.2E-04	19
HG-3 SS	August 9, 2008	1	44	2	11.3					1.2	2.5E-04	21
		2	98	2	20.7					1.4	3.0E-04	26
		3	157	2.8	37.9			0.7		1.3	2.6E-04	23

Table 4: Distance-Drawdown Analysis

Zone	Hydrogeologic Unit	COOPER-JACOB DISTANCE DRAWDOWN METHOD Radius of Influence (r_0) km	Pumping Rate (Q) m^3/s	Slope (s/log cycle) m/m	Elapsed Time (t) s	Transmiss-ivity (T) m^2/s	Storativity (S)	Actual Drawdown m	Theoretical Drawdown m	Approximate Well Efficiency
North Pit Wall (HG-7 LS)	LS	3	0.06	8.0	4.0E+05	**2.7E-03**	2.8E-04	18.42	24.0	*
	SLS	50	0.06	3.2	4.0E+05	**6.9E-03**	2.5E-06	18.42	16.6	90%
South Pit Wall (HG-3 LS)	LS	2.4	0.022	9.3	4.0E+05	**8.7E-04**	8.7E-05	17.27	18.0	*
	SLS	0.5	0.022	4.5	4.0E+05	**1.8E-03**	4.5E-03	17.27	16.0	93%

Notes:

* Measurements not used in the calculation of well efficiency.

Table 5: Summary of Other Pumping Test Analyses

Zone	Hydrogeologic Unit	BUTLER (1988) SOLUTION			THEIS (1935) SOLUTION		MOENCH AND PRICKETT (1972)
		Transmiss-ivity (T)	Storativity (S)	Radial Limits from HG-7 (R)	Transmiss-ivity (T)	Storativity (S)	Specific Yield (Sy)
		m^2/s	-	m	m^2/s	-	-
North Pit Wall (HG-7 LS)	LS	7.5E-03	9.0E-05				0.02
	SLS	1.4E-02	1.8E-04	<350			0.01
South Pit Wall (HG-3 LS)	LS				1.3E-03	1.5E-04	
	SLS	(2.0E-3) [a]	(2.0E-4) [a]	>350	2.5E-03	3.6E-03	0.02
> 2km North and South of Pit Area (LS-7 and LS-9)	LS	4.0E-03	2.7E-04	>350			
> 2 km East of Pit Area (LS-8)	LS	5.6E-03	1.0E-03	>350			

Notes:

a. These results are inferred to be applicable to the South Pit Wall zone but are based on analysis of data from the North Pit Wall zone which include an evaluation of limestone heterogeneity at a radial distance of 350 m from the North Pit Wall area.

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Table 6: Water Quality
Results for Groundwater
Physical Parameters

Location Sample ID Date QA/QC	**CCME* Aquatic Life Freshwater (mg/L)**	**GCDWQ** Community Drinking Water (mg/L)**	Notes	HG-3 LS L672682-1 15-AUG-08	HG-3 SS L672682-2 15-AUG-08 FDA	HG-3 SS L672682-5 15-AUG-08 FD	HG-7 LS L672682-3 15-AUG-08 FDA	HG-7 LS L672682-6 15-AUG-08 FD	HG-7 SS L672682-4 15-AUG-08
Field-Measured Parameters									
Conductivity (µS/cm)				443	504	504	451	451	451
Dissolved Oxygen	<5.5			2-3	2	2	8	8	3
Iron II	0.3	**0.3**	A	**0.6**	0.3	0.3	0.3	0.3	0.2
pH	6.5 to 9.0	**6.5 to 8.5**	A	7.5	7.6	7.6	7.4	7.4	7.5
Eh (mV)				-189	-169	-169	-169	-169	-182
Temperature (°C)				5.5	6.2	6.2	6.1	6.1	7
Physical Tests (Lab)									
Conductivity (µS/cm)				606	683	684	610	611	633
Hardness (as CaCO3)				242	167	165	287	271	257
pH	<6.5 or >9.0	**<6.5 or >8.5**	A	8.05	8.17	8.18	8.04	8.12	8.05
Total Suspended Solids				4.6	<3.0	<3.0	<3.0	7.9	<3.0
Total Dissolved Solids		**500**	A	335	390	388	284	344	351
Turbidity (NTU)		**0.3/1.0/0.1** [1]		**12.3**	**1.02**	**1.28**	**4.82**	**6**	**1.93**
Anions and Nutrients									
Ammonia as N	<0.017 or >185 [b]			0.143	0.207	0.265	0.058	0.06	0.104
Alkalinity, Total (as CaCO3)				300	305	312	301	318	294
Chloride (Cl)		**250**	A	11.9	23.9	23.8	9.82	9.82	18.9
Fluoride (F)	0.12	**1.5**		0.301	0.698	0.689	0.244	0.248	0.401
Sulfate (SO4)		**500**	A	12.9	27.7	27.6	16.4	16.4	22.2
Nitrate (as N)	2.9	**10** [2]		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	0.06	**3.2**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen				0.163	0.189	0.224	0.094	0.094	0.139
Cyanide, Weak Acid Diss	0.005 (free CN)	**0.2**		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Organic Carbon									
Total Organic Carbon				3.11	0.82	0.81	2.19	2.19	1.17

Notes
Analytical results are reported in mg/L (milligrams per litre) unless noted otherwise.
*Standards shown are from the Canadian Counsel of Ministers of the Environment Environmental Quality Guidelines (CCME-EQG) for freshwater aquatic life (December 200
**Standards shown are from Health Canada's Guidelines for Canadian Drinking Water Quality (GCDWQ) (May 2008).
NTU = nephelometric turbidity units
A = Aesthetic objective
a = Dissolved oxygen for warm-water biota: early life stages = 6.0 mg/L; other life stages = 5.5 mg/L. For cold-water biota: early life stages = 9.5 mg/L; other life stages = 6.5 mg/L.
b = Guideline is pH and temperature dependent. See CCME Ammonia Factsheet Table 2 (2000).
1 = Based on conventional treatment/slow sand or diatomaceous earth filtration/membrane filtration.
2 = For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.

Table 7: Water Quality Results for Groundwater: Total and Dissolved Metals

Location Sample ID Date QA/QC	MWQSOG* Tier II Water Quality Objectives[B]	MWQSOG* Tier III Water Quality Guidelines Drinking MAC[E] (mg/L)	IMAC[F] (mg/L)	Freshwater[B] (mg/L)	CCME** Aquatic Life Freshwater (mg/L)	GCDWQ*** Community Drinking Water (mg/L)	Notes	HG-3 LS L672682-1 15-AUG-08	HG-3 SS L672682-2 15-AUG-08 FDA	HG-3 SS L672682-5 15-AUG-08 FD	HG-7 LS L672682-3 15-AUG-08 FDA	HG-7 LS L672682-6 15-AUG-08 FD	HG-7 SS L672682-4 15-AUG-08
Field Parameters													
pH					<6.5 or >9.0	**<6.5 or >8.5**	A	7.49	7.61	7.61	7.44	7.44	7.47
Hardness (as CaCO3)								242	167	165	287	271	257
Total Metals													
Aluminum					0.005 / 0.1[d]	**0.1/0.2 [1]**	A	**0.108**	0.0215	0.0217	0.036	0.0349	0.0261
Antimony						**0.006**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic					0.005	**0.01**		0.00294	0.00028	0.00027	0.0023	0.00218	0.00021
Barium						**1**		0.0694	0.045	0.0445	0.076	0.0745	0.061
Beryllium								<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth								<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron						**5[G]**		0.177	0.401	0.391	0.11	<0.010	0.197
Cadmium					0.000017[G]	**0.005**		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Calcium								45.7	32	31.6	56.3	53.3	51.5
Chromium					0.001 / 0.0089[D]	**0.05**		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cobalt								0.00029	<0.00010	<0.00010	0.00028	0.00027	0.00019
Copper					0.002-0.004[c]	**1**	A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Iron					0.3	**0.3**	A	**0.734**	0.172	0.169	**0.337**	**0.356**	0.13
Lead					0.001-0.007[d]	**0.01**		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium								0.0279	0.0455	0.0447	0.0176	0.0156	0.0286
Magnesium								31.1	21.1	21	35.5	33.5	31.2
Manganese						**0.05**	A	0.00997	0.00833	0.00839	0.0091	0.00882	0.012
Mercury					0.000026	**0.001**		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum					0.073[G]			0.000393	0.00114	0.00112	0.000542	0.000521	0.00113
Nickel					0.025-0.150[e]			0.00117	<0.00050	0.00019	0.00109	0.00094	0.00101
Phosphorous								<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium								7.9	9.39	9.23	4.45	4.27	5.74
Selenium					0.001	**0.01**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon								5.06	4.03	4.01	4.76	4.78	4.06
Silver					0.0001			<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium						**200**	A	32.2	83.2	83.4	20.5	20.2	34
Strontium								0.262	0.372	0.372	0.218	0.218	0.314
Thallium					0.0008			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin								<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium								0.011	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium						**0.02[G]**		0.000276	0.000188	0.000183	0.000624	0.000577	0.00105
Vanadium								<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc					0.03	**5**	A	<0.05	<0.05	0.0727	<0.05	<0.05	<0.05

Table 7: Water Quality
Results for Groundwater:
Total and Dissolved Metals

Location	MWQSOG* Tier II	MWQSOG* Tier III Water Quality Guidelines			CCME** Aquatic Life Freshwater	GCDWQ*** Community Drinking Water	Notes	HG-3 LS	HG-3 SS	HG-3 SS	HG-7 LS	HG-7 LS	HG-7 SS
Sample ID	Water Quality	Drinking		Freshwater[B]				L672682-1	L672682-2	L672682-5	L672682-3	L672682-6	L672682-4
Date	Objectives[B]	MAC[E] (mg/L)	IMAC[F] (mg/L)	(mg/L)	(mg/L)	(mg/L)		15-AUG-08	15-AUG-08	15-AUG-08	15-AUG-08	15-AUG-08	15-AUG-08
QA/QC									FDA	FD	FDA	FD	
Dissolved Metals													
Aluminum				0.005 / 0.1[a]				<0.0010	<0.0010	0.0344	<0.0010	0.0215	<0.0010
Antimony			0.006					<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic	0.15[C]		0.025	Tier II				0.0011	0.000218	0.000227	0.000988	0.00122	0.000162
Barium		1						0.07	0.0473	0.0474	0.0743	0.0542	0.0631
Beryllium								<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth								<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron			5					0.166	0.361	0.347	0.0986	0.102	0.171
Cadmium	0.0032-0.0049[C,D]	0.005		Tier II				<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
Calcium								46.2	31.4	30.4	53.5	23.9	49.9
Chromium	0.0073-0.013[C,D]	0.05		Tier II				<0.0020	0.00107	0.00092	<0.0020	<0.00070	<0.0020
Cobalt								0.00016	<0.00010	<0.00010	<0.00010	<0.00010	0.00014
Copper	0.014-0.022[C,D]			Tier II				0.00092	0.00021	0.00034	0.00049	0.00033	0.00055
Iron				0.3				<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	0.0043-0.0078[C,D]	0.01		Tier II				<0.000050	<0.000050	0.000074	<0.000050	<0.000050	<0.000050
Lithium								0.0265	0.0413	0.0405	0.0163	0.0157	0.0265
Magnesium								31.7	20.4	19.9	33.6	32.1	29.7
Manganese								0.00815	0.00741	0.00734	0.00489	0.000318	0.0111
Mercury		0.001		0.0001				<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum				0.073				0.000418	0.00112	0.0011	0.00051	0.000525	0.00108
Nickel	0.079-0.13[C,D]			Tier II				0.00112	0.00033	<0.00010	0.00114	0.00075	0.0012
Phosphorus								<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium								8.03	9.17	8.84	4.18	4.36	5.48
Selenium		0.01		0.001				0.0001	<0.00010	0.00012	0.00013	<0.0010	0.00011
Silicon								5.08	4.24	4.25	5.04	5.04	4.33
Silver				0.0001				<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium								33.8	85	86.9	20.6	22.3	34.4
Strontium								0.281	0.386	0.377	0.217	0.191	0.316
Thallium				0.0008				<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin								<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium								<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium			0.02					0.000279	0.000168	0.000166	0.000591	0.000542	0.000996
Vanadium								<0.0010	<0.000050	0.000082	<0.0010	<0.0010	<0.0010
Zinc	0.18-0.29[C,D]			Tier II				<0.0010	0.0127	0.0201	0.001	0.0026	0.0038

Notes
Analytical results are reported in mg/L (milligrams per litre) unless noted otherwise.
*Standards shown are from the Manitoba Water Quality Standards, Objectives, and Guidelines (November 2002)
**Standards shown are from the Canadian Counsel of Ministers of the Environment Environmental Quality Guidelines (CCME-EQG) for freshwater aquatic life (December 2007).
***Standards shown are from Health Canada's Guidelines for Canadian Drinking Water Quality (GCDWQ) (March 2007).
A = Aesthetic objective
B = Objectives applicable to surface water (Aquatic Life)
C = Objective for chronic exposure with an averaging period of 4 days, exceeding not more than once in 3 years.
D = Tier II Water Quality Objectives for most metals are hardness dependent and are comprised of two factors - the first represents the toxicity of the total recoverable form of the metal and, when necessary, expressed as a relationship with hardness. This is then multiplied by a second factor to convert to a dissolved metal fraction.
E = Maximum Acceptible Concentration
F = Interim Maximum Acceptible Concentration
G = Interim Guideline
a = Aluminum guideline = 0.005 mg/L at pH <6.5; 0.1 mg/L at pH >=6.5
b = Cr(VI)/Cr(III)
c = Copper guideline = 0.004 mg/L at hardness = >180 mg/L.
d = Lead guideline = 0.007 mg/L at hardness >=180 mg/L.
e = Nickel guideline = 0.15 mg/L at hardness >=180 mg/L.
1 = Operational Guidance Value, designed to apply only to drinking water treatment plants using aluminium based coagulants.
2. - = not analyzed, FD = Field Duplicates, FDA = Field Duplicate Available, NC = not calculated

Location Sample Date Sample Control Number QA/QC	HG-3 SS L672682-2 15-AUG-08 FDA	HG-3 SS L672682-5 15-AUG-08 FD	Relative Percent Difference (%)	HG-7 LS L672682-3 15-AUG-08 FDA	HG-7 LS L672682-6 15-AUG-08 FD	Relative Percent Difference (%)
Total Metals						
Aluminum	0.022	0.022	0	0.036	0.035	3
Antimony	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC
Arsenic	0.00028	0.00027	4	0.0023	0.00218	5
Barium	0.045	0.045	0	0.076	0.075	1
Beryllium	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC
Bismuth	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC
Boron	0.4	0.39	3	0.11	<0.10	NC
Cadmium	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC
Calcium	32	31.6	1	56.3	53.3	5
Chromium	<0.0020	<0.0020	NC	<0.0020	<0.0020	NC
Cobalt	0.0001	0.0001	0	0.0001	0.0001	0
Copper	<0.00010	<0.00010	NC	0.00028	0.00027	4
Iron	0.172	0.169	2	**0.337**	**0.356**	5
Lead	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC
Magnesium	21.1	21	0	35.5	33.5	6
Manganese	0.0083	0.0084	1	0.0091	0.0088	3
Mercury	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC
Molybdenum	0.00114	0.00112	2	0.000542	0.000521	4
Nickel	<0.00050	<0.00050	NC	0.00109	0.00094	15
Potassium	9.39	9.23	2	4.45	4.27	4
Selenium	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC
Sodium	83.2	83.4	0	20.5	20.2	1
Uranium	0.00019	0.00018	5	0.00062	0.00058	7
Zinc	<0.05	0.073	**37**	<0.050	<0.050	NC
Anions and Nutrients						
Ammonia as N	0.207	0.265	**25**	0.058	0.06	3
Alkalinity, Total (as CaCO3)	305	312	2	301	318	5
Chloride (Cl)	23.9	23.8	0	9.82	9.82	0
Fluoride (F)	0.698	0.689	1	0.244	0.248	2
Sulfate (SO4)	27.7	27.6	0	16.4	16.4	0
Nitrate (as N)	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Nitrite (as N)	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC
Total Kjeldahl Nitrogen	0.189	0.224	17	0.094	0.094	0
Cyanide, Weak Acid Diss	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Dissolved Organic Carbon	-	-	-	-	-	-
Total Organic Carbon	0.82	0.81	1	2.19	2.19	0.0
Dissolved Metals						
Aluminum	<0.001	0.0344	**189**	<0.0010	0.0215	**182**
Antimony	<0.000050	<0.000050	NC	<0.000050	<0.000050	NC
Arsenic	0.000218	0.000227	4	0.000988	0.00122	**21**
Barium	0.0473	0.0474	0	0.0743	0.0542	**31**
Beryllium	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC
Bismuth	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC
Boron	0.361	0.347	4	0.0986	0.102	3
Cadmium	<0.000017	<0.000017	NC	<0.000017	<0.000017	NC
Calcium	31.4	30.4	3	53.5	23.9	**76**
Chromium	0.00107	0.00092	15	<0.0020	<0.00070	NC
Cobalt	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC
Copper	0.00021	0.00034	**47**	0.00049	0.00033	**39**
Iron	<0.010	<0.010	NC	<0.010	<0.010	NC
Lead	<0.000050	0.000074	**39**	<0.000050	<0.000050	NC
Lithium	0.0413	0.0405	2	0.0163	0.0157	4
Magnesium	20.4	19.9	2	33.6	32.1	5
Manganese	0.00741	0.00734	1	0.00489	0.000318	**176**
Mercury	<0.000010	<0.000010	NC	<0.000010	<0.000010	NC
Molybdenum	0.00112	0.0011	2	0.00051	0.000525	3
Nickel	0.00033	<0.00010	**107**	0.00114	0.00075	**41**
Phosphorus	<0.30	<0.30	NC	<0.30	<0.30	NC
Potassium	9.17	8.84	4	4.18	4.36	4
Selenium	<0.00010	0.00012	18	0.00013	<0.0010	**154**
Silicon	4.24	4.25	0	5.04	5.04	NC
Silver	<0.000010	<0.000010	NC	<0.000010	<0.000010	NC
Sodium	85	86.9	2	20.6	22.3	8
Strontium	0.386	0.377	2	0.217	0.191	13
Thallium	<0.000050	<0.000050	NC	<0.000050	<0.000050	NC
Tin	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC
Titanium	<0.010	<0.010	NC	<0.010	<0.010	NC
Uranium	0.000168	0.000166	1	0.000591	0.000542	9
Vanadium	<0.000050	0.000082	**48**	<0.0010	<0.0010	NC
Zinc	0.0127	0.0201	**45**	0.001	0.0026	**89**

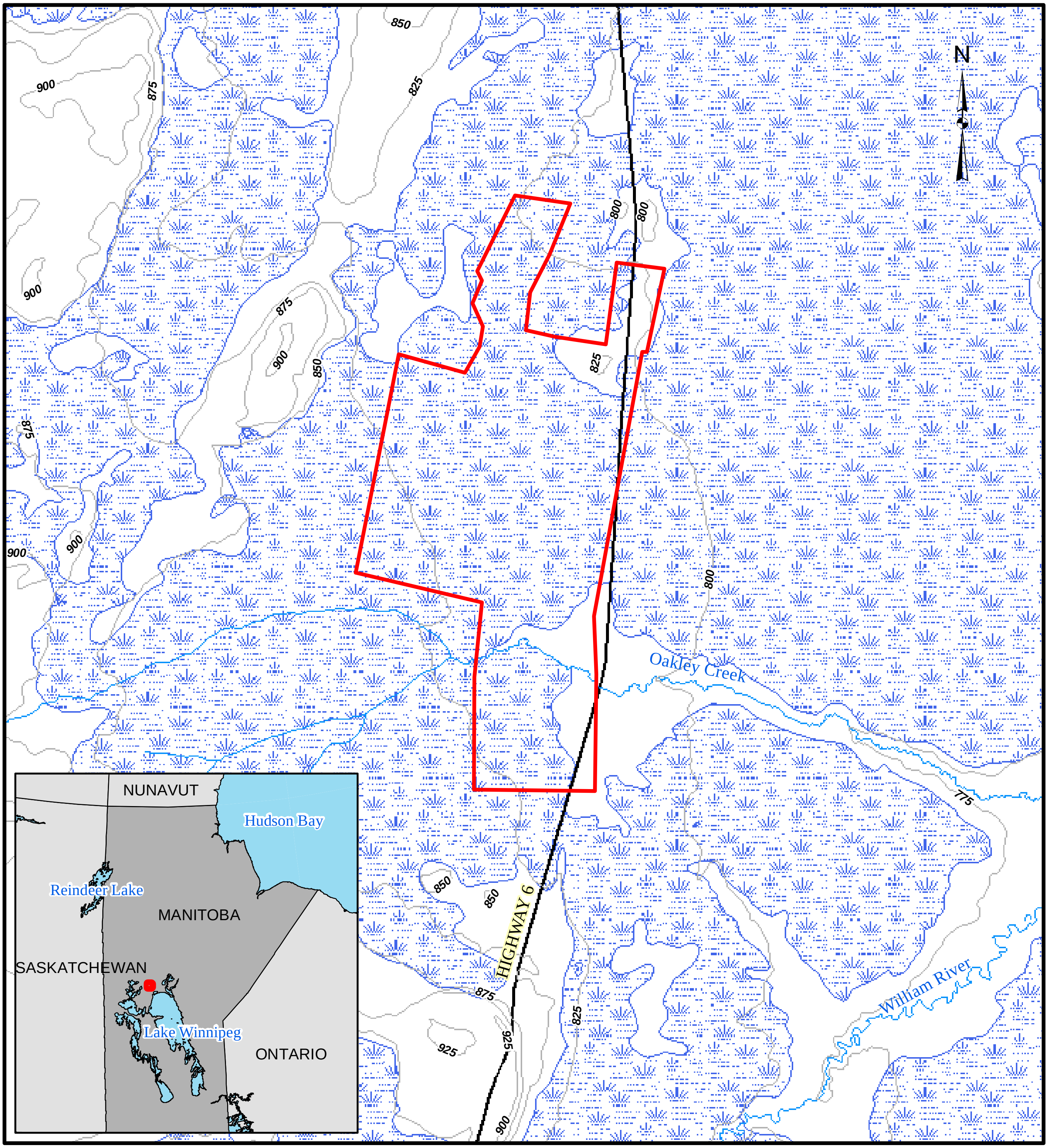
Notes:
1. All concentrations are in miligrams per litre
(mg/L) unless otherwise stated.
2. - = not analyzed, FD = Field Duplicates, FDA = Field Duplicate Available, NC = not calculated

Table 9: Summary of Hydrogeologic Parameters

Hydrogeologic Unit	**Overburden (OB)**	**Limestone (LS)**			**Sandstone (SS)**	**Weathered Granite (GR)**
Zone	all	North Pit Wall	South Pit Wall	2 km from Pit	near Pit	near Pit
Depth to the Top of Unit (m)	0	6	6	8	59	70
Unit Thickness (m)	7	30	30	30	11	10
T (m^2/s)	n/a	5E-03	1E-03	4E-03		n/a
S (-)	n/a	2E-04	1E-04	1E-03		n/a
K (m/s) *	K_H = 4E-8 ; K_V = 5E-9	2E-04	4E-05	1E-04		1E-08
S_s (m^{-1})		5E-06	4E-06	3E-05		7E-06
S_y (-)		0.02				

Notes:

*Hydraulic conductivity (K) assumed to be isotropic unless horizontal (K_H) and vertical (K_V) hydraulic conductivity is presented.



LEGEND

- Project Area
- Wetland
- Contour
- Stream
- Highway

2,000 0 2,000

SCALE 1:80,000 METRES

PROJECT	WARDROP VICTORY NICKEL MANITOBA, CANADA
TITLE	KEYPLAN

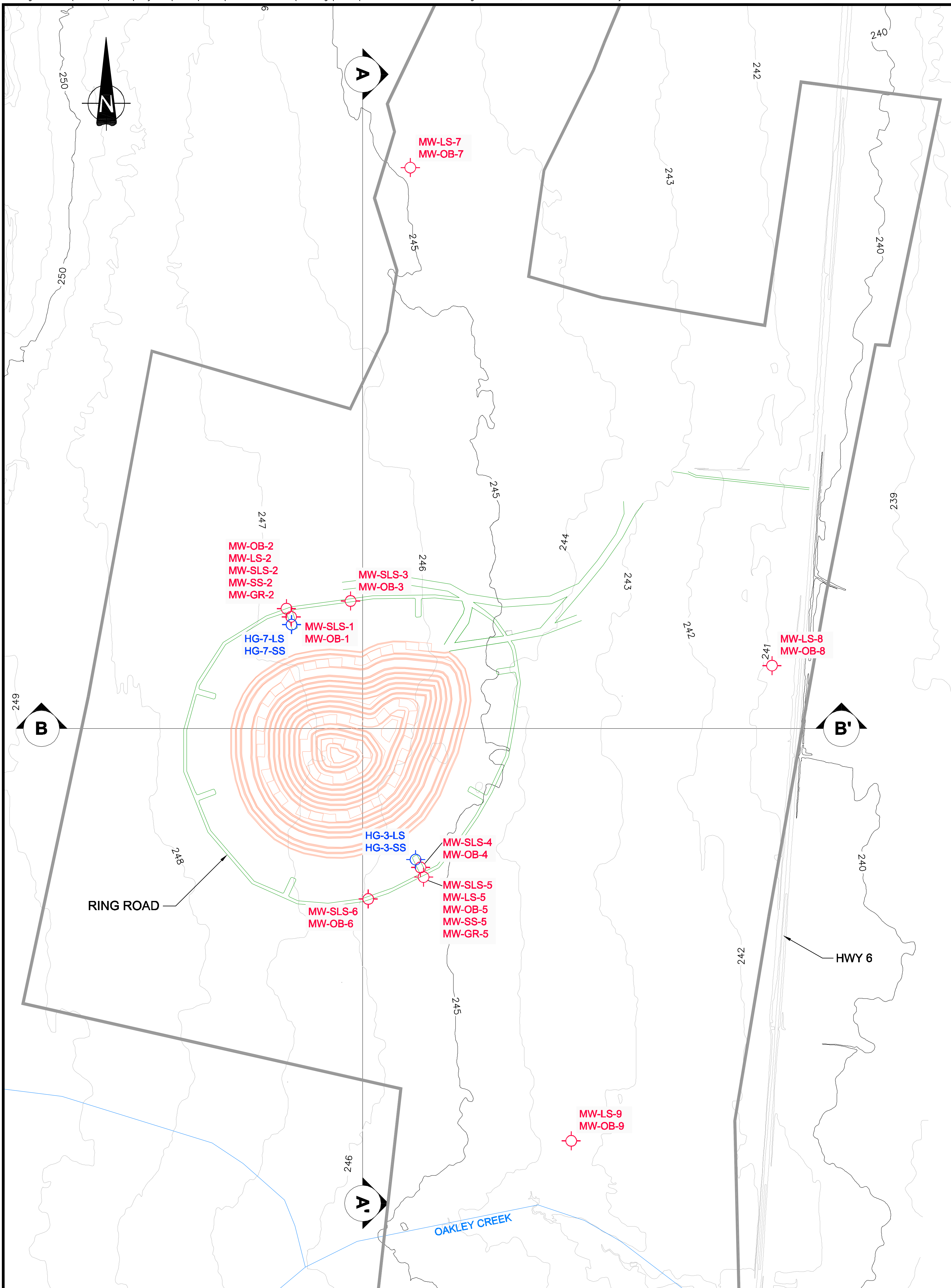
Golder Associates
Burnaby, B.C.

PROJECT No. 08-1428-0001			SCALE AS SHOWN	REV. 0
DESIGN	CR	26 Mar. 2008	FIGURE: 1	
GIS	AL	26 Mar. 2008		
CHECK				
REVIEW				

REFERENCE

Base data supplied by Geogratis CanVec (NTS Mapsheet 63J03).
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 14

N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\GIS\projects\figure-01-keyplan.mxd



LEGEND

- 246 TOPOGRAPHIC CONTOUR
- SITE BOUNDARY
- PUMPING WELL (HG WELLS)
- OBSERVATION WELL
  - OB - OVERBURDEN WELL
  - SLS - SHALLOW LIMESTONE WELL
  - LS - LIMESTONE WELL
  - SS - SANDSTONE WELL
  - GR - GRANITE WELL

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

PROJECT

VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

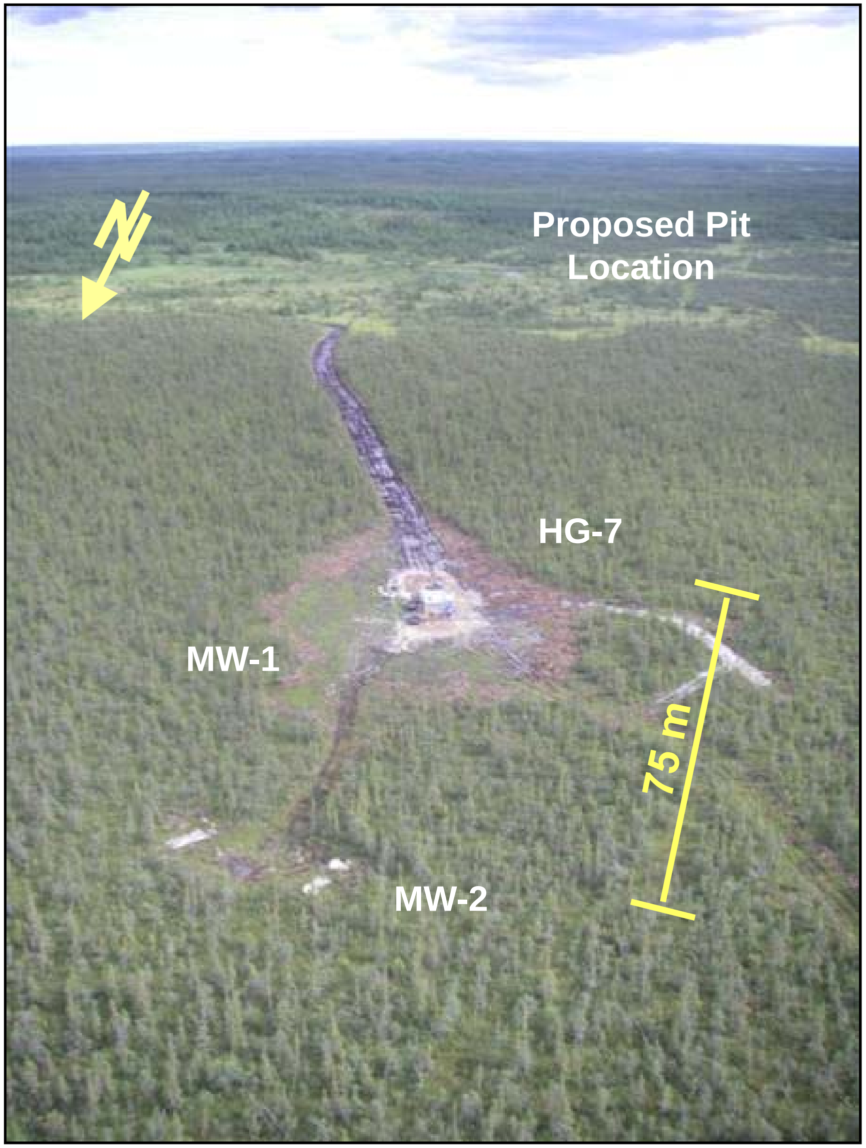
TITLE

SITE PLAN
LOCATION OF WELLS

PROJECT No.	08-1428-0001		PHASE No.	7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08		
CHECK			**FIGURE 2**	
REVIEW				

Golder Associates
Greater Vancouver Office, BC

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 3 4 13 .ppt



PROJECT	VICTORY NICKEL / MINAGO MULTI-WELL PUMPING TEST PROGRAM GRAND RAPIDS, M.B.
TITLE	**PUMPING WELLS HG-7 LS AND HG-7 SS**

PROJECT No.	08-1428-0001		FILE No. ----
DESIGN	MN	16OCT08	SCALE NTS / REV.
CADD			**FIGURE 3**
CHECK	CR	16OCT08	
REVIEW			

Golder Associates

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 3 4 13 .ppt

PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

TITLE

PUMP INSTALLATION AT HG-7 LS

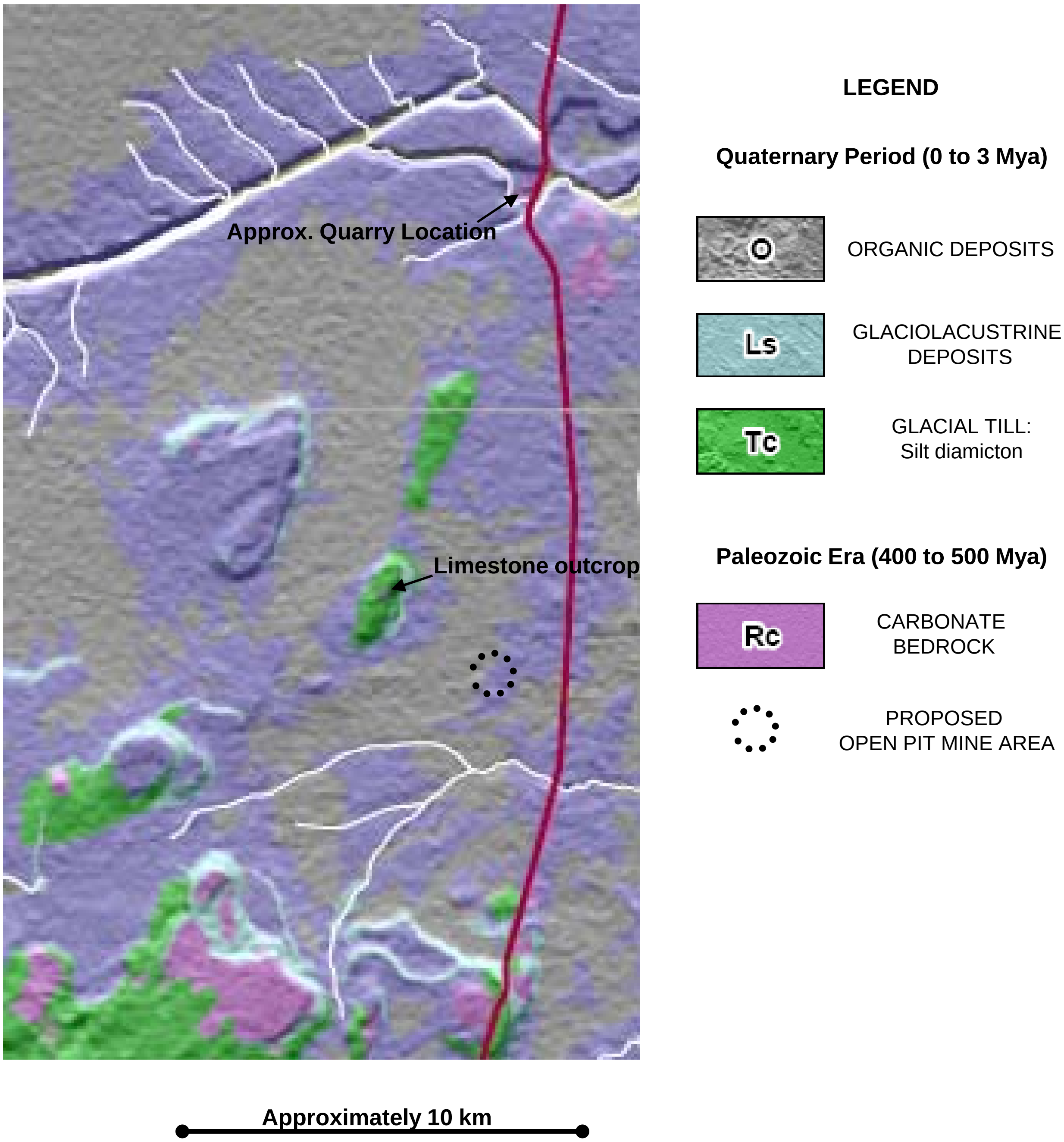
Golder Associates

PROJECT No.		08-1428-0001	FILE No. ----	
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 4**	
CHECK	CR	16OCT08		
REVIEW				

PROJECT	VICTORY NICKEL / MINAGO MULTI-WELL PUMPING TEST PROGRAM GRAND RAPIDS, M.B.
TITLE	**SUBSIDENCE MONITORING**

Golder Associates	PROJECT No.	08-1428-0001		FILE No. ----	
	DESIGN	MN	16OCT08	SCALE NTS	REV.
	CADD			**FIGURE 5**	
	CHECK	CR	16OCT08		
	REVIEW				

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt



REFERENCE FOR BASE MAP:
Matile, G.L.D., and Keller, G.D., 2006. Surficial geology of the Wekusko Lake map sheet (NTS 63J), Manitoba; Manitoba Science, Technology, Energy, and Mines; Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-63J, scale 1:250 000.

PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

TITLE
REGIONAL SURFICIAL GEOLOGY

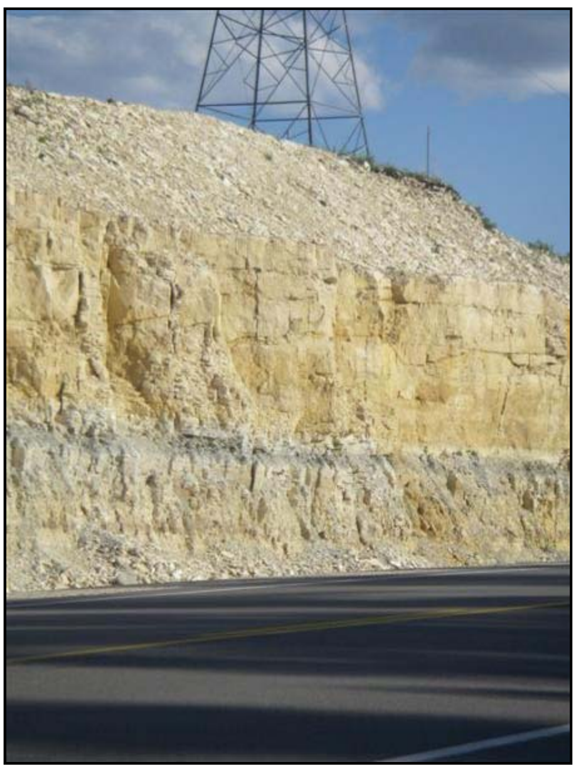
Golder Associates

PROJECT No.	08-1428-0001		FILE No.	----
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD				
CHECK	CR	16OCT08	**FIGURE 6**	
REVIEW				

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt

A. Limestone outcrop at a quarry located approximately 12 km north-northeast of the Site.

C. Minago River at the Highway 6 bridge, approximately 12 km north of the Site.



B. Limestone outcrop along Highway 6 road cut, approximately 9 km south of the Site.

D. Flowing artesian conditions at MW-7-LS.

PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

TITLE

LIMESTONE OBSERVATIONS

Golder Associates

PROJECT No.		08-1428-0001	FILE No. ----	
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 7**	
CHECK	CR	16OCT08		
REVIEW				

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt

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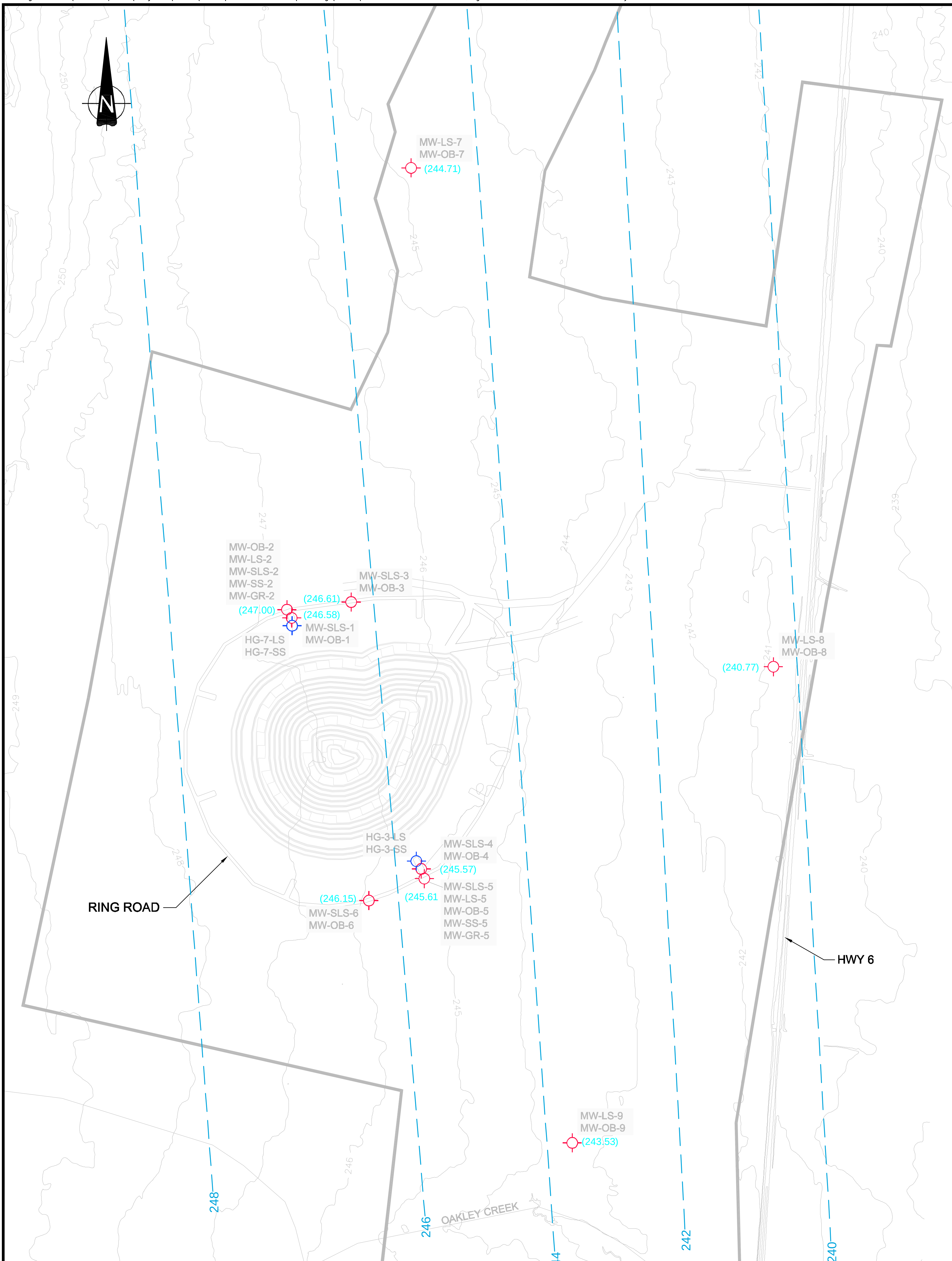


LEGEND

—246— TOPOGRAPHIC CONTOUR

SITE BOUNDARY

PUMPING WELL (HG WELLS)

OBSERVATION WELL

OB - OVERBURDEN WELL
SLS - SHALLOW LIMESTONE WELL
LS - LIMESTONE WELL
SS - SANDSTONE WELL
GR - GRANITE WELL

HYDRAULIC HEAD CONTOURS (m)

(246.15) HYDRAULIC HEAD MEASURED ON AUGUST 2 TO 9, 2008

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

PROJECT

VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

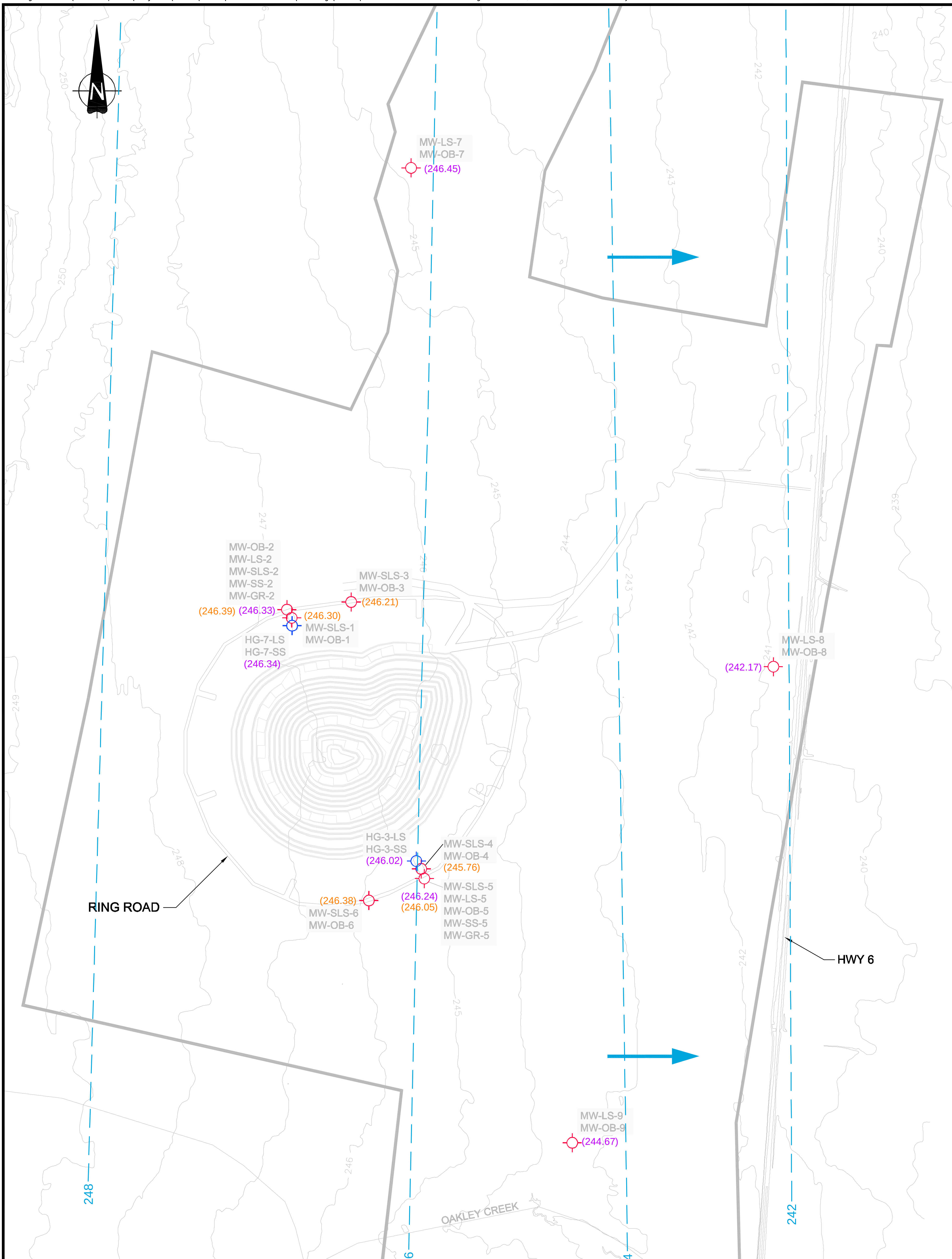
TITLE

PRE-PUMPING HYDRAULIC HEAD CONTOURS IN THE OVERBURDEN

Golder Associates
Greater Vancouver Office, BC

PROJECT No.	08-1428-0001		PHASE No.	7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08		
CHECK			**FIGURE 8A**	
REVIEW				

Drawing File: N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\Drafting\7000\0814280001-7000-08B.dwg March 2, 2009 1:18:52 PM By: ODurcau



LEGEND

—246—	TOPOGRAPHIC CONTOUR
	SITE BOUNDARY
	PUMPING WELL (HG WELLS)
	OBSERVATION WELL
	OB - OVERBURDEN WELL SLS - SHALLOW LIMESTONE WELL LS - LIMESTONE WELL SS - SANDSTONE WELL GR - GRANITE WELL
	HYDRAULIC HEAD CONTOURS (m)
	INFERRED GROUNDWATER FLOW DIRECTION
(245.76)	HYDRAULIC HEAD MEASURED IN THE SHALLOW LIMESTONE ON AUGUST 2 TO 9, 2008
(246.15)	HYDRAULIC HEAD MEASURED IN THE DEEP LIMESTONE ON AUGUST 2 TO 9, 2008

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

PROJECT

VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

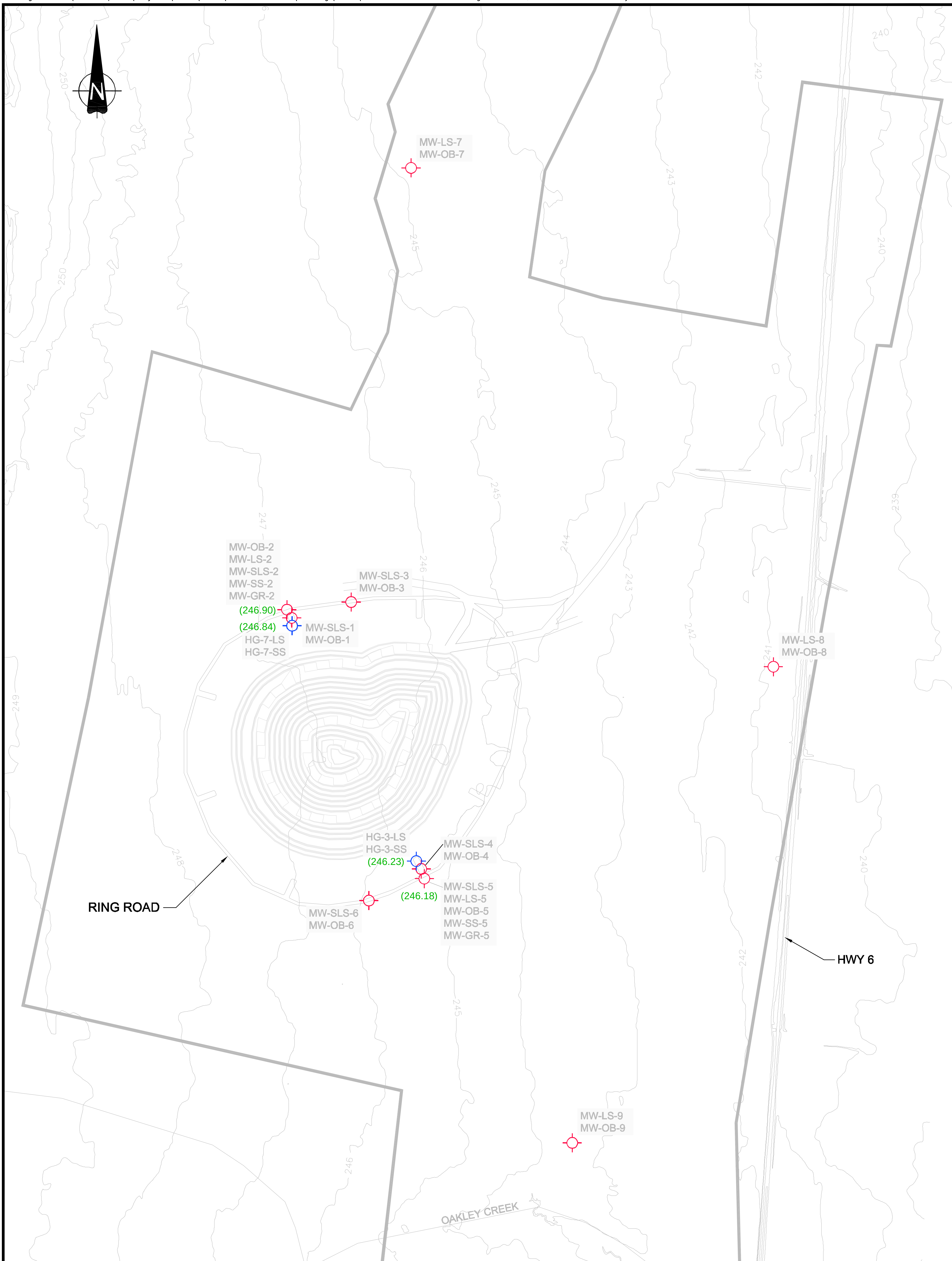
TITLE

PRE-PUMPING HYDRAULIC HEAD CONTOURS IN THE LIMESTONE

Golder Associates
Greater Vancouver Office, BC

PROJECT No.	08-1428-0001		PHASE No.	7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08		
CHECK			**FIGURE 8B**	
REVIEW				

Drawing File: N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\Drafting\7000\0814280001-7000-08C.dwg March 2, 2009 1:19:31 PM By: ODurcau



LEGEND

- 246 TOPOGRAPHIC CONTOUR
- SITE BOUNDARY
- PUMPING WELL (HG WELLS)
- OBSERVATION WELL
  - OB - OVERBURDEN WELL
  - SLS - SHALLOW LIMESTONE WELL
  - LS - LIMESTONE WELL
  - SS - SANDSTONE WELL
  - GR - GRANITE WELL
- HYDRAULIC HEAD CONTOURS (m)
- (245.76) HYDRAULIC HEAD MEASURED ON AUGUST 2 TO 9, 2008

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

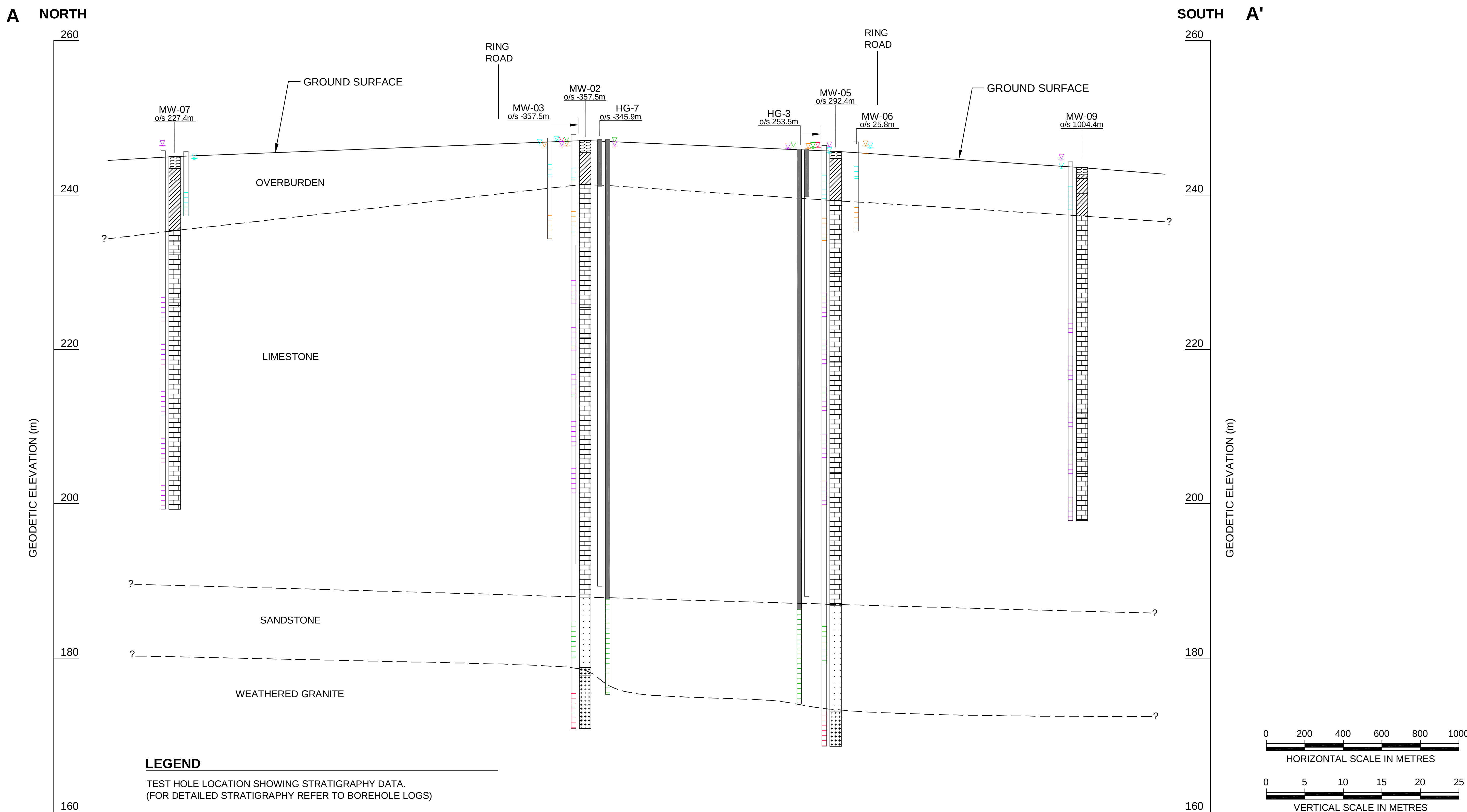
BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

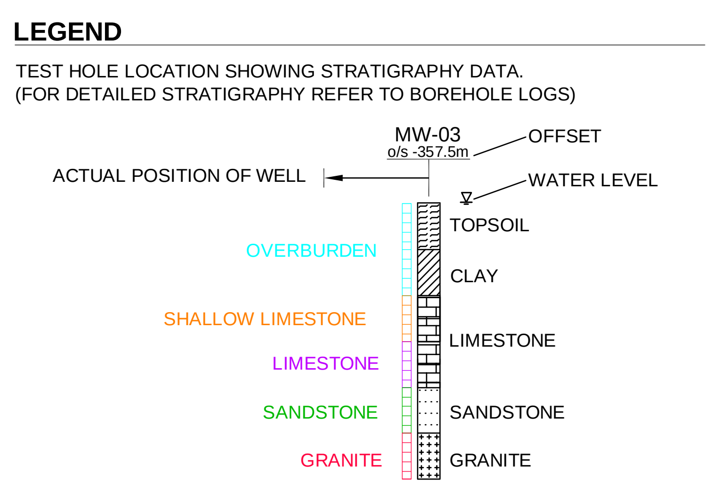
PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
PRE-PUMPING HYDRAULIC HEAD IN THE SANDSTONE

Golder Associates
Greater Vancouver Office, BC

PROJECT No.	08-1428-0001		PHASE No.	7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08		
CHECK			**FIGURE 8C**	
REVIEW				



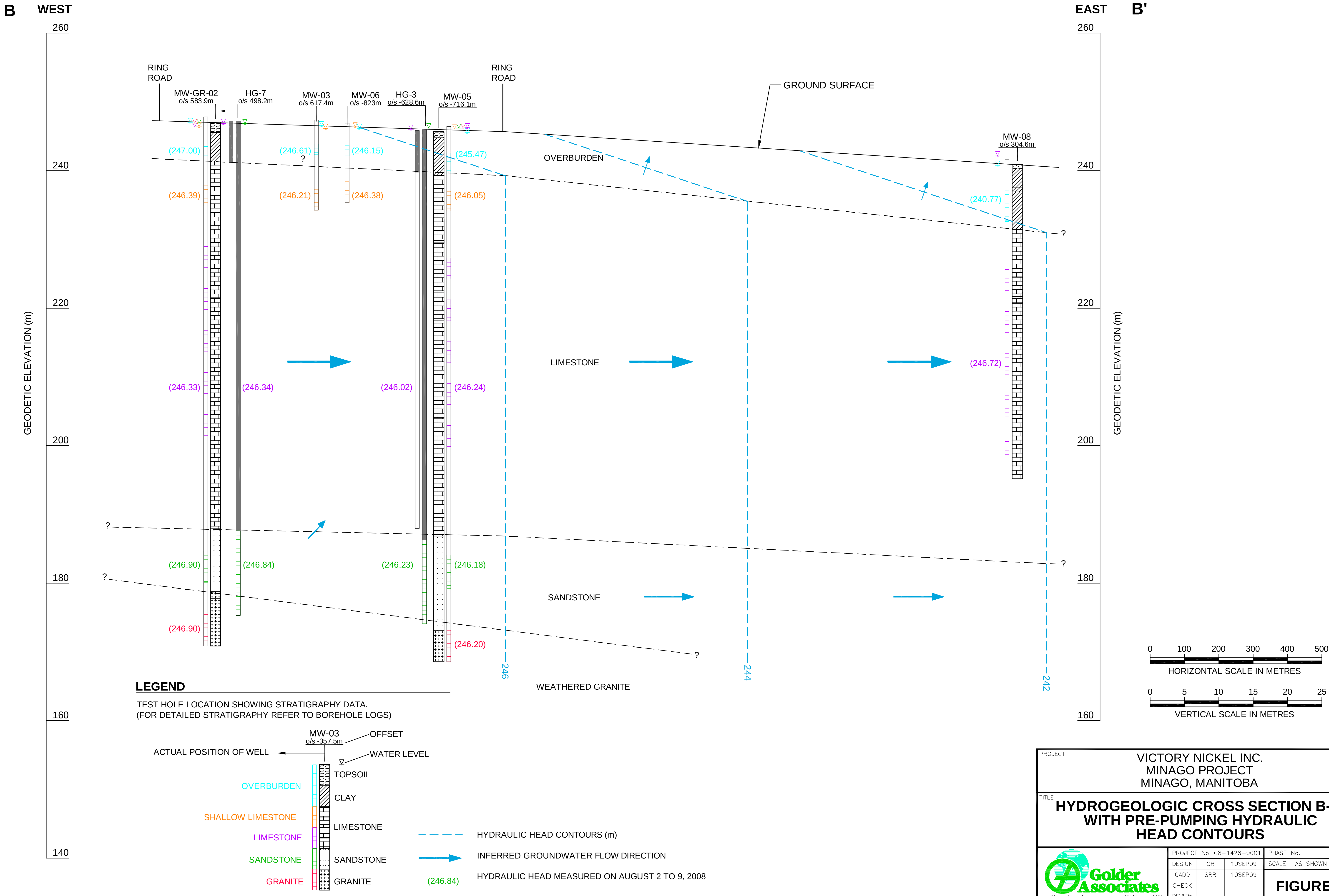


PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
HYDROGEOLOGIC CROSS SECTION A-A'

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 08-1428-0001			PHASE No.	7000
DESIGN	CR	10SEP09	SCALE AS SHOWN	REV. –
CADD	SRR	10SEP09	**FIGURE 9**	
CHECK				
REVIEW				



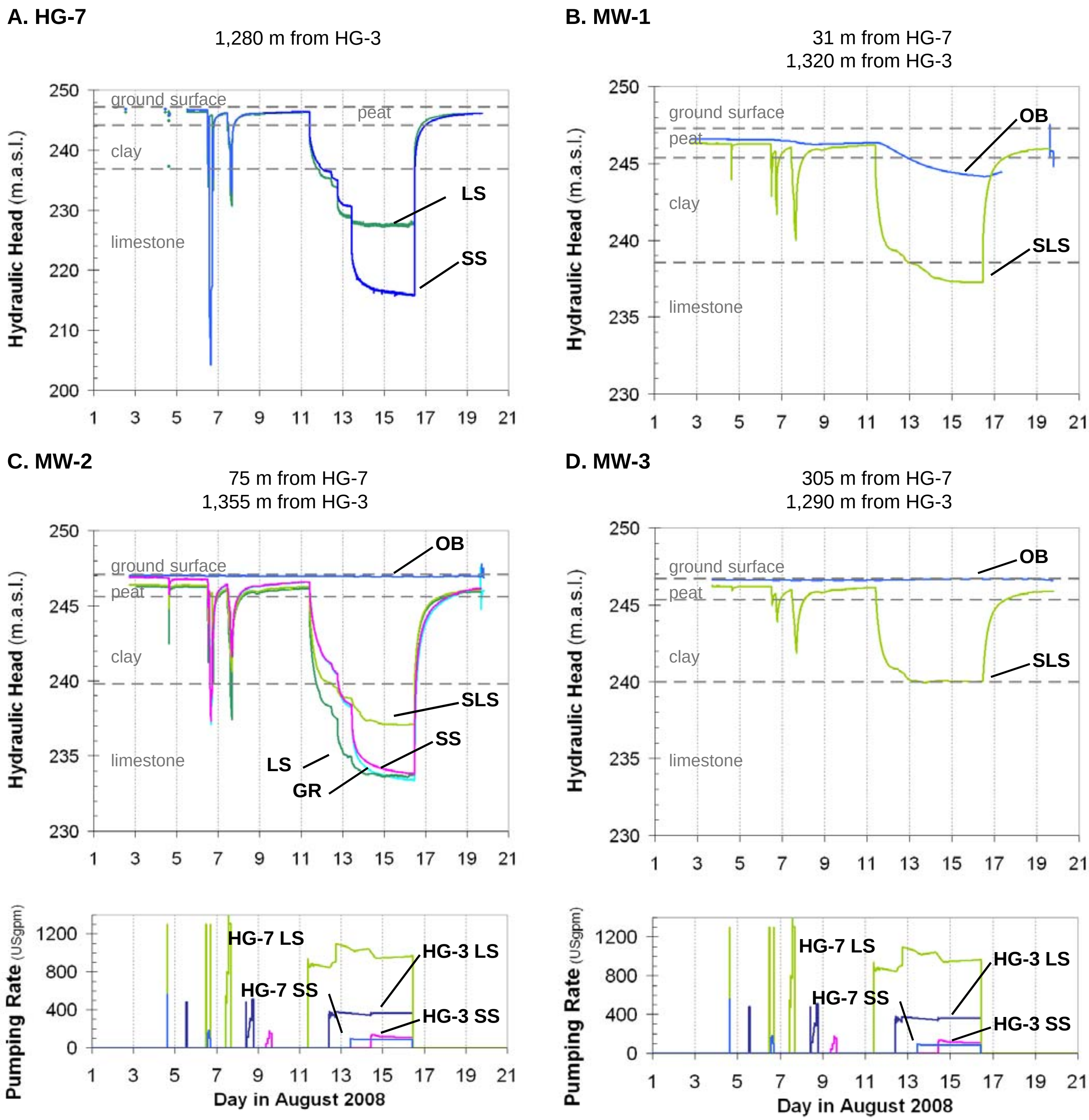
Drawing File: N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\Drafting\7000\0814280001-7000-10.dwg March 2, 2009 1:20:31 PM By: ODurcau

PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
HYDROGEOLOGIC CROSS SECTION B-B' WITH PRE-PUMPING HYDRAULIC HEAD CONTOURS

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 08-1428-0001			PHASE No.	7000
DESIGN	CR	10SEP09	SCALE AS SHOWN	REV. –
CADD	SRR	10SEP09		
CHECK			**FIGURE 10**	
REVIEW				

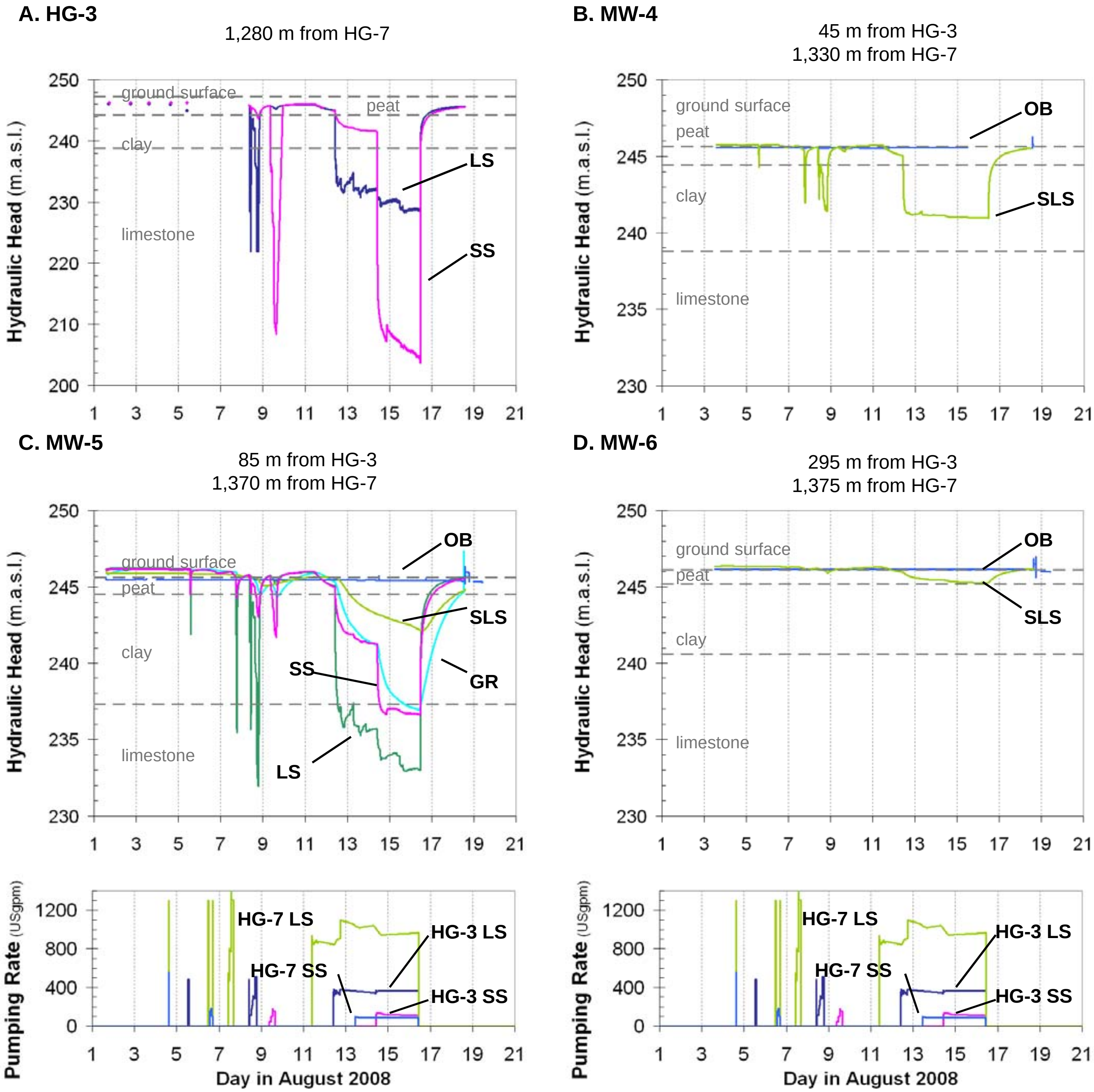


NOTES:
1.) The vertical scale on (A) the plot of hydraulic head measured at the pumping wells is different than the vertical scale on (B,C,D) the plots of hydraulic head measured at the observation wells.

PROJECT	VICTORY NICKEL / MINAGO MULTI-WELL PUMPING TEST PROGRAM GRAND RAPIDS, M.B.
TITLE	**TIME-SERIES PLOTS OF HYDRAULIC HEAD AND PUMPING RATE WITHIN 300 M OF HG-7**

PROJECT No.	08-1428-0001	FILE No. ----	
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 11**
CHECK	CR	16OCT08	
REVIEW			

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt



NOTES:

1.) The vertical scale on (A) the plot of hydraulic head measured at the pumping wells is different than the vertical scale on (B,C,D) the plots of hydraulic head measured at the observation wells.

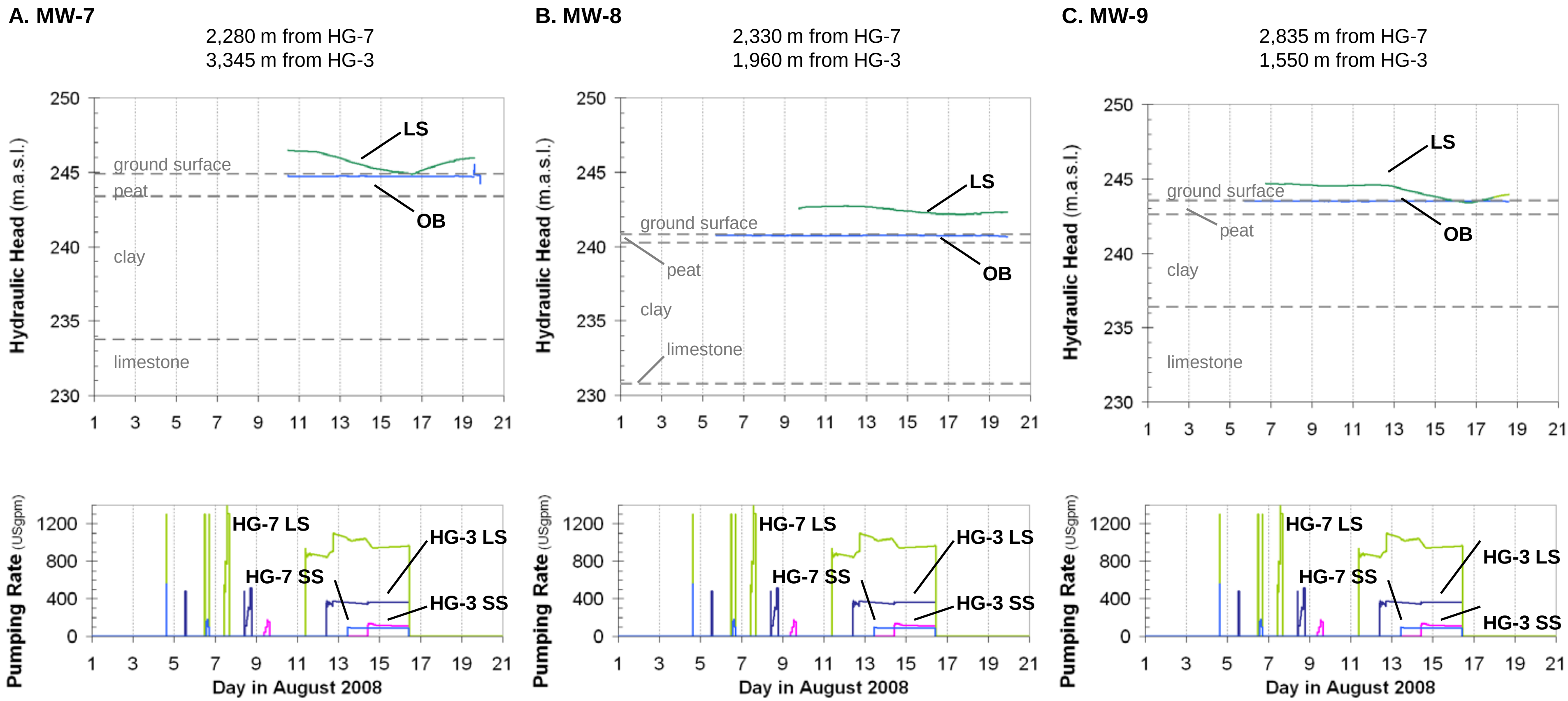
PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

TITLE
TIME-SERIES PLOTS OF HYDRAULIC HEAD AND PUMPING RATE WITHIN 300 M OF HG-3

Golder Associates

PROJECT No.	08-1428-0001		FILE No.	----
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 12**	
CHECK	CR	16OCT08		
REVIEW				

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 3 4 13 .ppt

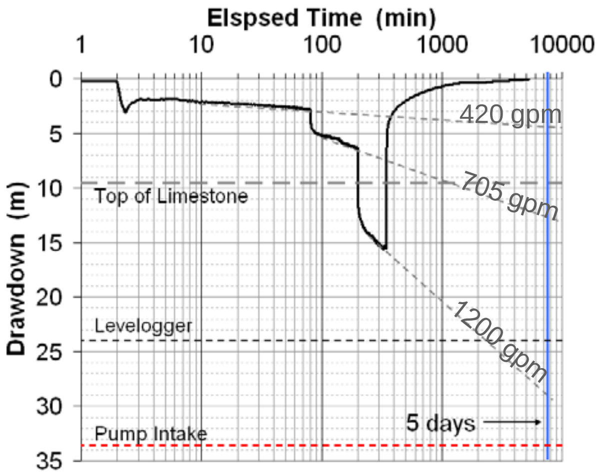


PROJECT	VICTORY NICKEL / MINAGO MULTI-WELL PUMPING TEST PROGRAM GRAND RAPIDS, M.B.
TITLE	**TIME-SERIES PLOTS OF HYDRAULIC HEAD AND PUMPING RATE ABOUT 2 km FROM PUMPING WELLS**

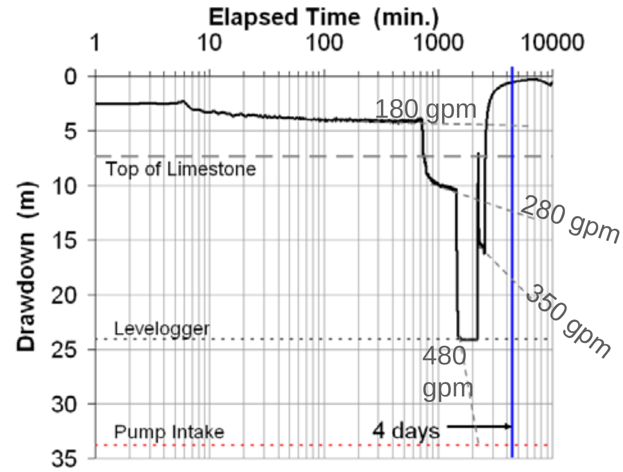
Golder Associates

PROJECT No.	08-1428-0001		FILE No.	----
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 13**	
CHECK	CR	16OCT08		
REVIEW				

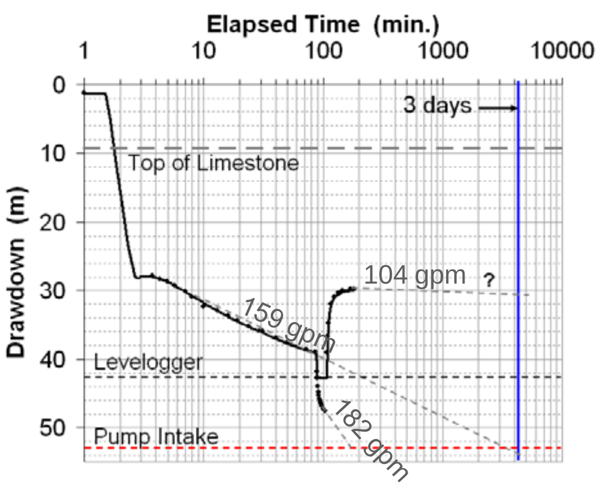
A. HG-7 LS



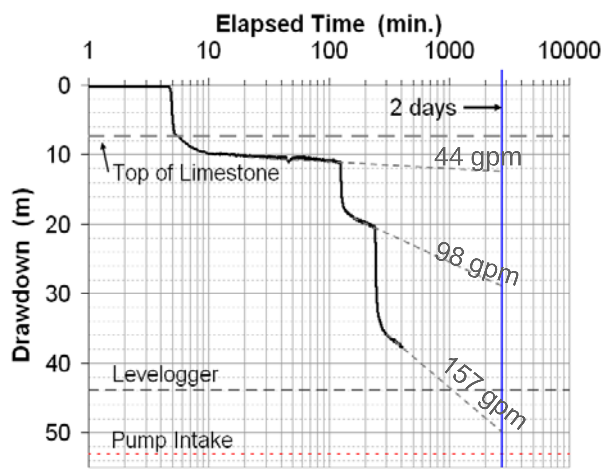
B. HG-3 LS



C. HG-7 SS



D. HG-3 SS



PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

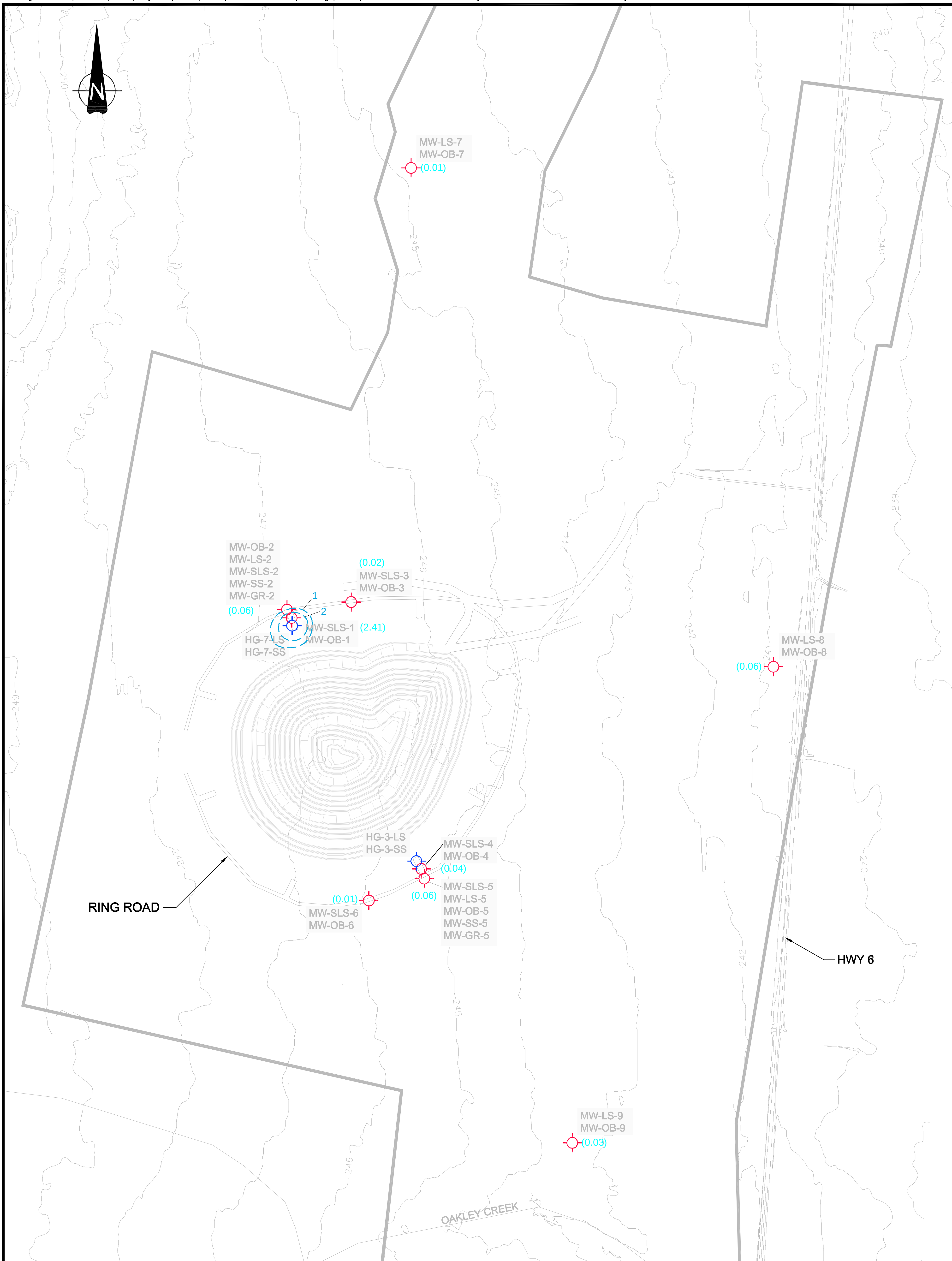
TITLE
STEP DRAWDOWN TEST PLOTS

Golder Associates

PROJECT No.	08-1428-0001		FILE No. ----	
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 14**	
CHECK	CR	16OCT08		
REVIEW				

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt

Drawing File: N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\Drafting\7000\0814280001-7000-15A.dwg March 2, 2009 1:21:04 PM By: ODurcau



LEGEND

246 TOPOGRAPHIC CONTOUR

SITE BOUNDARY

PUMPING WELL (HG WELLS)

OBSERVATION WELL

OB - OVERBURDEN WELL
SLS - SHALLOW LIMESTONE WELL
LS - LIMESTONE WELL
SS - SANDSTONE WELL
GR - GRANITE WELL

DRAWDOWN CONTOURS (m)

(1.0) MAXIMUM DRAWDOWN ON AUGUST 16, 2008 AT 11.00

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

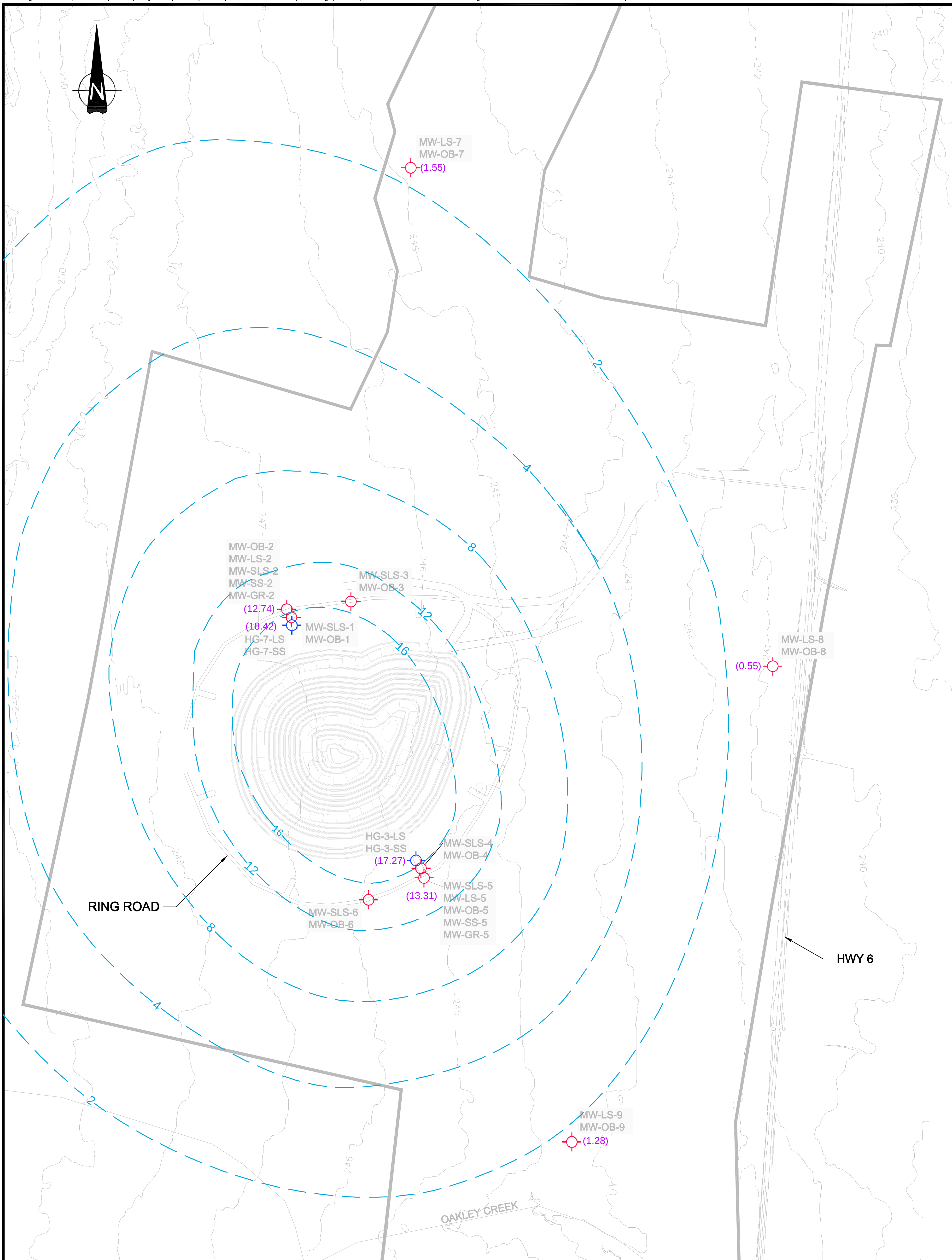
PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
MAXIMUM DRAWDOWN IN THE OVERBURDEN

Golder Associates
Greater Vancouver Office, BC

PROJECT No.	08-1428-0001	PHASE No.		7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08		
CHECK			FIGURE 15A	
REVIEW				

Drawing File: N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\Drafting\7000\0814280001-7000-15B.dwg March 2, 2009 1:21:45 PM By: ODurcau



LEGEND

—246— TOPOGRAPHIC CONTOUR

SITE BOUNDARY

PUMPING WELL (HG WELLS)

OBSERVATION WELL

OB - OVERBURDEN WELL
SLS - SHALLOW LIMESTONE WELL
LS - LIMESTONE WELL
SS - SANDSTONE WELL
GR - GRANITE WELL

DRAWDOWN CONTOURS (m)

(13.31) MAXIMUM DRAWDOWN ON AUGUST 16, 2008 AT 11.00

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

PROJECT

VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE

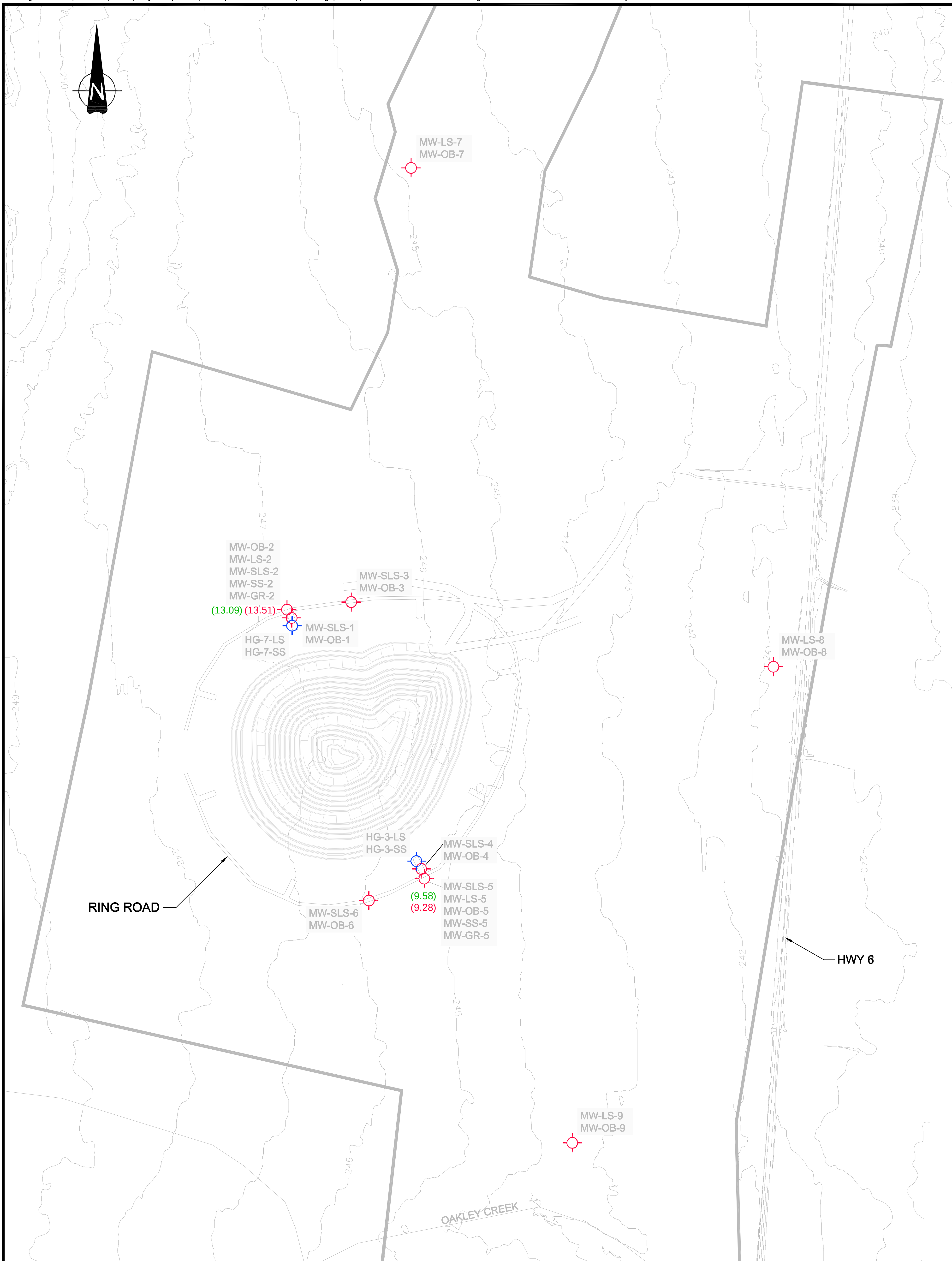
MAXIMUM DRAWDOWN IN THE LIMESTONE

Golder Associates
Greater Vancouver Office, BC

PROJECT No.	08-1428-0001	PHASE No.	7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08	
CHECK			
REVIEW			

FIGURE 15B

Drawing File: N:\Bur-Graphics\Projects\2008\1428\08-1428-0001\Drafting\7000\0814280001-7000-15C.dwg March 2, 2009 1:22:29 PM By: ODurcau



LEGEND

- 246 TOPOGRAPHIC CONTOUR
- SITE BOUNDARY
- PUMPING WELL (HG WELLS)
- OBSERVATION WELL
  - OB - OVERBURDEN WELL
  - SLS - SHALLOW LIMESTONE WELL
  - LS - LIMESTONE WELL
  - SS - SANDSTONE WELL
  - GR - GRANITE WELL
- DRAWDOWN CONTOURS (m)

(9.58) MAXIMUM DRAWDOWN IN SANDSTONE ON AUGUST 16, 2008 AT 11.00

(13.51) MAXIMUM DRAWDOWN IN WEATHERED GRANITE ON AUGUST 16, 2008 AT 11.00

0 200 400 600 800 1000

SCALE IN METRES

REFERENCES

BASE PLAN BY WARDROP ENGINEERING INC.
CAD FILE: WNTR08_GEOTEC_INV.DWG
DATED: 30 OCT., 2007

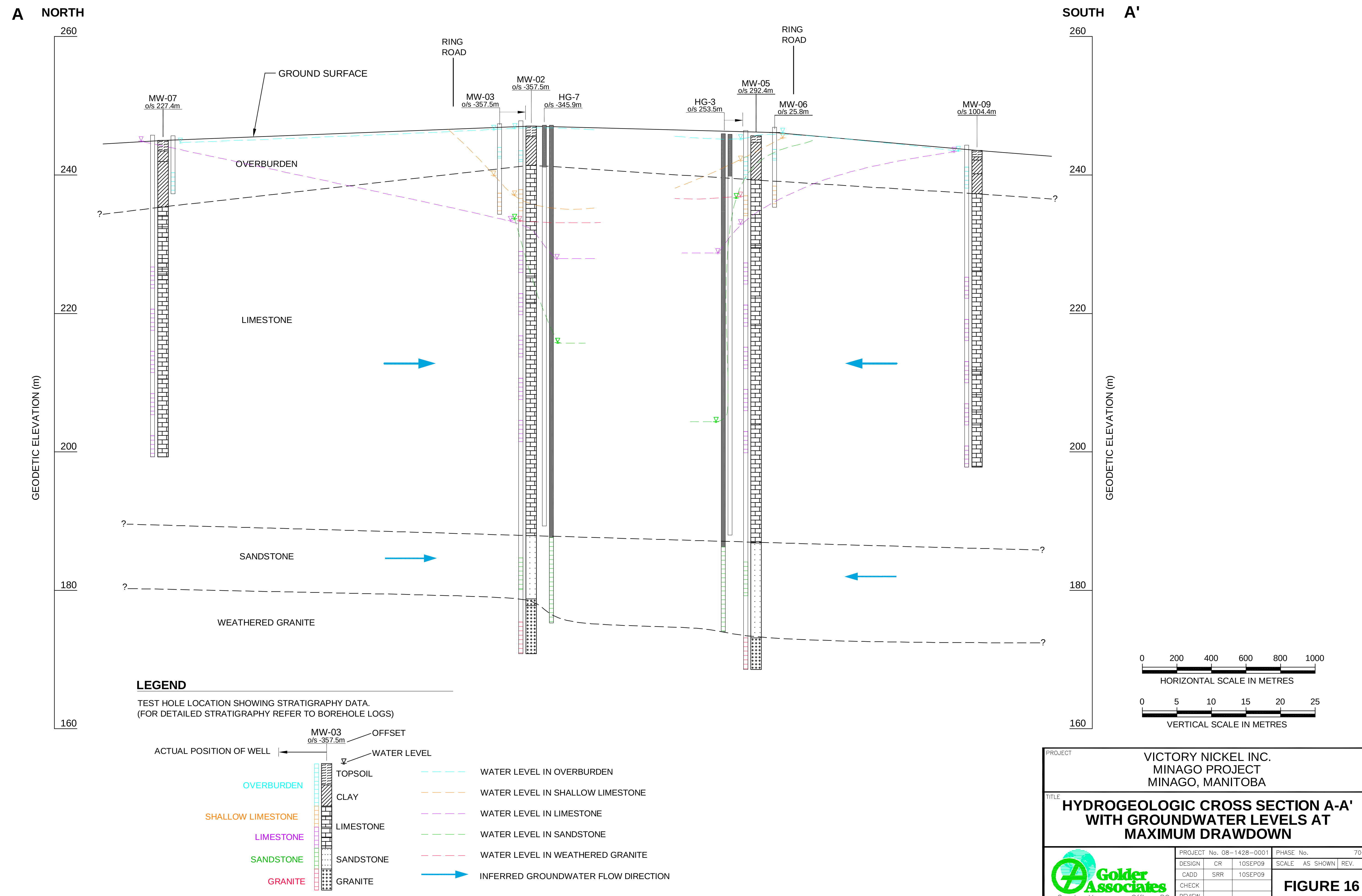
PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
MAXIMUM DRAWDOWN IN THE SANDSTONE AND WEATHERED GRANITE

Golder Associates
Greater Vancouver Office, BC

PROJECT No.	08-1428-0001	PHASE No.	7000
DESIGN	CR	01OCT08	SCALE AS SHOWN	REV. -
CADD	GG	01OCT08	
CHECK			
REVIEW			

FIGURE 15C

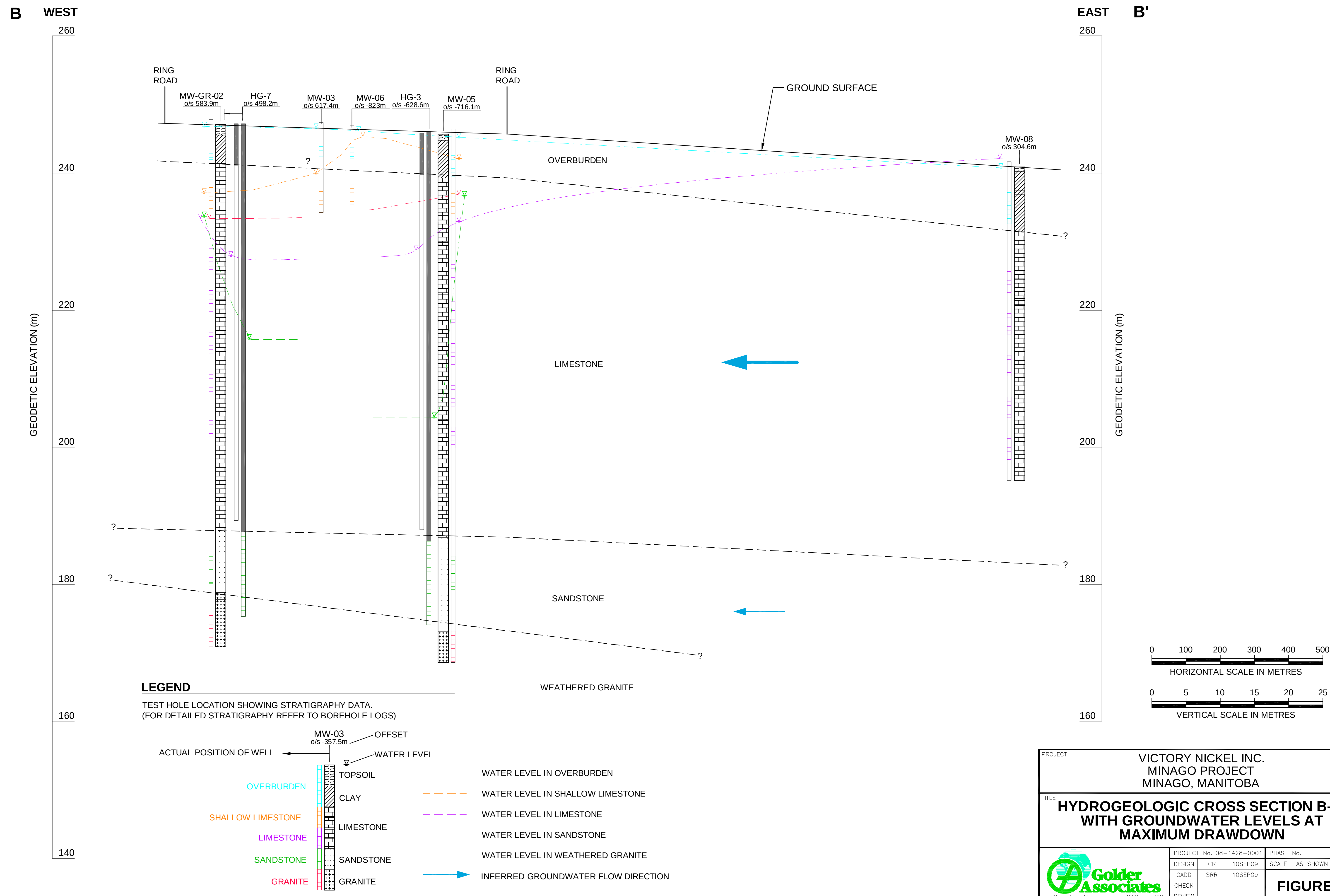


PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
HYDROGEOLOGIC CROSS SECTION A-A' WITH GROUNDWATER LEVELS AT MAXIMUM DRAWDOWN

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 08-1428-0001			PHASE No.	7000
DESIGN	CR	10SEP09	SCALE AS SHOWN	REV. –
CADD	SRR	10SEP09		
CHECK			**FIGURE 16**	
REVIEW				



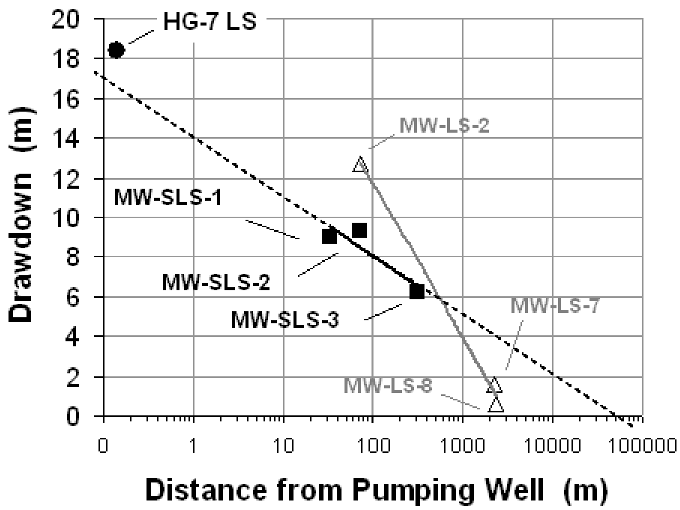
PROJECT
VICTORY NICKEL INC.
MINAGO PROJECT
MINAGO, MANITOBA

TITLE
HYDROGEOLOGIC CROSS SECTION B-B' WITH GROUNDWATER LEVELS AT MAXIMUM DRAWDOWN

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 08-1428-0001			PHASE No.	7000
DESIGN	CR	10SEP09	SCALE AS SHOWN	REV. –
CADD	SRR	10SEP09	**FIGURE 17**	
CHECK				
REVIEW				

A. HG-7 LS



$$T_{LS} = \frac{2.3Q}{2\pi(slope_{LS})} = 2.7 \cdot 10^{-3} m^2 / s$$

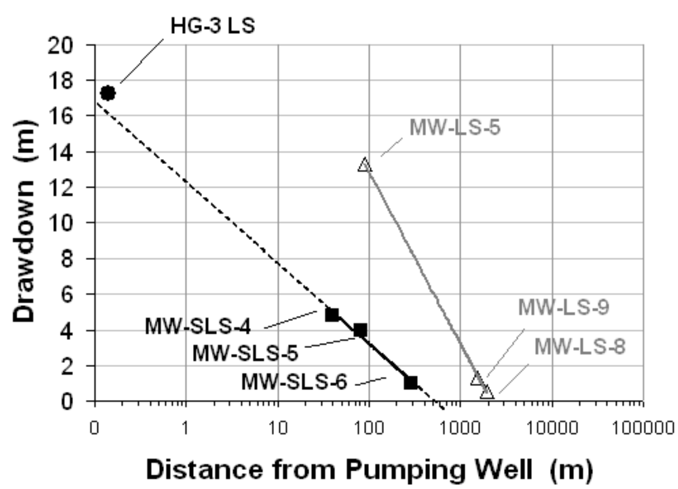
$$T_{SLS} = \frac{2.3Q}{2\pi(slope_{SLS})} = 6.9 \cdot 10^{-3} m^2 / s$$

$$S_{LS} = 2.25T \frac{t}{r_0^2} = 2.8 \cdot 10^{-4}$$

$$S_{SLS} = 2.25T \frac{t}{r_0^2} = 2.5 \cdot 10^{-6}$$

Well Efficiency = 90%

B. HG-3 LS



$$T_{LS} = \frac{2.3Q}{2\pi(slope_{LS})} = 8.7 \cdot 10^{-4} m^2 / s$$

$$T_{SLS} = \frac{2.3Q}{2\pi(slope_{SLS})} = 1.8 \cdot 10^{-3} m^2 / s$$

$$S_{LS} = 2.25T \frac{t}{r_0^2} = 8.7 \cdot 10^{-5}$$

$$S_{SLS} = 2.25T \frac{t}{r_0^2} = 4.5 \cdot 10^{-3}$$

Well Efficiency = 93%

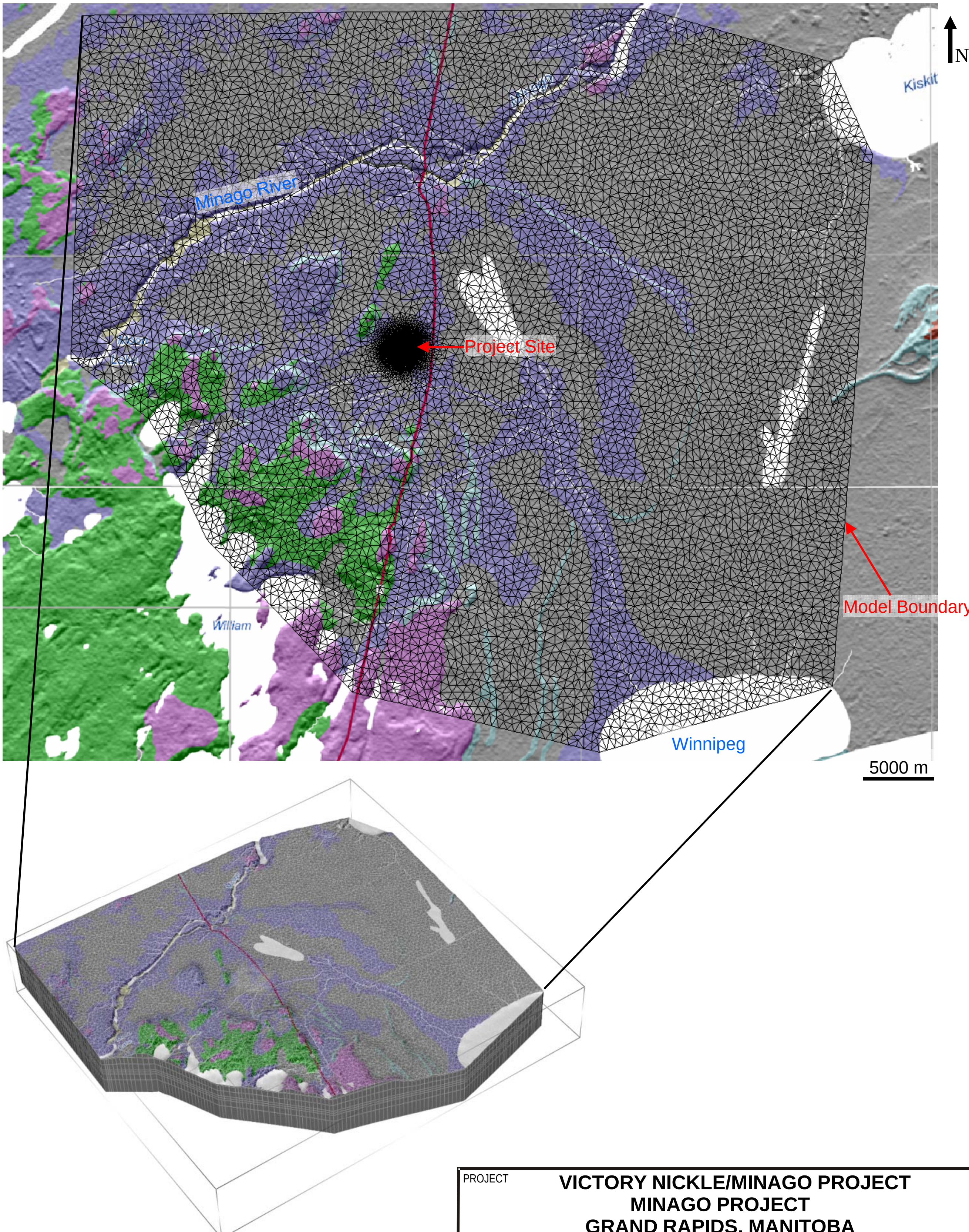
PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

TITLE
DISTANCE - DRAWDOWN ANALYSIS

Golder Associates

PROJECT No.	08-1428-0001		FILE No.	----
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD				
CHECK	CR	16OCT08	**FIGURE 18**	
REVIEW				

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt



Map Reference:
Matile, G.L.D., and Keller, G.D., 2006. Surficial geology of the Wekusko Lake map sheet (NTS 63J), Manitoba; Manitoba Science, Technology, Energy, and Mines; Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-63J, scale 1:250 000.

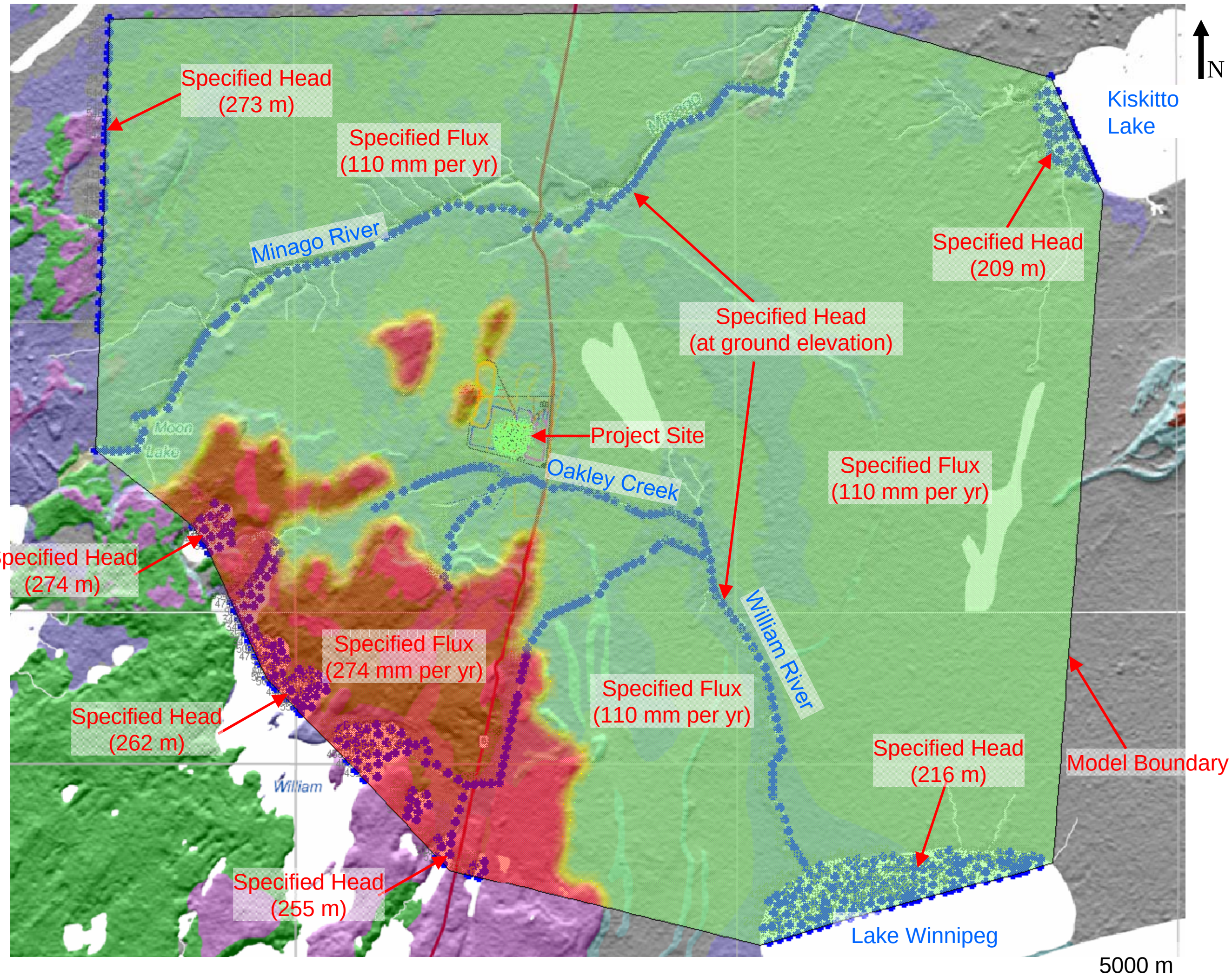
PROJECT
VICTORY NICKLE/MINAGO PROJECT
MINAGO PROJECT
GRAND RAPIDS, MANITOBA

TITLE
EXTENT OF FINITE ELEMENT MESH

Golder Associates

PROJECT No.	----		FILE No.	----
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	**FIGURE 19**	
CHECK	WZ	14OCT08		
REVIEW				

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 19 to 26.ppt



NOTE:
Specified heads set to ground elevation and constrained to outflow only were assigned everywhere along the top of model to simulate seepage faces.
All other boundaries not labelled above were set to no flow (zero-flux).
Specified flux set to 18 mm\yr was assigned along model bottom to represent groundwater inflow from granitic bedrock.

Map Reference:
Matile, G.L.D., and Keller, G.D., 2006. Surficial geology of the Wekusko Lake map sheet (NTS 63J), Manitoba; Manitoba Science, Technology, Energy, and Mines; Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-63J, scale 1:250 000.

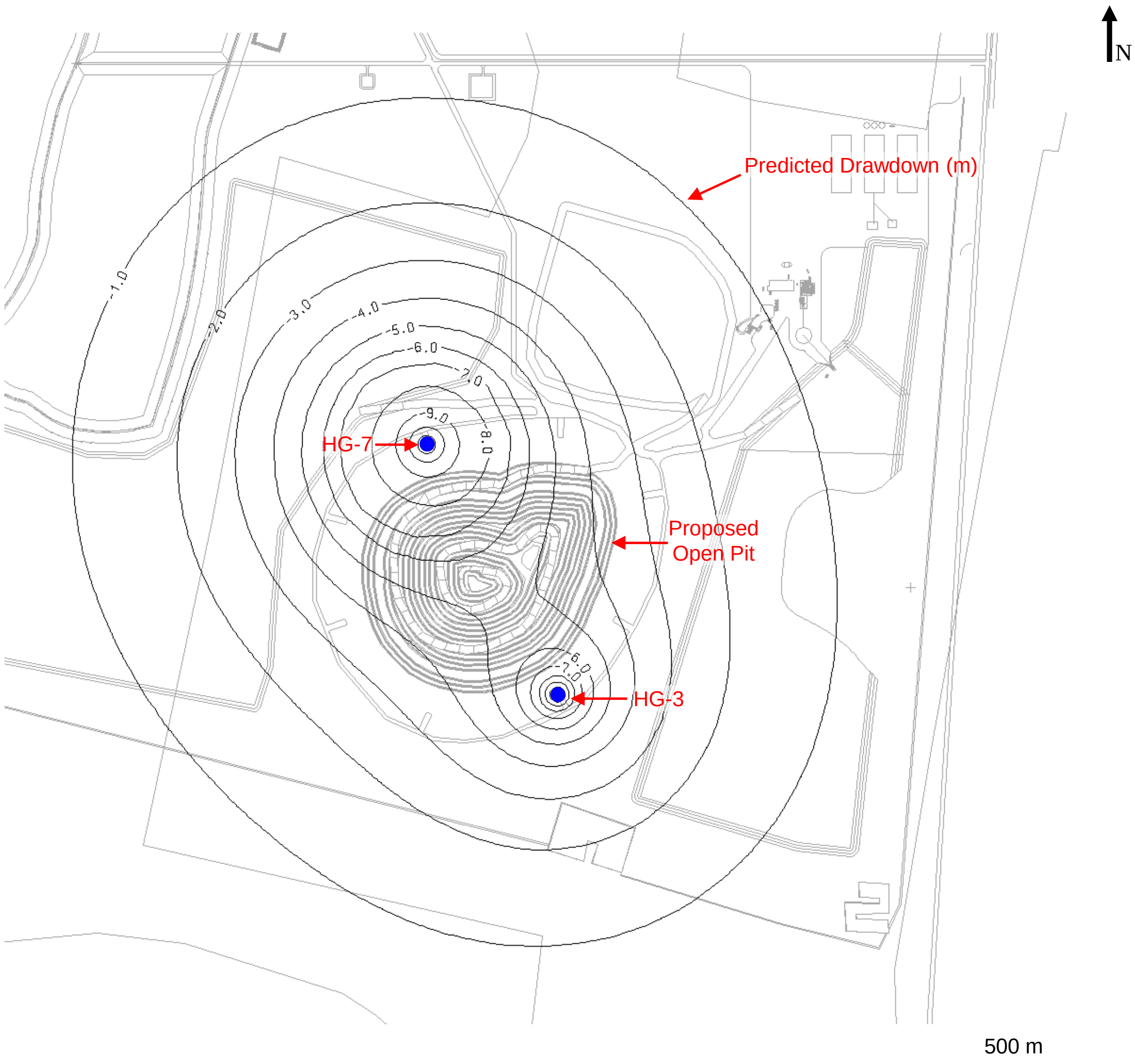
FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 19 to 26.ppt

PROJECT
VICTORY NICKLE/MINAGO PROJECT
MINAGO PROJECT
GRAND RAPIDS, MANITOBA

TITLE
MODEL BOUNDARY CONDITIONS

Golder Associates

PROJECT No.	----		FILE No. ----	
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	**FIGURE 20**	
CHECK	WZ	14OCT08		
REVIEW				



Map Reference:
Wardrop file *change dump and tailings.dwg*

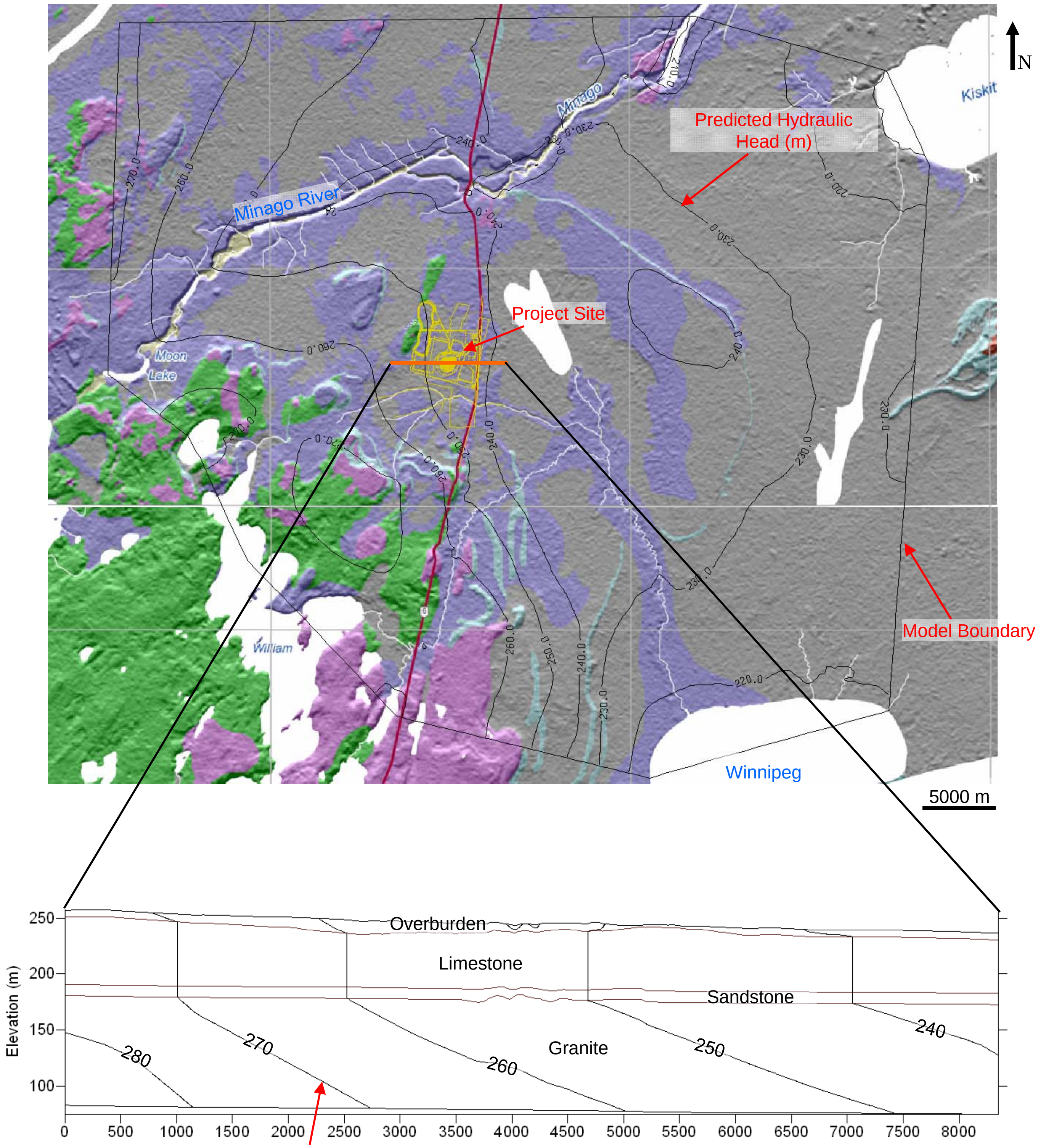
FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 19 to 26.ppt

PROJECT
VICTORY NICKLE/MINAGO PROJECT
MINAGO PROJECT
GRAND RAPIDS, MANITOBA

TITLE
RESULTS OF MODEL CALIBRATION
PUMPING TEST

Golder Associates

PROJECT No.	----		FILE No. ----	
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	**FIGURE 21**	
CHECK	WZ	14OCT08		
REVIEW				



Map Reference:
Matile, G.L.D., and Keller, G.D., 2006. Surficial geology of the Wekusko Lake map sheet (NTS 63J), Manitoba; Manitoba Science, Technology, Energy, and Mines; Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-63J, scale 1:250 000.

PROJECT	VICTORY NICKLE/MINAGO PROJECT MINAGO PROJECT GRAND RAPIDS, MANITOBA			
TITLE	RESULTS OF MODEL CALIBRATION PRE-PUMPING CONDITIONS LIMESTONE UNIT			
PROJECT No.	----		FILE No. ----	
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	FIGURE 22	
CHECK	WZ	14OCT08		
REVIEW				

Golder Associates

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 19 to 26.ppt

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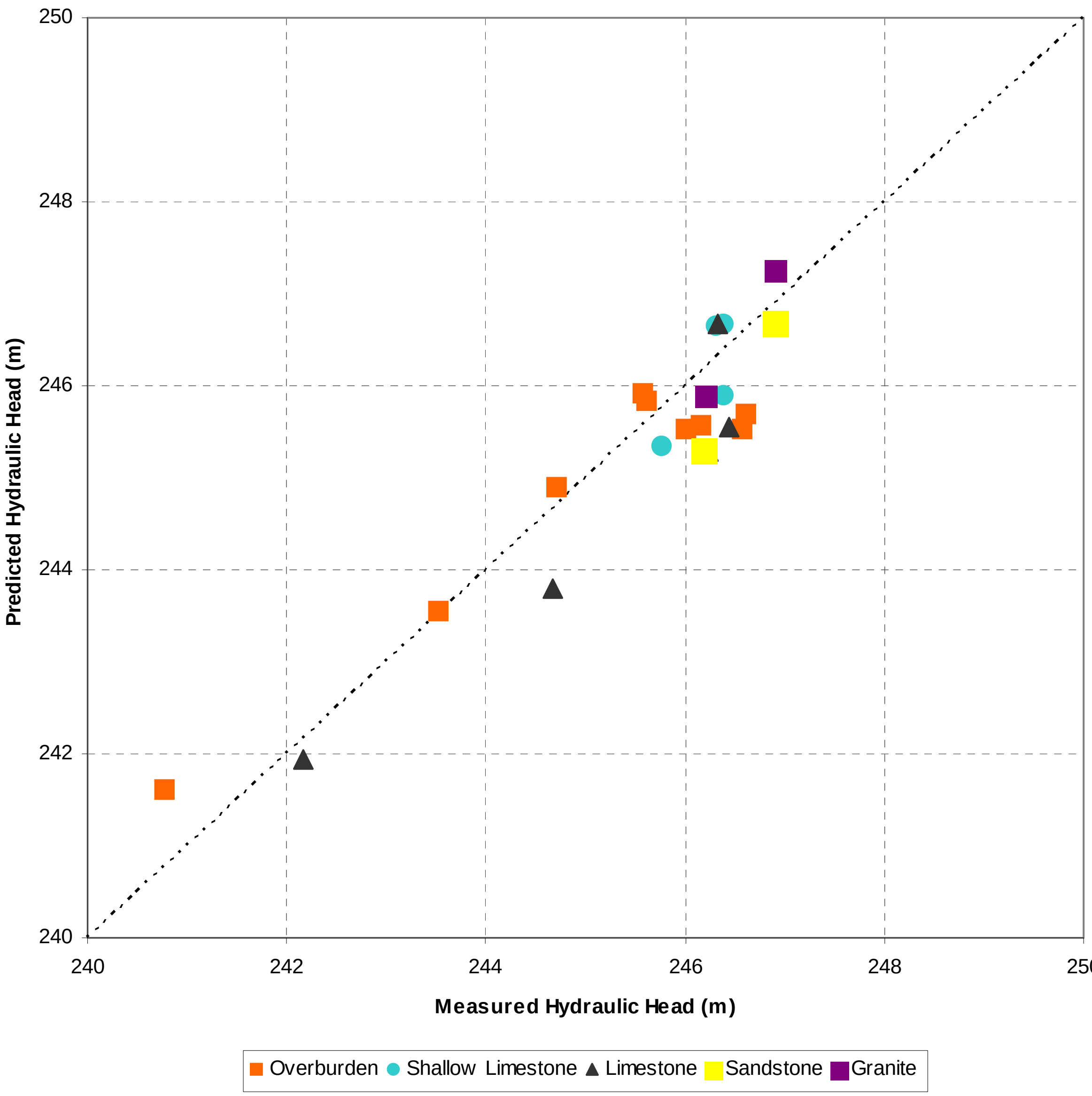
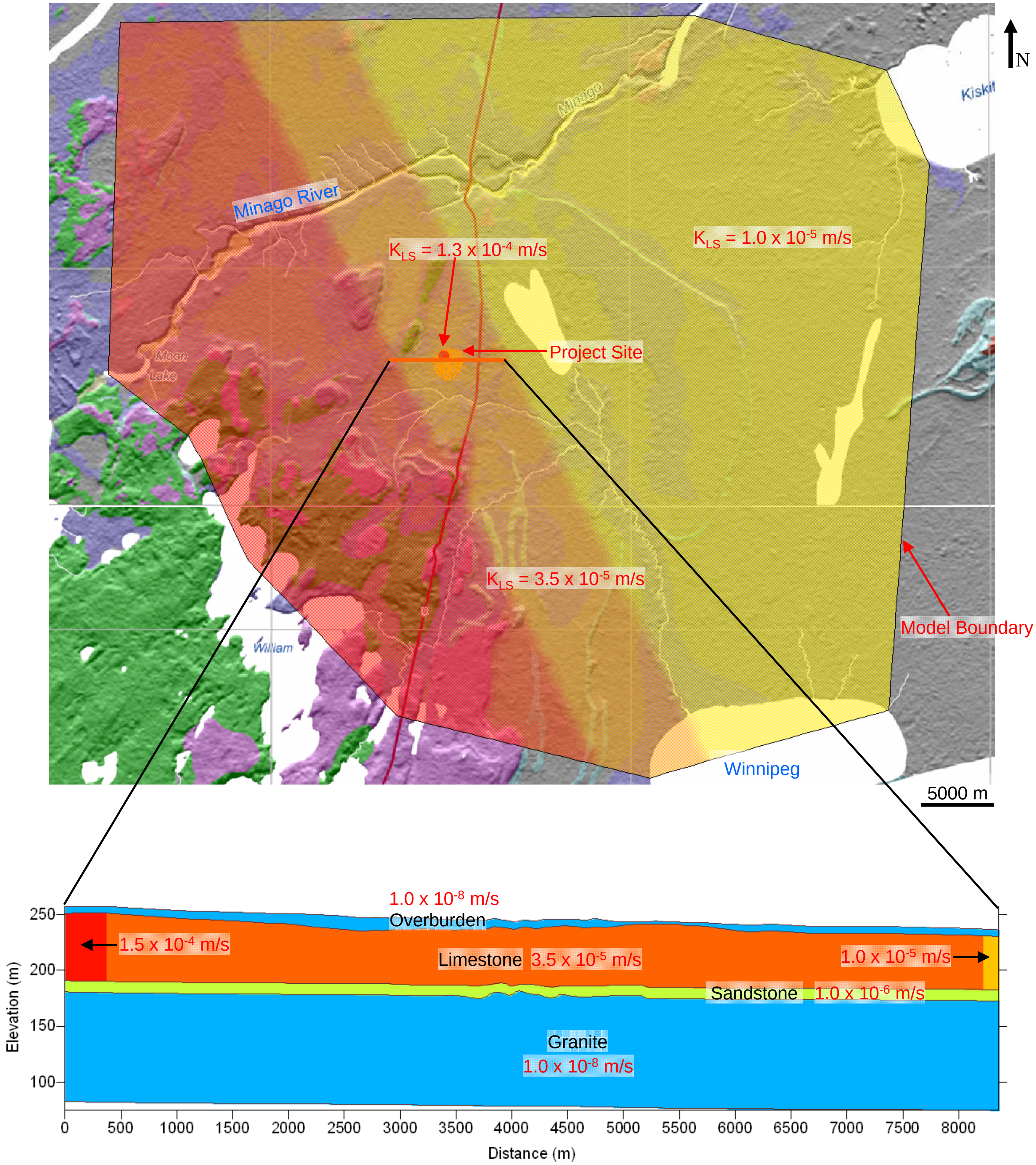


PROJECT	VICTORY NICKLE/MINAGO PROJECT MINAGO PROJECT GRAND RAPIDS, MANITOBA			
TITLE	RESULTS OF MODEL CALIBRATION PREDICTED VS. MEASURED HYDRAULIC HEADS			
Golder Associates	PROJECT No.	----		FILE No. ----
	DESIGN	WZ	14OCT08	SCALE NTS / REV.
	CADD	WZ	14OCT08	FIGURE 23
	CHECK	WZ	14OCT08	
	REVIEW			

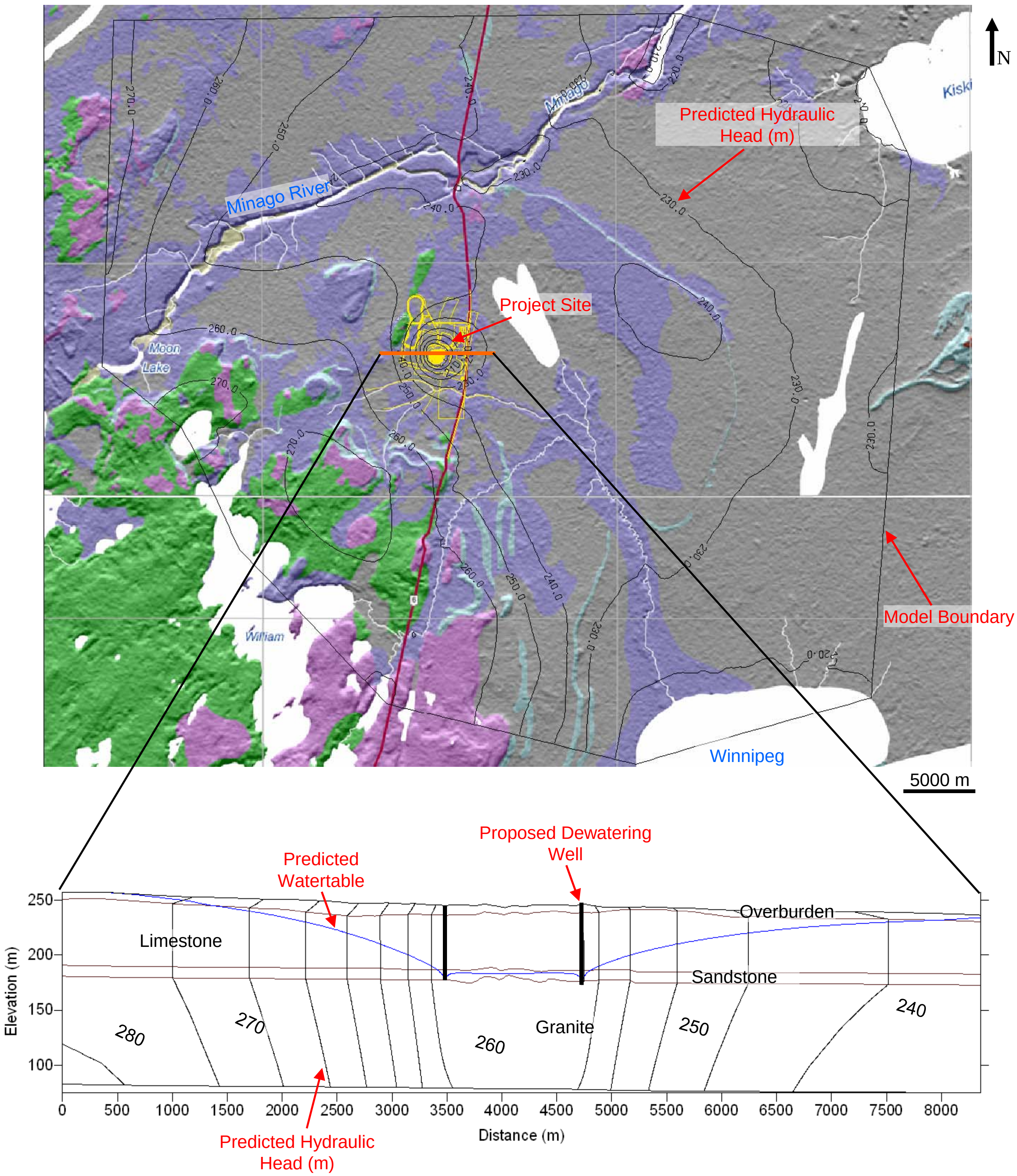


Map Reference:
Matile, G.L.D., and Keller, G.D., 2006. Surficial geology of the Wekusko Lake map sheet (NTS 63J), Manitoba; Manitoba Science, Technology, Energy, and Mines; Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-63J, scale 1:250 000.

PROJECT	VICTORY NICKLE/MINAGO PROJECT MINAGO PROJECT GRAND RAPIDS, MANITOBA			
TITLE	CALIBRATED MODEL PARAMETERS			
PROJECT No.	----		FILE No. ----	
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	FIGURE 24	
CHECK	WZ	14OCT08		
REVIEW				

Golder Associates

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 19 to 26.ppt



PROJECT	VICTORY NICKLE/MINAGO PROJECT MINAGO PROJECT GRAND RAPIDS, MANITOBA
TITLE	**PREDICTED HYDROGEOLOGIC CONDITIONS WITH DEWATERING WELLS**

Golder Associates

PROJECT No.	----		FILE No. ----	
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	**FIGURE 25**	
CHECK	WZ	14OCT08		
REVIEW				

Map Reference:
Matile, G.L.D., and Keller, G.D., 2006. Surficial geology of the Wekusko Lake map sheet (NTS 63J), Manitoba; Manitoba Science, Technology, Energy, and Mines; Manitoba Geological Survey, Surficial Geology Compilation Map Series SG-63J, scale 1:250 000.

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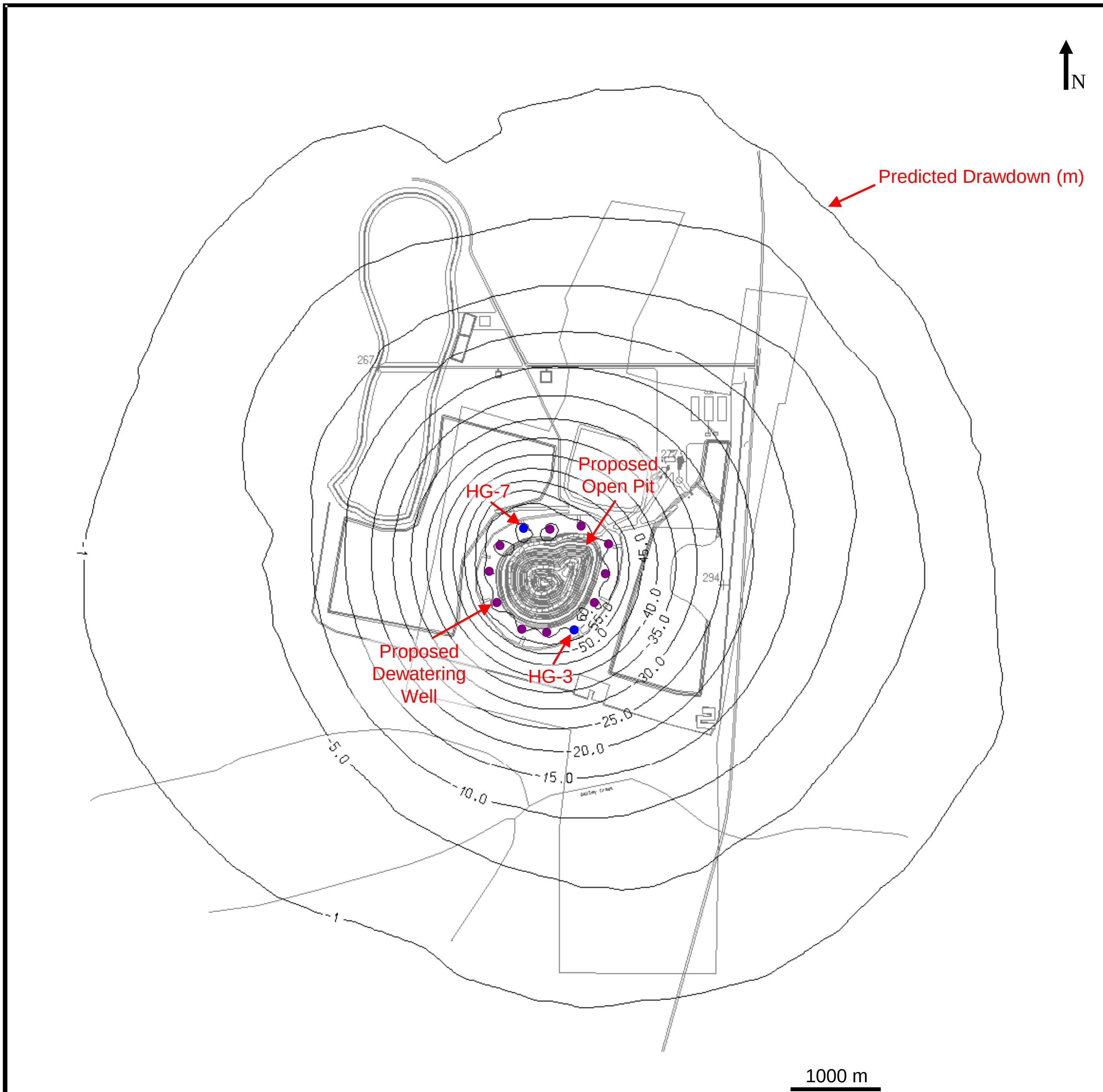


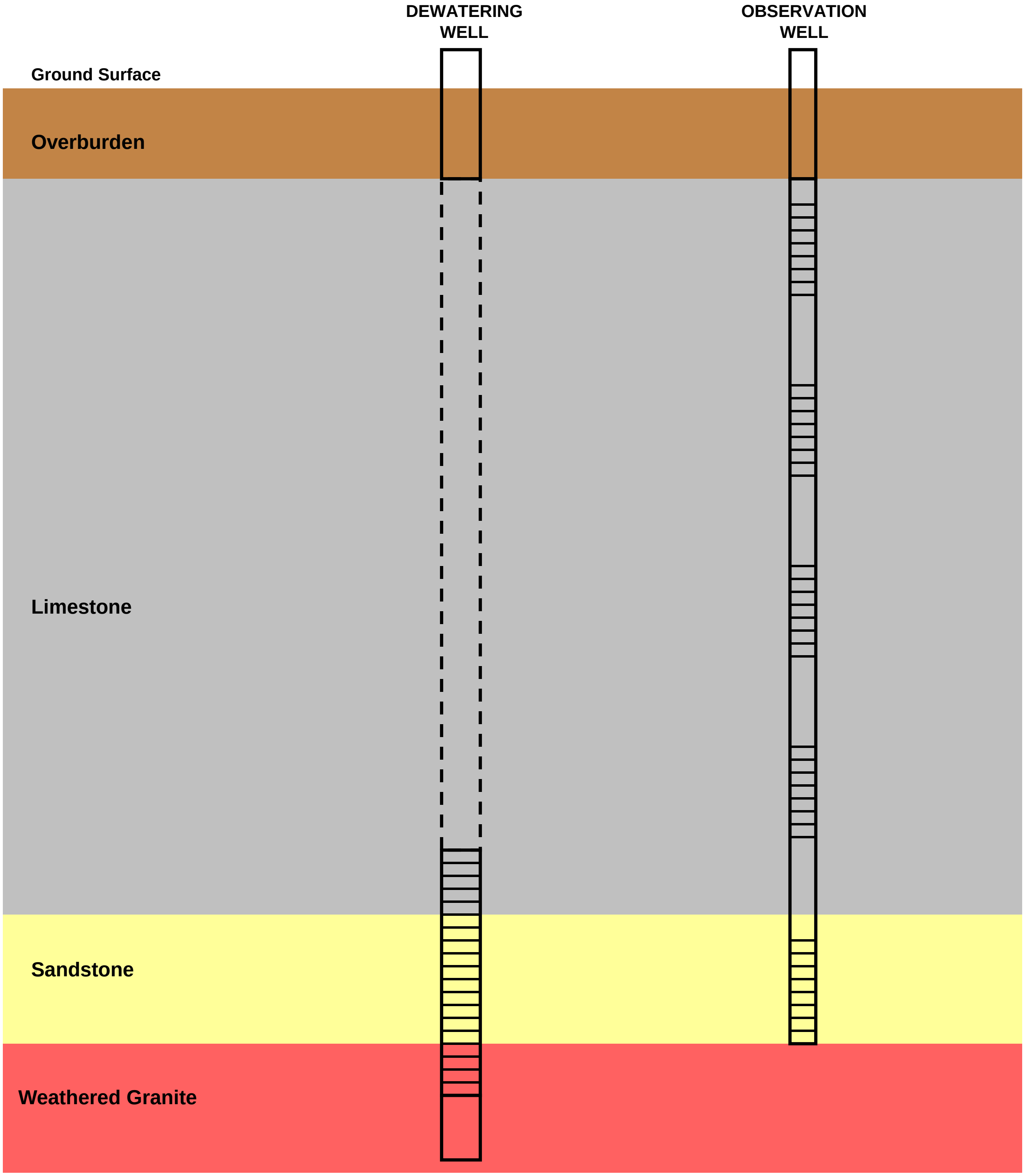
Map Reference:
Wardrop file *change dump and tailings.dwg*

PROJECT	**VICTORY NICKLE/MINAGO PROJECT** **MINAGO PROJECT** **GRAND RAPIDS, MANITOBA**
TITLE	**PREDICTED DRAWDOWN** **CONE IN THE LIMESTONE UNIT**

Golder Associates

PROJECT No.	----		FILE No. ----	
DESIGN	WZ	14OCT08	SCALE NTS	REV.
CADD	WZ	14OCT08	**FIGURE 26**	
CHECK	WZ	14OCT08		
REVIEW				

FILE: \\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 19 to 26.ppt



PROJECT
VICTORY NICKEL / MINAGO
MULTI-WELL PUMPING TEST PROGRAM
GRAND RAPIDS, M.B.

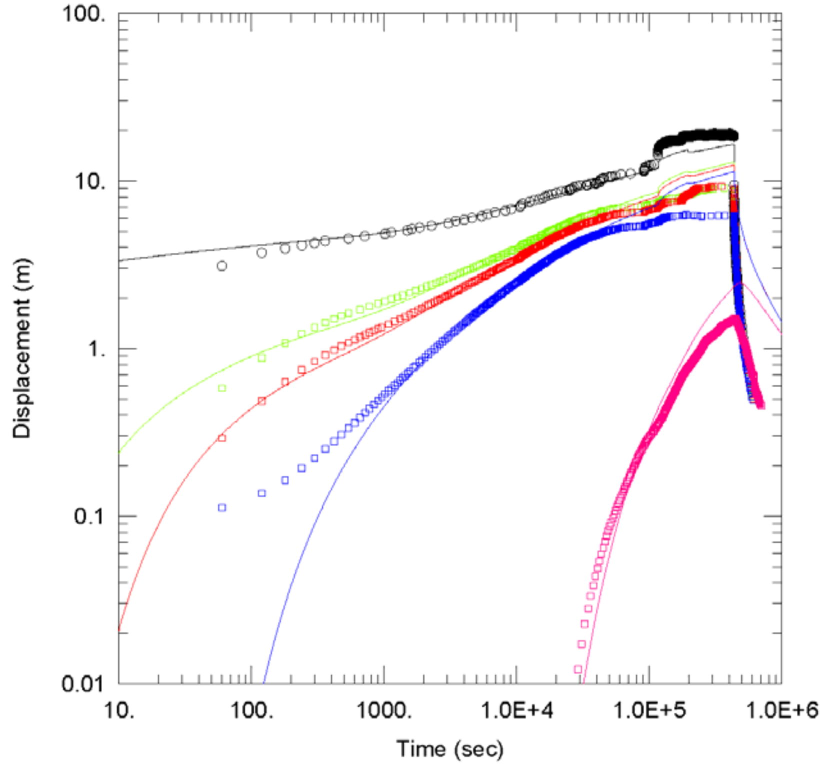
TITLE
SCHEMATIC FOR PROPOSED DEWATERING WELLS AND OBSERVATION WELLS

PROJECT No.	08-1428-0001		FILE No. ----	
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE 27**	
CHECK	CR	16OCT08		
REVIEW				

FILE:\\Bur1-s-filesrv2\final\2008\1428\08-1428-0001\Phase 7000\Rep 0302_09 Dewatering Investigation FINAL\Figures\Figures 5 6 7 11 12 14 18 and 27.ppt

APPENDIX I

PUMPING TEST ANALYSES



WELL TEST ANALYSIS

Data Set: O:\...\Butler model.aqt
Date: 10/02/08 Time: 16:01:52

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-7 LS	487056.573	5993994.852

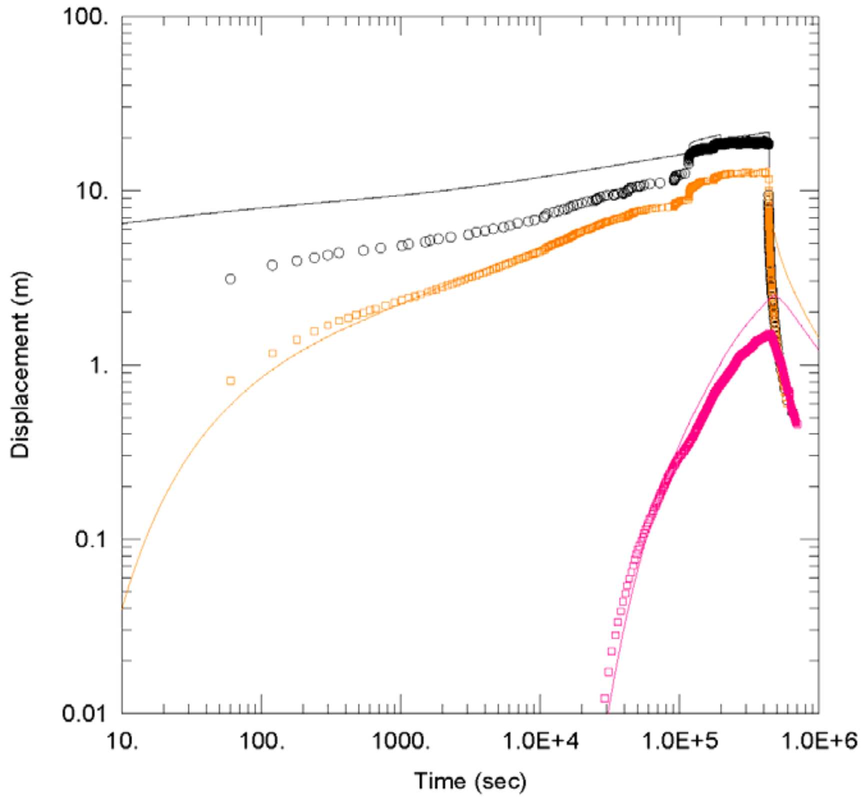
Observation Wells

Well Name	X (m)	Y (m)
○ HG-7 LS	487056.573	5993994.852
□ MW-SLS-1	487057.937	5994027.412
□ MW-SLS-2	487050.998	5994066.573
□ MW-SLS-3	487341.271	5994103.972
□ MW-LS-7	487632.331	5996198.771

SOLUTION

Aquifer Model: Confined Solution Method: Butler

T1 = 0.01445 m^2/sec S1 = 0.0001794
T2 = 0.001986 m^2/sec S2 = 0.0002
R = 350. m



WELL TEST ANALYSIS

Data Set: O:\...\Butler model.aqt
Date: 10/15/08 Time: 08:50:49

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-7 LS	487056.573	5993994.852

Observation Wells

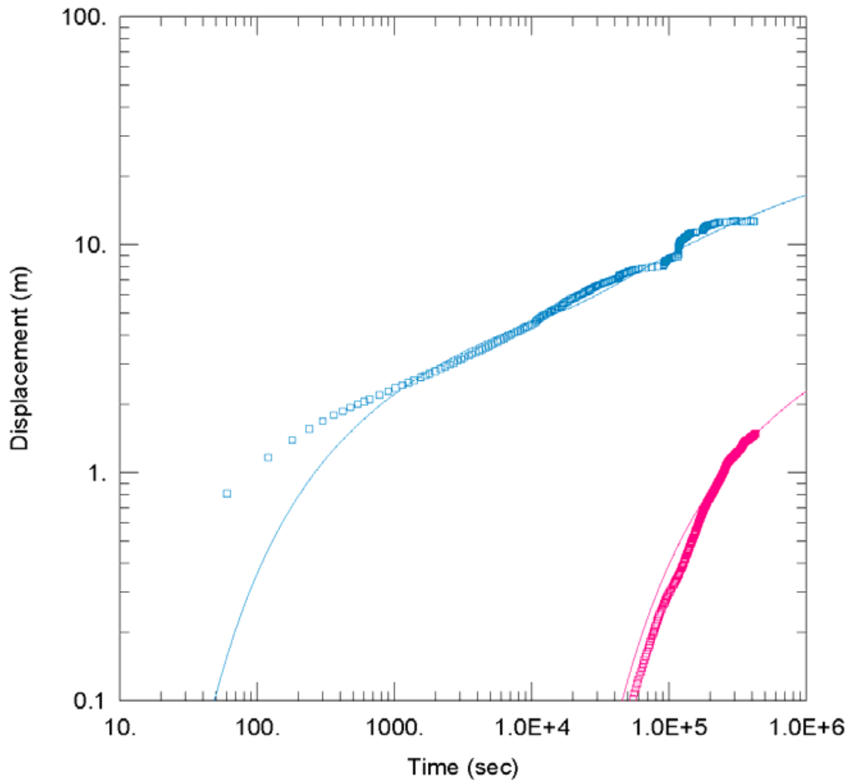
Well Name	X (m)	Y (m)
○ HG-7 LS	487056.573	5993994.852
□ MW-LS-2	487038.929	5994067.226
□ MW-LS-7	487632.331	5996198.771

SOLUTION

Aquifer Model: Confined Solution Method: Butler

T1 = 0.007494 m^2/sec
T2 = 0.001986 m^2/sec
R = 350. m

S1 = 8.72E-5
S2 = 0.0002



WELL TEST ANALYSIS

Data Set: O:\...\ALL WELLS Moench-Prickett LS wells.aqt
Date: 10/06/08 Time: 10:35:36

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-7 LS	487056.573	5993994.852
HG-7 SS	487059.036	5993984.751
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

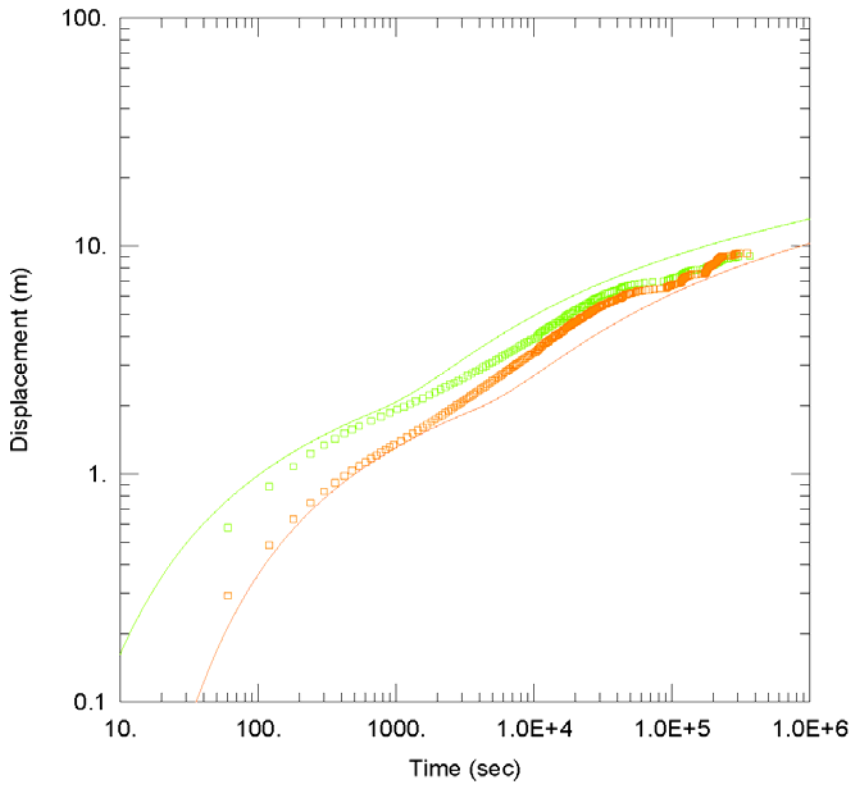
Observation Wells

Well Name	X (m)	Y (m)
□ MW-LS-2	487038.929	5994067.226
□ MW-LS-7	487632.331	5996198.771

SOLUTION

Aquifer Model: Confined Solution Method: Moench-Prickett

T = 0.0013 m^2/sec S = 7.0E-5
Sy = 0.017 H-b = 5. m



WELL TEST ANALYSIS

Data Set: O:\...\ALL WELLS Moench-Prickett.aqt
Date: 10/06/08 Time: 10:34:38

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-7 LS	487056.573	5993994.852
HG-7 SS	487059.036	5993984.751
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

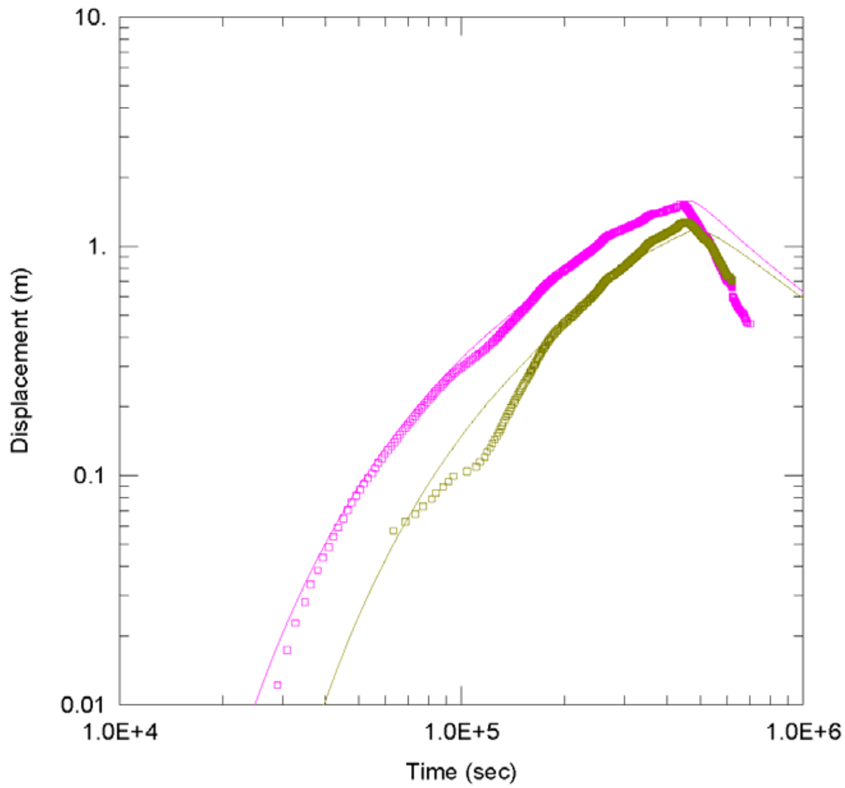
Observation Wells

Well Name	X (m)	Y (m)
MW-SLS-1	487057.937	5994027.412
MW-SLS-2	487050.998	5994066.573

SOLUTION

Aquifer Model: Confined Solution Method: Moench-Prickett

T = 0.0025 m^2/sec S = 7.0E-5
Sy = 0.00966 H-b = 1.906 m



WELL TEST ANALYSIS

Data Set: O:\...\FAR WELLS.aqt
Date: 10/06/08 Time: 10:28:12

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-7 LS	487056.573	5993994.852
HG-7 SS	487059.036	5993984.751
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

Observation Wells

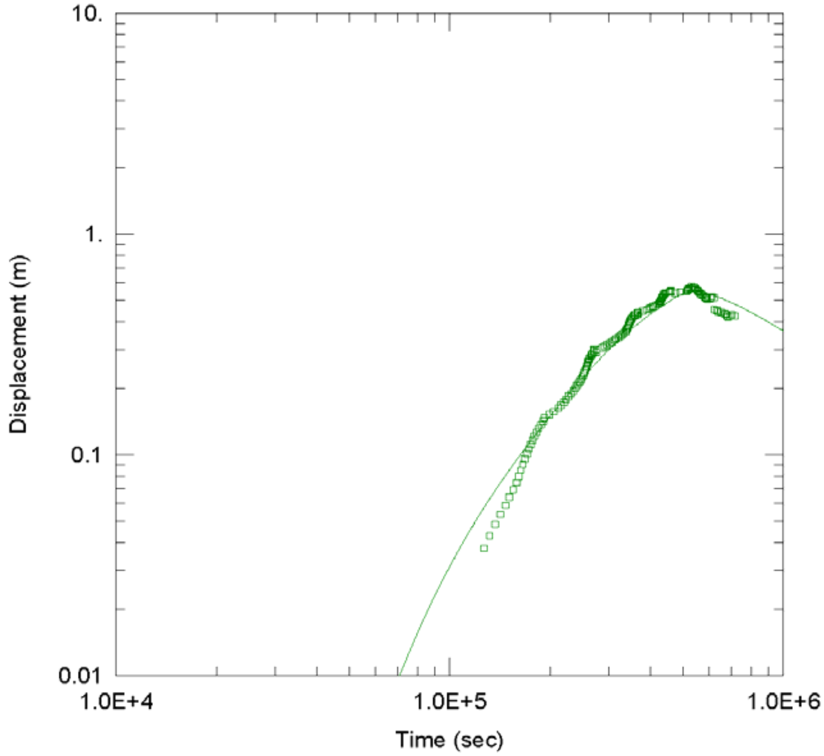
Well Name	X (m)	Y (m)
MW-LS-7	487632.331	5996198.771
MW-LS-9	488409.358	5991493.314

SOLUTION

Aquifer Model: Confined Solution Method: Butler

$T1 = 0.014\ m^2/sec$
$T2 = 0.004\ m^2/sec$
R = 350. m

S1 = 0.0002
S2 = 0.00027



WELL TEST ANALYSIS

Data Set: O:\...\FAR WELLS.aqt
Date: 10/02/08 Time: 16:17:56

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-7 LS	487056.573	5993994.852
HG-7 SS	487059.036	5993984.751
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

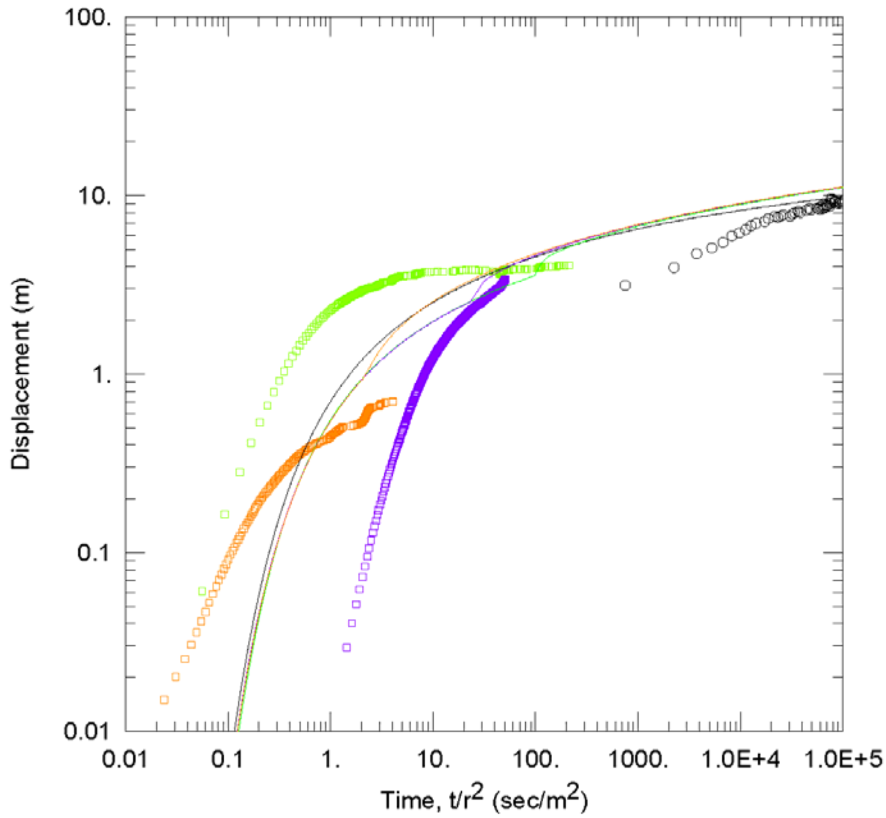
Observation Wells

Well Name	X (m)	Y (m)
□ MW-LS-8	489380.175	5993791.158

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

T1 = 0.014 m^2/sec
S1 = 0.0002
T2 = 0.0056 m^2/sec
S2 = 0.001
R = 350. m



WELL TEST ANALYSIS

Data Set: O:\...\HG-3 SLS wells, no recovery, interference subtracted, 1d subtracted.aqt
Date: 10/06/08 Time: 10:31:53

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-7 LS
Test Date: Aug 11-16, 2008

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

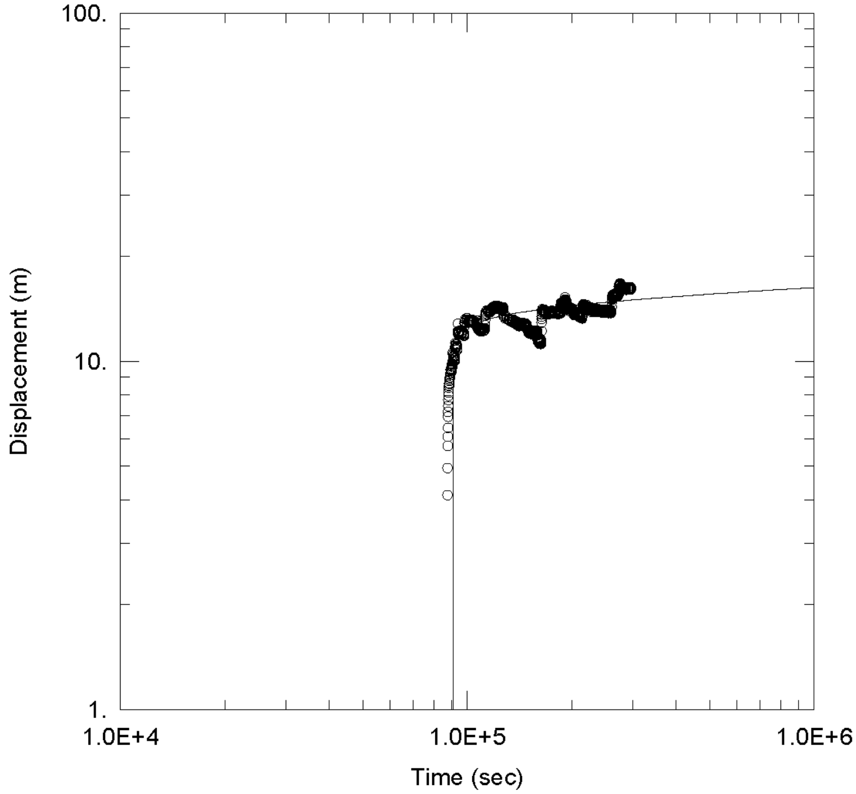
Observation Wells

Well Name	X (m)	Y (m)
○ HG-3 LS	487656.767	5992847.44
□ MW-SLS-4	487681.215	5992815.514
□ MW-SLS-5	487703.579	5992779.397
□ MW-SLS-6	487430.714	5992663.533

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 0.0025 m^2/sec
S = 0.0036
Kz/Kr = 1.
b = 67. m



WELL TEST ANALYSIS

Data Set: O:\...\HG-3 wells, no recovery, Moench-Pricket.aqt
Date: 10/15/08 Time: 09:21:55

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-3 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

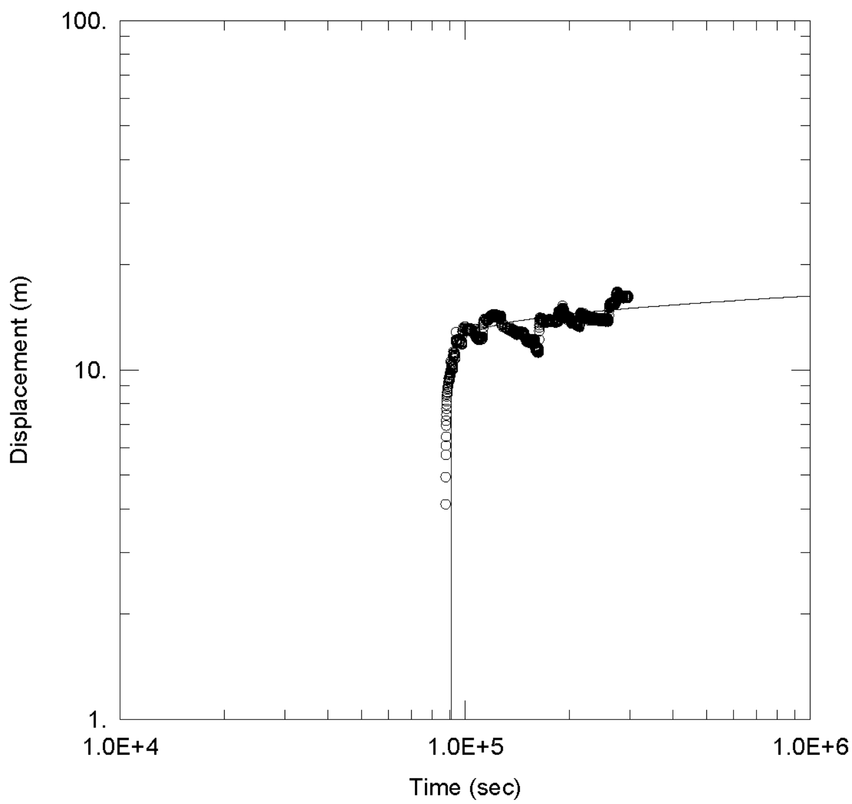
Observation Wells

Well Name	X (m)	Y (m)
○ HG-3 LS	487656.767	5992847.44

SOLUTION

Aquifer Model: Confined Solution Method: Moench-Prickett

T = 0.002 m^2/sec S = 0.0007
Sy = 0.02 H-b = 5. m



WELL TEST ANALYSIS

Data Set: O:\...\HG-3 wells, no recovery, Moench-Pricket.aqt
Date: 10/15/08 Time: 09:21:55

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001-7000
Location: Grand Rapids, MB
Test Well: HG-3 LS
Test Date: Aug 11-16, 2008

AQUIFER DATA

Saturated Thickness: 67. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
HG-3 LS	487656.767	5992847.44
HG-3 SS	487658.468	5992857.948

Observation Wells

Well Name	X (m)	Y (m)
○ HG-3 LS	487656.767	5992847.44

SOLUTION

Aquifer Model: Confined Solution Method: Moench-Prickett

T = 0.002 m^2/sec
S = 0.0007
Sy = 0.02
H-b = 5. m

Hantush-Jacob Method (1955)- Leaky Aquifers - Steady State Flow

Given	Q (m3/s)	0.06	pumping rate
	T (m2/s)	0.014	near HG-7
	T (m2/s)	0.003	near HG-3
	T (m2/s)	0.003	near MW7 and MW 9
	T (m2/s)	0.005	near MW8

Find: K' (hydraulic conductivity of overlying aquitard

Solutions:

$$s^* = \frac{2.3Q}{2\pi T}\left(\log 1.12\frac{L}{r}\right)$$

and

$$L = \sqrt{T\left(\frac{D'}{K'}\right)}$$

Therefore

$$L = \frac{r}{1.12}10^{\left(\frac{x^*2\pi T}{2.3Q}\right)}$$

$$K' = D'T/L^2$$

Case 1	s* (m)	2.41	steady state drawdown at observation well
OB-1	r (m)	31	distance from pumping well
	T m2/s	0.014	
	Q (m3/s)	0.06	pumping rate
	D' (m)	5	saturated thickness of aquitard
	L (m) =	951.34	leakage factor
	K' (m/s)=	**7.73E-08**	

Case 2	s* (m)	0.06	steady state drawdown at observation well
OB-2	r (m)	75	distance from pumping well
	T m2/s	0.014	
	Q (m3/s)	0.06	pumping rate
	D' (m)	5	saturated thickness of aquitard
	L (m) =	73.13	
	K' (m/s)=	**1.31E-05**	

Case 3	s* (m)	0.02	steady state drawdown at observation well
OB-3	r (m)	305	distance from pumping well
	T m2/s	0.014	
	Q (m3/s)	0.06	pumping rate
	D' (m)	5	saturated thickness of aquitard
	L (m) =	280.43	
	K' (m/s)=	**8.90E-07**	

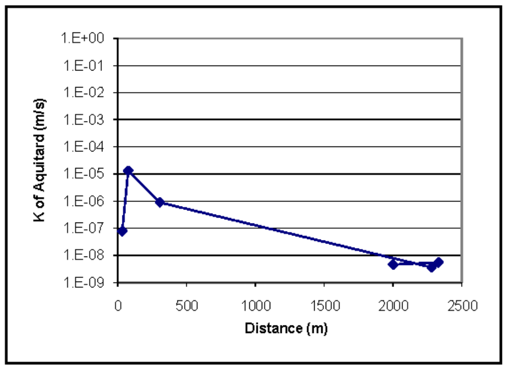
Case 7	s* (m)	0.01	steady state drawdown at observation well
OB-7	r (m)	2280	distance from pumping well
	T m2/s	0.003	
	Q (m3/s)	0.06	pumping rate
	D' (m)	5	saturated thickness of aquitard
	L (m) =	2,042.13	
	K' (m/s)=	**3.60E-09**	

Case 8	s* (m)	0.06	steady state drawdown at observation well
OB-8	r (m)	2330	distance from pumping well
	T m2/s	0.005	
	Q (m3/s)	0.088	pumping rate
	D' (m)	5	saturated thickness of aquitard
	L (m) =	2,125.45	
	K' (m/s)=	**5.53E-09**	

Case 9	s* (m)	0.03	steady state drawdown at observation well
OB-9	r (m)	2000	distance from pumping well
	T m2/s	0.003	
	Q (m3/s)	0.088	pumping rate
	D' (m)	5	saturated thickness of aquitard
	L (m) =	1,797.24	
	K' (m/s)=	**4.64E-09**	

SUMMARY OF RESULTS

Case	Well	Distance (r	K (m/s)
1	**MW-OB-1**	31	**7.7E-08**
2	**MW-OB-2**	75	**1.3E-05**
3	**MW-OB-3**	305	**8.9E-07**
4	**MW-OB-7**	2280	**3.6E-09**
5	**MW-OB-8**	2330	**5.5E-09**
6	**MW-OB-9**	2000	**4.6E-09**

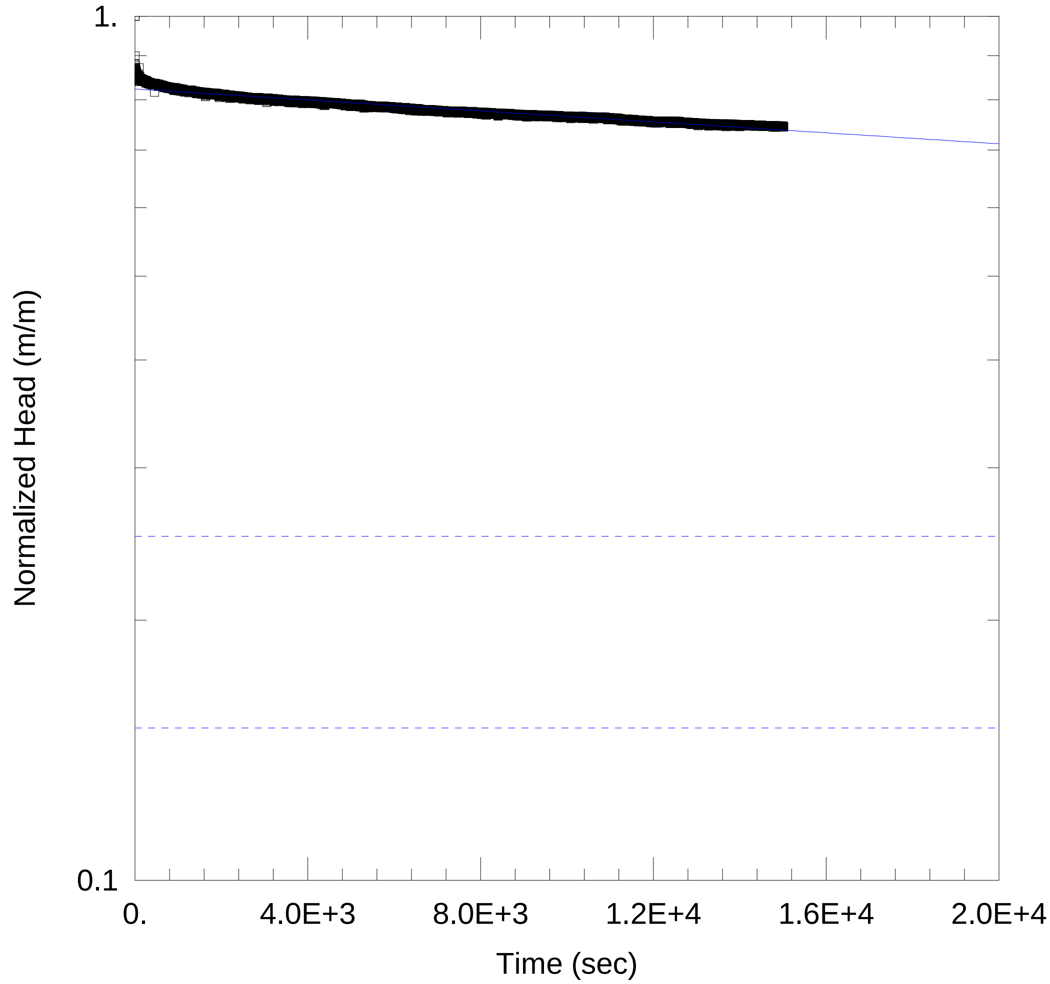


APPENDIX II

ANALYSIS OF SINGLE-WELL RESPONSE TESTS

TABLE II-1:
Summary of Results: Single-Well Response Tests

	Units	Symbol	MWOB-1	MWOB-2	MWOB-4	MWOB-5	MWOB-6	MWOB-7	MWGR-2	MWGR-5
Well Construction										
Well Diameter (for 2" diam well)	m		0.051	0.051	0.051	0.051	0.051	0.051	0.038	0.038
Casing Radius	m	r(c)	0.025	0.025	0.025	0.025	0.025	0.025	0.019	0.019
Well / Sand Pack Radius	m	r(w)	0.048	0.064	0.064	0.064	0.064	0.064	0.048	0.048
Borehole Radius	m	r(sk)	0.048	0.064	0.064	0.064	0.064	0.064	0.048	0.048
Depth to bottom of Well	m		6.86	5.18	5.79	7.62	3.96	7.62	76.2	77.11
Screen Length	m		3.06	1.58	1.85	3.35	1.56	3.02	4.6	4.66
porosity of sand pack	mm		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Test Details										
Date			19-Aug-08	19-Aug-08	18-Aug-08	18-Aug-08	18-Aug-08	19-Aug-08	19-Aug-08	18-Aug-08
Start Time	h:mm		14:54	15:41	12:55	13:55	14:58	13:15	15:41	13:23
Displacement Method	-		Slug	Slug	Slug	Slug	Slug	Slug	Slug	Slug
Rising or Falling Head	-		Falling head	Falling head	Falling head	Falling head	Falling head	Falling head	Falling head	Falling head
Depth to Water	m		1.716	1.196	1.253	1.501	1.206	1.315	1.18	0.432
Depth to Top of Screen	m		3.8	3.6	3.94	4.27	2.4	4.6	71.6	72.45
Water level within screen?	-		no	no	no	no	no	no	no	no
Apply Correction for Effective Casing Radius			no	no	no	no	no	no	no	no
Static water column height	m	H	5.144	3.984	4.537	6.119	2.754	6.305	75.02	76.678
Saturated Aquifer Thickness	m	b	5.144	3.984	4.537	6.119	2.754	6.305	7.92	4.57
Height of water above screen	m	d	2.084	2.404	2.687	2.769	1.194	3.285	70.42	72.018
Saturated Screen Length	m	L	3.06	1.58	1.85	3.35	1.56	3.02	4.6	4.66
Volume Displaced	L		1.3E+00	8.9E-01	1.0E+00	1.3E+00	8.9E-01	1.0E+00	8.9E-01	1.3E+00
Volume Displaced	m3		1.3E-03	8.9E-04	1.0E-03	1.3E-03	8.9E-04	1.0E-03	8.9E-04	1.3E-03
Calculated Displacement (m)	m		0.617	0.441	0.493	0.617	0.441	0.493	0.787	1.160
Calculated Displacement corrected(m)			0.617	0.441	0.493	0.617	0.441	0.493	0.787	1.160
Measured Displacement (m)	m	Ho	0.564	0.454	0.442	0.617	0.450	0.486	0.743	1.064
Water level drops below top of screen?	-		no	no	no	no	no	no	no	no
Results										
Solution Type			Hvorslev	Hvorslev	Hvorslev	Hvorslev	Hvorslev	Hvorslev	CBP	Hvorslev
Es t imated Storativity (Slug in)			-	-	-	-	-	-	5.8E-05	-
Es t imated Transmissivity (Slug in)			-	-	-	-	-	-	2.8E-06	-
Estimated Hydraulic Conductivity			**7.6E-09**	**8.3E-09**	**1.5E-07**	**6.0E-09**	**1.2E-08**	**5.5E-06**	**3.5E-07**	**3.7E-09**
Lithology			OVERBURDEN	OVERBURDEN	OVERBURDEN	OVERBURDEN	OVERBURDEN	OVERBURDEN	GRANITE	GRANITE
Geometric Mean	**m/s**		**3.9E-08**						**3.6E-08**	
Maximum	**m/s**		**5.5E-06**							
Minimum	**m/s**		**6.0E-09**							



WELL TEST ANALYSIS

Data Set: O:\...\MWOB-1_New Ho.aqt
Date: 10/16/08 | Time: 16:22:59

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWOB-1
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 5.144 m
Anisotropy Ratio (Kz/Kr): 1.

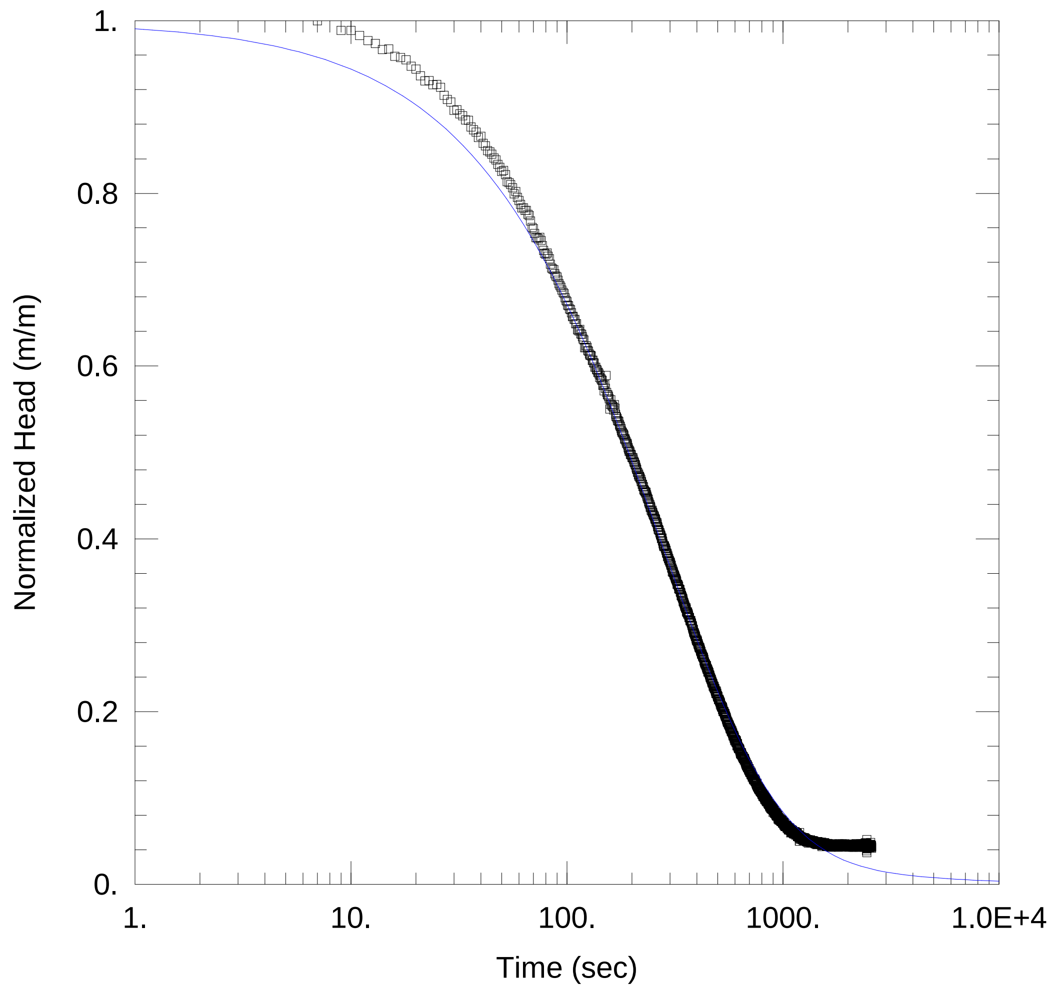
WELL DATA (MWOB-1)

Initial Displacement: 0.5637 m
Total Well Penetration Depth: 5.144 m
Casing Radius: 0.025 m
Static Water Column Height: 5.144 m
Screen Length: 3.06 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 3.614E-9 m/sec
y0 = 0.4642 m



WELL TEST ANALYSIS

Data Set: O:\...\MWGR-2.aqt
Date: 10/16/08 Time: 16:16:58

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWGR-2
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 7.92 m Anisotropy Ratio (Kz/Kr): 1.

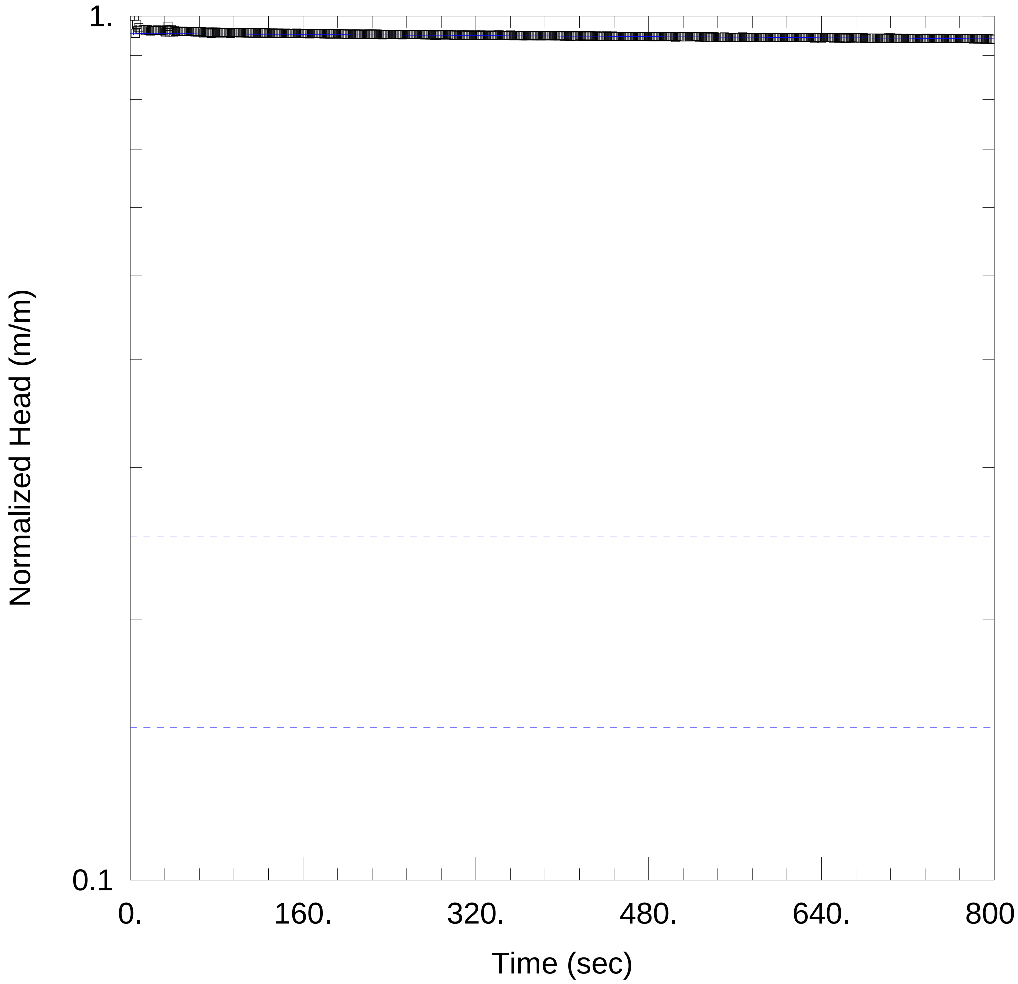
WELL DATA (MWGR-2)

Initial Displacement: 0.7434 m
Total Well Penetration Depth: 75.02 m
Casing Radius: 0.019 m
Static Water Column Height: 75.02 m
Screen Length: 4.6 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 2.802E-6 m^2/sec
S = 5.816E-5



WELL TEST ANALYSIS

Data Set: O:\...\MWGR-5_Slug out New Ho.aqt
Date: 10/16/08 Time: 16:21:10

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWGR-5
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 4.57 m
Anisotropy Ratio (Kz/Kr): 1.

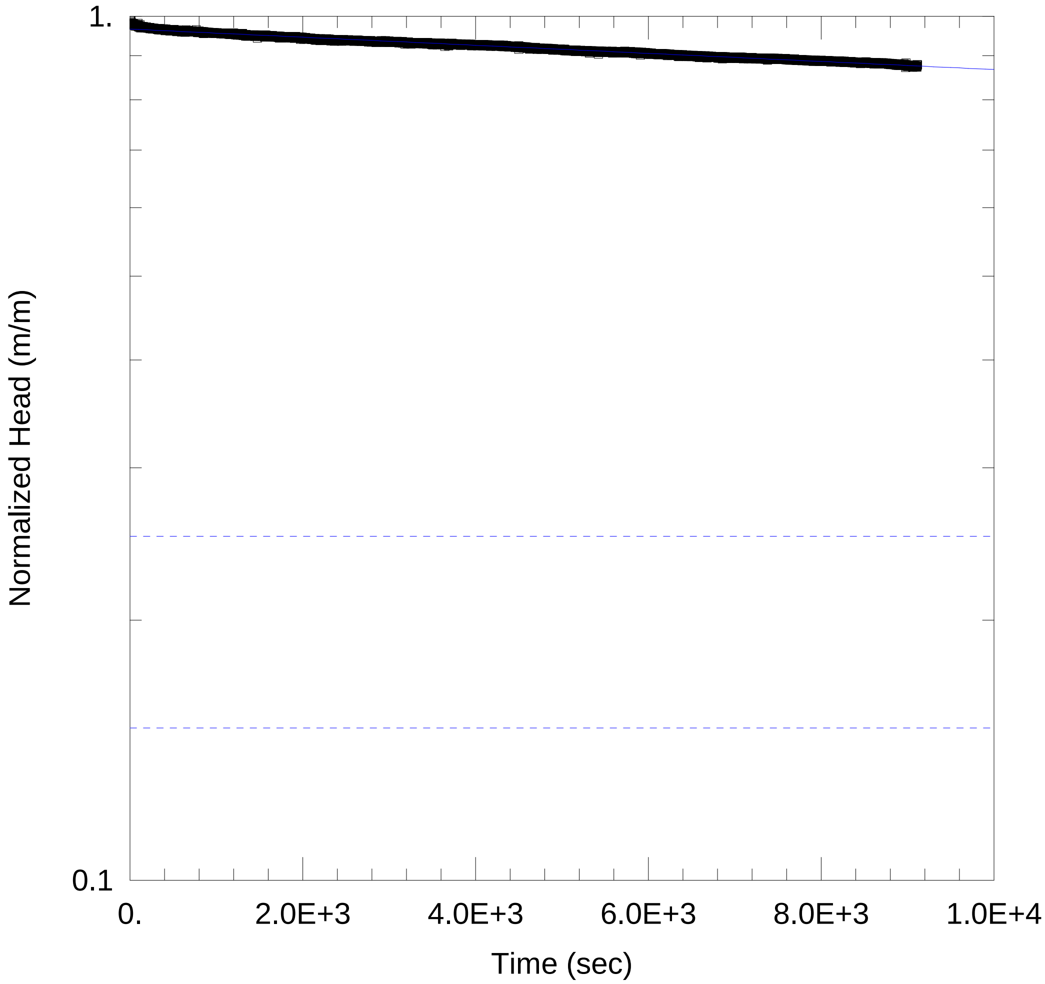
WELL DATA (MWGR-5)

Initial Displacement: 1.11 m
Total Well Penetration Depth: 76.68 m
Casing Radius: 0.019 m
Static Water Column Height: 76.68 m
Screen Length: 4.66 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 3.753E-9 m/sec
y0 = 1.06 m



WELL TEST ANALYSIS

Data Set: O:\...\MWOB-2 New Ho.aqt
Date: 10/16/08
Time: 16:24:03

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWOB-2
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 3.984 m
Anisotropy Ratio (Kz/Kr): 1.

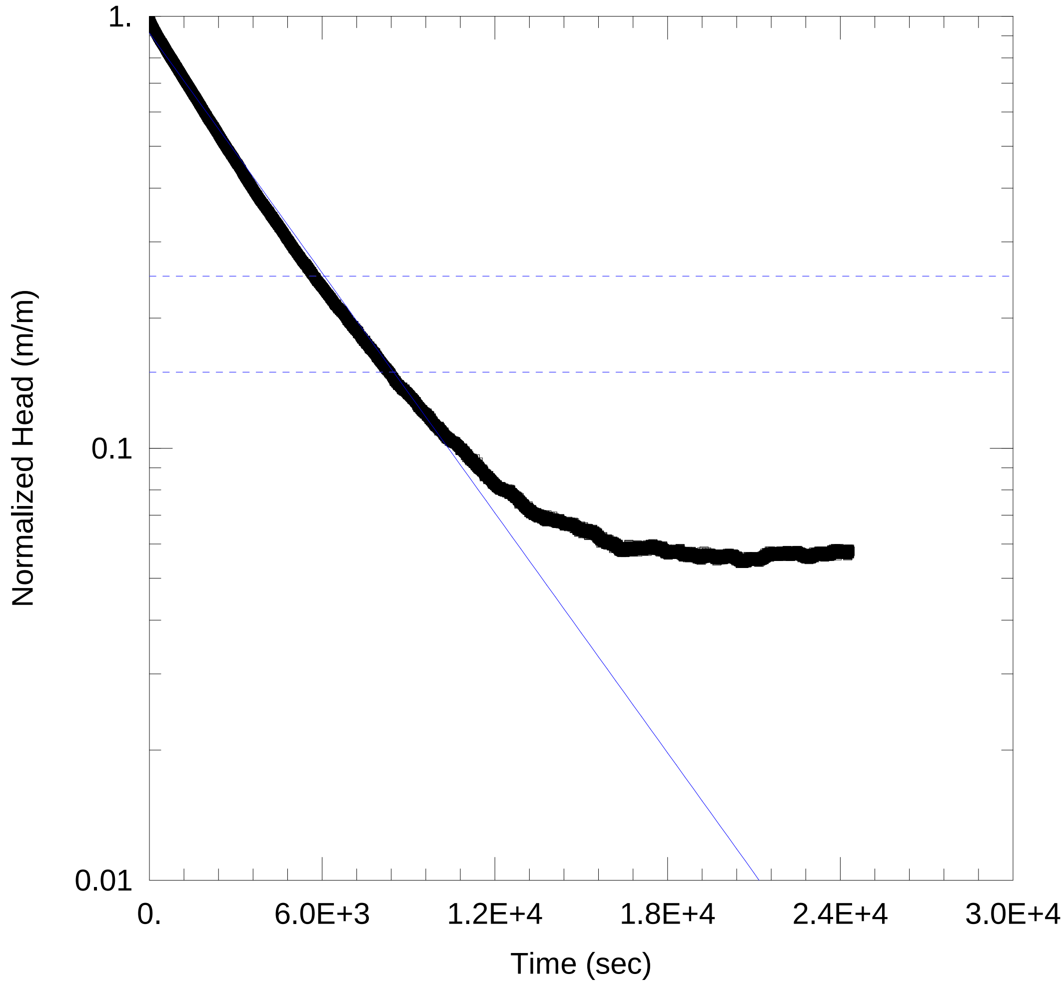
WELL DATA (MWOB-2)

Initial Displacement: 0.454 m
Total Well Penetration Depth: 3.984 m
Casing Radius: 0.025 m
Static Water Column Height: 3.984 m
Screen Length: 1.58 m
Well Radius: 0.064 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 8.317E-9 m/sec
y0 = 0.4386 m



WELL TEST ANALYSIS

Data Set: O:\...\MWOB-4_Slug out_New Ho.aqt
Date: 10/16/08 Time: 16:25:11

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWOB-4
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 4.537 m
Anisotropy Ratio (Kz/Kr): 1.

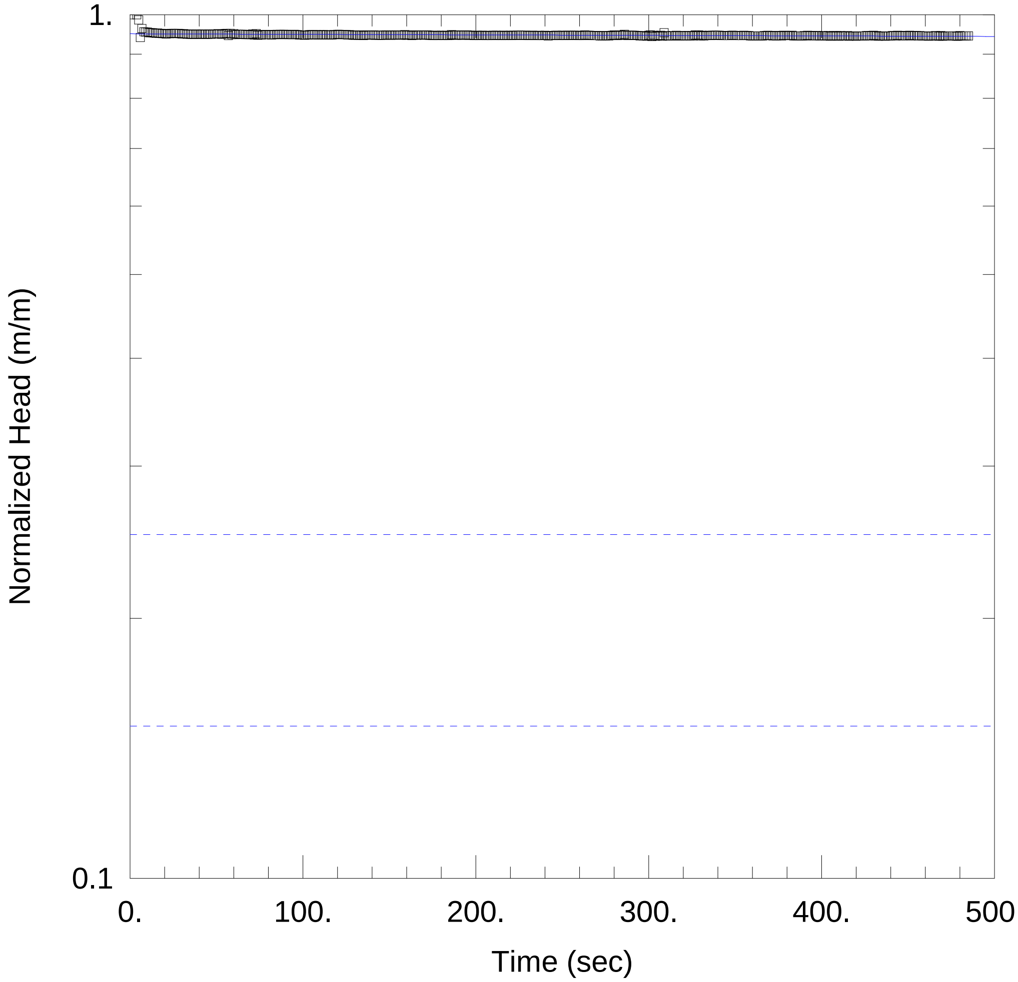
WELL DATA (MWOB-4)

Initial Displacement: 0.5256 m
Total Well Penetration Depth: 4.537 m
Casing Radius: 0.025 m
Static Water Column Height: 4.537 m
Screen Length: 1.85 m
Well Radius: 0.064 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 1.461E-7 m/sec
y0 = 0.4806 m



WELL TEST ANALYSIS

Data Set: O:\...\MWOB-5_Slug out_New Ho.aqt
Date: 10/16/08 Time: 16:50:34

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWOB-5
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 6.119 m Anisotropy Ratio (Kz/Kr): 1.

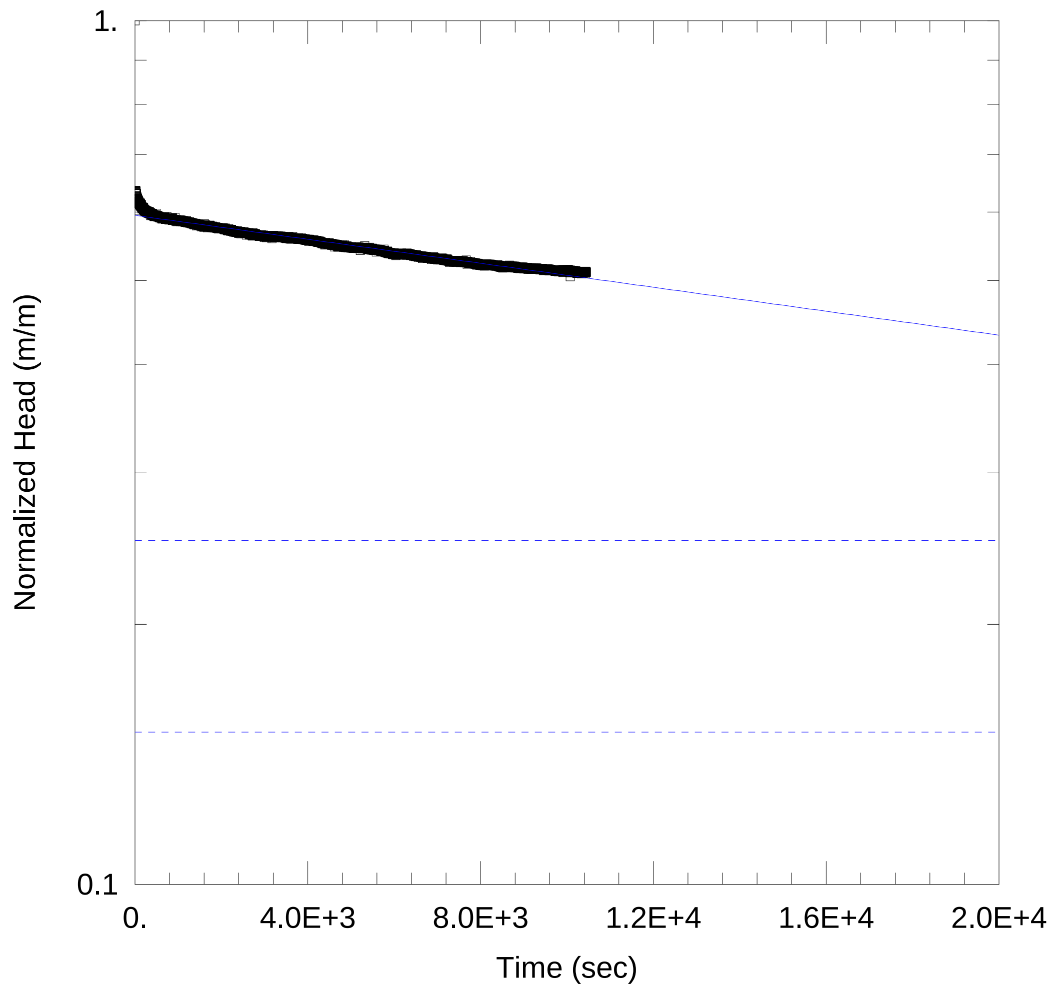
WELL DATA (MWOB-5)

Initial Displacement: 0.6172 m
Total Well Penetration Depth: 6.119 m
Casing Radius: 0.025 m
Static Water Column Height: 6.119 m
Screen Length: 3.35 m
Well Radius: 0.064 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.031E-9 m/sec y0 = 0.5864 m



WELL TEST ANALYSIS

Data Set: O:\...\MWOB-6.aqt
Date: 10/16/08 Time: 16:52:10

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWOB-6
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 2.754 m Anisotropy Ratio (Kz/Kr): 1.

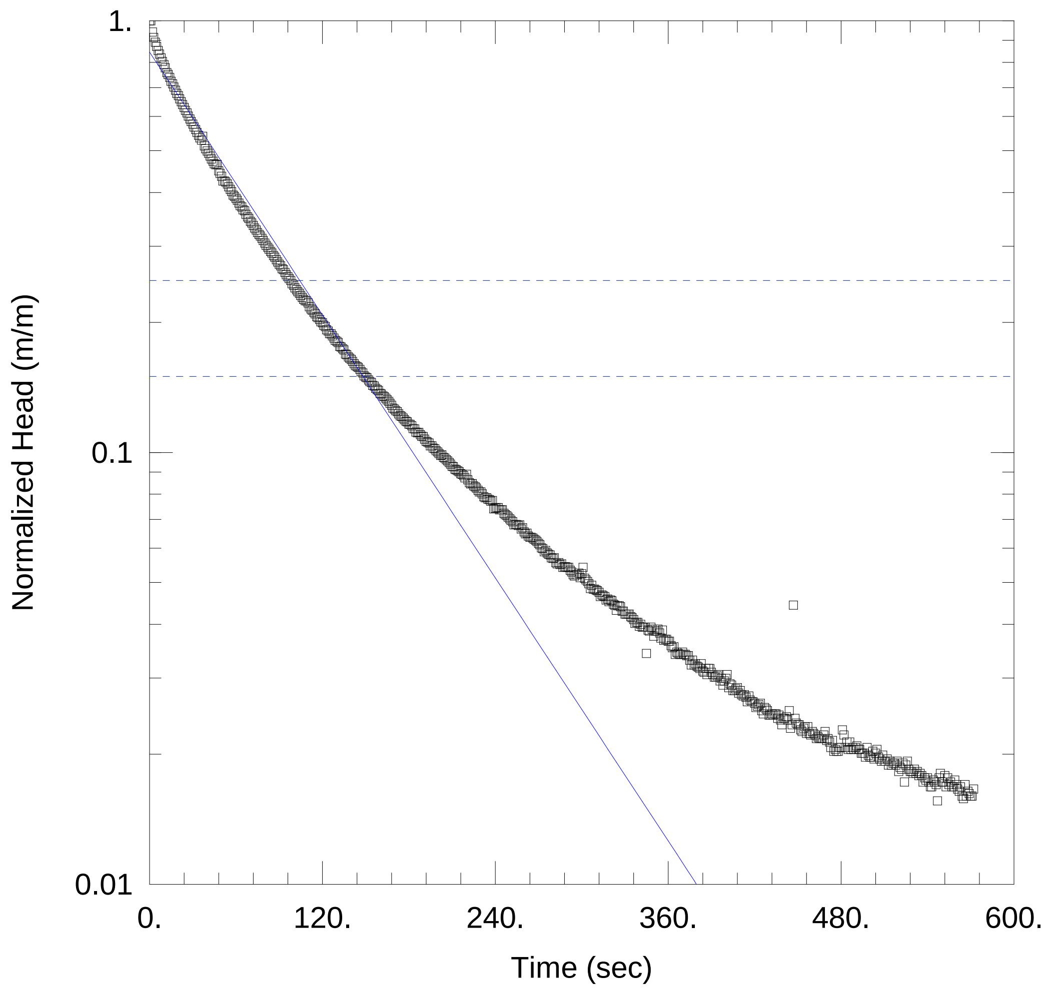
WELL DATA (MWOB-6)

Initial Displacement: 0.708 m
Total Well Penetration Depth: 2.754 m
Casing Radius: 0.025 m
Static Water Column Height: 2.754 m
Screen Length: 1.56 m
Well Radius: 0.064 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.244E-8 m/sec y0 = 0.4213 m



WELL TEST ANALYSIS

Data Set: O:\...\MWOB-7_Slug out_New Ho.aqt
Date: 10/16/08 Time: 16:54:56

PROJECT INFORMATION

Company: Golder Associates
Client: Victory Nickel
Project: 08-1428-0001
Location: Minago
Test Well: MWOB-7
Test Date: Aug.18-19,2008

AQUIFER DATA

Saturated Thickness: 6.305 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MWOB-7)

Initial Displacement: 0.4875 m
Total Well Penetration Depth: 6.305 m
Casing Radius: 0.025 m
Static Water Column Height: 6.305 m
Screen Length: 3.02 m
Well Radius: 0.064 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 5.499E-6 m/sec y0 = 0.4124 m

APPENDIX III

LABORATORY REPORT

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

GOLDER ASSOCIATES LTD.
ATTN: MATTHEW NEUNER
500 - 4260 STILL CREEK DRIVE
BURNABY BC V5C 6C6

Reported On: 16-OCT-08 12:05 PM
Revision: 2

Lab Work Order #: **L672682** **Date Received:** **21-AUG-08**

Project P.O. #:
Job Reference: 08-1428-0001-7000
Legal Site Desc:
CofC Numbers: 15225

Other Information:

Comments: October 16, 2008 - Data has been added for Total Nickel, Cobalt and Molybdenum, for all samples. All other data remains unchanged.

Amber Springer
Account Manager

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Part of the **ALS Laboratory Group**
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Phone: +1 604 253 4188 Fax: +1 604 253 6700 www.alsglobal.com
A Campbell Brothers Limited Company

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L672682-1	L672682-2	L672682-3	L672682-4	L672682-5
	Description					
	Sampled Date	15-AUG-08	15-AUG-08	15-AUG-08	15-AUG-08	15-AUG-08
	Sampled Time					
	Client ID	15225-01	15225-02	15225-03	15225-04	15225-05
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	7.9	<5.0	5.7	5.1	<5.0
	Conductivity (uS/cm)	606	683	610	633	684
	Hardness (as CaCO3) (mg/L)	242	167	287	257	165
	pH (pH)	8.05	8.17	8.04	8.05	8.18
	Total Dissolved Solids (mg/L)	335	390	284	351	388
	Turbidity (NTU)	12.3	1.02	4.82	1.93	1.28
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	300	305	301	294	312
	Ammonia as N (mg/L)	0.143	0.207	0.058	0.104	0.265
	Chloride (Cl) (mg/L)	11.9	23.9	9.82	18.9	23.8
	Fluoride (F) (mg/L)	0.301	0.698	0.244	0.401	0.689
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.163	0.189	0.094	0.139	0.224
	Sulfate (SO4) (mg/L)	12.9	27.7	16.4	22.2	27.6
Cyanides	Cyanide, Weak Acid Diss (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	3.11	0.82	2.19	1.17	0.81
Total Metals	Aluminum (Al)-Total (mg/L)	0.108	0.022	0.036	0.026	0.022
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	0.00294	0.00028	0.00230	0.00021	0.00027
	Barium (Ba)-Total (mg/L)	0.069	0.045	0.076	0.061	0.045
	Boron (B)-Total (mg/L)	0.18	0.40	0.11	0.20	0.39
	Cadmium (Cd)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Calcium (Ca)-Total (mg/L)	45.7	32.0	56.3	51.5	31.6
	Chromium (Cr)-Total (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Cobalt (Co)-Total (mg/L)	0.00029	<0.00010	0.00028	0.00019	<0.00010
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	0.734	0.172	0.337	0.130	0.169
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00073	<0.00050
	Magnesium (Mg)-Total (mg/L)	31.1	21.1	35.5	31.2	21.0
	Manganese (Mn)-Total (mg/L)	0.0100	0.0083	0.0091	0.0120	0.0084
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Total (mg/L)	0.000393	0.00114	0.000542	0.00113	0.00112
	Nickel (Ni)-Total (mg/L)	0.00117	<0.00050	0.00109	0.00101	<0.00050
	Potassium (K)-Total (mg/L)	7.90	9.39	4.45	5.74	9.23
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sodium (Na)-Total (mg/L)	32.7	83.2	20.5	34.0	83.4
	Uranium (U)-Total (mg/L)	0.00028	0.00019	0.00062	0.00105	0.00018
	Zinc (Zn)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	0.073

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte					
	Sample ID	L672682-6				
	Description					
	Sampled Date	15-AUG-08				
	Sampled Time					
	Client ID	15225-06				
WATER						
Physical Tests	Colour, True (CU)	5.6				
	Conductivity (uS/cm)	611				
	Hardness (as CaCO3) (mg/L)	271				
	pH (pH)	8.12				
	Total Dissolved Solids (mg/L)	344				
	Turbidity (NTU)	6.00				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	318				
	Ammonia as N (mg/L)	0.060				
	Chloride (Cl) (mg/L)	9.82				
	Fluoride (F) (mg/L)	0.248				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.094				
	Sulfate (SO4) (mg/L)	16.4				
Cyanides	Cyanide, Weak Acid Diss (mg/L)	<0.0050				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.19				
Total Metals	Aluminum (Al)-Total (mg/L)	0.035				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	0.00218				
	Barium (Ba)-Total (mg/L)	0.075				
	Boron (B)-Total (mg/L)	<0.10				
	Cadmium (Cd)-Total (mg/L)	<0.00020				
	Calcium (Ca)-Total (mg/L)	53.3				
	Chromium (Cr)-Total (mg/L)	<0.0020				
	Cobalt (Co)-Total (mg/L)	0.00027				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	0.356				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Magnesium (Mg)-Total (mg/L)	33.5				
	Manganese (Mn)-Total (mg/L)	0.0088				
	Mercury (Hg)-Total (mg/L)	<0.00020				
	Molybdenum (Mo)-Total (mg/L)	0.000521				
	Nickel (Ni)-Total (mg/L)	0.00094				
	Potassium (K)-Total (mg/L)	4.27				
	Selenium (Se)-Total (mg/L)	<0.0010				
	Sodium (Na)-Total (mg/L)	20.2				
	Uranium (U)-Total (mg/L)	0.00058				
	Zinc (Zn)-Total (mg/L)	<0.050				

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	APHA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-NO2-IC-VA	Water	Nitrite by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-NO3-IC-VA	Water	Nitrate by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CN-WAD-MID-COL-VA	Water	Weak Acid Cyanide by Colormetric	APHA 4500-CN "Cyanide"

This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Weak acid dissociable (WAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.

COLOUR-TRUE-VA	Water	Color (True) by Spectrometer	APHA 2120 "Color"

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
HG-TOT-DW-CVAFS-VA	Water	Total Mercury in Water by CVAFS	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-TOT-DW-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-DW-MS-VA	Water	Total Metals in Water by ICPMS	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-LOW-MS-VA	Water	Total Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500-NH3 "Nitrogen (Ammonia)"

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
N/A - Result not available. Refer to qualifier code and definition for explanation

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

ALS Laboratory Group Quality Control Report

Workorder: L672682 Report Date: 16-OCT-08

Client: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DRIVE
BURNABY BC V5C 6C6
Contact: MATTHEW NEUNER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-COL-VA	**Water**							
Batch R715642								
WG825495-5 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			99		%		85-115	27-AUG-08
WG825495-6 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			101		%		85-115	27-AUG-08
WG825495-7 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			100		%		88-112	27-AUG-08
WG825495-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	27-AUG-08
WG825495-3 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	27-AUG-08
WG825495-8 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	27-AUG-08
WG825495-9 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	27-AUG-08
ANIONS-CL-IC-VA	**Water**							
Batch R715081								
WG824572-11 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			99		%		94-106	27-AUG-08
WG824572-2 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			99		%		94-106	27-AUG-08
WG824572-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	27-AUG-08
WG824572-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	27-AUG-08
WG824572-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	27-AUG-08
WG824572-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	27-AUG-08
WG824572-8 MB								
Chloride (Cl)			<0.50		mg/L		0.5	27-AUG-08
ANIONS-F-IC-VA	**Water**							
Batch R715081								
WG824572-11 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			103		%		93-107	27-AUG-08
WG824572-2 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			101		%		93-107	27-AUG-08
WG824572-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	27-AUG-08

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-F-IC-VA	**Water**							
Batch R715081								
WG824572-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	27-AUG-08
WG824572-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	27-AUG-08
WG824572-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	27-AUG-08
WG824572-8 MB								
Fluoride (F)			<0.020		mg/L		0.02	27-AUG-08
ANIONS-NO2-IC-VA	**Water**							
Batch R715081								
WG824572-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			99		%		91-109	27-AUG-08
WG824572-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			100		%		91-109	27-AUG-08
WG824572-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	27-AUG-08
WG824572-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	27-AUG-08
WG824572-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	27-AUG-08
WG824572-6 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	27-AUG-08
WG824572-8 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	27-AUG-08
ANIONS-NO3-IC-VA	**Water**							
Batch R715081								
WG824572-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			102		%		91-109	27-AUG-08
WG824572-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			102		%		91-109	27-AUG-08
WG824572-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	27-AUG-08
WG824572-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	27-AUG-08
WG824572-6 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	27-AUG-08
WG824572-8 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	27-AUG-08

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-SO4-IC-VA	**Water**							
Batch R715081								
WG824572-11 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			100		%		93-107	27-AUG-08
WG824572-2 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			100		%		93-107	27-AUG-08
WG824572-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	27-AUG-08
WG824572-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	27-AUG-08
WG824572-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	27-AUG-08
WG824572-6 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	27-AUG-08
WG824572-8 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	27-AUG-08
CARBONS-TOC-VA	**Water**							
Batch R714715								
WG825001-10 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			100		%		85-115	27-AUG-08
WG825001-2 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			105		%		85-115	27-AUG-08
WG825001-4 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			106		%		85-115	27-AUG-08
WG825001-6 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			106		%		85-115	27-AUG-08
WG825001-8 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			99		%		85-115	27-AUG-08
WG825001-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	27-AUG-08
WG825001-3 MB								
Total Organic Carbon			<0.50		mg/L		0.5	27-AUG-08
WG825001-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	27-AUG-08
WG825001-7 MB								
Total Organic Carbon			<0.50		mg/L		0.5	27-AUG-08
WG825001-9 MB								
Total Organic Carbon			<0.50		mg/L		0.5	27-AUG-08
CN-WAD-MID-COL-VA	**Water**							

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CN-WAD-MID-COL-VA	**Water**							
Batch R714405								
WG824311-2 CRM		**VA-WAD-CONTROL**						
Cyanide, Weak Acid Diss			97		%		85-115	26-AUG-08
WG824311-1 MB								
Cyanide, Weak Acid Diss			<0.0050		mg/L		0.005	26-AUG-08
COLOUR-TRUE-VA	**Water**							
Batch R714298								
WG824628-7 CRM		**VA-COL-C-25**						
Colour, True			100		%		85-115	26-AUG-08
WG824628-8 CRM		**VA-COL-C-25**						
Colour, True			114		%		85-115	26-AUG-08
WG824628-11 DUP		**L672682-1**						
Colour, True		7.9	7.8	J	CU	0.1	20	26-AUG-08
WG824628-1 MB								
Colour, True			<5.0		CU		5	26-AUG-08
WG824628-2 MB								
Colour, True			<5.0		CU		5	26-AUG-08
WG824628-3 MB								
Colour, True			<5.0		CU		5	26-AUG-08
WG824628-4 MB								
Colour, True			<5.0		CU		5	26-AUG-08
WG824628-5 MB								
Colour, True			<5.0		CU		5	26-AUG-08
WG824628-6 MB								
Colour, True			<5.0		CU		5	26-AUG-08
EC-PCT-VA	**Water**							
Batch R715213								
WG825229-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			96		%		90-110	28-AUG-08
WG825229-1 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08
WG825229-2 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08
WG825229-3 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08
WG825229-4 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08
WG825229-5 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-PCT-VA	**Water**							
Batch R715213								
WG825229-6 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08
WG825229-7 MB								
Conductivity			<2.0		uS/cm		2	28-AUG-08
HG-TOT-DW-CVAFS-VA	**Water**							
Batch R715048								
WG824657-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			105		%		88-112	27-AUG-08
WG824657-5 DUP		**L672682-3**						
Mercury (Hg)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	27-AUG-08
WG824657-1 MB								
Mercury (Hg)-Total			<0.00020		mg/L		0.0002	27-AUG-08
MET-TOT-DW-ICP-VA	**Water**							
Batch R713836								
WG821758-3 CRM		**VA-HIGH-WATRM**						
Iron (Fe)-Total			98		%		90-110	25-AUG-08
Sodium (Na)-Total			95		%		85-115	25-AUG-08
WG821758-1 MB								
Iron (Fe)-Total			<0.030		mg/L		0.03	25-AUG-08
Sodium (Na)-Total			<2.0		mg/L		2	25-AUG-08
MET-TOT-DW-MS-VA	**Water**							
Batch R712897								
WG821758-1 MB								
Aluminum (Al)-Total			<0.010		mg/L		0.01	22-AUG-08
Arsenic (As)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Barium (Ba)-Total			<0.020		mg/L		0.02	22-AUG-08
Boron (B)-Total			<0.10		mg/L		0.1	22-AUG-08
Cadmium (Cd)-Total			<0.00020		mg/L		0.0002	22-AUG-08
Calcium (Ca)-Total			<0.10		mg/L		0.1	22-AUG-08
Chromium (Cr)-Total			<0.0020		mg/L		0.002	22-AUG-08
Copper (Cu)-Total			<0.0010		mg/L		0.001	22-AUG-08
Lead (Pb)-Total			<0.00050		mg/L		0.0005	22-AUG-08
Magnesium (Mg)-Total			<0.10		mg/L		0.1	22-AUG-08
Manganese (Mn)-Total			<0.0020		mg/L		0.002	22-AUG-08
Potassium (K)-Total			<0.10		mg/L		0.1	22-AUG-08
Selenium (Se)-Total			<0.0010		mg/L		0.001	22-AUG-08

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-DW-MS-VA	**Water**							
Batch R712897								
WG821758-1 MB								
Uranium (U)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Zinc (Zn)-Total			<0.050		mg/L		0.05	22-AUG-08
Batch R713432								
WG821758-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			109		%		90-110	22-AUG-08
Antimony (Sb)-Total			103		%		90-110	22-AUG-08
Arsenic (As)-Total			108		%		90-110	22-AUG-08
Barium (Ba)-Total			108		%		90-110	22-AUG-08
Boron (B)-Total			104		%		85-115	22-AUG-08
Cadmium (Cd)-Total			104		%		90-110	22-AUG-08
Calcium (Ca)-Total			107		%		85-115	22-AUG-08
Chromium (Cr)-Total			110		%		90-110	22-AUG-08
Copper (Cu)-Total			104		%		90-110	22-AUG-08
Lead (Pb)-Total			105		%		90-110	22-AUG-08
Magnesium (Mg)-Total			107		%		85-115	22-AUG-08
Manganese (Mn)-Total			107		%		90-110	22-AUG-08
Potassium (K)-Total			105		%		85-115	22-AUG-08
Selenium (Se)-Total			108		%		90-110	22-AUG-08
Uranium (U)-Total			110		%		90-110	22-AUG-08
Zinc (Zn)-Total			105		%		85-115	22-AUG-08
WG821758-1 MB								
Antimony (Sb)-Total			<0.00050		mg/L		0.0005	22-AUG-08
MET-TOT-LOW-MS-VA	**Water**							
Batch R712897								
WG821758-1 MB								
Aluminum (Al)-Total			<0.0010		mg/L		0.001	22-AUG-08
Arsenic (As)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Barium (Ba)-Total			<0.000050		mg/L		0.00005	22-AUG-08
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	22-AUG-08
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	22-AUG-08
Boron (B)-Total			<0.010		mg/L		0.01	22-AUG-08
Cadmium (Cd)-Total			<0.000050		mg/L		0.00005	22-AUG-08
Calcium (Ca)-Total			<0.020		mg/L		0.02	22-AUG-08
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	22-AUG-08

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-LOW-MS-VA	**Water**							
Batch R712897								
WG821758-1 MB								
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Copper (Cu)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Lead (Pb)-Total			<0.000050		mg/L		0.00005	22-AUG-08
Lithium (Li)-Total			<0.0050		mg/L		0.005	22-AUG-08
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	22-AUG-08
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	22-AUG-08
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	22-AUG-08
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	22-AUG-08
Potassium (K)-Total			<0.050		mg/L		0.05	22-AUG-08
Selenium (Se)-Total			<0.0010		mg/L		0.001	22-AUG-08
Silver (Ag)-Total			<0.000010		mg/L		0.00001	22-AUG-08
Sodium (Na)-Total			<0.050		mg/L		0.05	22-AUG-08
Strontium (Sr)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Thallium (Tl)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Tin (Sn)-Total			<0.00010		mg/L		0.0001	22-AUG-08
Uranium (U)-Total			<0.000010		mg/L		0.00001	22-AUG-08
Vanadium (V)-Total			<0.0010		mg/L		0.001	22-AUG-08
Zinc (Zn)-Total			<0.0010		mg/L		0.001	22-AUG-08
Batch R713432								
WG821758-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			109		%		90-110	22-AUG-08
Antimony (Sb)-Total			103		%		90-110	22-AUG-08
Arsenic (As)-Total			108		%		90-110	22-AUG-08
Barium (Ba)-Total			108		%		90-110	22-AUG-08
Beryllium (Be)-Total			109		%		90-110	22-AUG-08
Bismuth (Bi)-Total			103		%		90-110	22-AUG-08
Boron (B)-Total			104		%		85-115	22-AUG-08
Cadmium (Cd)-Total			104		%		90-110	22-AUG-08
Calcium (Ca)-Total			107		%		85-115	22-AUG-08
Chromium (Cr)-Total			110		%		90-110	22-AUG-08
Cobalt (Co)-Total			108		%		90-110	22-AUG-08
Copper (Cu)-Total			104		%		90-110	22-AUG-08
Lead (Pb)-Total			105		%		90-110	22-AUG-08
Lithium (Li)-Total			108		%		90-110	22-AUG-08

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-LOW-MS-VA	**Water**							
Batch R713432								
WG821758-3 CRM		**VA-HIGH-WATRM**						
Magnesium (Mg)-Total			107		%		85-115	22-AUG-08
Manganese (Mn)-Total			107		%		90-110	22-AUG-08
Molybdenum (Mo)-Total			112	RM-H	%		90-110	22-AUG-08
Nickel (Ni)-Total			102		%		90-110	22-AUG-08
Potassium (K)-Total			105		%		85-115	22-AUG-08
Selenium (Se)-Total			108		%		90-110	22-AUG-08
Silver (Ag)-Total			104		%		90-110	22-AUG-08
Sodium (Na)-Total			109		%		85-115	22-AUG-08
Strontium (Sr)-Total			108		%		90-110	22-AUG-08
Thallium (Tl)-Total			102		%		85-115	22-AUG-08
Tin (Sn)-Total			108		%		90-110	22-AUG-08
Uranium (U)-Total			110		%		90-110	22-AUG-08
Vanadium (V)-Total			107		%		90-110	22-AUG-08
Zinc (Zn)-Total			105		%		85-115	22-AUG-08
WG821758-1 MB								
Antimony (Sb)-Total			<0.00022		mg/L		0.00022	22-AUG-08
NH3-SIE-VA	**Water**							
Batch R713849								
WG824048-4 CRM		**VA-NH3-SIE-2MG/L**						
Ammonia as N			102		%		85-115	25-AUG-08
WG824048-1 MB								
Ammonia as N			<0.020		mg/L		0.02	25-AUG-08
WG824048-2 MB								
Ammonia as N			<0.020		mg/L		0.02	25-AUG-08
WG824048-3 MB								
Ammonia as N			<0.020		mg/L		0.02	25-AUG-08
PH-PCT-VA	**Water**							
Batch R715213								
WG825229-10 CRM		**VA-PH7-BUF**						
pH			7.04		pH		6.9-7.1	28-AUG-08
TDS-VA	**Water**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-VA	**Water**							
Batch R714728								
WG824364-2 CRM		**VA-TDS-INFUS-425**						
Total Dissolved Solids			97		%		88-112	27-AUG-08
WG824364-4 CRM		**VA-TDS-INFUS-425**						
Total Dissolved Solids			96		%		88-112	27-AUG-08
WG824364-6 DUP		**L672682-6**						
Total Dissolved Solids		344	336		mg/L	2.4	20	27-AUG-08
WG824364-1 MB								
Total Dissolved Solids			<10		mg/L		10	27-AUG-08
WG824364-3 MB								
Total Dissolved Solids			<10		mg/L		10	27-AUG-08
TKN-SIE-VA	**Water**							
Batch R714226								
WG824592-2 CRM		**VA-TKN-CSPK1**						
Total Kjeldahl Nitrogen			94		%		85-115	26-AUG-08
WG824592-3 CRM		**VA-TKN-CSPK25**						
Total Kjeldahl Nitrogen			98		%		85-115	26-AUG-08
WG824592-4 DUP		**L672682-6**						
Total Kjeldahl Nitrogen		0.094	0.083	J	mg/L	0.011	0.2	26-AUG-08
WG824592-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	26-AUG-08
Batch R715451								
WG826012-2 CRM		**VA-TKN-CSPK1**						
Total Kjeldahl Nitrogen			99		%		85-115	28-AUG-08
WG826012-3 CRM		**VA-TKN-CSPK25**						
Total Kjeldahl Nitrogen			98		%		85-115	28-AUG-08
WG826012-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	28-AUG-08
TURBIDITY-VA	**Water**							
Batch R714970								
WG825478-11 CRM		**VA-TURB-SPK-8**						
Turbidity			101		%		85-115	28-AUG-08
WG825478-2 CRM		**VA-TURB-SPK-8**						
Turbidity			101		%		85-115	27-AUG-08
WG825478-4 CRM		**VA-TURB-SPK-8**						
Turbidity			101		%		85-115	27-AUG-08
WG825478-6 CRM		**VA-TURB-SPK-8**						
Turbidity			99		%		85-115	27-AUG-08
WG825478-9 CRM		**VA-TURB-SPK-8**						

Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-VA		**Water**							
Batch	**R714970**								
WG825478-9	**CRM**		**VA-TURB-SPK-8**						
Turbidity				101		%		85-115	28-AUG-08
WG825478-7	**DUP**		**L672682-1**						
Turbidity			12.3	11.9		NTU	3.3	39	27-AUG-08
WG825478-1	**MB**								
Turbidity				<0.10		NTU		0.1	27-AUG-08
WG825478-10	**MB**								
Turbidity				<0.10		NTU		0.1	28-AUG-08
WG825478-3	**MB**								
Turbidity				<0.10		NTU		0.1	27-AUG-08
WG825478-5	**MB**								
Turbidity				<0.10		NTU		0.1	27-AUG-08
WG825478-8	**MB**								
Turbidity				<0.10		NTU		0.1	28-AUG-08

ALS Laboratory Group Quality Control Report

Legend:

Limit	99% Confidence Interval (Laboratory Control Limits)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

L672682

CHAIN-OF-CUSTODY RECORD/ANALYSIS REQUEST

№ 15225 page____of____

Golder Associates
500–4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone: 604-298-6623 Fax: 604-298-5253

Project Number: 08-1428-0001-7000		Laboratory Name: ALS ENVIRONMENTAL	
[redacted]		Address: 1988 TRIUMPH ST., VANCOUVER, BC	
Golder Contact: MATTHEW NEUNER	Golder E-mail Address: mneuner @golder.com	Tel/Fax: 604-253-~~6700~~ 4188	Contact: AMBER SPRINGER

Office the final reports should be sent to:

- ☑ 500–4260 Still Creek Drive, Burnaby, BC V5C 6C6, Tel: 604-298-6623, Fax: 604-298-5253
- ☐ 202–2790 Gladwin Road, Abbotsford, BC V2T 4S8, Tel: 604-850-8786, Fax: 604-850-8756
- ☐ 2640 Douglas Street, Victoria, BC V8T 4M1, Tel: 250-881-7372, Fax: 250-881-7470

Analyses Required

Sample Control Number (SCN)	[redacted]	Sample Matrix (over)	Date Sampled (D/M/Y)	[redacted]	Number of Containers	DRINKING WATER (FULL, NO METALS)	AMMONIA AS N	CYANIDE (WAD)	NITROGEN (TKN)	TOT. ORG. CARBON					RUSH	Remarks (over)
15225 -01			15/8/08		5	↓	↓	↓	↓	↓						
-02			↓		5											
-03					5											
-04					5											
-05					5											
-06					5											
-07																NOT
-08																HAZARDOUS
-09																
-10																NO KNOWN
-11																CONTAMINANTS
-12																

Sampler's Signature [signature]	Relinquished by: Signature	Company GOLDER	Date 15 Aug 08	Time 16:45	Received by: Signature	Company
Sample Storage (°C)	Relinquished by: Signature	Company	Date	Time	Received by: Signature	Company
Comments:	Method of Shipment:	Waybill No.:	Received for Lab by:		Date	Time
	Shipped by:	Shipment Condition: Seal Intact:	Temp (°C) 9	Cooler opened by: ZH	Date Aug 21, 08 12:05	Time

WHITE: Golder copy YELLOW: Lab copy PINK: Lab returns with Final Report

Golder Associates
500–4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone: 604-298-6623 Fax: 604-298-5253

CHAIN-OF-CUSTODY RECORD/ANALYSIS REQUEST

№ 15225 Page ___ of ___

Project Number: 08-1428-0001-7000		Laboratory Name: ALS ENVIRONMENTAL	
Short Title: MINAGO PROJECT/VICTORY NICKEL PUMPING TEST		Address: 1988 TRIUMPH ST., VANCOUVER, BC	
Golder Contact: MATTHEW NEUNER	Golder E-mail Address: mneuner @golder.com	Tel/Fax: 604-253-~~6700~~ 4188	Contact: AMBER SPRINGER

Office the final reports should be sent to:

- ☑ 500–4260 Still Creek Drive, Burnaby, BC V5C 6C6, Tel: 604-298-6623, Fax: 604-298-5253
- ☐ 202–2790 Gladwin Road, Abbotsford, BC V2T 4S8, Tel: 604-850-8786, Fax: 604-850-8756
- ☐ 2640 Douglas Street, Victoria, BC V8T 4M1, Tel: 250-881-7372, Fax: 250-881-7470

Analyses Required

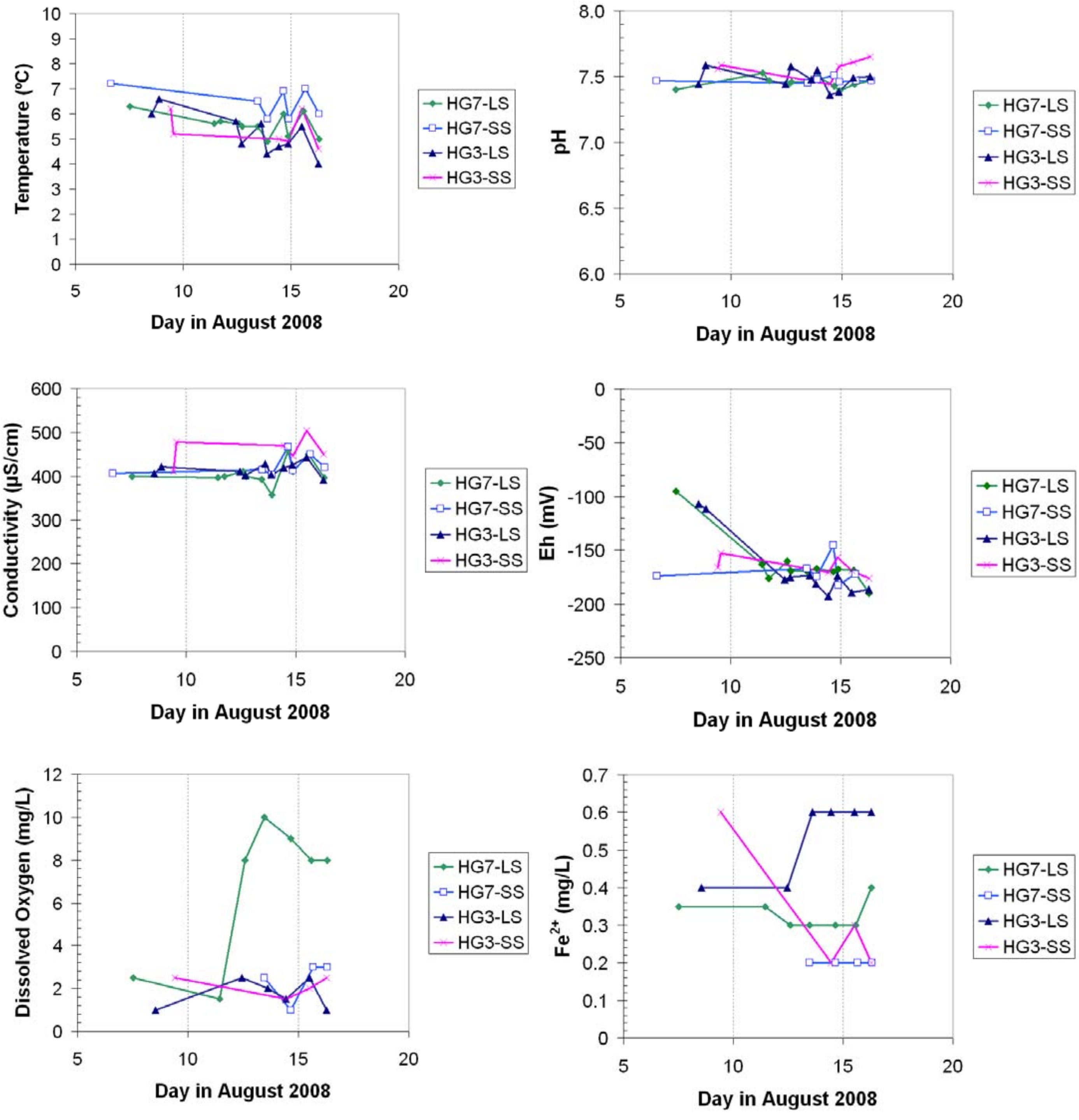
Sample Control Number (SCN)	Sample Location	Sa. #	Sample Depth (m)	Sample Matrix (over)	Date Sampled (D/M/Y)	Time Sampled (HH:MM)	Sample Type (over)	QAQC Code (over)	Related SCN (over)	Number of Containers	DRINKING WATER (FULL, NO ANCILLARY)	AMMONIA AS N	CYANIDE (WAD)	NITROGEN (TKN)	TOT. ORG. CARBON						RUSH	Remarks (over)
15225-01	HG-3 LS	/	/		15/8/08	12:30	WATER			5	↓	↓	↓	↓	↓							
-02	HG-3 SS				↓	12:30	↓			5												
-03	HG-7 LS					14:00				5												
-04	HG-7 SS					14:00				5												
-05	HG-3 SS					12:30				5												
-06	HG-7 LS					14:00				5												
-07																						
-08																						NOT
-09																						HAZARDOUS
-10																						
-11																						NO KNOWN
-12																						CONTAMINANTS

Sampler's Signature: Matthew Neuner (signature)	Relinquished by: Signature	Company: GOLDER	Date: 15 Aug 08	Time: 16:45	Received by: Signature	Company
Sample Storage (°C)	Relinquished by: Signature	Company	Date	Time	Received by: Signature	Company
Comments:	Method of Shipment:	Waybill No.:		Received for Lab by:	Date	Time
	Shipped by:	Shipment Condition: Seal Intact:		Temp (°C) / Cooler opened by:	Date	Time

WHITE: Golder copy YELLOW: Lab copy PINK: Lab returns with Final Report

APPENDIX IV

FIELD MEASURED WATER QUALITY PLOTS



PROJECT	VICTORY NICKEL / MINAGO MULTI-WELL PUMPING TEST PROGRAM GRAND RAPIDS, M.B.
TITLE	**GROUNDWATER CHEMISTRY FIELD PARAMETERS**

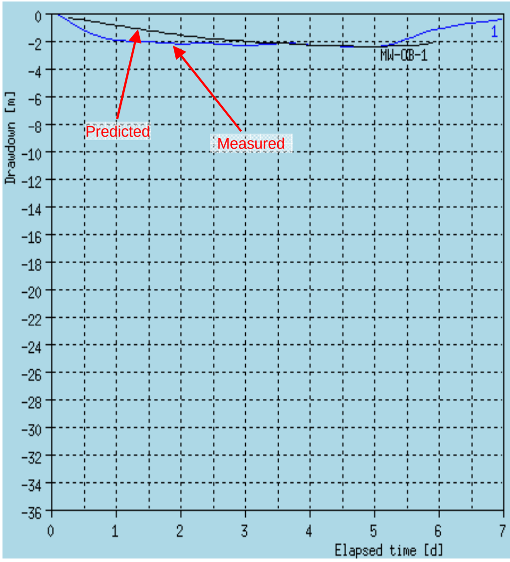
Golder Associates

PROJECT No.	08-1428-0001		FILE No.	----
DESIGN	MN	16OCT08	SCALE NTS	REV.
CADD			**FIGURE IV-1**	
CHECK	CR	16OCT08		
REVIEW				

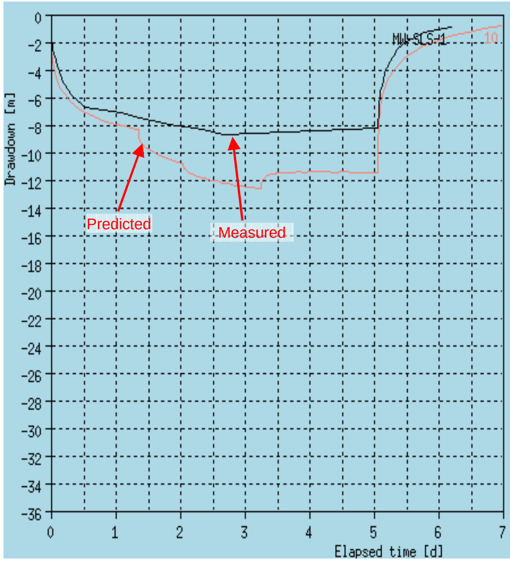
REVISION DATE: 16 OCT 08 BY: MN FILE: O:\Active_2008\1428\08-1428-0001 Victory Nickel Inc- Minago Site\Pumping Test Program\Report\Figures\Figures 5+6+11+12+14 Portrait.ppt

APPENDIX V

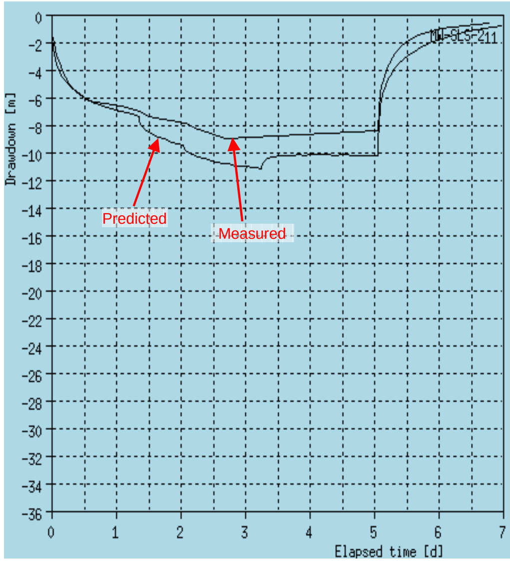
RESULTS OF MODEL CALIBRATION PUMPING TEST



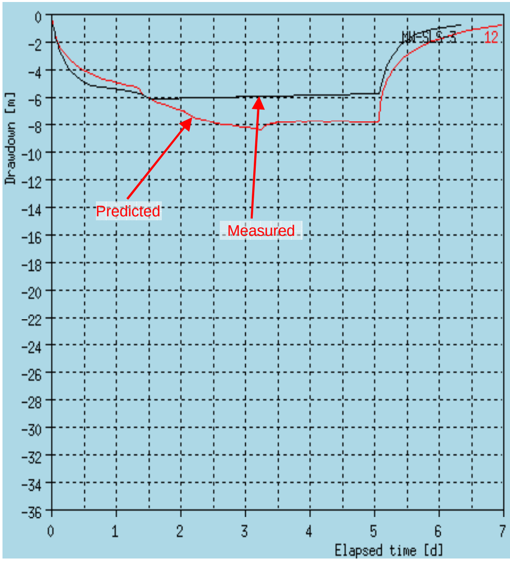
A. Results for observation well MW-OB-1.



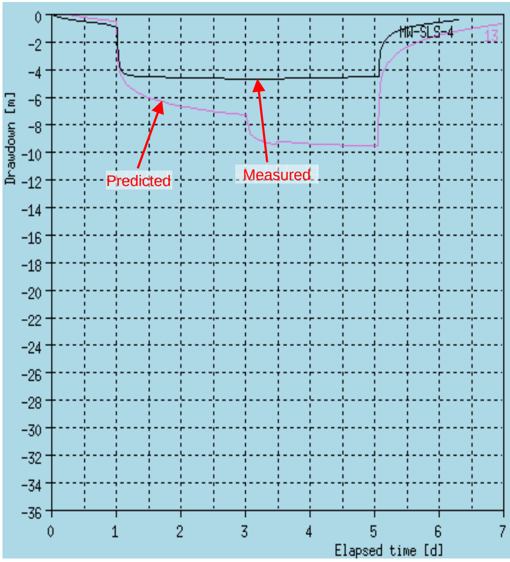
B. Results for observation well MW-SLS-1.



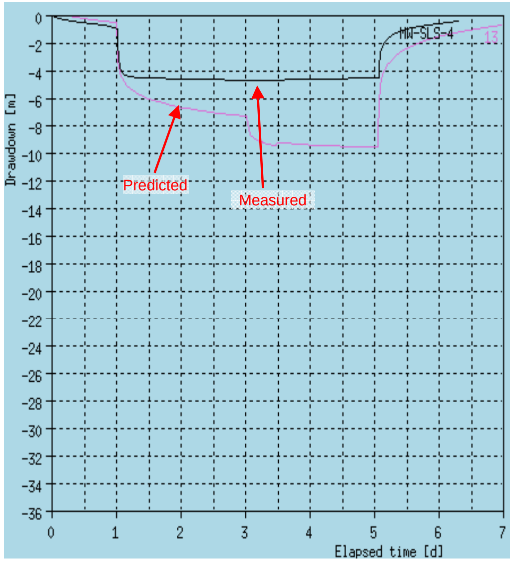
C. Results for observation well MW-SLS-2.



D. Results for observation well MW-SLS-3.



E. Results for observation well MW-SLS-4.



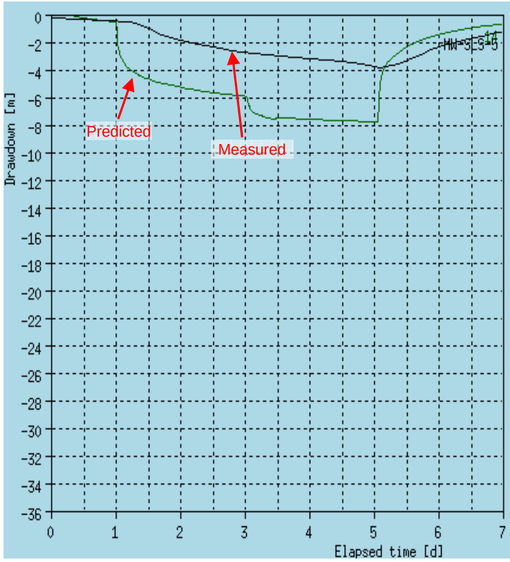
F. Results for observation well MW-SLS-4.

PROJECT
VICTORY NICKLE/MINAGO PROJECT
MINAGO PROJECT
GRAND RAPIDS, MANITOBA

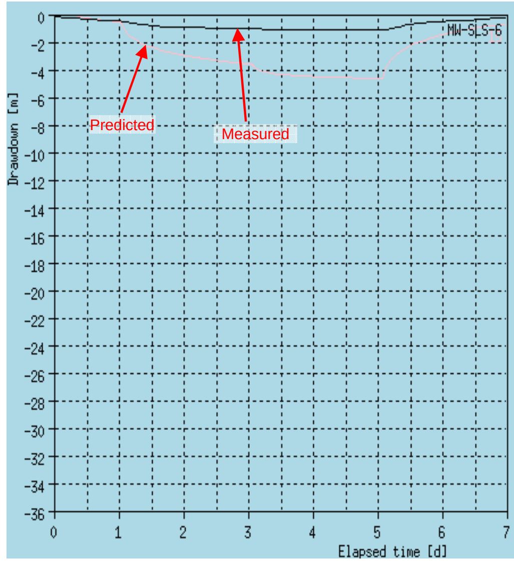
TITLE
RESULTS OF MODEL CALIBRATION
PUMPING TEST

Golder Associates

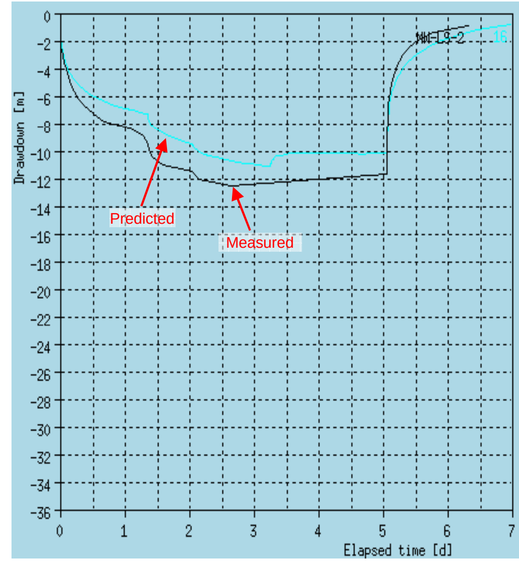
PROJECT No.	----		FILE No. sections.ppt	
DESIGN	WZ	10SEP08	SCALE NTS	REV.
CADD	WZ	10SEP08	**FIGURE V-1**	
CHECK	DC	10SEP08		
REVIEW				



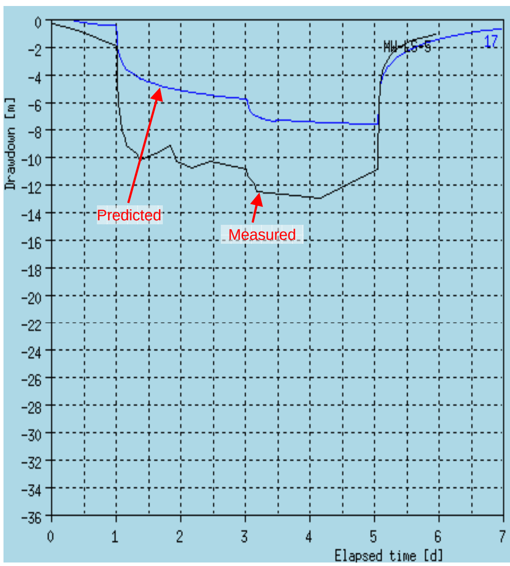
A. Results for observation well MW-SLS-5.



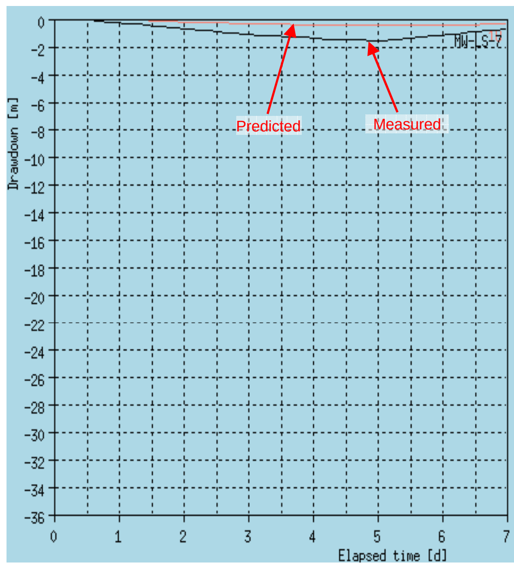
B. Results for observation well MW-SLS-6.



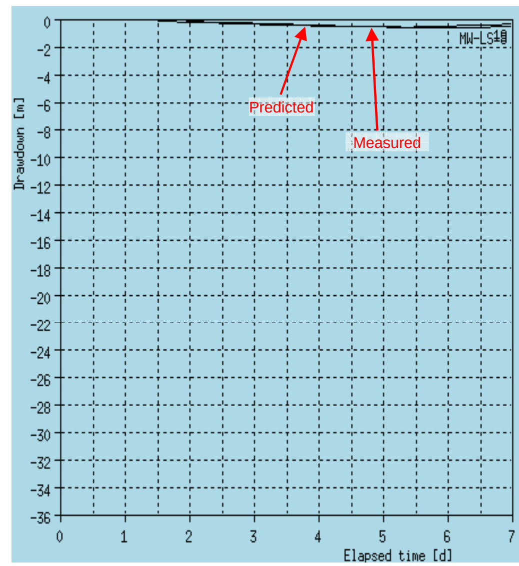
C. Results for observation well MW-LS-2.



D. Results for observation well MW-LS-5.



E. Results for observation well MW-LS-7.



F. Results for observation well MW-LS-8.

PROJECT

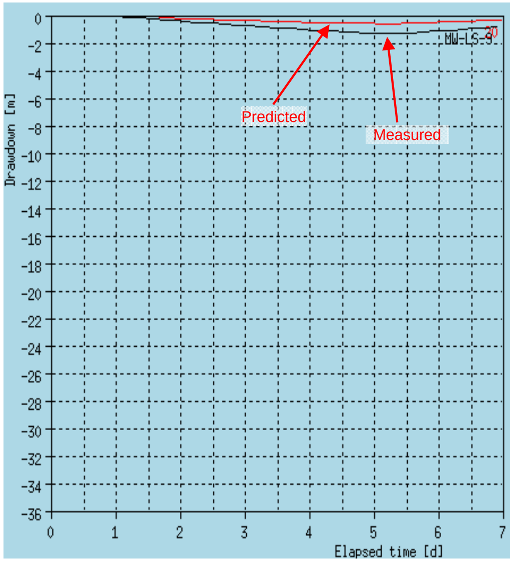
VICTORY NICKLE/MINAGO PROJECT
MINAGO PROJECT
GRAND RAPIDS, MANITOBA

TITLE

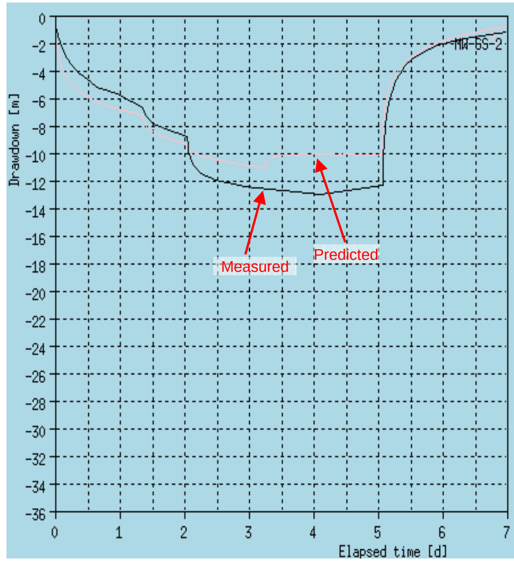
RESULTS OF MODEL CALIBRATION PUMPING TEST

Golder Associates

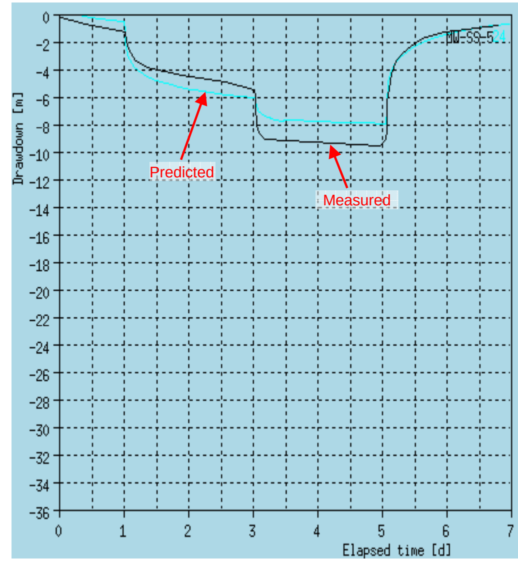
PROJECT No.	----		FILE No. sections.ppt	
DESIGN	WZ	10SEP08	SCALE NTS	REV.
CADD	WZ	10SEP08	**FIGURE V-2**	
CHECK	DC	10SEP08		
REVIEW				



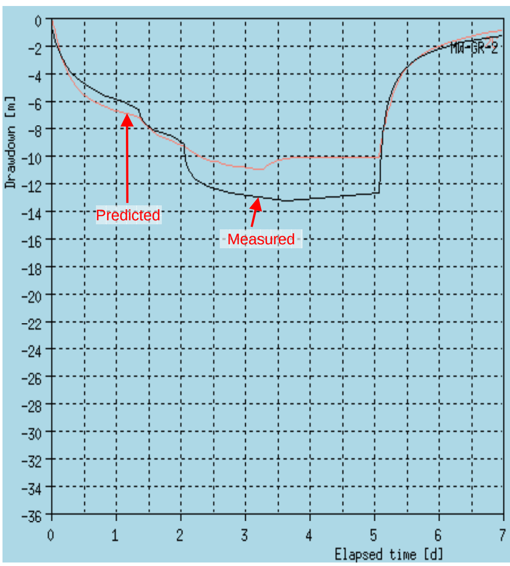
A. Results for observation well MW-LS-9.



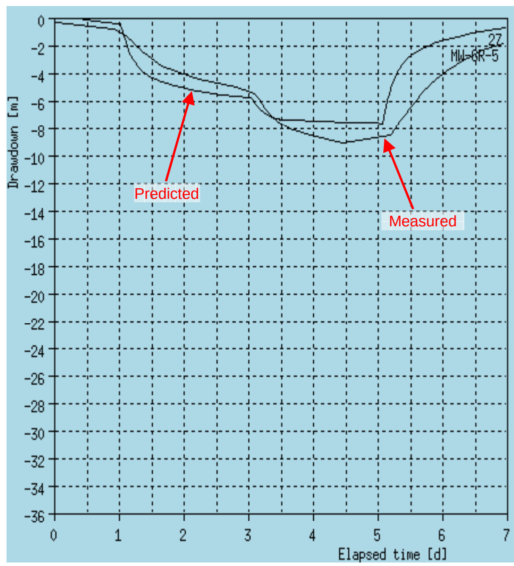
B. Results for observation well MW-SS-2.



C. Results for observation well MW-SS-5.



D. Results for observation well MW-GR-2.



E. Results for observation well MW-LS-7.

PROJECT

VICTORY NICKLE/MINAGO PROJECT
MINAGO PROJECT
GRAND RAPIDS, MANITOBA

TITLE

RESULTS OF MODEL CALIBRATION
PUMPING TEST

Golder Associates

PROJECT No.	----		FILE No. sections.ppt	
DESIGN	WZ	10SEP08	SCALE NTS	REV.
CADD	WZ	10SEP08	**FIGURE V-3**	
CHECK	DC	10SEP08		
REVIEW				