

GEOCRES No. 31L-64

DIST. 13 REGION

W.P. No. 51-75-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 11

LOCATION GROUNDWATER QUALITY ASSESSMENT
TOWN OF POWASSAN

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

memorandum



GEOCREG No 31L-64

To: M. Devata
Chief Foundation Engineer
Downsview


Date: 30 April 1993

From: Geotechnical Section
Northern Region

Subject: W.P. 51-75-00
Hwy 11 at Powassan
Hydrogeological Investigation
Powassan Municipal Well
District # 13, North Bay
=====

Attached is 93 04 29 Memo from Ms. M. Young and a copy of Golder's Report. The recommendations on pages 16 and 17 suggest a review of the piling for the proposed Hwy 11/Hwy 534 overpass to assure that any design assumptions associated with the piling are consistent with subsurface conditions.

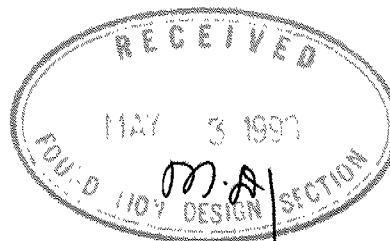
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cc: Environmental - M. Young
P. Furst
File (2)



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Report on

**HYDROGEOLOGICAL CONDITIONS AND
POTENTIAL MUNICIPAL WELL
INTERFERENCE OF HIGHWAY 11/HIGHWAY 534
OVERPASS CONSTRUCTION
POWASSAN, ONTARIO**

WP51-75-00

Submitted to:

Ministry of Transportation
North Bay, Ontario

GEOCRES NO 31L-64

Distribution:

4 Copies: Ministry of Transportation, North Bay, Ontario
2 Copies: Golder Associates Ltd., Mississauga, Ontario

April 1993

921-1623

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April 7, 1993

921-1623

Ministry of Transportation
Office of the Regional Director
P.O. Box 3030
447 McKeown Ave.
North Bay, Ontario
P1B 8L2

Attention: Ms. Mary Young
Environmental Planner

RE: POWASSAN HYDROGEOLOGY REPORT

Dear Ms. Young

Please find attached four copies of the report "Hydrogeological Conditions and Potential Municipal Well Interference of Highway 11/Highway 534 Overpass Construction, Powassan, Ontario".

If you have any questions, please do not hesitate to call.

Yours truly,

GOLDER ASSOCIATES LTD.

A handwritten signature in dark ink, appearing to read "Rob Blair".

Rob Blair, M.Sc.
Associate

RDB/dh
Att.

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by the Ministry of Transportation, Ontario (MTO) to carry out an assessment of the hydrogeological conditions in the vicinity of their proposed Highway 11 - Highway 534 overpass in the Town of Powassan. The town is a community of approximately 1100 people located within South Himsworth Township approximately 30 km south of North Bay (see Figure 1).

The key component of this hydrogeological review is the assessment of potential interference with the Powassan municipal well water supply as a result of the proposed construction. The municipal wells are located approximately 300 m northwest of the proposed construction site. The proposed overpass construction will take Highway 534 across a two lane bridge over Highway 11 and link it with Clark St. The concrete abutments of the bridge will be built on clayey silt soils and consequently require H-piling. In addition, the overpass will include on and off ramps from Highway 11 with associated construction grading.

2.0 SOURCES OF INFORMATION

Information concerning the hydrogeological conditions beneath Powassan was obtained through a site reconnaissance visit and review of reports and documents.

- **Site Reconnaissance**

The site reconnaissance included a visit to Powassan by a Golder hydrogeologist on November 30, 1992. The hydrogeologist toured the area to assess the general physiography including areas of exposed rock, clay plains and streams. The town council was contacted and Mr. Calvin Young, the town foreman who is also responsible for maintenance of the water supply system, assisted in identifying relevant reports and documents concerning the municipal wells, as previously discussed.

The municipal wells (Wells 1 and 2) were examined with the assistance of Mr. Young, static water levels were obtained and drawdown was observed during pumping. One water quality sample was collected from Well 2 (the main production well) and a second sample was obtained from Genesee Creek adjacent to Well 2. The samples were analysed by Barringer Laboratories and the results are provided following the text.

- **Relevant Reports and Documents:**

The following reports and documents were reviewed for this study:

1. Report by the Ministry of the Environment on the Distribution System Water Quality of the Town of Powassan, dated March 3, 1983.

The report discussed the results of water quality sampling at various points within the town water distribution system and concluded that the chemical water quality was very good, although corrosively aggressive. The water was also free of bacterial organisms. A localized area of high turbidity (1.80 FTU) was identified in the distribution system at King St. that was attributed to rust from the cast iron watermain.

2. Report by MTO Engineering Materials Office Foundation Design Section (Geocres No. 31L-52) titled Preliminary Foundation Investigation for Proposed Interchange at Highways 11 and 534, dated August 27, 1983.

The report provided the results of seven geotechnical boreholes (BH-1, BH-1A, BH-2 to BH-6) drilled within the proposed overpass area.

3. Report by MTO Engineering Materials Office Foundation Design Section (Geocres 31L-55) titled Highway 534/Highway 11, Powassan Overpass dated December 9, 1991.

The report provides the results of an additional seven geotechnical boreholes (BH-1 to BH-7) and design criteria for the preferred overpass location at the existing intersection of Highway 11 and Highway 534. The report provides recommendations for the installation of H-piles for support of the overpass structure.

4. MOE published water well records for the period between 1954 and 1982 within the Powassan area including Concessions 12 and 13, Lots 10 to 21 of South Himsworth Township.
5. Town of Powassan municipal well pumping records from 1989 through November 1992. Information included daily pumping records from Well 1 and Well 2 and daily water levels in the wells.
6. Town of Powassan water quality monitoring results from the municipal well supply for the period from 1989 through November 1992. The results included major element chemistry and bacteria provided by the MOE laboratories.
7. Report by R.J. Burnside & Associates Ltd. (Report No. M-212) to the Town of Powassan titled Connection of Groundwater Supply MOE Report No. 7-0067, dated August 1982.

The report describes the proposed connection of the municipal well supply to the existing watermain distribution system. The report also included four appendices including a hydrogeology report from Crowley Groundwater Limited presenting the pump test results for Municipal Supply Well No. 1, dated July 3, 1981 (Appendix A), MTO comments on the hydrogeology report (Appendix B), results of water quality testing of Well 1 (Appendix C) and an inspection report on the town's existing standpipe (reservoir tank) (Appendix D).

8. MOE Water Works Permit 7-0672-92-006 dated November 1, 1982.

Permit provided details on the stratigraphy, construction, permitted pumping rate (100 Igpm) and pump house facilities for Well No. 1.
9. Report by R.J. Burnside & Associates Ltd. (Report No. M-212) to the Town of Powassan titled Connection of Groundwater Supply, Supplement to August 1982, dated May 1984.

The report provided details on the construction, performance and water main connection of Well No. 2.

- 10.. Letter from Crowley Groundwater Limited to the Town of Powassan dated May 4, 1992 discussing the redevelopment of Well 2 which also provided some information of well construction and pumping capacity.
11. Health Unit monthly analysis of bacterial content in the well water for 1991 and 1992. In all samples total coliform and fecal coliform counts were zero.
12. Geological Survey of Canada, Paper 71-26, Quaternary Geology of the North Bay - Mattawa Region by J.E. Harrison dated 1972.

The report includes the Powassan area and describes the surficial soil condition.
13. Ontario Geological Survey Map 5044, North Bay, dated 1979.

The map provides interpretation of surficial soil deposits including the Powassan area.

3.0 PHYSIOGRAPHY

- **Surficial Deposits**

The Town of Powassan lies within a flat to gently undulating glaciolacustrine clay plain that has been extensively developed for farming. The plain is bounded by areas of bedrock ridges that rise 20 to 40 m above the plain as shown on Figure 2. Kame moraine deposits of sand and gravel locally flank the bedrock ridges and two such areas have been developed for gravel pits (see Figure 2). These granular deposits extend beneath the glaciolacustrine silt and clay deposits. The subsequent retreat of the glacial lake from the area has also locally left a veneer of sand deposits on the clay, partly as beach material derived from the exposed kame deposits.

- **Drainage**

Powassan is drained by Genesee Creek, a meandering stream that flows westward across the clay plain. The creek occupies a floodplain approximately 150 to 200 m in width where it passes beneath Highway 11. The edges of the floodplain are marked by banks that rise 5 to 10 m. The creek discharges into the South River approximately 1.5 km west of the town. The South River flows northward in broad meanders that have incised approximately 5 m into the clay plain and eventually discharges to Lake Nipissing.

4.0 HYDROGEOLOGY

Groundwater resources within the Powassan area are principally associated with the sand and gravel deposits that underlie the glaciolacustrine clay plain. Two wells (Well 1 and Well 2) completed in these deposits provide the municipal water supply for the town. The fractured bedrock surface also provides a secondary groundwater supply utilized for individual domestic water supplies within the surrounding unserviced areas.

4.1 Review of MOE Well Records

The MOE well records for the Powassan area covering the period from 1954 to 1983 identified 56 wells within Concessions 12 and 13, Lots 10 to 21 of South Himsworth Township. The locations of the wells and their reported test rates are shown on Figure 3. The majority of the wells tend to be located outside of the municipally serviced area. No well records exist for many rural farms, but these farms are most likely supplied by dug or drilled wells completed prior to the period when well records were collected.

The groundwater source and yields of the domestic wells are summarized on Table 1. Of the 56 well records, 8 were completed in overburden while 48 were completed in the upper bedrock. The overburden wells yielded 1 to 6 gpm averaging 3.5 gpm. The yield of the bedrock wells varied from 0 (dry hole) to 25 gpm, averaging 4.8 gpm. These yields are typical of northern Ontario domestic wells completed to supply individual dwellings.

The MOE drilled five test wells in 1980, four of them near Genesee Creek immediately east of town and the fifth near Highway 11 and Clark St., at the locations shown on Figure 3. The wells were drilled in an attempt to identify a municipal well supply for the town. However, the yields obtained (2 to 15 Igpm) were not satisfactory to provide the 100 Igpm estimated to be required for the town at that time.

4.2 Municipal Water Supply

The two municipal wells (Wells 1 and 2) that provide the water supply for Powassan are located between Highway 534 and Genesee Creek, approximately 175 m west of Highway 11 at the location shown on Figure 4. Well 1 is a standby well while Well 2, located on the Genesee Creek floodplain, is the main supply well that is in continual service.

Well 1 and Well 2 were drilled for the Town of Powassan in 1981 and 1983 respectively, by Crowley Groundwater Limited (Crowley) and subsequently connected to the municipal watermain in 1982 and 1984 respectively, following the appropriate engineering studies and MOE approvals (References 7, 8 and 9). Localized problems of turbidity related to iron and corrosion were noted in the watermain distribution system during a study following the connection of Well 1 (Reference 1). However, it is not known if the problem, predated the connection of the well.

Prior to the installation of the municipal wells, the town obtained its municipal water supply from Genesee Creek. This supply was considered to be less than desirable by the town due to surface water quality and supply problems (Mr. Calvin Young, pers. comm.). In addition to this supply, the water main distribution system is largely constructed with ductile iron and cast iron piping.

The town also has a municipal sewer system that includes three sewage lagoons with surface areas of 3 to 4 ha each that are located immediately north of Genesee Creek and west of Highway 11 (within 200 m of the municipal wells) as shown on Figure 3. The lagoons are apparently constructed on the clay plain above the floodplain of the creek and the sewage water elevations in the lagoons vary from 242 to 252 m, some 4 to 14 m above the level of Genesee Creek, as shown on Figure 4.

- **Well Construction**

- Well 1

The ground surface elevation at Well 1 is 246.3 m. The well was drilled to a depth of 24.1 m and completed as a 150 mm (6 in.) dia. cased well with a 127 mm (5 in.) dia. well screen set between depths of 19.4 and 23.2 m within sand and gravel deposits (Reference 8) as indicated on Section A-A of Figure 5. A submersible pump was set in the well at a depth of 16.3 m (Elev. 290.0 m) and is operated at 100 Igpm, the maximum pumping rate permitted by the MOE.

- Well 2

It became apparent in 1982 that additional water supplies would be needed for the town. Therefore, a second 150 mm (6 in.) dia. test well was drilled in May 1983 by Crowley approximately 70 m north of Well 1. The presence of high yield conditions was identified and authorization was given by the town to construct a 305 mm (12 in.) dia. production well

designated as Well 2 approximately 3 m west of the test well. Well 2 was completed in the fall of 1983.

The ground surface elevation at Well 2 is 240.0 m. Well 2 was drilled to a total depth of 21.9 m and the bottom 3 m was subsequently backfilled with sand prior to setting the screen. The screen is a galvanized Doer and Louvre, 254 mm (10 in.) dia. type set between depths of 9.8 and 18.6 m in sand and gravel (Reference 9) as indicated on Section A-A, Figure 5. The screen design consists of No. 34 slot from 11.0 to 13.7 m, No. 40 slot from 13.7 to 17.7 m and No. 34 slot from 17.7 to 18.6 m.

Well 2 has a 55 horsepower submersible pump set between depths of 8.8 and 11.0 m (top and bottom of pump), the top of the pump being at an elevation of 231.1 m and it is connected to surface by a 127 mm (5 in.) dia. black iron riser pipe. The operating rate of the pump is 400 Igpm, the rate permitted by the MOE, and the well is fitted with a pressure sustaining valve to prevent overpumping.

- **Well Monitoring**

The town monitors the total amount of water pumped and the water level in Well 1 and Well 2 on a daily basis when they are in service. Well 1 is also monitored when in service. The pumping data for 1992 showing the total monthly pumping from Well 1 and Well 2, and the average pumping rate is summarized on Table 2. The average daily pumping and the average hours per day pumping accrued in Well 2 during 1992 is summarized on Table 3.

- **Pumping**

The total monthly amount of water produced by Well 1 and Well 2 during 1992 varied between 2,706,000 to 8,330,000 Imp.gal. (see Table 2). The vast majority of the pumping for the period from January to November came from Well 2 totalling 37,160,000 Imp.gal., while Well 1 produced 4,237,000, about 10 percent of the total production.

The average water consumption for the town, based on the monthly pumping varied between 61 and 187 Igpm (see Table 2). Consumption in March and April was 187 and 136 Igpm

respectively, twice the normal production. Excluding these months, the average consumption varied between 61 and 79 Igpm.

A summary of the Well 2 pumping records indicates that pumping takes place for approximately 3.7 to 4.9 hr/day to supply the required consumption based on the well operating at a set pumping rate of 400 Igpm (see Table 3). The well was pumped at 11.3 and 10.7 hr/day during the period of heavy pumping in March and April, 1992 respectively.

- **Water Levels**

The water level in Well 1, during pumping, varies from 8.0 to 11.5 m below ground surface (elev. 238.3 to 234.8 respectively). These levels are 1.5 to 5.0 m below the static level.

The water level in Well 2 also varies from 8.0 to 11.5 m below ground surface during pumping, but the elevations vary from 232.0 to 228.5 m, up to 6 m below the level of Well 1.

4.3 Subsurface Conditions

The subsurface conditions in the vicinity of the proposed Highway 534/Highway 11 overpass were identified from the drilling of 14 geotechnical boreholes by the MTO in 1984 and 1990 (References 2 and 3). The locations of the boreholes are shown on Figure 4 and the soils encountered are summarized on Sections A-A and B-B of Figure 5 and 6 respectively. Municipal Wells 1 and 2 are also projected onto Section B-B, although the soils information is limited to well drillers descriptions.

The soil sequence beneath the proposed overpass is 28 m to greater than 31 m thick overlying granitic bedrock (see Section B-B, Figure 6). The soil is comprised of three main layers. The uppermost layer consists of approximately 4 to 12 m of cohesive, very soft to very stiff clayey silt, trace sand with occasional seams of sandy silt. This material represents the glaciolacustrine deposits which comprise the surrounding clay plain.

The second soil layer underlying the clayey silt is comprised of non-cohesive, very loose to compact sandy silt with trace clay, becoming sandier with depth. The sandy silt may grade

laterally to sand with trace silt and clay (BH 84-6, Section A-A). The deposit is variable in thickness but is generally in the range of 10 to 15 m, locally varying up to 29 m (BH 84-6).

The third, or basal soil layer is comprised 6 to 9 m of non-cohesive, very dense sand and gravel with trace silt and occasional cobbles and boulders. This layer contains a 1 to 3 m thick horizon of very loose sand (see Section B-B). It was noted to overly bedrock in BH 90-7 and the gravel content was generally noted to increase with depth.

It is difficult to directly correlate soil stratigraphy between the geotechnical boreholes and the municipal wells due to the limited descriptions in the latter case. However, as indicated on Section A-A, Well 1 encountered sand and gravel between depths of 12 and 24 m. Well 2, drilled on the Genesee Creek floodplain, reportedly encountered sand to a depth of 3.4 m overlying clay with thin layers of sand between 3.4 and 10.4 m. Sand and gravel was encountered between depths of 10.4 and 18.9 m overlying clay, gravel and sand (possibly till) between 18.9 and 21.9 m.

The sand and gravel encountered in the lower half of Well 2, is the municipal aquifer (i.e. the water production horizon). This horizon likely correlates with the basal sand and gravel layer encountered in the overpass investigations indicating that the municipal aquifer extends beneath the proposed construction site.

4.4 Groundwater Levels

- **Static Groundwater Levels**

The 1991 MTO geotechnical investigation in the proposed overpass area (Reference 3) obtained groundwater levels in the open boreholes that varied from 5.5 to 6.5 m below ground surface. These water levels varied in elevation from approximately 239 m east of Highway 11 to 245 m west of Highway 11. The static water levels (no pumping) in the municipal wells, measured in December 1992 varied from 0.7 m (Well 2) to 6.5 m (Well 1) below ground surface, corresponding to elevations of approximately 239.3 to 239.8 m respectively, (see Section B-B). The static level of Well 2 was noted to be about 0.5 m above the water level of the adjacent section of Genesee Creek. The static level in Well 2 is also consistent with the static levels reported in 1983 during the initial testing which varied between 239.6 and 240.5 m.

The static groundwater level information indicates that the direction of groundwater flow is approximately north to northeast toward Genesee Creek. Under these conditions the creek is a groundwater discharge zone.

- **Aquifer Conditions**

Well 1 was pump tested by Crowley in 1981. The results of the test indicated a relatively high aquifer transmissivity (ability of the aquifer to transmit water) of 1300 m²/day and an aquifer storativity (release of water from aquifer storage per unit decline in head) between 1x10⁻⁶ and 7x10⁻⁶. From the transmissivity, the safe yield for Well 1 was estimated to be 200 Igpm. The aquifer was interpreted to be confined based on the low storativity, probably by the clayey and silty horizons overlying the sand and gravel aquifer such as encountered by the MTO geotechnical drilling.

A pump test was also carried out in Well 2 following its completion (Reference 9). No reference to transmissivity or storativity calculations could be found, but a safe well yield of 800 Igpm was recommended. Prior to the pump test, the static water level elevation in Well 2 varied between 240.05 m (slightly above the ground elevation of 240.0 m) and 239.6 m. The well was test pumped at 439 Igpm for 8 hr. and the water level drawdown in the well stabilized at 9.3 m below ground surface (Elev. 230.7 m) after 2.5 hrs. of pumping. The drawdown in the test well located 3 m from Well 2 was 8.3 m following 8 hrs. of pumping. The drawdown in a 50 mm (2 in.)

dia. test well located 76 m south of Well 2 near Well 1, was 3.6 m after 7.3 hr. of pumping. This drawdown is consistent with that presently observed in Well 2 during pumping.

Extrapolation of the groundwater level drawdown observed from the three wells during the pump test, indicates that the radius of influence of groundwater level drawdown, and hence groundwater flow to the well, is approximately 1,000 m (see Figure 7). Considering that the present drawdown in Well 2 during pumping is quite similar to that of the initial pump test, this radius of influence is likely representative of the existing conditions.

It was noted during the site reconnaissance on November 30, 1992 that the water level in Well 2 was 0.7 m below ground surface (239.3 m) when the pump was not in operation. This level is very similar to the static level observed in 1983 when the well was constructed. Also, during the site reconnaissance, Well 2 was pumped and the water level in the adjacent test well fell rapidly to 7.8 m below ground surface following 2 min. of pumping. When the pump was shut off, the water level rapidly returned to the static level within 10 minutes. Based on these observations, it is apparent that the drawdown cone associated with pumping Well 2 rebounds to static conditions during the periods of the day when the well is not in service which is approximately 80 to 90 percent of the day.

The proposed overpass construction site, located approximately 300 m from the Well 2, is likely situated within the zone of groundwater level drawdown associated with the pumping of Well 2. Considering pumping occurs for 4 to 5 hours per day on average, the drawdown influence potentially reaches the site daily then rebounds to static conditions when pumping ceases.

4.5 Water Quality

- **Groundwater from Well 2**

The water quality results of the groundwater sample from Well 2 and the surface water sample from Genesee Creek collected on November 30, 1992 are provided in Appendix A.

The groundwater from Well 2 appeared very clear and was odourless. The sample results indicates the water is slightly alkaline (pH 7.32), moderately hard with total dissolved solids of 205 mg/L. In terms of its chemical composition, it is a calcium (27.5 mg/L), magnesium (9.8

mg/L), bicarbonate (93.2 mg/L as CaCO_3) water with traces of sulphate (14.3 mg/L) and chloride (10.6 mg/L) typical of sand and gravel aquifers. The nitrate concentration in the groundwater was 1.05 mg/L as N which is slightly elevated but not untypical of developed areas. The water was free of dissolved iron (<0.01 mg/L) as well as other heavy metals. Total suspended solids were less than 0.1 mg/L and the turbidity of the water was also very low (0.3 F.T.U.) which is consistent with its appearance.

The town also monitors the water chemistry of the well supply semi-monthly for a limited suite of parameters as outlined on Table 4. The results of this monitoring, between 1989 and 1992, are consistent with the sample results obtained from this study.

The well water supply is monitored monthly by the Health Unit and a review of the 1992 and 1992 monitoring data indicated that both total coliform and fecal coliform bacteria counts were consistently zero. These results and the water chemistry previously discussed supports the town's high appraisal of the quality of their water supply.

- **Genesee Creek**

The surface water sample from Genesee Creek (Sample SW-1) was slightly acidic (pH 6.39), very soft with total dissolved solids of 94 mg/L, less than half that of the groundwater. Chemically, the water is a calcium (5.36 mg/L), magnesium (1.98 mg/L), bicarbonate (13.8 mg/L as CaCO_3) water. It also contains traces of sulphate (9.12 mg/L) and chloride (10.6 mg/L). The chemical composition, although much more dilute, is similar to the groundwater indicating that in addition to surface runoff, the stream also receives a significant component of groundwater discharge.

The surface water had slightly elevated dissolved iron (0.35 mg/L), likely related to the slightly acidic nature of the water, typical of northern Ontario surface streams. Nitrate in the surface water was very low (0.14 mg/L as N).

- **Summary**

The differences in the groundwater and surface water chemistry suggests that the groundwater in the aquifer tapped by Well 2 is not directly derived from infiltration from Genesee Creek, but

includes more regional flow within the aquifer which potentially receives recharge from a broad area. The groundwater correspondingly has a longer residence time within the aquifer allowing for chemical equilibrium with the formation resulting in the higher concentrations of dissolved solids encountered.

The groundwater contains traces of nitrate and sulphate indicating that the water is still oxidative suggesting that it is part of a relatively rapid recharging, active flow system which is also consistent with the reported corrosive aggressiveness of the water. The lack of any odour such as H_2S also indicates that the water is still slightly oxidative and that there is very little dissolved organic material in the water. The slightly oxidative condition of the groundwater will also suppress the solubility of iron which is consistent with the very low iron concentrations in the water sample.

5.0 POTENTIAL FOR IRON BACTERIA CONTAMINATION OF THE AQUIFER

Concern has been raised that construction activity associated with the proposed overpass, specifically pile driving, may contaminate the municipal aquifer with iron bacteria and adversely affect the quality of the community's water supply. The bacteria are not harmful to health, but their activity can result in the water producing iron staining problems and, in extreme cases, the bacteria can cause the clogging of well screens. To date, there is no problem with iron bacteria in the municipal well.

Iron bacteria are ubiquitous in the near surface environment. However, the activity of iron bacteria in an aquifer requires specific geochemical conditions such as chemically reduced groundwater coming into contact with oxygenated conditions in a well bore or reservoir. A key limiting factor to the development of the bacteria is the presence of dissolved ferrous iron which tends to be associated with chemically reduced groundwater. The bacteria activity becomes noticeable when the concentration of dissolved iron in the water consistently exceeds 0.1 mg/L. Considering that the groundwater in the municipal aquifer does not appear to be chemically reduced and is free of dissolved iron (< 0.01 mg/L), it will not tend to support the growth of iron bacteria.

It has been our experience that drilling investigations and pile driving do not, in themselves, cause problems with iron bacteria in aquifers unless the geochemical behaviour of the aquifer is upset through the mixing of aquifer waters of different quality, specifically the introduction of chemically reduced, iron containing water into an oxygenated environment such as the municipal well. The potential for a situation of this nature occurring at the construction site is very low based on the aquifer testing. Therefore, pile driving for the overpass construction should not alter the aquifer geochemistry and accordingly, not adversely effect the quality of the municipal aquifer water supply.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been developed for the hydrogeological assessment:

- The municipal aquifer that provides the Town of Powassan's water supply appears to underlie the proposed Highway 11/Highway 534 overpass construction site.
- The construction site is likely situated within the zone of pumping influence of the municipal wells located approximately 300 m to the north.
- Based on the chemical testing of the water from the municipal aquifer, construction piling will not alter the aquifer geochemistry and consequently, will not affect the quality of the water.
- To assure that construction activity, including piling, has no influence on water quality, it is recommended that the water supply from the municipal wells be monitored for general water quality parameters including dissolved iron and turbidity. The monitoring schedule should include the periods prior to, during and following construction. The frequency of monitoring will depend on the construction schedule.
- The monitoring schedule should be weekly for a period of four weeks prior to construction, to identify the baseline conditions. Weekly monitoring should be carried out when active construction is occurring, including periods where piling is in progress. Weekly monitoring for one month following construction will be sufficient to identify any residual effects of construction. Following this period, monthly monitoring for one year, carried out as part of the municipalites monthly monitoring should identify any future water quality variation associated with the completed piling projects.
- Construction activity should be carried out with diligence to prevent potential contamination of the underlying municipal aquifer by appropriate surface grading operations to control runoff and minimize surface ponding and handling of materials such as fuels, lubricants and the like.

- In addition, the proposed detailed construction design should be reviewed by a geotechnical engineer to assure that any design assumptions associated with piling are consistent with subsurface conditions.

GOLDER ASSOCIATES LTD.



Sean McFarland, M.Sc.
Hydrogeologist



Rob Blair, M.Sc.
Senior Hydrogeologist
Associate

SM/RB/dh

TABLE 1
SUMMARY OF DOMESTIC WELL YIELD

Overburden Wells		
No. of Wells	Yield (lgpm)	
	Range	Average
8	1 - 6	3.5
Bedrock Wells		
48	0 - 25	4.8

TABLE 2

SUMMARY OF MUNICIPAL WATER CONSUMPTION, 1992

Month	Monthly Consumption (Imp. gal.)			Average Consumption (lgpm)		
	Well 2	Well 1	Total	Well 2	Well 1	Total
Jan	2,714,000	-	2,714,000	61	-	61
Feb	1,933,000	778,000	2,711,000	46	19	65
Mar	7,879,000	451,000	8,330,000	177	10	187
Apr	5,890,000	-	5,890,000	136	-	136
May	3,219,000	-	3,219,000	72	-	72
June	1,983,000	1,424,000	3,407,000	46	33	79
July	2,614,000	517,000	3,131,000	58	12	70
Aug	2,892,000	-	2,892,000	65	-	65
Sept	2,012,000	1,067,000	3,079,000	46	25	71
Oct	3,119,000	-	3,119,000	70	-	70
Nov	2,772,000	-	2,772,000	64	-	64
Dec	3,001,000	-	3,001,000	67	-	67

TABLE 3
SUMMARY OF WELL 2 PUMPING
FOR 1992

Month	No. of Days Pumped	Average Daily Pumping Imp. gal.	Average Pumping Time* hours/day
Jan.	31	88,000	3.7
Feb.	21	92,000	3.8
Mar.	29	272,000	11.3
Apr.	23	256,000	10.7
May	31	104,000	4.3
June	17	117,000	4.9
July	26	101,000	4.2
Aug.	31	93,000	3.9
Sept.	20	101,000	4.2
Oct.	30	104,000	4.3
Nov.	30	92,000	3.8
Dec.	31	97,000	4.0

* Time based on Well 2 pumping rate of 400 Igpm

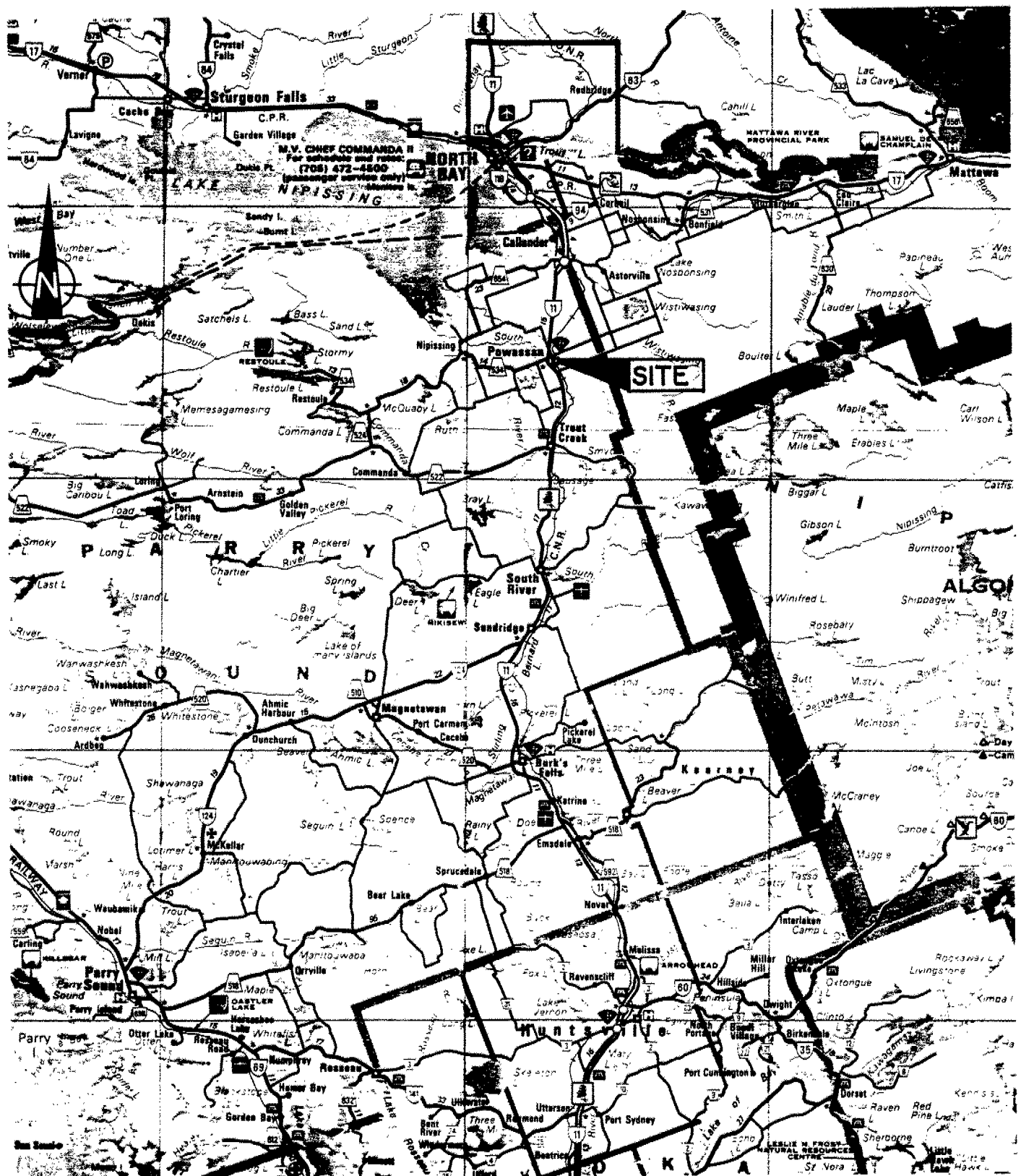
TABLE 4
SUMMARY OF MUNICIPAL WELL WATER QUALITY

Parameter	Town of Powasson/MOE (1989 - 1992)* Pumping Station Well Water	Golder Associates (November 1992)	
		Pumphouse Well 2	Genesee Creek (SW1)
Conductivity (μ mhos/km)	209 - 310	245	68
Hardness (mg/L as CaCO_3)	89 - 140	109	21
Alkalinity (mg/L as CaCO_3)	78 - 124	93.2	13.8
pH	7.1 - 8.1	7.32	6.39
Chloride (mg/L)	6.5 - 22.0	10.6	4.7
Turbidity (Formazin Turbidity Units)	0.21 - 7.7	0.3	3.4
Colour (True Colour Units)	<0.5 - 8.0	-	-
Digestion (Colourimetric mg/L as Fe)	<0.05 - 0.70	<0.01**	0.35**

Notes: * Based on 30 analysis from January 30, 1989 to November 8, 1992.
 ** Dissolved iron concentration

SITE LOCATION PLAN

FIGURE I



Map Scale 1:700,000 Échelle

kilometres 10 0 10 20 30 40 kilometres

Date DEC. / 1992.

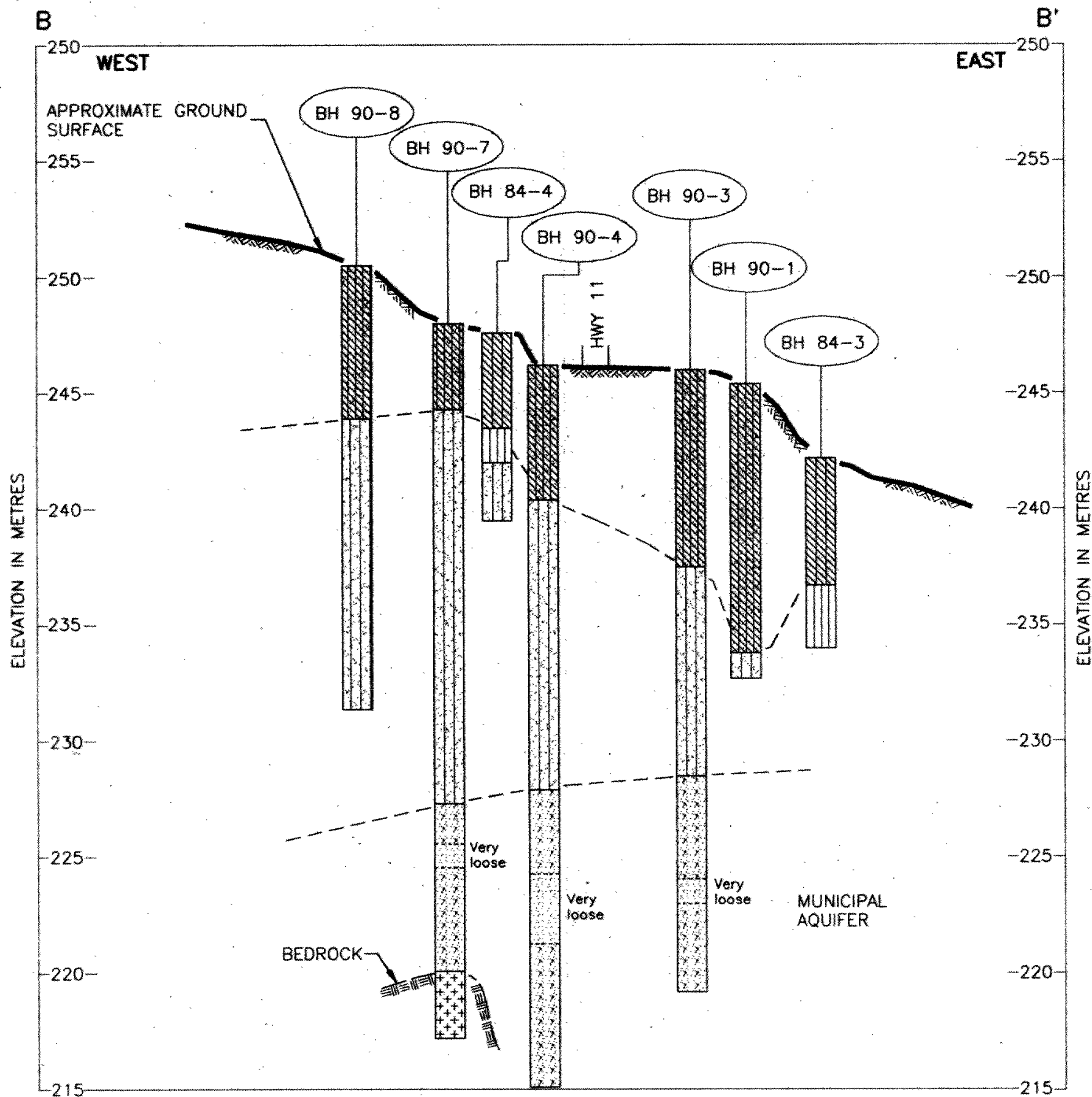
Project 921-1623

Golder Associates

Drawn DV

Chkd. S.M.

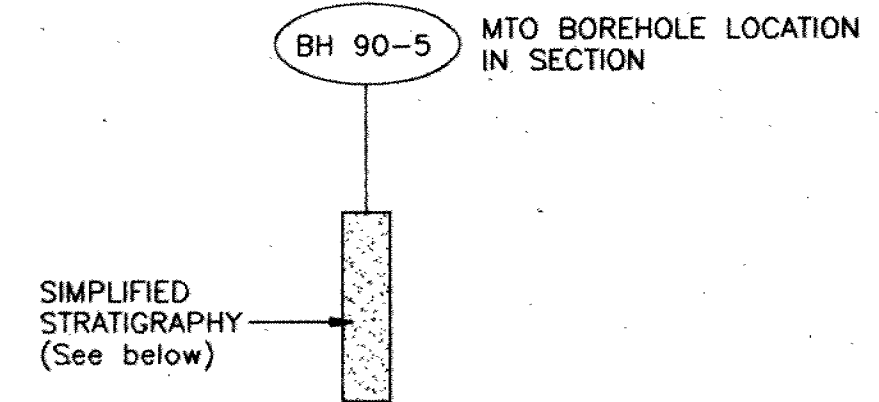
OVERSIZE DRAWING



CROSS SECTION B-B'

FIGURE 6

LEGEND



SIMPLIFIED STRATIGRAPHY

	FILL		SILTY CLAY
	SILT		CLAYEY SILT
	SAND		GRAVEL AND SAND
	SANDY SILT		GRANITE BEDROCK

NOTE

1. GROUND SURFACE ELEVATION BASED ON ONTARIO BASE MAP NO. 20 17 6200 51000 AND MTO BASE MAP NO. B-509-11-5.
2. BOREHOLE INFORMATION OBTAINED FROM MTO REPORT NUMBERS 31L-52, 31L-55.
3. FOR LOCATION OF SECTION B-B' REFER TO FIGURE 4.

SCALE

HORIZONTAL 1 : 2000
VERTICAL 1 : 200

Date DEC 16, 1992

Project 921-1623

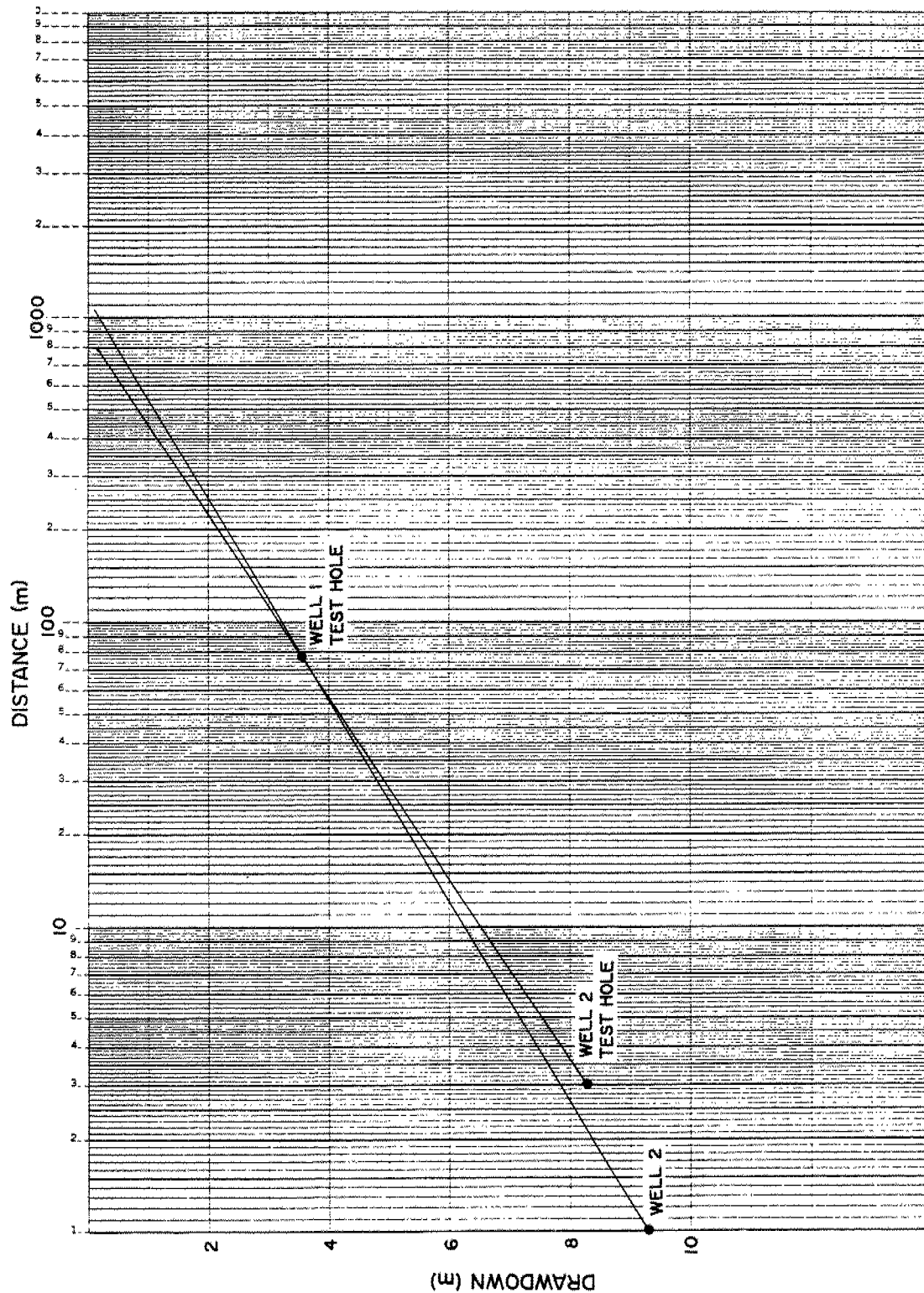
Golder Associates

Drawn TDR

Chkd Am

DRAWDOWN VERSES DISTANCE WELL 2 PUMP TEST

FIGURE 7



Date JANUARY, 1993

Project 921-1623

Golder Associates

Drawn TDR

Chkd. S.M.

Form GA-U-4 (Imperial)

A

APPENDIX A
WATER QUALITY RESULTS

January, 1993

921-1623

BARRINGER

LABORATORIES

5735 McAdam Road
Mississauga, Ontario
L4Z 1N9
Tel: (416) 890-8566
Fax: (416) 890-8575
Wats: 1-800-263-8040

22-Dec-92

GOLDER ASSOCIATES
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Mississauga, ON
L5N 5S3

Page: 1
Copy: 1 of 2
Set: 1

Attn: Mr. Sean McFarland
Project: 921-1623

Received: 2-Dec-92 16:00

PO #:

Job: 927939

Status: Final

Water Samples

Sample Id	pH pH Elec. pH Units	Alk 4.5 Tit. 1 mg CaCO3/L	Sp. Cond. SS Elec. umhos/cm	Turb. Fluor. FTU	F- IC mg/L	Cl- IC mg/L	NO2-N IC mg/L	Br- IC mg/L
WELL 2	7.32	93.2	68	0.3	0.17	10.6	<0.02	<0.05
SW-1	6.39	13.8	245	3.4	<0.10	4.70	<0.02	<0.05
Blank	5.25	0.8	2	0.1	<0.10	<0.01	<0.02	<0.05
QC Standard (actual)	4.44	49.6	715	1.8	0.60	2.07	1.12	1.99
QC Standard (expected)	4.45	50.0	718	1.8	0.60	2.00	1.00	2.00
Repeat WELL 2	7.25	93.2	68	0.3	0.20	10.8	<0.02	<0.05

Sample Id	NO3-N IC mg/L	PO4-3 IC mg/L	SO4= IC mg/L	TDS Grav. mg/L	TSS Grav. mg/L	Ag ICAP mg/L	Al ICAP mg/L	As ICAP mg/L
WELL 2	1.05	<0.1	14.3	205	<0.1	0.005	<0.05	<0.1
SW-1	0.14	<0.1	9.12	94	1.4	<0.005	0.15	<0.1
Blank	<0.02	<0.1	<0.05	<1	<0.1	<0.005	<0.05	<0.1
QC Standard (actual)	0.43	2.0	2.05	315	6.7	0.043	9.88	0.9
QC Standard (expected)	0.44	2.0	2.00	250	10.0	0.040	10.0	1.0
Repeat WELL 2	1.06	<0.1	14.1	195	<0.1	<0.005	<0.05	<0.1



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Attn: Mr. Sean McFarland
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PO #:

Job: 927939

Status: Final

Water Samples

Sample Id	B ICAP mg/L	Ba ICAP mg/L	Be ICAP mg/L	Bi ICAP mg/L	Ca ICAP mg/L	Cd ICAP mg/L	Co ICAP mg/L	Cr ICAP mg/L
WELL 2	<0.01	0.116	<0.0005	<0.1	27.5	<0.005	<0.01	<0.01
SW-1	<0.01	0.023	<0.0005	<0.1	5.36	<0.005	<0.01	<0.01
Blank	<0.01	<0.005	<0.0005	<0.1	<0.05	<0.005	<0.01	<0.01
QC Standard (actual)	0.22	0.969	0.0191	1.0	49.1	0.192	0.20	0.20
QC Standard (expected)	0.20	1.00	0.0180	1.0	50.0	0.200	0.20	0.20
Repeat WELL 2	0.01	0.116	<0.0005	<0.1	27.6	<0.005	<0.01	<0.01

Sample Id	Cu ICAP mg/L	Fe ICAP mg/L	K ICAP mg/L	Mg ICAP mg/L	Mn ICAP mg/L	Mo ICAP mg/L	Na ICAP mg/L	Ni ICAP mg/L
WELL 2	<0.01	<0.01	3	9.83	<0.01	<0.05	6.1	<0.05
SW-1	<0.01	0.35	<1	1.88	0.03	<0.05	3.1	<0.05
Blank	<0.01	<0.01	<1	<0.05	<0.01	<0.05	<0.1	<0.05
QC Standard (actual)	0.20	9.53	10	7.88	0.20	0.51	50.0	0.19
QC Standard (expected)	0.20	10.0	10	8.00	0.20	0.50	50.0	0.20
Repeat WELL 2	<0.01	<0.01	2	9.89	<0.01	<0.05	6.1	<0.05



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Water Samples

Sample Id	P ICAP mg/L	Pb ICAP mg/L	S ICAP mg/L	Sb ICAP mg/L	Se ICAP mg/L	Si ICAP mg/L	Sn ICAP mg/L	Sr ICAP mg/L
WELL 2	<0.1	<0.05	4.5	<0.1	<0.1	7.06	<0.1	0.175
SW-1	<0.1	<0.05	2.6	<0.1	<0.1	3.92	<0.1	0.045
Blank	<0.1	<0.05	<0.1	<0.1	<0.1	<0.05	<0.1	<0.001
QC Standard (actual)	10.1	0.20	10.5	0.9	1.0	10.1	1.0	0.193
QC Standard (expected)	10.0	0.20	10.0	1.0	1.0	10.0	1.0	0.200
Repeat WELL 2	<0.1	<0.05	4.6	<0.1	<0.1	7.10	<0.1	0.175

Sample Id	Ti ICAP mg/L	V ICAP mg/L	Zn ICAP mg/L	CAB Calc. %
WELL 2	<0.005	<0.005	0.01	-1.12
SW-1	<0.005	<0.005	<0.01	1.18
Blank	<0.005	<0.005	<0.01	-35.70
QC Standard (actual)	0.196	0.198	0.20	-67.05
QC Standard (expected)	0.200	0.200	0.20	-67.14
Repeat WELL 2	<0.005	<0.005	0.01	-1.14

PAGE.004/004
TO GOLDER
FROM BARRINGER LABS
DEC 22 '92 15:08



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Project: 921-1623

Received: 2-Dec-92 16:00

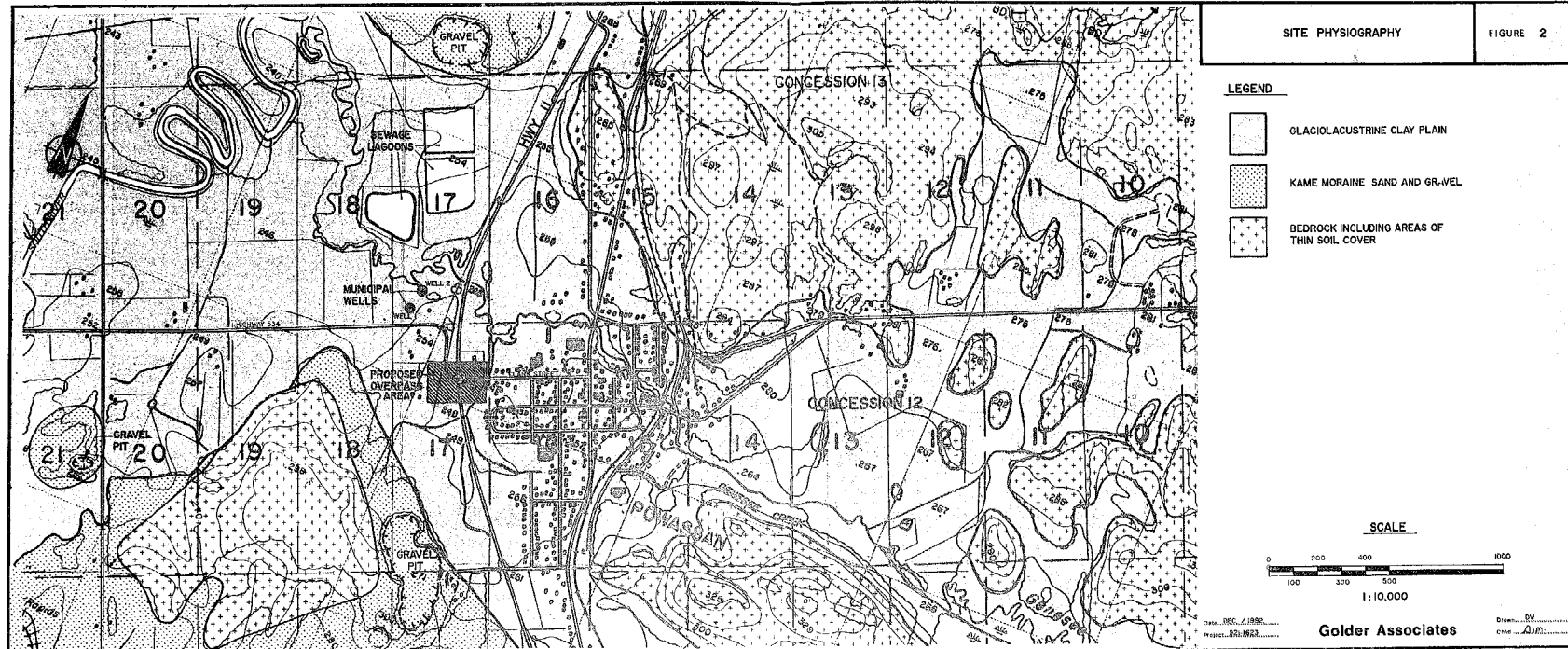
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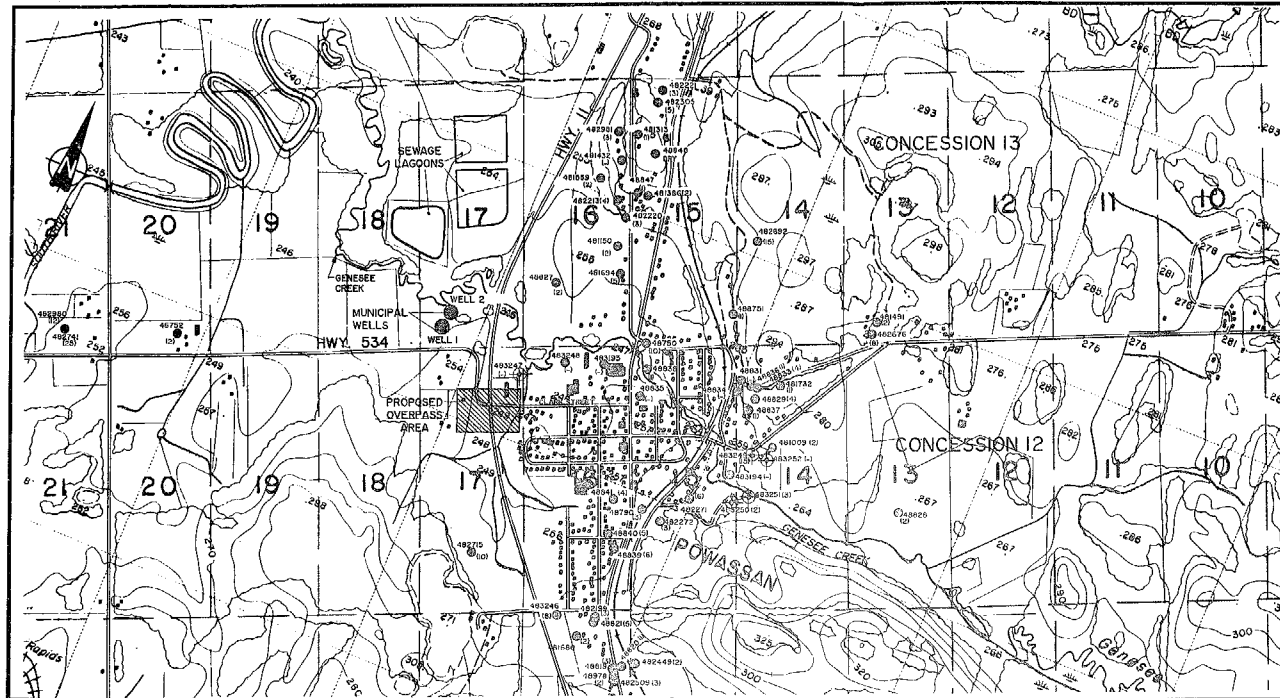
Job: 927939

Status: Final

Job approved by:
Signed:

.....
Agnes Love, B.Sc.
Manager, Environmental Inorganic Services





GROUNDWATER SUPPLY

FIGURE 3

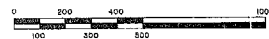
LEGEND

- 402682 — MOE WELL NUMBER
- WATER WELL LOCATION IN PLAN
- (5) — TEST RATE (GALLONS PER MINUTE)
- NOT TESTED
- MUNICIPAL WATER SUPPLY WELL
- ⊙ MOE TEST WELL

NOTE

WELL LOCATIONS BASED ON UTM COORDINATES PROVIDED IN MOE WELL RECORDS

SCALE



1:10,000

Date: DEC. 7, 1992
Project: 92-1633

Goldier Associates

Drawn by: J.M.
Checked by: J.M.

