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## ST. MARYS CEMENT FLAMBOROUGH QUARRY PROPERTY

# Draft Technical Support Document GRS Proof of Concept Testing Program

**Submitted to:**  
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REPORT



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## 1.0 INTRODUCTION

St. Marys Cement (Canada) (SMC) has made applications to develop a quarry on its 158 ha property located in the Township of Flamborough in the City of Hamilton. The property is located at the northwest corner of Concession Road 11 East and Milborough Line on Part Lots 1, 2 and 3, Concession 11, Township of Flamborough. In support of the Category 2, Class "A" Quarry Below Water licence application under the Ontario Aggregate Resources Act (ARA), a Hydrogeological Level 2 Report prepared by AECOM Canada Ltd. (AECOM), formerly Gartner Lee Limited (Gartner Lee), was submitted (Hydrogeological Level 2 Report St Marys Flamborough Quarry, AECOM, February 2009). In that report AECOM proposed that a groundwater recharge system (GRS) be implemented along the perimeter of the majority of the extraction area to mitigate the effects of locally lowering the water table in the vicinity of nearby water receptors such as adjacent wetlands, streams and water wells.

In response to a request from the MOE and others to conduct 'proof of concept' testing for the proposed GRS, SMC has retained Golder Associates Ltd. (Golder) to develop and implement a testing program to demonstrate the 'proof of concept'. This testing program will involve the pumping and subsequent recharge of groundwater and, as such, is subject to the Permit To Take Water (PTTW) requirements set forth by the MOE for water taking over 50,000 l/day.

This report has been prepared in support of an application for a Category 3 PTTW and is updated from the previous report submitted December 2009, to incorporate changes and provide additional detail and clarification on the testing program. The report revisions reflect the Agency/stakeholder consultation which consisted of four technical meetings, two clarification memos, a site visit and supplementary correspondence. This report also includes: relevant background information on the ARA licencing process; the anticipated process for this project moving forward; an overview of the results of previous pumping test programs; and, the details of the proposed testing program.

The objective of the currently proposed testing program is to demonstrate that groundwater levels can be raised by recharging at wells to/above static levels after initial lowering by pumping, and thereafter controlled by varying the rate of recharge. The term 'Proof of Concept', with respect to this testing program, relates to a 'proof of hydrogeological concept', as the proposed testing is directed to assessing aquifer conditions and well separation and is not directly intended to prove the long term operational performance of a future GRS, which would be addressed in later stages of the overall proposal for the property.

In summary, the proposed testing program comprises pumping to lower the water table locally at a test well that is to be located in the vicinity of the perimeter of the planned excavation. To avoid stressing the nearby wetlands, test pumping will be conducted at an intermediate and then higher pumping rate for a period of time sufficient to induce local lowering of groundwater levels within the aquifer without causing a measurable impact on the wetland. After each pumping step, the pumped water will be directed to nearby recharge wells with associated monitoring of water levels in nearby bedrock and overburden monitoring wells being carried out continuously. This testing program will be conducted sequentially at three locations around the perimeter of the planned excavation with the complete program repeated in a different season within a 10 month period. Additionally short-term recharge tests will be conducted at four other locations generally around the perimeter of the proposed extraction limit.



The proposed testing program is not required to be phased. The testing program at three locations repeated over two seasons constitutes one test held under this permit. Approval of this permit would constitute approval for the complete testing program, subject to conditions of the permit.

The results of this testing program will be used to support a full assessment of the 'proof of concept' for a future site-wide scale GRS system that would be used to control groundwater levels in the vicinity of the proposed extraction area.

### 1.1 Background

As part of the previously completed hydrogeological assessment, AECOM carried out site characterization activities including aquifer performance tests (from 2004 to 2008) at four test locations, which are shown on Figure 1 (attached). These locations are labelled 'Previous Pumping Test' on the figure. This included an assessment of hydrological and aquatic conditions, and detailed monitoring of surface water features during test pumping events (Stantec, 2008). An overview of these test results are provided below.

Pumping Test - April 2004 72 Hr (3 day) Test at TW10 - 15 L/s (Gartner Lee, 2004):

- Response to test pumping was observed in bedrock monitors 465 m from TW10.
- There was no discernable response to test pumping at surface water monitoring locations.

Pumping Test - December 2004 168 Hr (7 day) Test at TW12 – 38 L/s and TW 13 – 10 L/s (Gartner Lee, 2005):

- The zone of influence at the end of testing extended 575 m in shallow and 700 m in deep rock at TW12 and 170 m in both shallow and deep rock at TW13.
- The effect of pumping at surface water monitoring locations was discernable at only one of seven mini-piezometers, MP-12, located 90 m northwest of TW12.
- There was no discernable response to test pumping observed at surface water stations (Gartner Lee, 2005) at either test location.
- One call was received at the interference complaint call centre. This call was received before pumping began and was a concern regarding flooding downstream of the discharge area. The high water level was due to a storm event and not to the discharge of pumped water.
- There was no discernable response to test pumping in the three monitored private wells (Gartner Lee, 2005).

Pumping Test - July 2008 192 Hr (8 day) Test at TW14 – 10 L/s (Stantec, 2008; Gartner Lee, 2008a & 2008b):

- Samples of pumped water contained free cyanide and zinc levels exceeding PWQO.



- Diversion of the pumped groundwater to the nearby wetland did not have a discernable effect on the flows in Mountsberg Creek.
- The effect of pumping at surface water monitoring locations was discernable at 2 nearby seeps.
- There was no effect on surface water quality attributable to the pumping test discharge.
- Seven calls were received at the interference complaint call centre. All relevant interference complaints were investigated and were determined to be not related to the testing program.
- No measurable drawdown was detected at monitored nearby private wells during the pumping of TW14. It should be noted that the communal private well at Stonebrook Estates was taken offline during this test.

Recently a short term recharge test was conducted by Golder using existing wells and a trucked-in potable water source. Results of the two Recharge Tests that were carried out in October 2009 are summarized below.

- The duration of the tests were 1.5 and 2 hours, both carried out within the same day. The first test was carried out at TW14 under a recharge rate of 6.3 L/s and the second test was carried out at a smaller diameter cored hole R5 under a recharge rate of 3 L/s.
- Recharge at TW14 raised water levels up 6 m in TW14 and the adjacent formation. A mound was developed above the pre-test static water level with the 1 m mound contour extending approximately 70 m from TW14.
- Recharge at R5 raised water levels up 6.3 m in R5 and 4 m in the adjacent wells. A groundwater mound was developed above the pre-test static water level with the 1 m mound contour extending approximately 25 m from R5.
- Calculated transmissivity on recharge at TW14 was similar to that which was calculated during pumping, confirming that the aquifer behaves in a similar manner during pumping and recharge of water.

Reporting of this short term recharge test will be included in the report to be prepared following this proposed testing program.

Summary details of the completed aquifer and recharge tests are provided in Table 1.

## 1.2 Process

During the stakeholder meetings several lengthy discussions took place regarding the approvals process and how comments from the agencies and stakeholders would be incorporated at various stages of the process. An outline of the approvals process was provided in the January 21, 2010 and February 24, 2010 clarification memorandums, and has been included herein. A significant level of Agency/stakeholder interaction is anticipated throughout this process and, as such, this process may be modified. We have included the chart below as a guide for the following discussion.



ARA Application Submitted	Agency/stakeholder interaction
Proof of Concept GRS Field Testing	PTTW – GRS <u>Field Testing</u>
Analysis of Results	Discussion/ inputs&concerns
Updated 3-Dimensional Flow Modelling	Discussion/ inputs&concerns
Design of Full Scale System with Operational Parameters	Discussion/ inputs&concerns
Development of AMP	Discussion/ inputs&concerns
Development of Performance Demonstration Plan	Discussion/ inputs&concerns
PTTW Application Submission (subsequent to OMB)	PTTW – GRS <u>System</u>
Implementation of Full GRS System	Monitoring reports

- Approval required
- Quarry can be stopped anytime

The ARA application has been submitted and this document forms part of the PTTW permit application for the GRS proof of concept testing. The remaining tasks listed have yet to be initiated, and are considered future tasks to be completed as part of the process. Should the application be directed to the Ontario Municipal Board (OMB) any work carried out prior to the hearing would be subject to review as part of the evidence presented. If successful at the OMB a PTTW application for the full system would be applied for by SMC, which would require approval by the MOE. The following addresses each of these tasks.

### 1.2.1 Past (Completed) Tasks – Aggregate Resources Act (ARA) Application

A summary of the ARA application process is provided below:

- Hydrogeological investigations including long term monitoring have been ongoing since 2003.
- Submission of applications for Planning Act approval in September 2004.
- ARA submission to MNR by SMC in January 2009; including hydrogeology (Gartner Lee/AECOM), surface water hydrology (Stantec), aquatic biology and natural environment (Stantec/Savanta) technical reports.



- ARA process formally commenced in April 2009.

One of the concerns raised during the February 4<sup>th</sup> meeting was that all of the technical work now being considered was not included in the original ARA application. While inclusion of this type of work may be typical for an application under an EA process, additional technical work, as is now proposed for the Flamborough site, is typically conducted following the ARA submission to allow for effective response to Agency and stakeholder concerns/input. The open dialogue during the Agency/stakeholder consultation process helps shape the end development that will, in turn, address the concerns raised during this process.

### 1.2.2 Current Tasks – Proof of Concept GRS Field Testing

A summary of the proposed GRS Field Testing program is provided below:

- SMC retained Golder Associates (Golder) to develop proof of concept GRS testing program in September 2009.
- Preliminary small scale recharge test at two existing wells was carried out in October 2009. MOE were onsite to observe.
- Agency (MOE/MNR) meeting to review proposed plan for GRS proof of concept testing program in November 2009.
- Draft PTTW submission in December 2009 for proof of concept testing was provided to gain comment from various agencies and stakeholders.
- Extensive Agency/stakeholder liaison ongoing at this time to refine program for 'proof of concept' GRS testing.
- Expect to complete 'proof of concept' GRS testing and submission of factual report of test results within one year of issuance of the PTTW.

**The stage of the program we are currently addressing as part of this application for a PTTW, relates only to the proof of concept GRS field testing program.** This testing program comprises the bulk of the field work required. The results from this testing program, previously reported investigations and the ongoing monitoring program will provide the basis for the development of the design of the GRS system for this site as is discussed below.

### 1.2.3 Future Tasks

This section addresses the tasks to be completed following the GRS testing program prior to ultimate approval of the quarry and implementation of the GRS.



### **1.2.3.1 Analysis of Results**

The first step that will be required once the field program has been completed for the GRS proof of concept test is an extensive analysis of the data obtained from each of the tests including:

- Analysis for each test area including aquifer characteristics, flow rates per recharge well, extent of groundwater mounding, responsiveness of water level changes to adjustments in recharge rates.
- Further assessment of groundwater/surface water interaction.
- Develop design parameters for well spacing and flow rates, separation between quarry face, recharge wells and sensitive areas etc., for inclusion in the flow model and consideration for the design of GRS.

### **1.2.3.2 Updating 3-Dimensional Flow Modelling**

Additional groundwater flow modelling of the site will be conducted using the revised parameters obtained during the field testing. The initial groundwater flow modelling (completed by AECOM as part of the ARA application) was essentially a regional assessment of the groundwater/surface water conditions around the site and a general assessment as to whether or not mitigation measures would be needed to off-set those potential impacts. Once the site specific information is developed from this proposed proof of concept GRS testing program, a 3-dimensional groundwater flow model will be developed as follows:

- Construct and calibrate 3-dimensional numerical flow model covering the watershed with local scale refinements over the site.
- Model construction to incorporate previous investigation results/data and include GRS proof of concept findings.
- Simulations performed to assess the extent of groundwater level decline at the site perimeter for early, intermediate and final stages of quarry development.
- Simulations performed to incorporate the GRS to mitigate impacts associated with quarry dewatering, closure (flooding) and post-closure including sensitivity of GRS design parameters (flow rates, well separation, aquifer transmissivity).
- Update impact assessment.

This updated model will be revisited during the development of the water balance to ensure consistency.

### **1.2.3.3 Water Balance**

Once the groundwater model has been completed it will be of key importance to refine the water balance for the site in order to account for the seasonal and annual needs of a future operating GRS around the site. This water balance will include the following tasks:



- Develop monthly water balance for the site incorporating GRS operation and site water needs during various future stages of development of the site.
- Consider year over year climate changes (based on historical record) with consideration of plausible climate change predictions.
- Liaison with Halton C.A. and other Agency/stakeholders to review and provide input.
- Complete water balance for site operations, flood back and post-closure conditions.

This updated flow model, impact assessment and water balance will be revisited during the development of design of the GRS.

### **1.2.3.4 Design of Full Scale System**

Once the groundwater flow model and water balance for the site have been refined, the design of the GRS will be developed; including consideration of operational issues, maintenance and monitoring as follows:

- Develop conceptual design – layout, controls, monitoring, operational aspects for discussion with Agencies including construction details, timing of installation, operational requirements including maintenance and monitoring etc.
- Develop plan for testing recharge wells on an ‘as installed basis’ to confirm suitability for use of each well in the completed GRS system and/or adjust well separation on a local scale.
- Agency liaison to review and provide input.
- Develop detailed design that addresses any further outstanding concerns raised during the process.

This GRS design, along with the updated flow model and impact assessment will be included as part of the AMP and will be available for final review and comment prior to an Ontario Municipal Board (OMB) Hearing.

### **1.2.3.5 Development of the AMP**

The Adaptive Management Plan (AMP) for a site is a key component of the future operation of any mitigation system. It incorporates the objectives and performance targets of the operational GRS as well as a plan to address any unforeseen circumstances that may occur during operations. The AMP will also include a comprehensive monitoring and response program that outlines the steps SMC, or any future operator of the site, must comply with in order to ensure the protection of the surrounding wetland features. The steps for the development of the AMP will include the following:

- Development of a conceptual AMP that includes objectives, monitoring targets, reporting protocols, management actions, role of Agencies/stakeholders.



- Agency/stakeholder liaison to establish the steps in developing the AMP, setting of performance targets, responsibilities, reporting requirements etc.
- Financial assurance package for operations to be developed in detail outside of the AMP but would address issues such as flooding, post-closure stages and the long-term commitment of the operator for completion of the required tasks.
- Develop AMP for Agency review and comment.
- Incorporation of comments into a final AMP for which agency sign-off will be required.

The AMP will be available for review and comment prior to the OMB Hearing; however it is not a part of this PTTW application package.

### 1.2.3.6 Development of Performance Demonstration Plan

An important additional step that will be proposed is the completion of a demonstration of the fully operating system upon initiation of quarrying. The details of this will be provided as a Performance Demonstration Plan to be reviewed by the agencies/stakeholders. Details would include:

- Development of a program to demonstrate the effectiveness of the GRS in the early stages of site operations when a dewatered quarry face is available.
- Agency/stakeholder liaison to review/refine the plan prior to finalization and inclusion as a licence condition.

The Performance Demonstration Plan will be available for review and comment prior to the OMB hearing.

### 1.2.3.7 Supporting Documents for Long-Term PTTW Submission

The updated flow model and water balance, the AMP and Performance Demonstration Plan will form the documentation to be addressed at the OMB Hearing. This documentation will have been circulated during the process to the agency/stakeholder group for feedback and comment during this time and is expected to incorporate the necessary adjustments to satisfy the concerns raised prior to the hearing. Ultimately these documents, and any amendments as required as part of the OMB decision, will be submitted as part of an application to the MOE for a long-term PTTW for site operations. This is not to be confused with the immediate request for a **short-term PTTW** for the 'proof of concept' testing program proposed herein.

## 2.0 SITE SETTING

This section provides a brief summary of the environmental conditions within the study area. As required by Section 10 of the PTTW application, pertinent environmental features in the vicinity of the three test areas are provided on Figure 2.



The following site description is quoted from the Hydrogeological Level 2 Report (AECOM, 2009):

*The property is located within a rural, predominantly agricultural area. It is bounded by residential development and forested wetland to the north, residential development and agricultural land to the west, mainly forested area to the east and Concession 11 Road East to the south. Components of the Lower Mountsberg Creek Wetland Complex are located in the northern portion of the site and components of this Wetland are present south along Concession 11 Road East and in the southeast, associated with Flamboro Creek. The Lower Mountsberg Creek Wetland Complex has been designated a Provincially Significant Wetland (PSW) by the MNR. The central portion of the property consists of cultivated land separated by treed hedgerows. The southwest portion of the property is in mixed and deciduous forest.*

*The central area of the subject property forms a shallow dome, with the ground surface falling off in all directions. The ground elevation on the southern part of the property, closest to Concession 11 Road East, is about 281 mASL and rises to about 295 mASL in the central portion of the property, sloping downward to the north to an elevation of about 285 mASL in the wetland. A shallow ridge cuts southward through the eastern portion of the property, with a topographic high of about 297 mASL noted.*

### 2.1 Physiography and Drainage

The following description of physiography and drainage is quoted from the Hydrogeological Level 2 Report (AECOM, 2009):

*The St Marys' property is located fully within the Flamborough Plain physiographic region as defined by Chapman and Putnam (1984). The Flamborough Plain is characterized as an area of shallow, glacially derived overburden lying on the limestone/dolostone plain that forms the upland above the Niagara Escarpment northwest of Hamilton.*

*... Drumlin features are present north of the St Marys property near the Mountsberg Reservoir and wetlands are common in low-lying areas, adjacent to topographic uplands. Bedrock exposures within the Plain occur close to the Escarpment, with a small area identified on the St Marys property near the east boundary about 500 m north of Concession 11 Road East.*

*The overburden deposits in the Flamborough area consist of glacial sediment of Pleistocene Age with local accumulations of alluvium and organic 'muck' of Recent Age. The Pleistocene deposits include unstratified till, stratified outwash sand and gravel, and lacustrine silt and fine sand.*

*... The dominant surface unit is the Wentworth Till, a sandy-silt till, which is locally stony. The till is largely derived from the underlying bedrock (dolomite, shale and sandstone) exposed along the Niagara Escarpment to the east. The till also forms the core of the drumlins located in the northern part of Flamborough. Outwash and lacustrine deposits are commonly found in association with the till. These deposits are produced during periods of ice melt and frequently occur inter-bedded with the till.*

*Decaying vegetation and fine sediment (silt and clay) form the parent material of the organic 'muck' that is prevalent in low-lying areas between topographic highs.*



... The property is within the Upper Bronte Creek Watershed, draining either to the Mountsberg Creek subwatershed (north, west and southwest) or the Flamboro Creek subwatershed (southeast/east).

The drainage network on the property is shown in Figure [3.3]. The headwaters of a Mountsberg Creek tributary (referred to as Tributary A) originate within the wetland/swamp located on the northern portion of the property. The wetland is mapped as part of the Lower Mountsberg Creek Wetland Complex. The central portion of the wetland is seasonally flooded, with a southwest trending channel (Tributary A) evident. Tributary A connects with the main branch of Mountsberg Creek about 250 m west of the site.

The channels of two additional Mountsberg Creek tributaries referred to as C and D cut across the southwestern portion of the property. Tributary C, which originates in a woodland area located on the adjacent property to the west, extends across the southwest corner of the CBM property.

Tributary D extends through a wooded area directly north of Concession 11 Road East and drains a small dug pond present in this area. This wooded area is part of the Lower Mountsberg Creek Wetland Complex (added during field work conducted collaboratively amongst Stantec and the MNR). Flow in this tributary is intermittent. Tributary D connects with Tributary C, immediately south of Concession 11 Road East and with the main channel of Mountsberg Creek about 1 km further to the south.

The other watercourse that crosses the property is Flamboro Creek, which extends across the southeast corner of the property and drains towards the south. The low wetland area adjacent to Flamboro Creek on the property is a component of the Lower Mountsberg Creek Wetland Complex. A small, off channel pond is located on property, north and east of the Creek, about 50 m west of Milborough Town Line road.

Both Flamboro Creek and Mountsberg Creek connect with Bronte Creek about 2 km to the south.

## 2.2 Hydrogeology

The following description of site hydrogeology is quoted from the Hydrogeological Level 2 Report (AECOM, 2009):

*The regional hydrogeology is strongly influenced by the geology. The overburden provides a thin mantle of material over the bedrock surface, which exhibits limited groundwater resource capabilities in the vicinity of the site. These unconsolidated materials act to either promote or limit precipitation infiltration into the underlying Amabel Formation. The Amabel Formation is the dominant hydrostratigraphic unit throughout the broader area and at the site. Groundwater flow is principally through this unit with the water table in most areas occurring within the bedrock. The thin cover of soils overlying the bedrock is generally unsaturated, or seasonally influenced by high water table conditions. The bedrock underlying the Amabel Formation, specifically the Fossil Hill/Merritton and Cabot Head Formations are less transmissive compared to the Amabel Formation and, as such, form a hydraulic boundary beneath the Amabel Formation.*

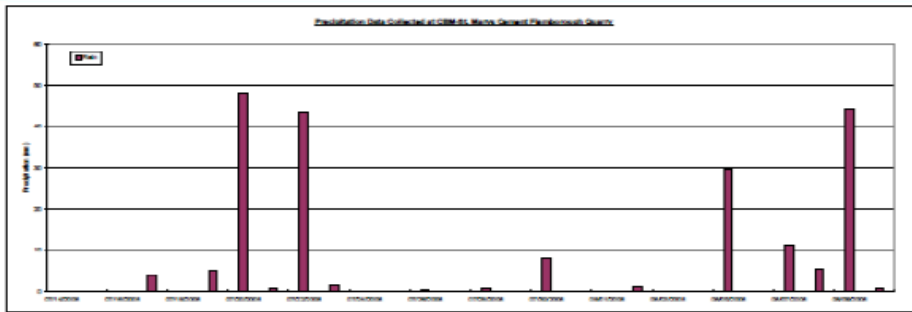


The Amabel Formation dolostone (proposed for extraction) ranges in thickness from 26 m to 37 m, and comprises the main hydrostratigraphic unit in the study area. This unit is capped with a thin overburden layer generally comprised of fine to mixed till with areas of silty sand, with thickness ranging from less than 1 m to locally as much as 5 m. A thin dolomite unit (Fossil Hill/Merritton), and below that shales of the Cabot Head Formation, comprise the base of the sequence investigated at the site (AECOM, 2009).

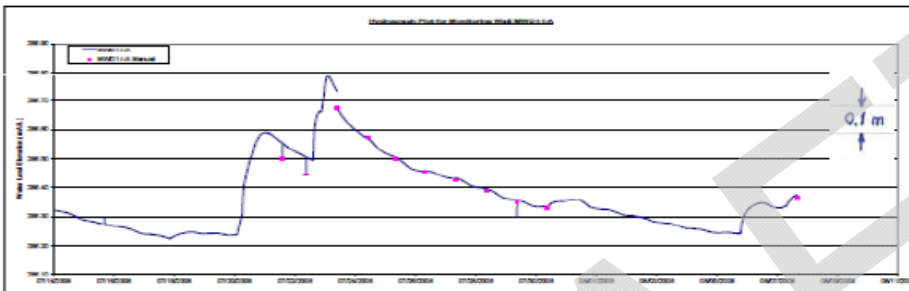
A large amount of hydrogeological characterization work focussed primarily on the Amabel Formation has been completed, including borehole packer testing, slug testing, flowmeter profiling and aquifer transmissivity testing, by AECOM on this site from 2004 to 2009. This data was compiled and independently reviewed, along with MOE water well records, by S.S. Papadopulos and Associates. Inc. (Papadopulos) in 2009 to assess the characteristics of groundwater flow through the Amabel Formation. Papadopulos concluded that estimates of aquifer transmissivity derived from onsite well testing are consistent with estimates derived from the MOE water well records in the region.

### **2.3 Groundwater/Surface Water Interaction**

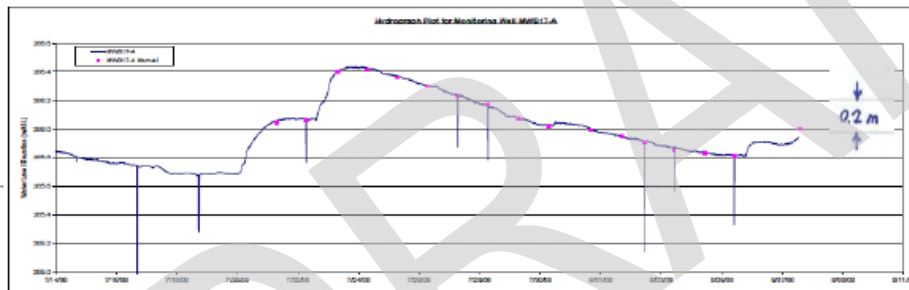
Bedrock groundwater at this site discharges to local surface water and wetland features adjacent to the site. This interaction is evident from the extensive monitoring record developed to date and is illustrated by two representative hydrographs provided below. These hydrographs were taken from the ARA technical reports and clearly show the similarity of the water level fluctuations in bedrock and overburden monitoring wells in response to precipitation at two locations on the site; suggesting the clear interaction between groundwater and surface water and wetlands.



NE corner of site  
Rainfall Data (July and  
August 2008)



MW01-I-A  
Top of Overburden



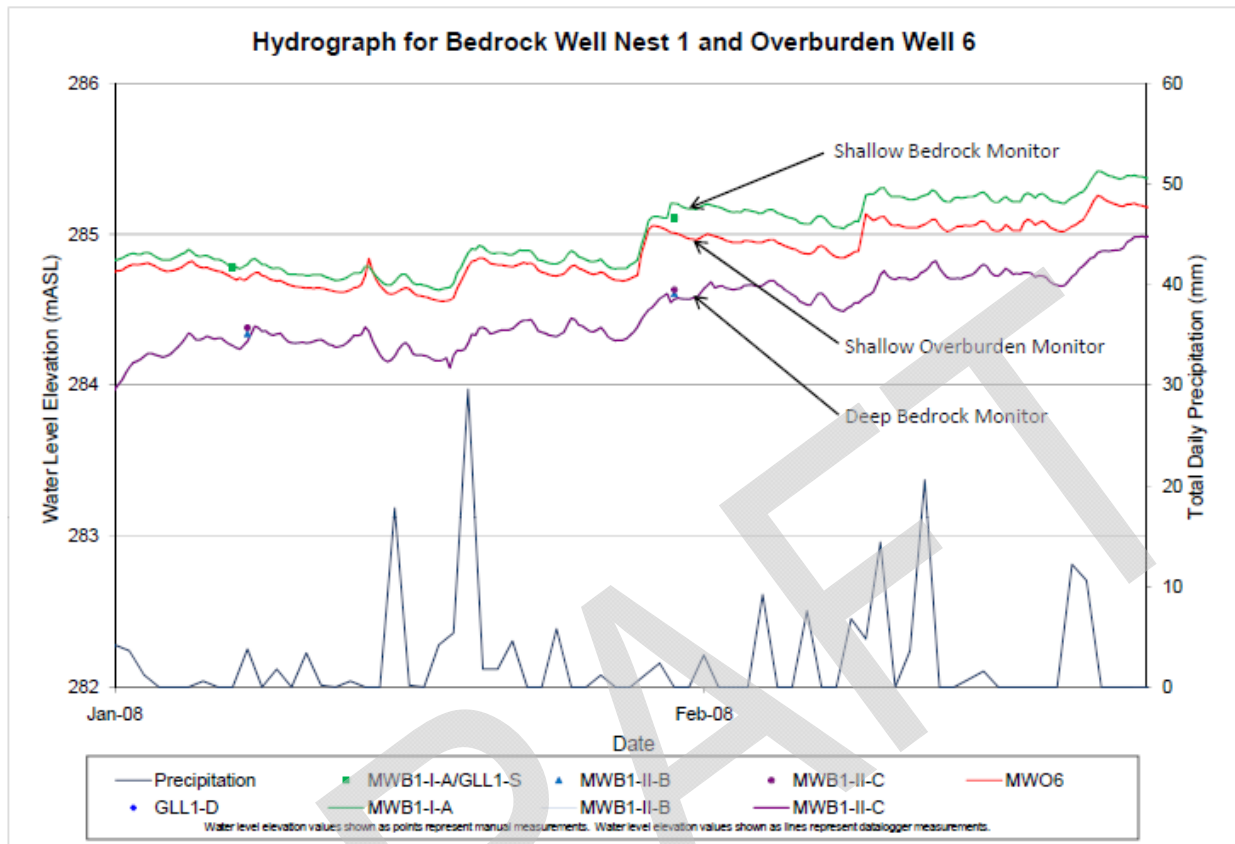
MWB17-A  
Top of Rock

Gartner Lee, 2008

Monitoring wells MWO1-1-A and MWB17-A, are located in the northeast section of the site and are about 100 m apart. The above graphs were copied from the Phase 1 Pumping Test Report, Gartner Lee Limited, August 2008; Appendix E.1 and E.3. The water levels in both the bedrock and overburden monitors clearly respond to precipitation events in a similar manner and show a similar seasonal decline through the period July to August 2008.

A multi-level monitoring nest located in the northwest corner of the property, MWO6 and MWB1, also shows essentially the same water level fluctuations in the shallow bedrock and overburden in response to precipitation events and seasonal trends (see figure below showing January 2008 to March 2008 water levels, after AECOM 2009). In addition, groundwater levels in the shallow bedrock (green line) are consistently slightly higher than in the adjacent overburden monitor (red line) demonstrating upward hydraulic gradients at this location that are indicative of groundwater discharge from the bedrock to adjacent wetlands.

Monitoring wells proposed for this GRS testing program will be incorporated into the ongoing water monitoring program at this site. Analysis of the more extensive water level monitoring record will be relied on to further demonstrate the nature of the groundwater/surface interaction at this site.



Given the interaction between bedrock groundwater and the surface environment, SMC has proposed a perimeter GRS be constructed and operated to prevent unacceptable impacts on the adjacent surface water/wetland features from occurring as a consequence of quarry dewatering.

## 2.4 Groundwater Use

A figure derived from the MOE water well database of water wells within 1 km of the property boundary is included as Figure 3.

The following summary of groundwater use is quoted from the Hydrogeological Level 2 Report (AECOM, 2009):

*Groundwater within the general vicinity of the property is used for domestic, municipal and commercial purposes. These takings draw primarily from the Amabel Formation with the two largest known takings being the municipal water takings at Carlisle and Freulton.*

*Local residential properties draw supplies from the Amabel Formation and use this water for domestic and farm purposes. The MOE water well database has records for a total of 69 water wells which plot within 1 km of the site boundaries. These wells are all*



*completed in the bedrock. It is likely that other wells are present; however, water well records have not been filed for these wells.*

*Groundwater quality in the water well records is reported to be 'fresh', with four records not reporting quality. Most of the water use is identified as being for domestic, with two as stock (MOE #2805488, 6811367), one as commercial (MOE #6803052), two public supply (MOE#6813737, 6813738) and one unclassified (MOE #6813380). The public supply wells are located at the Stonebrook Estates subdivision located to the northwest of the subject property, comprising a communal water supply for the residential subdivision.*

*The specific capacities reported in the records vary from 0.10 to 80. Recommended pumping rates are typically 1.5 L/s (20 igpm) or higher, indicating that the wells can sustain most domestic requirements.*

*Based on the records, well depths average 16.6 m, ranging from 6.4 to 30.8 m. On average, wells are completed to an elevation of about 272.8 mASL, with a range of 259.7 to 290.8 mASL.*

Further discussion with respect to water supply contingency plans is provided in Section 4, below.

### 3.0 PROPOSED RECHARGE TESTING PROGRAM

#### 3.1 Pre-Testing Activities

Pumping, recharge and monitoring wells are to be drilled at three areas to facilitate this testing program (see Figure 1). As discussed in the following section, a winter drilling program has been completed at selected locations. These locations were identified by Halton Conservation and other stakeholders as areas which should be preferably accessed during winter or dry summer conditions in order to limit rutting and disturbances to vegetation.

##### 3.1.1 Drilling and Monitoring Well Installations

At each test area, the test pumping well, and recharge wells will be completed to the base of the Amabel Formation consistent with the construction of existing wells. The nearby bedrock monitoring wells, to be located between the pumping well and the nearby environmentally sensitive features, will each be completed with a deep and shallow piezometer. Overburden piezometers will be installed in the vicinity of bedrock monitoring wells and adjacent to wetland features, according to their accessibility, and as ground conditions permit.

Bedrock drilling will be completed with an air rotary rig equipped with a down hole hammer. All bedrock boreholes including pumping and recharge wells will be drilled to a minimum diameter of 6 inches. Flow profiling of the open borehole will be completed in all bedrock boreholes and will be used to identify the water producing zones. These results will be used to select the intervals for the piezometer screens at bedrock monitoring locations. All pumping, recharge, bedrock monitoring wells will be completed with a protective surface casing and equipped with lockable well caps. Overburden wells will be drilled to



appropriate diameter for monitoring well or mini-piezometer installation depending on drilling method i.e., post hole auger etc., and will be similarly equipped with a surface casing with lockable well cap. A mini-piezometer will also be installed and monitored at the seep near MWB12 as part of this program. Construction of all wells will be done under the supervision of licensed professionals with experience in geotechnical excavation or well construction. Conservation Halton has advised that they will not require a permit with respect to the installation of the test or monitoring wells.

It is possible that at one of the test locations at least one of the recharge wells will be constructed at a shallower depth in order to determine the effectiveness of recharging through shallow wells versus deeper, fully penetrating wells. This will be determined prior to construction of the wells, and be based on drilling results.

Test areas were selected based on a review of existing bedrock hydrogeology data, site geometry, proximity to sensitive environmental features and distribution of existing site characterization data. Exact locations of the wells have been sited based on confirmed wetland limits (Stantec), making use of existing roads to minimize disturbance of vegetation, and taking into account stakeholder concerns tabled during consultation meetings and the January 27, 2010 site visit.

### 3.1.2 Winter Drilling Program

In response to the concerns about ground conditions and the potential impact to sensitive environmental features at some of the drilling locations proposed, a site visit was conducted by Golder and SMC on January 27, 2010 with key stakeholders (Conservation Halton, MNR, City of Hamilton, Stonebrook Estates, Dougan & Associates on behalf of CART, North South Environmental on behalf of FORCE, and FORCE) as well as the drilling contractor, Chris Gerrits of Gerrits Drilling and a Stantec ecologist. In addition, drill rig access to the vicinity of Test Areas B and C was found to be a concern for the contractor if ground conditions were not either frozen or dry. The proposed drilling locations at Test Areas A, B and C (pumping, recharge and monitoring wells) were viewed in the field, including the access routes for the drill rig and the area required for support vehicle access. Conservation Halton advised that locations within or immediately adjacent to the wetland in Area B should be accessed with heavy drilling equipment only when the ground was frozen (or during dry conditions later in the summer).

A winter drilling program was then progressed between March 8 to 12, 2010 at Area B (three monitoring wells) and Area C (one monitoring well) to take advantage of the still frozen ground conditions (see Figure 1). Drill rig mobilization and set up in the sensitive area within Area B (as identified by Conservation Halton) was supervised by a Stantec ecologist. Flow profiling at these wells is ongoing at this time and piezometer installation will be scheduled soon thereafter. An invitation was extended by SMC to the various stakeholders to visit the site during the winter drilling program; however, no visitors requested site access during this work program.



### 3.2 Water Quality Sampling and Step Testing

All wells will be developed upon completion of drilling activities. Water quality will be sampled from all three pumping wells following well development, in advance of step testing, to confirm water quality is suitable for recharge at all pumping well locations. Notification to appropriate stakeholders will take place upon receipt of water quality results. Details on water quality sampling are discussed in Section 3.5 below.

A step test will then be conducted to establish the test pumping rates for an intermediate pumping level and the maximum sustainable drawdown level for each pumping well.

### 3.3 Recharge Testing Program

Testing of the recharge wells will be carried out at three locations (see Figures 4, 5, and 6) sequentially over two different seasons, likely winter and summer. Summer testing will take place in the dry season, when low flow conditions prevail (i.e., typically August). Testing will proceed when the drilling program is complete, either in summer or winter. There is no technical reason why the winter testing program must be completed before the summer program and, as such, the first seasonal program will be initiated following receipt of the PTTW. The general procedure of each of the test locations will be as follows:

- 1) At each of three test locations, install a pumping test well generally at the perimeter of the proposed excavation (other than at Test Area A) and recharge wells in the proposed quarry set back, with monitoring wells (a minimum of 4 locations) to be located nearby. At Test Area B recharge wells will be located outside of the setback, within the existing extraction limit, to address stakeholder concerns regarding their location in this area. These holes will be flow profiled and completed with monitoring well piezometers as described in Section 3.1 above. Water quality sampling at the pumping well will take place after the pumping well has been developed as described in Sections 3.2 and 3.5. Data loggers will be installed in all newly installed wells (note all existing monitoring wells are currently equipped with data loggers).
- 2) Short term “step tests” of the pumping well over a 1 to 8 hour period to establish pumping rates and the intermediate and maximum sustainable drawdown level. Notification of results will be forwarded to appropriate stakeholders following step testing.
- 3) Each pumping event will continue until groundwater levels in nearby monitoring wells are generally stable (to be determined in the field but expected based on previous experience to be well within 24 hours). During this portion of the test, the pumped water will be discharged to ground surface in the central area of the site, as is discussed below. Thereafter, the pumped water will be redirected into the three recharge wells for the combined pumping/recharge portion of the test. The flow rate to each recharge well will be metered separately. The pumping rate will of necessity be increased during the combined pumping/recharge portion of the test to generally maintain the water level in the pumping well at about the intermediate drawdown level. Recharging of pumped water will then be discontinued and pumping rate increased for a period of constant rate pumping with the water level in the pumped well drawdown to about to the maximum sustainable drawdown while groundwater levels in nearby monitoring wells stabilize. Thereafter the pumped water will be redirected into the



three recharge wells for the second period of combined pumping/recharge. Again, of necessity, the pumping rate will be increased to generally maintain the water level in the pumping well at about the maximum sustainable drawdown.

During the combined pumping/recharge phases of each test, the recharge rate to the wells will be varied (with some water pumped to surface discharge and recharge rates varied between the wells), such that the degree of control over the height of the recharge mound can be demonstrated. Each test is expected to take 5 to 6 days to complete; generally with constant rate pumping only on days 1 and 3 or 4 (if test requires 6 days) and combined pumping/recharge on days 2, 3 (if test requires 6 days), 4 and 5 (possibly 6 if test requires 6 days). Depending on conditions and results, testing may be done continuously over a 5 to 6 day period, or testing may be conducted over two intervals with a period of recovery between the first and second phases (i.e., a recovery period before testing at the maximum sustainable drawdown). In total it is expected that this pumping program would require a total of 30 days (5 days/3 areas/2 seasons) of pumping and combined pumping/recharge assuming no equipment malfunctions or inclement weather conditions. The table below summarizes the anticipated testing program.

**Anticipated Testing Program Schedule at Each Location**

Test Day	Program Activity	Target Drawdown in Pumping Well
1	Pumping	Intermediate Level
2	Continued Pumping and Recharge	
3	Pumping	Maximum Sustainable Level
4	Continued Pumping and Recharge	
5	Continued Pumping and Recharge with adjustment of recharge rate	

- 4) Samples of pumped water will be collected daily for laboratory analysis of metals and general chemistry parameters (See Section 3.5 below). Field chemistry readings on the pumped water (pH, electrical conductance, temperature, Eh) will be taken at regular intervals using suitable probes and a flow through cell. A turbidity meter will be placed in line during testing to continuously record the turbidity of the water that is to be recharged.
- 5) Water level monitoring will be continued following the completion of pumping and recharge testing. Newly installed monitors, including mini-piezometers in the vicinity of wetlands and streams will become part of the long term groundwater monitoring program.



Over a period of as much as six weeks, testing will be conducted sequentially at each of the three Areas A, B and C (see Figures 4 to 6) with the complete program repeated at a later season within a 10 month period. A conceptual schematic of the test set up is included as Figure 7. Testing activities will be undertaken by licensed water well technicians (Lotowater) with minimal equipment limited to piping, pumps, generators etc. as indicated on this figure. Typical precautionary measures, such as the placement of spill pads under generators and fuel supplies will be employed with this equipment to minimize the risk of potential spills. Due to the simplicity of the set-up, there is no necessity for a spill management plan covering this testing program. Measures will be taken to ensure site security during testing.

### 3.4 Flow Rate Monitoring

Flow rates will be measured individually at each recharge well and along the discharge line with continuous monitoring of flow meters installed inline (as per Figure 7). The flow meters used on the discharge and recharge lines will have been calibrated within the 12-month period prior to the start of pumping. Calibration records will be submitted with the final report to the MOE.

### 3.5 Groundwater Discharge Plan

Pumped groundwater not otherwise required as the source of water for recharge testing will be discharged to ground surface at the centre of site and allowed to dissipate via seepage to the subsurface. The general location for the discharge of pumped groundwater is indicated on Figure 1. A discharge structure similar to that used in the 2008 pump test at TW14 will be used for splash and erosion control at the discharge location. A schematic diagram of the previously constructed discharge structure can be found in Appendix A.

The discharge area selected is comprised of sandy overburden where no previous water ponding has been observed, thus infiltration is expected to readily occur. A significant amount of surface storage exists over the large field extending between the discharge location and the nearest down slope surface water feature (>600 m away) thus, overland run-off to surface water features is not expected.

If frozen ground conditions prevail and the opportunity to discharge to surface becomes more limited, the recharge component of the testing program will be initiated sooner to prevent pumped water from flowing overland to reach the adjacent stream.

Conservation Halton has advised that they will not require a permit with respect to discharge of water from the pumping tests.

### 3.6 Water Quality Sampling

Laboratory analysis of water quality samples taken from the pumping wells after well development will be completed to Ontario drinking water quality standards (ODWS) to ensure water quality is suitable for



recharge into the aquifer. Sampling will take place following well development and the City of Hamilton (Public Health department) and appropriate stakeholders will be notified of these results prior to the testing program.

As the pumped water will be either discharged to surface in the middle of the site or recharged via recharge wells, and is not planned to be discharged to local surface water courses, it is appropriate to sample groundwater from the pumped wells once per day. These samples will be submitted for laboratory analysis of the parameters included in Table 2. Volatile organic compound (VOC) sampling from the pumping well will be included in the water quality program for Test Area B during the step testing and pumping/recharge testing phases of the program. Given the results of previous analysis during the 2008 testing program, there is no need for analysis of PCB's or copper in this testing program. PCB's were not detected in any samples during the program and copper levels were significantly below the ODWS (Gartner Lee, 2008b).

Field chemistry and turbidity will be monitored at regular intervals during testing. A turbidity meter will be placed in line at all pumping well locations to continuously record the turbidity of the water that is being recharged. Field chemistry parameters to be collected are included in Table 2. Water quality results obtained from the samples collected during the recharge tests will be used in future geochemical interpretation of long-term recharge water quality. This will be completed during the design phase of a future full-scale GRS system in order to address performance issues. This will, in turn, provide information on carbonate balance and some understanding, along with predictive modelling, of effects of long term pumping/recharge i.e., potential for karstification and precipitation/clogging to be considered in the overall design of the full-scale system.

A turbidity meter will be placed in line to continuously record the turbidity of the pumped water during the pumping and the combined pumping/recharge phase of each test.

### **3.7 Water Resources Monitoring Plan**

Monitoring will be carried out at each test set up in the pumping wells, recharge wells and monitoring wells including overburden monitors, and nearby surface water features during the proposed pumping and recharge tests. Existing and approximate location of proposed monitors at Test Areas A, B and C are identified on Figures 4, 5 and 6, respectively. Table 3 lists the locations to be monitored during this testing program.

Existing groundwater monitoring wells are equipped with data loggers. For the recharge testing program, these will be re-set to record water levels at 1 or 5 min intervals, depending on their location relative to the test being carried out. Water level data will be collected at least a week prior to, during the pre-test, testing and recovery periods. Recovery period monitoring intervals will be selected at a suitable frequency based on observations during pumping. Transducers will be downloaded on a schedule based on their capacity in a method that causes minimal disturbance to test monitoring. There is no need to download these transducers daily. Manual water levels will be collected according to the schedule in Table 3 and will be reviewed by a qualified professional daily with transducers recording continuously.



In order to provide water level information to the various stakeholders during the testing period, approximately 6 to 8 perimeter wells will be downloaded and processed prior to the end of each testing period (see Section 4.3). The perimeter wells are located between the proposed test areas and any surrounding receptors.

Wells to be installed as part of this program will be instrumented with data loggers set to record at the same frequency. Manual depth to water measurements will also be collected periodically during the testing program. Surface water levels will be monitored manually at least once per day at nearby existing stations.

There is no intention to stress the wetland system during the planned testing. The proposed GRS proof of concept test is not intended to impact the wetland system but rather demonstrate that groundwater levels adjacent to the wetlands can be controlled by recharging to prevent impacts to the wetland system. This is also the design intent of the proposed GRS system.

### 3.8 Offsite Wells/Private Well Monitoring

Test Area A is within 500 m from the neighbouring Stonebrook Estates (Stonebrook) communal supply wells (MOE #6813737 and #6813738). Before the 2008 testing at TW14, SMC worked with the operator of the water and wastewater treatment plants at Stonebrook, TEAM Aquatic Management (TEAM Aquatic), to safeguard their water supply during testing. As part of this program the following items were incorporated into their well and treatment system:

- A datalogger for continuous water level monitoring was installed in the pumping well (Lotowater, 2008); and
- A turbidity meter was installed on the raw water intake (TEAM Aquatic, 2008).

No impact to this communal water supply well (i.e., the lowering of water levels to unacceptable levels) was observed during the previous pumping test (of eight days duration) where the well was taken offline. Given these results, no impacts are expected during the proposed testing at Area A, the closest of the three testing locations, for the shorter pumping tests combined with recharge. The previously installed equipment will be used to monitor water levels in the pumping well and turbidity of the pumped water during testing at Area A. A licensed water well contractor (Lotowater) will take daily manual water level readings at Stonebrook water supply wells during the testing interval.

Stonebrook intends to operate as usual during the testing program given the lack of effect noted during the previous testing program and their desire to assess well performance, while recharge operations are being conducted. They expect to operate only one production well at Stonebrook during the testing events at Area A to represent normal operating conditions. It is expected that a pumping rate of approximately 150 m<sup>3</sup>/day between the hours of 8:00 and 16:00 would be achieved in order to simulate peak flow pumping conditions. They intend to include a flow meter on the two inch diameter discharge line to monitor flow rates during pumping and further, that the discharge would by-pass the treatment system and be directed to the ground in the vicinity of Bronte Creek via an erosion control structure. Stonebrook are to liaise directly with the MOE and CA for their concurrence with this proposed program.



They may also elect to operate their communal wells at the full permitted rate during one of the two planned testing events at Area A. They intend to monitor water quality and turbidity via their electronic turbidity meter and will conduct visual inspections three times per day. They will not take their wells offline unless the need arises. As with the previous pumping test SMC will work with TEAM Aquatic during the testing to safeguard their water supply system.

The City of Hamilton has requested that water level monitoring be conducted at two nearby domestic wells (6813438 near Area B and 6803048 near Area C) in the event that pumping rates exceed 20 L/sec. This monitoring will be conducted during testing pending the results of the step testing and the determination of test pumping rates. Domestic well monitoring activities will be subject to homeowner permission being granted and the well being in a condition suitable for monitoring, as established by Lotowater from a well condition survey.

A door to door survey of residential wells was undertaken as part of the previous 2008 PTTW conditions and thus is not necessary in advance of this testing. In cooperation with FORCE and Stonebrook, private domestic well monitoring will be available to wells within 1,000 meters of the pumping well during testing, if requested by the well owner, subject to a signed access agreement and satisfactory inspection of well condition. Any monitored private wells will be fitted with a datalogger for continuous water level monitoring during testing. Dataloggers will be downloaded on the completion of testing to minimize disturbance to the well. Water quality sampling will be completed for general chemistry prior to the start of testing and after/during testing if deemed appropriate by the licensed water well contractor upon well inspection or in response to a water well interference complaint. Private well owners will be provided their monitoring results on termination of the testing program upon request.

### **3.9 GRS Decommissioning**

Pumping and recharge wells will not be decommissioned at the end of testing, rather they will remain as open borehole installations to be used on the second round of testing and then incorporated into the long term groundwater monitoring program.

### **3.10 Short Term Recharge Tests**

To improve the understanding of aquifer characteristics, namely bedrock transmissivity elsewhere around the planned perimeter of the proposed excavation, and to further support the feasibility of the recharge concept, four short term recharge tests are to be performed in one season only. Test locations have been selected to take advantage of existing monitoring well locations, (MWB6, MWB7, MWB4 and MWB28), as shown on Figure 1. A recharge well is to be installed across the Amabel Formation at each test area using air rotary drilling techniques. A short duration pumping test with a total extracted volume of less than 50,000 L/day will be conducted to provide an estimate of aquifer transmissivity. At some time thereafter, a short term recharge test utilizing a trucked-in source of potable water, will be completed with monitoring of flow rates and water levels.



### 3.11 Independent Testing Oversight

Independent third party oversight during this testing is not necessary as the work will be carried out under the direction of a licensed P.Geo. or P.Eng. The results including copies of the factual reports will also be submitted for independent review by Genivar for CART, who also retain P.Geo. and P.Eng. professionals in their employment.

## 4.0 POTENTIAL IMPACTS OF PROPOSED TESTING PROGRAM

As discussed in Section 1.1, there have previously been four pumping tests at various locations across the site. The impacts from these tests can be summarized as follows:

- There were no impacts to private well owners during three of the performed pumping tests. (Gartner Lee, 2005, 2008b; AECOM, 2009); and
- There was no effect on surface water streams during any of the previous testing (Gartner Lee, 2005, 2008b; AECOM, 2009).

The pumping rates for the proposed pumping tests are expected to be consistent with those of the previous pumping tests; however the duration of pumping without recharge will be much shorter. Based on the results of the previous pumping tests, and given that for at least half of the pumping duration, pumped groundwater will be recharged back to the aquifer, no significant impacts to local environmental features are anticipated. Indeed the monitoring, undertaken to examine the 'proof of concept', will be used to confirm this. The results of this will be reviewed prior to conducting the second round of testing at all three locations.

### 4.1 Notification

Notification to stakeholders of testing activities and relevant technical information will be provided as follows:

- Prior to drilling program proceeding in Area A, advance notification to the immediate neighbours will be provided.
- The City of Hamilton will be notified of testing dates and of the planned pumping rates after step testing has been completed. Golder will provide the following information to the City of Hamilton and appropriate stakeholders before commencement of testing: flow profiling results; pumping well water quality results; pumping well step testing results; expected pumping rates; and laboratory analytical results of the pre-test water samples from the three pumping wells.
- Notification of testing will be provided to the community preceding each of the two (2) planned testing events. A testing event is considered to be the complete series of consecutive testing at Area A, B and C during one season. Notification to private well owners within 1,000 m of the test wells one week prior to testing as detailed below:



At least one week before the start of the pumping tests, SMC will deliver a notice to private well owners within 1,000 m of the test wells, which will include the approximate date and time of the start of the testing program. A copy of this letter is provided in Appendix B. The notice will also include a 24 hour contact number for an on-call licensed well technician (Lotowater) in case any well performance issues should arise during testing. This notification will be repeated for the second round of testing (at all three locations) later in the year.

## **4.2 Proposed Contingency Measures**

A plan has been prepared to ensure that no person or property will be adversely affected by the test. Contractors will be stationed at the test wells 24 hours per day, seven days per week during the pumping period to immediately suspend groundwater pumping or recharge if required.

On-call licensed well technician (Lotowater) will respond during the test to any well complaints that are received via the 24 hour contact number distributed with the test notifications to private well owners within 1,000 m of the test wells. Immediately upon receiving a complaint, Lotowater will be dispatched to the private well owner's site to provide corrective action. If necessary, Lotowater will be able to disconnect the owner from their well and supply water via a temporary water storage tank. All plumbing connections for this work would be completed by Lotowater. Lotowater will sub-contract filling of the tank as necessary, to a local potable water supply company.

As discussed above in Section 3.7, during testing at Area A, the Stonebrook communal supply well will be monitored using existing installed monitoring equipment. In the event that the viability of this supply is affected during this testing program, Lotowater will arrange for bulk potable water to be delivered to Stonebrook's storage tanks at the water plant, which can be fed into the communal supply system. To alleviate possible water interference concerns during testing a contingency water supply tank may be set up at Stonebrook during the first round of testing to be immediately available in the event it is needed, alternatively a tanker truck of water feeding the system directly could also be considered. The need for a pre-test set up will be reassessed following the first round of testing prior to the second season test program.

In cooperation with FORCE, private domestic well monitoring will be available during testing, if requested by the well owner, subject to a signed access agreement and satisfactory inspection of existing well conditions.

Private well interference complaints received by SMC during testing will be resolved by Lotowater in the same manner as the previous 2008 pump test at TW14. Lotowater's procedure on resolution of interference complaints and provision of temporary water supply is provided in Appendix C. The MOE will be notified of any complaint arising from the taking of water under this permit.



### 4.3 Data Review and Stakeholder Information/Engagement

SMC will ensure that effects from testing are documented and provided to the public through a transparent process. The public and stakeholders will be assured of the results of testing activities through the following engagement plan:

- Publishing of hydrographs from key perimeter wells at the end of testing in each of Areas A, B and C. These are expected to be released to the public on the final day of testing (Friday) at each location as an indication of the potential for pumping to effect offsite wells (i.e., impacts will be noted in these perimeter wells prior to off-site receptors since they are located between the test locations and off-site domestic wells).
- Collection (according to Table 3) and daily review of manual water level readings by a qualified professional for an indication of possible impacts on local features.
- Scheduled site tours during testing at all locations will be offered to members of the public along with access to a qualified professional to answer questions.
- Presentation of the factual test summary report 30 days following full recovery on the completion of a round testing at Areas A, B and C (see Section 4.4 below).

Monitoring of several key perimeter wells (see Table 3), will be carried out to demonstrate the potential effect of pumping on offsite locations. These wells will be closely monitored with dataloggers during testing. The 5 day tests, expected to commence on a Monday barring weather or equipment malfunction, will progress through the two pumping levels and recharge events, at which time these perimeter well dataloggers will be downloaded (expected end of day Thursday), plotted into hydrographs, and will be made publicly available by end of day on Friday (the final day of testing). This will serve as a real time indication of the potential for testing to effect neighbouring properties/features. Throughout testing, manual water levels will be collected according to the schedule in Table 3 and will be reviewed by a qualified professional daily for an indication of possible impacts on local features. Evaluation and interpretation of monitoring results is not an instantaneous process and is one that will be reported on in the factual reports. As such, daily review of water level data in the form of a public meeting is not required during this test.

Transparency of process will also be demonstrated through scheduled site tours during testing and the presentation of the factual test summary report 30 days following the completion of testing. Site tours will be scheduled, two days per test location during both rounds of testing where members of the public will be provided access to view the testing in process and a qualified person to answer questions.

### 4.4 Reporting

In addition to the program updates provided immediately after testing as specified above, formal reporting on testing activities will include the following reports on completion of each round of testing:

- A factual test summary report, to be distributed to stakeholders 30 days following recovery at all test areas;



- A factual report with all test data will be provided 60 days after the release of the factual test summary report;
- A stakeholder meeting following release of the complete factual report to discuss testing results; and
- A complete factual report at the end of both rounds of testing to be provided to the MOE at the end of the complete program.

A factual test summary report will be produced and distributed to the stakeholders 30 days following recovery of the first round of testing at Test Areas A, B and C. It is expected to include the following: all offsite monitoring data, a summary of pumping and recharge rates and events, representative hydrographs within each test area and beyond the area affected by testing onsite, documentation of interference complaints and how they were resolved. A factual report with all test data will be provided 60 days after the release of the factual test summary report to be followed by a stakeholders meeting and include an interpretation of the results. This factual report will include a record of the pumping and recharge rates, hydrographs of key observation well responses during testing, documentation of any complaints that may have been received by Golder, Lotowater and/or SMC and the water quality data obtained from all of the samples taken. Within one month prior to the planned repeat testing program (at the three test areas) SMC will advise the MOE of the proposed program and timing along with the notification procedure. After the second round of tests are completed a factual test summary report will be produced and distributed to the stakeholders 30 days following recovery of the last set of data.

A complete factual report will be provided for both rounds of testing as well as the short term recharge tests, at the end of the program within a 90 day period.

## 5.0 CLOSURE

We trust this report provides sufficient information to approve the Category 3 PTTW application for the proposed pumping test program at Test Areas A, B and C. Should you have any questions, or require further information, please do not hesitate to contact the undersigned.



## 6.0 REFERENCES

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- TEAM Aquatic Management, 2008. Letter to Bill Bardswich at Hamilton Region Re: Initial Draw Down Test St. Marys Cement Site. July 9 2008.

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## Report Signature Page

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# TABLES

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**TABLE 1  
Summary of Previous Pump Testing**

Date	Location	Pumping/ Recharge Rate	Duration of Pumping/ Recharge Test	Total Drawdown/ Mound Observed in Pumping Well	Zone of Influence	Response in Surface Water Streams	Maximum Drawdown in Nearby Private Wells
		(L/s)		(m)	(m)		(m)
April 2004	TW10 (currently MWB10)	15 L/s	3 days	20	465m*	None	Not monitored (brief test)
December 2004	TW12 (currently MWB12)	38L/s	6 days	17	575m in shallow and 700m in deep bedrock	None	None
	TW13 (currently MWB13)	10L/s	7 days	24	170m in both shallow and deep bedrock	None	None
July 2008	TW14	10 L/s	8 days	14	130m shallow, 350m intermediate, 620m deep bedrock horizon	None	None
October 2009 Recharge Test	TW14	6 L/s	93 mins	6	1 m mound extended approx 70m from TW 14**	None	Not monitored (too short)
October 2009 Recharge Test	R5	3 L/s	120 mins	6	1 m mound extended approx 25m from R5**	None	Not monitored (too short)

**Note:** \* - no zone of influence was reported. Response to test pumping was observed in a bedrock monitor located 465m from TW10.

\*\* - no zone of influence, comment on extent of mound development during short recharge test.

**TABLE 2**  
**Water Quality Parameters**

TEST AREA	METHOD OF ANALYSIS	ANALYTE GROUPING	ANALYTE	
AREAS A, B, & C	FIELD METERS	GENERAL INDICATORS	pH	
			Conductivity	
			TDS (calculated)	
			Eh (redox potential)	
			Temperature	
			Turbidity	
	LABORATORY ANALYSIS	MAJOR IONS	Chloride	
			Sulphate	
			Alkalinity	
			Calcium	
			Sodium	
			Magnesium	
			Potassium	
			Ammonia	
			Nitrate	
		MINOR IONS	Nitrite	
			Fluoride	
			Bromide	
			Cyanide	
			METALS	Arsenic
				Barium
				Boron
				Cadmium
				Chromium
	Iron			
	Lead			
	Nickel			
Zinc				
Mercury				
AREA B ONLY		VOLATILE ORGANIC COMPOUNDS	Volatile Scan including chlorinated organics & aromatic hydrocarbons	

**TABLE 3**  
**Schedule for Monitoring Program**

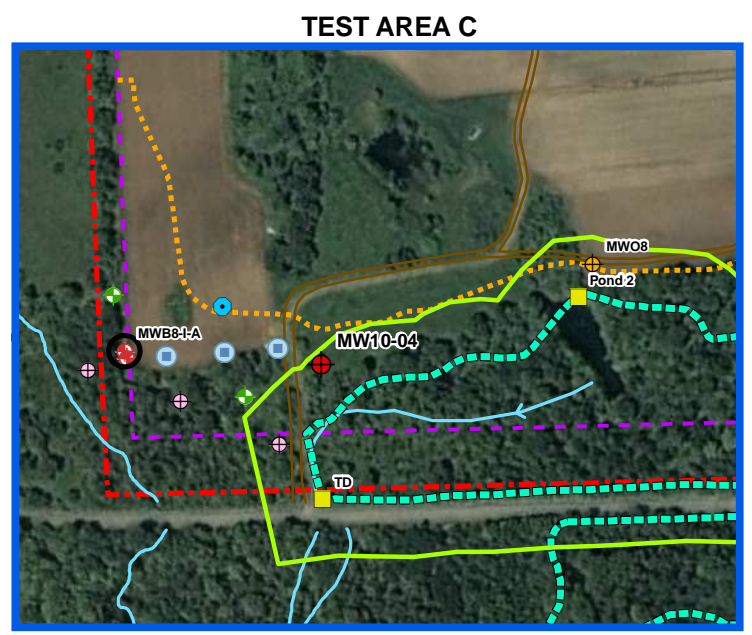
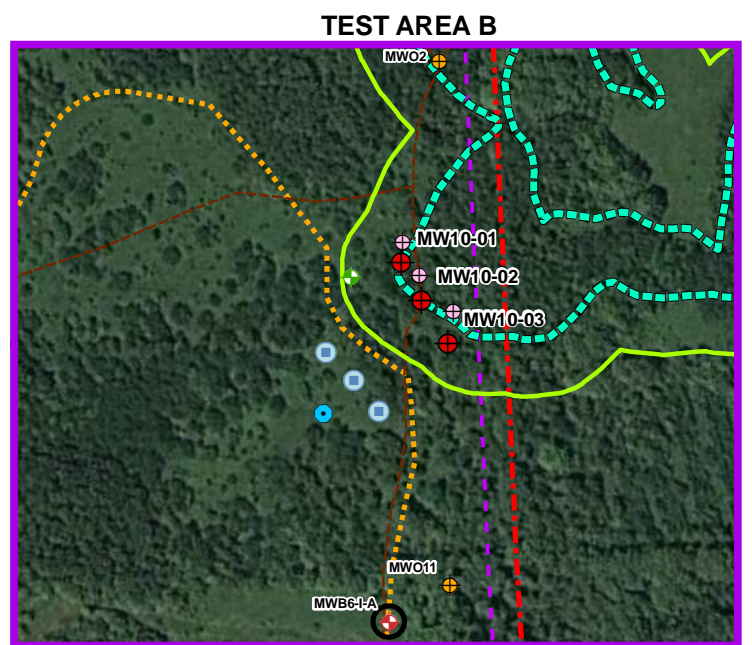
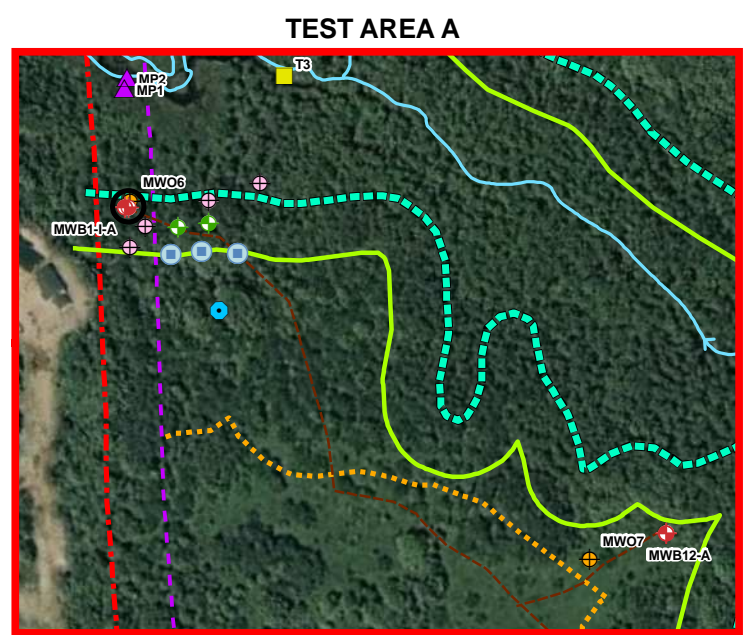
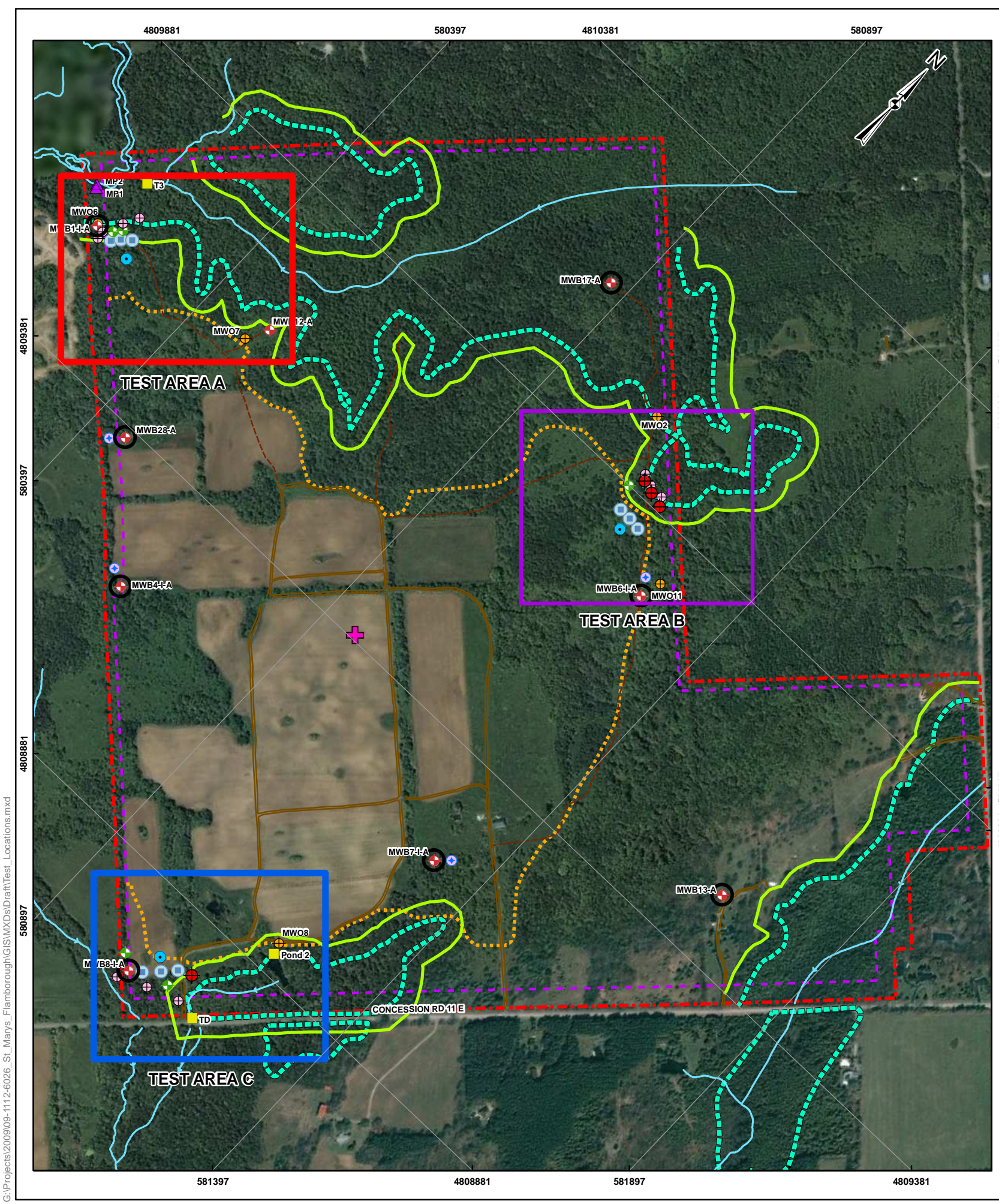
TEST LOCATION (From Figure 1)	MONITOR TYPE	MONITORING LOCATION	METHOD OF MEASUREMENT		MINIMUM MONITORING FREQUENCY OF MANUAL READINGS DURING PUMPING
AREA A	PUMPING / RECHARGE WELLS	PW A	M	E	4 Times per day
		RW 1	M	E	
		RW 2	M	E	
		RW 3	M	E	
	BEDROCK/ OVERBURDEN MONITORS	MW 1	M	E	2 Times per day
		MW 2	M	E	
		MW 3	M	E	
		MW 4	M	E	
		MW 5	M	E	
		MW 6	M	E	
		MW 7	M	E	
		MP near MWB12	M	E	
		MWB1	M	E	
		MWO6	M	E	
	SURFACE WATER MONITORS	M 2	M	E	Once per day
T 3		M	E		
PERIMETER MONITORS	MWB1	M	E	Once per day	
	MWB28	M	E		
AREA B	PUMPING / RECHARGE WELLS	PW B	M	E	4 Times per day
		RW 1	M	E	
		RW 2	M	E	
		RW 3	M	E	
	BEDROCK / OVERBURDEN MONITORS	MW 1	M	E	2 Times per day
		MW 2	M	E	
		MW 3	M	E	
		MW 4	M	E	
		MW 5	M	E	
		MW 6	M	E	
		MW 7	M	E	
		MWO2	M	E	
		MWO 11	M	E	
	MWB6	M	E		
	SURFACE WATER MONITORS	SWF-1	M	E	Once per day
MWB17		M	E		
PERIMETER MONITORS	MWB6	M	E	Once per day	
AREA C	PUMPING / RECHARGE WELLS	PW C	M	E	4 Times per day
		RW 1	M	E	
		RW 2	M	E	
		RW 3	M	E	
	BEDROCK / OVERBURDEN MONITORS	MW 1	M	E	2 Times per day
		MW 2	M	E	
		MW 3	M	E	
		MW 4	M	E	
		MW 5	M	E	
		MW 6	M	E	
		MWB 8	M	E	
		MWO 8	M	E	
	MWO 9	M	E		
	SURFACE WATER MONITORS	TD	M	E	Once per day
		POND 2	M	E	
PERIMETER MONITORS	MWB4	M	E	Once per day	
	MWB8	M	E		
	MWB13	M	E		

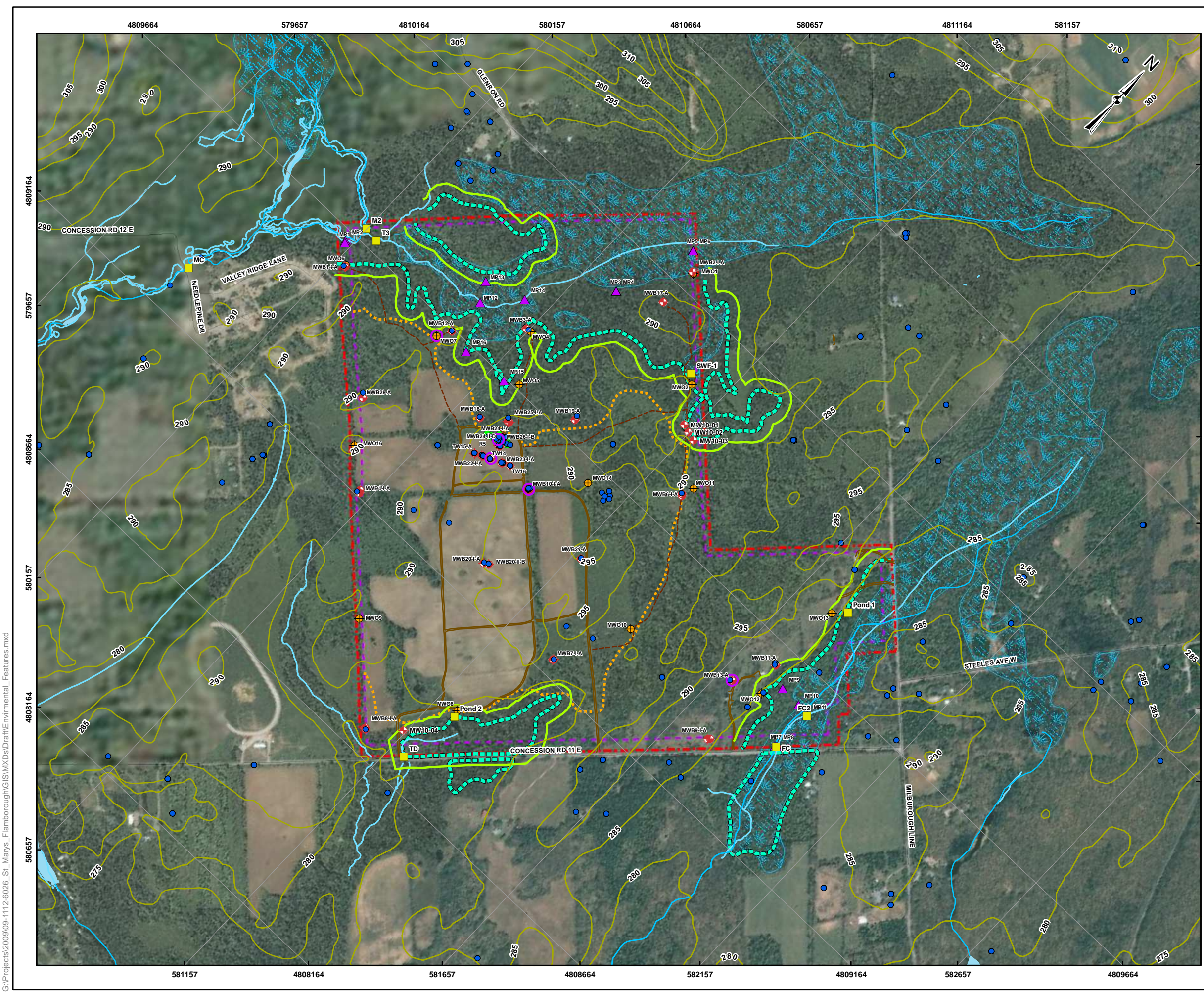
**Note:** E = Continuous water level monitoring at 5 minute intervals with datalogger  
M = Manual water level monitoring  
Shading = existing monitors  
Locations will be adjusted based on access and presentation of ecological features.



# FIGURES

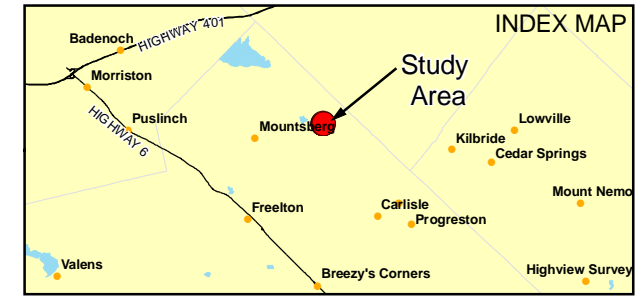
DRAFT





**LEGEND**

- Location of Previous Aquifer Testing
- MOE Water Well Record
- ▲ Mini-Piezometer
- ⊕ Bedrock Monitoring Well
- ⊕ Overburden Monitoring Well
- Corehole
- Surface Water Monitoring Location
- Tributary
- - - Trail
- Site Road
- - - Limit of Extraction
- - - Wetland Boundary (Delineated by Stantec)
- 30 m Wetland Buffer
- - - Setback
- - - Licence Boundary
- ▨ Waterbody (NRVIS)
- ▨ Wetland (NRVIS)



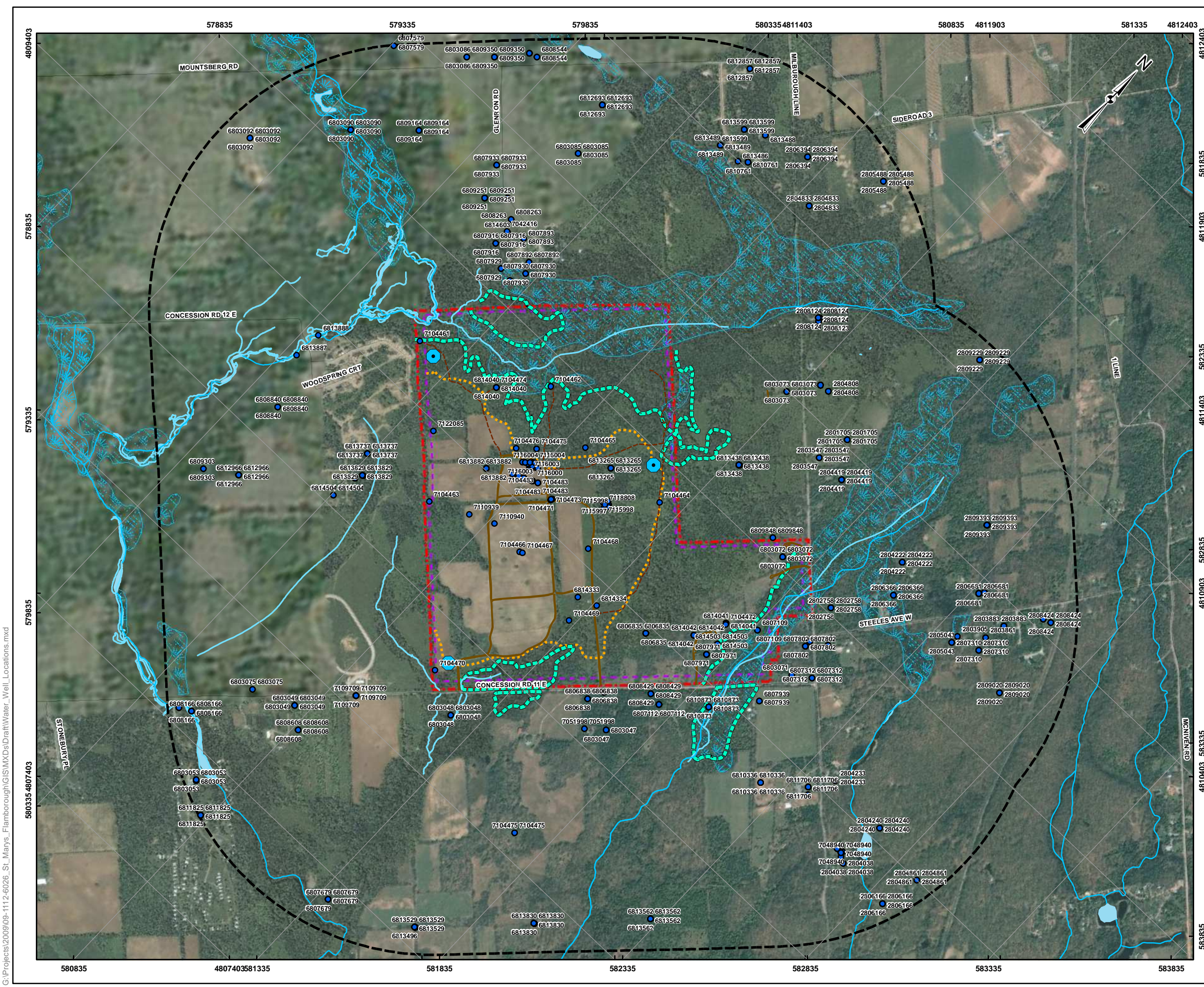
**REFERENCE**

Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17  
 Tributaries, trails, property boundary, setback, extraction limit and  
 site roads from Harrington McAvan Ltd  
 Imagery: Ikonos World Mosaic, dated 2000/04/23.

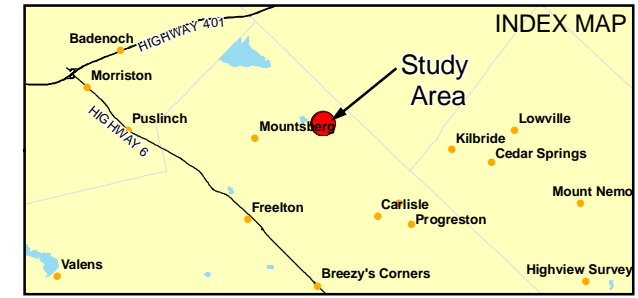
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PROJECT	CBM - GRS TESTING FLAMBOROUGH		
TITLE	<b>ENVIRONMENTAL FEATURES</b>		
 Golder Associates Mississauga, Ontario	PROJECT NO. 09-1112-6026	SCALE AS SHOWN	REV. 0.0
	DESIGN KD 19 Oct. 2009		
	GIS KD 24 Mar. 2010		
	CHECK GY 24 Mar. 2010		
REVIEW JP 24 Mar. 2010			
<b>FIGURE: 2</b>			

G:\Projects\2009\09-1112-6026\_St\_Marys\_Flamborough\GIS\MXDs\Draft\Environmental\_Features.mxd



- LEGEND**
- MOE Water Well Within 1km of Site Boundary
  - Approximate Pumping Well Location
  - Tributary
  - - - Trail
  - Site Road
  - - - Limit of Extraction
  - Wetland Boundary (Delineated by Stantec)
  - Setback
  - Licence Boundary
  - Waterbody (NRVIS)
  - Wetland (NRVIS)
  - 1km Buffer of Site Boundary



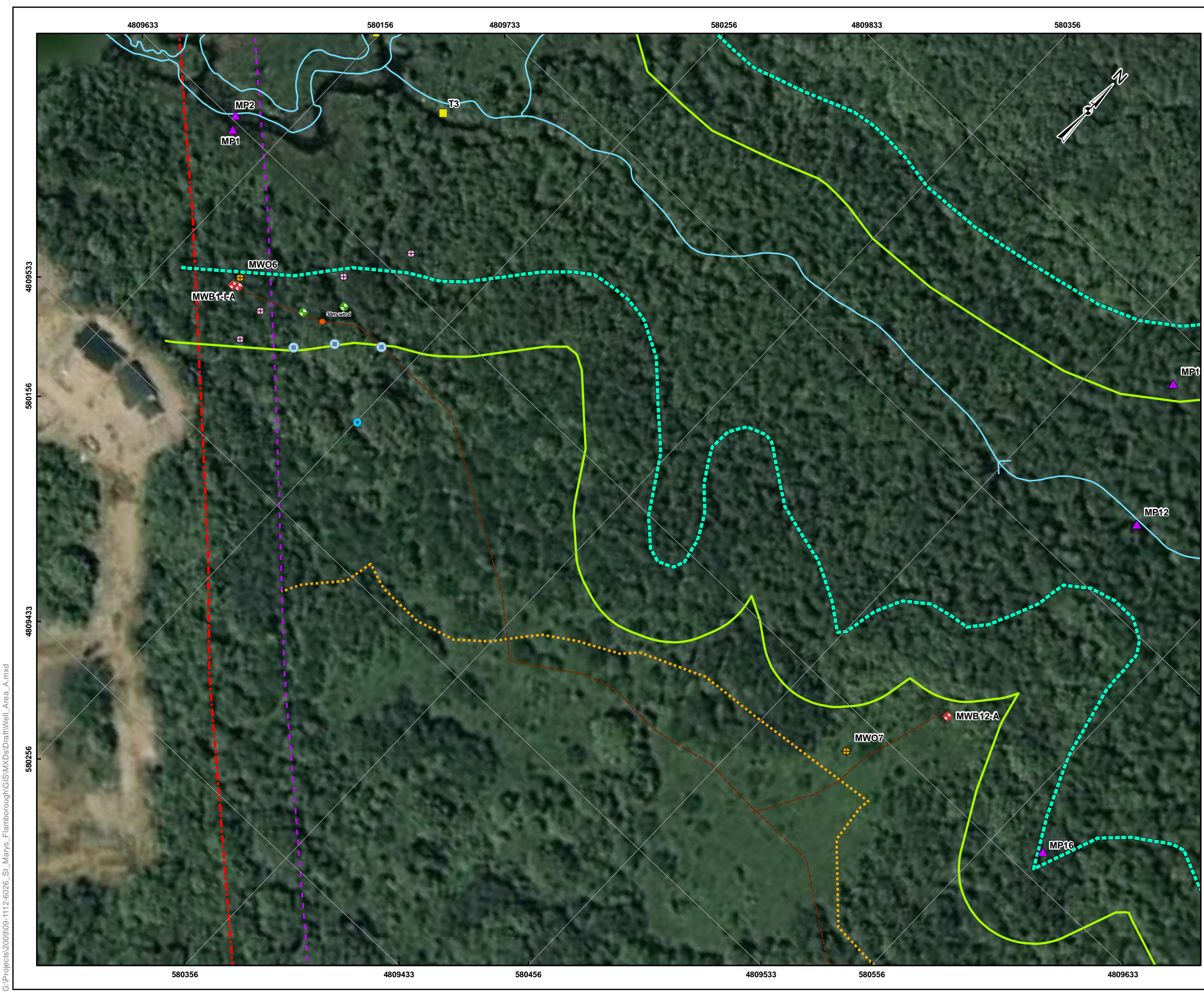
**REFERENCE**

Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17  
 Tributaries, trails, property boundary, setback, extraction limit and  
 site roads from Harrington McAvan Ltd  
 Imagery: Ikonos World Mosaic, dated 2000/04/23.

200 100 0 200 400 600  
 SCALE 1:14,000 METRES

PROJECT		CBM - GRS TESTING FLAMBOROUGH	
TITLE			
MOE WATER WELL LOCATIONS WITHIN 1km OF SITE BOUNDARY			
 Golder Associates Mississauga, Ontario	PROJECT NO.	09-1112-6026	SCALE AS SHOWN
	DESIGN	KD	19 Oct. 2009
	GIS	KD	25 Mar. 2010
	CHECK	GY	25 Mar. 2010
	REVIEW	JP	25 Mar. 2010
			<b>FIGURE: 3</b>

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**LEGEND**

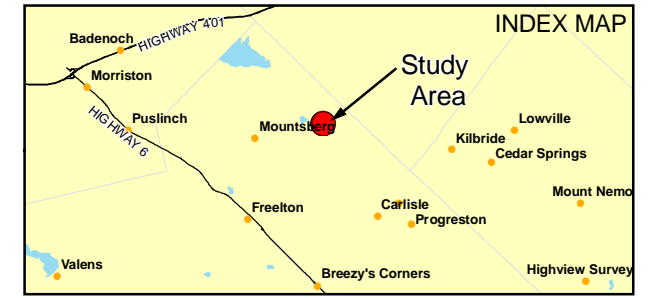
**GOLDER INSTALLATION - TO BE DRILLED**

- Approximate Pumping Well Location
- Approximate Recharge Well Location
- Approximate Overburden Monitor Location
- Approximate Bedrock Monitoring Well Location

**GARTNER LEE INSTALLATION**

- Mini-Piezometer
- Bedrock Monitoring Well
- Overburden Monitoring Well
- Corehole
- Surface Water Monitoring Location


Tributary  
Trail  
Site Road  
Limit of Extraction  
Wetland Boundary (Delineated by Stantec)  
30 m Wetland Buffer  
Setback  
Licence Boundary



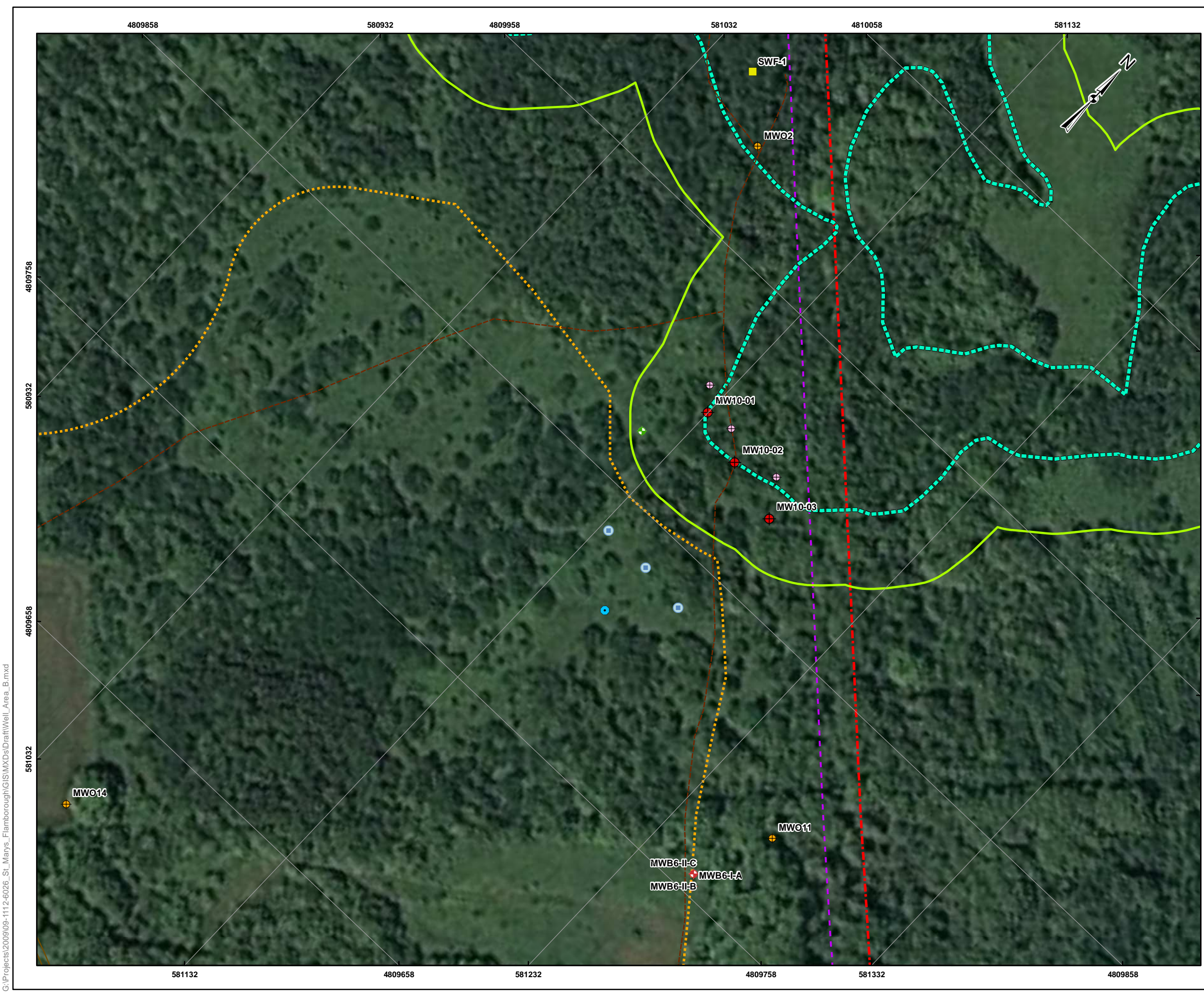
**REFERENCE**

Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17  
 Tributaries, trails, property boundary, setback, extraction limit and  
 site roads from Harrington McAvan Ltd  
 Imagery: Ikonos World Mosaic, dated 2000/04/23.

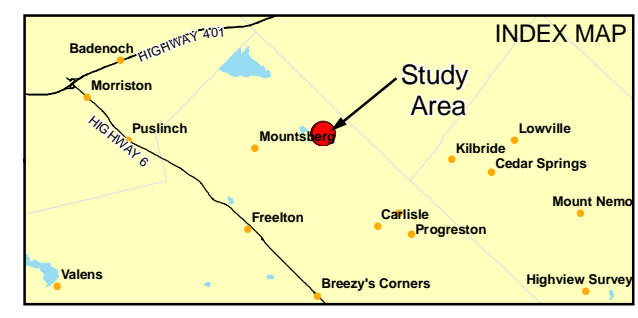
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PROJECT	CBM - GRS TESTING FLAMBOROUGH		
TITLE	TEST AREA A		
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	DESIGN	KD	19 Oct. 2009
	GIS	KD	23 Mar. 2010
	CHECK	GY	23 Mar. 2010
	REVIEW	JP	23 Mar. 2010
<b>FIGURE: 4</b>			

G:\Projects\2009\09-1112-6026\_St\_Marys\_Flamborough\GIS\MXDs\DraftWell\_Area\_A.mxd




- LEGEND**
- GOLDER INSTALLATION - TO BE DRILLED**
- Approximate Pumping Well Location
  - Approximate Recharge Well Location
  - ⊕ Approximate Overburden Monitor Location
  - ⊕ Approximate Monitoring Well Location
- GOLDER INSTALLATION**
- ⊕ Bedrock Monitoring Well (March 2010)
- GARTNER LEE INSTALLATION**
- ▲ Mini-Piezometer
  - ⊕ Bedrock Monitoring Well
  - ⊕ Overburden Monitoring Well
  - Corehole
  - Surface Water Monitoring Location
  - Tributary
  - - - Trail
  - Site Road
  - ⋯ Limit of Extraction
  - Wetland Boundary (Delineated by Stantec)
  - 30 m Wetland Buffer
  - Setback
  - Licence Boundary



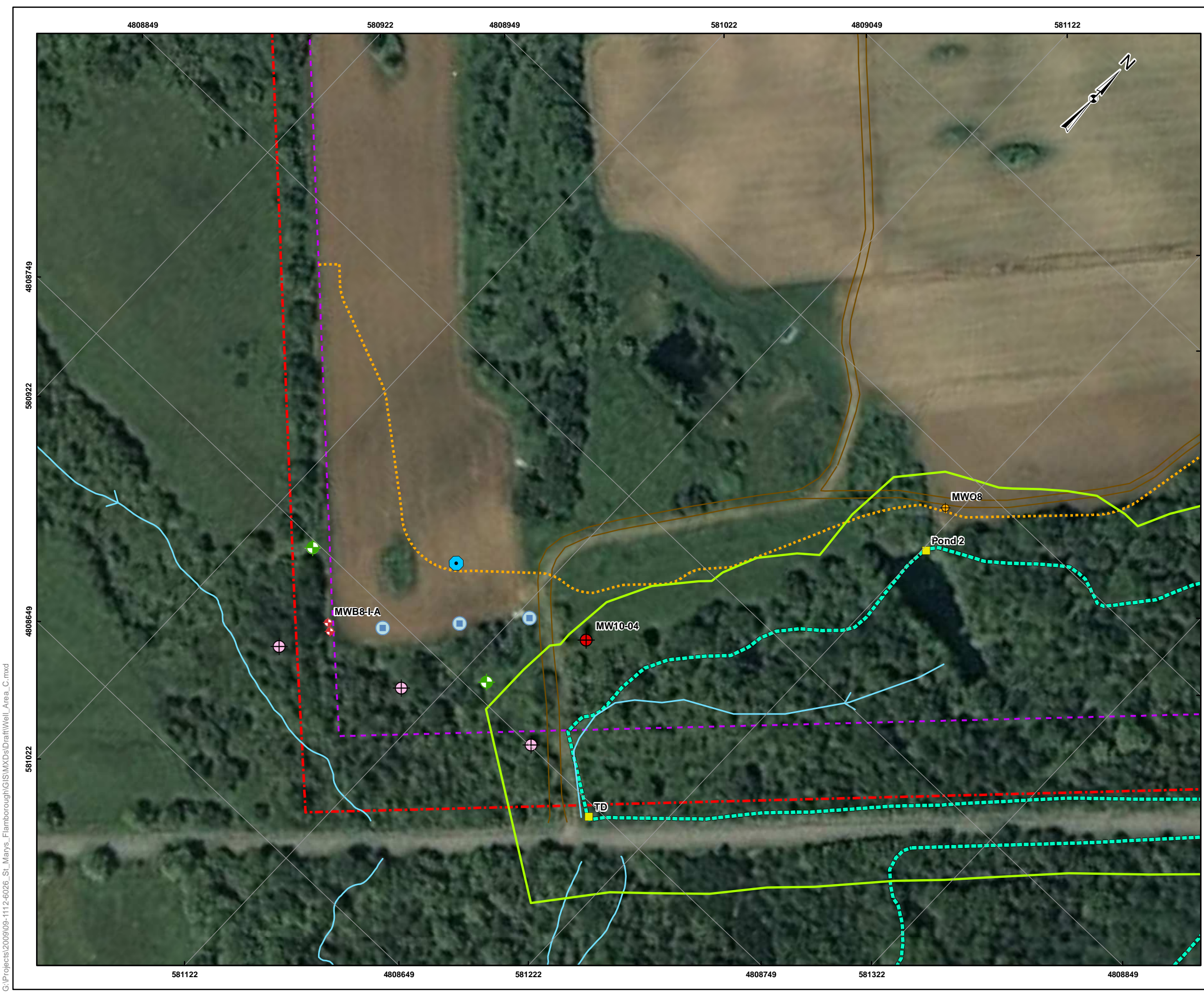
**REFERENCE**

Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4  
 Produced by Golder Associates Ltd under licence from Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17  
 Tributaries, trails, property boundary, setback, extraction limit and site roads from Harrington McAvan Ltd  
 Imagery: Ikonos World Mosaic, dated 2000/04/23.

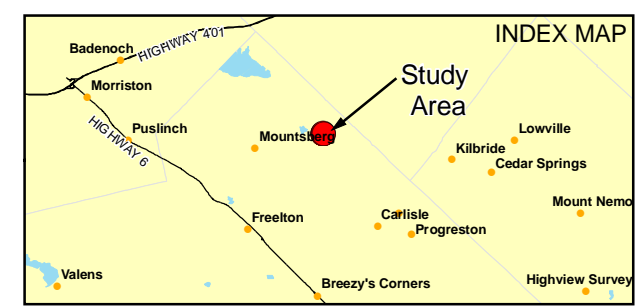
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PROJECT	CBM - GRS TESTING FLAMBOROUGH		
TITLE	TEST AREA B		
 Mississauga, Ontario	PROJECT NO.	09-1112-6026	SCALE AS SHOWN
	DESIGN	KD	19 Oct. 2009
	GIS	KD	23 Mar. 2010
	CHECK	GY	23 Mar. 2010
	REVIEW	JP	23 Mar. 2010
			<b>FIGURE: 5</b>

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- LEGEND**
- GOLDER INSTALLATION - TO BE DRILLED**
- Approximate Pumping Well Location
  - Approximate Recharge Well Location
  - Approximate Overburden Monitor Location
  - Approximate Monitoring Well Location
- GOLDER INSTALLATION**
- Bedrock Monitoring Well (March 2010)
- GARTNER LEE INSTALLATION**
- Mini-Piezometer
  - Bedrock Monitoring Well
  - Overburden Monitoring Well
  - Corehole
  - Surface Water Monitoring Location
  - Tributary
  - Trail
  - Site Road
  - Limit of Extraction
  - Wetland Boundary (Delineated by Stantec)
  - 30 m Wetland Buffer
  - Setback
  - Licence Boundary

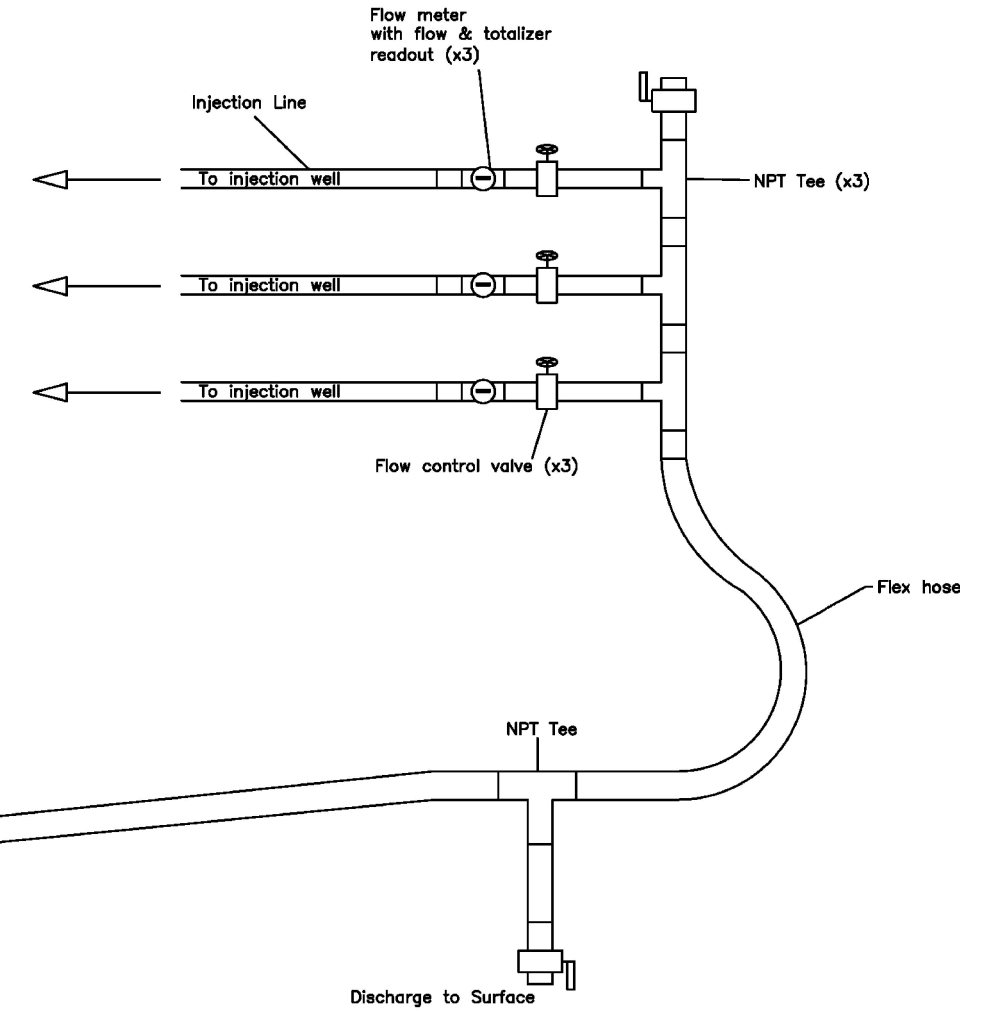
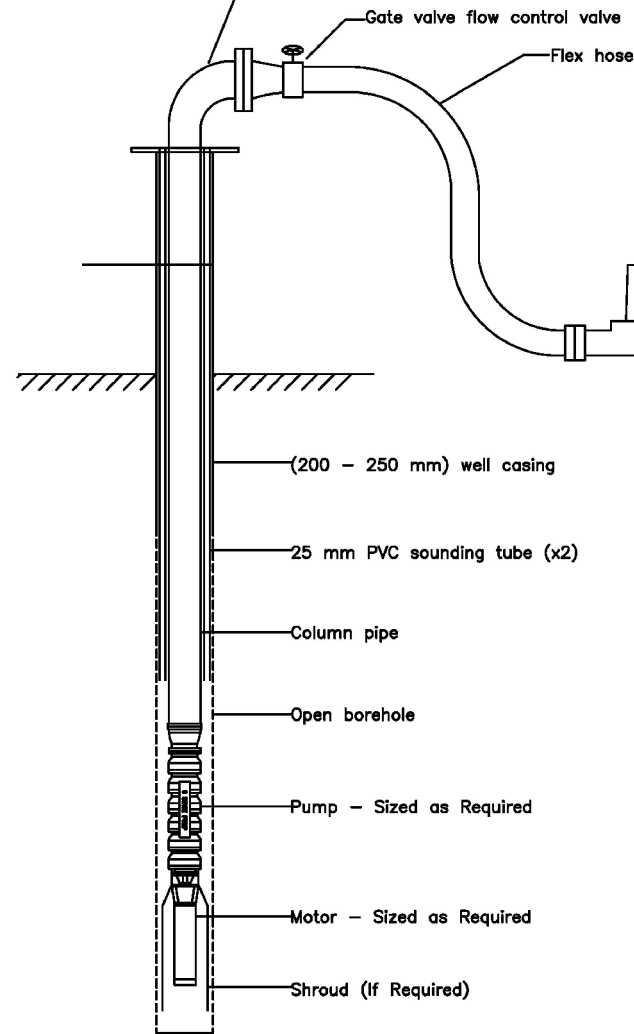
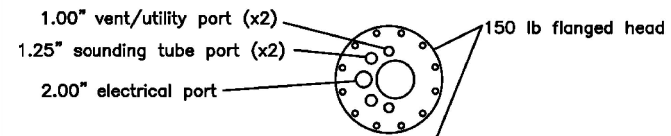
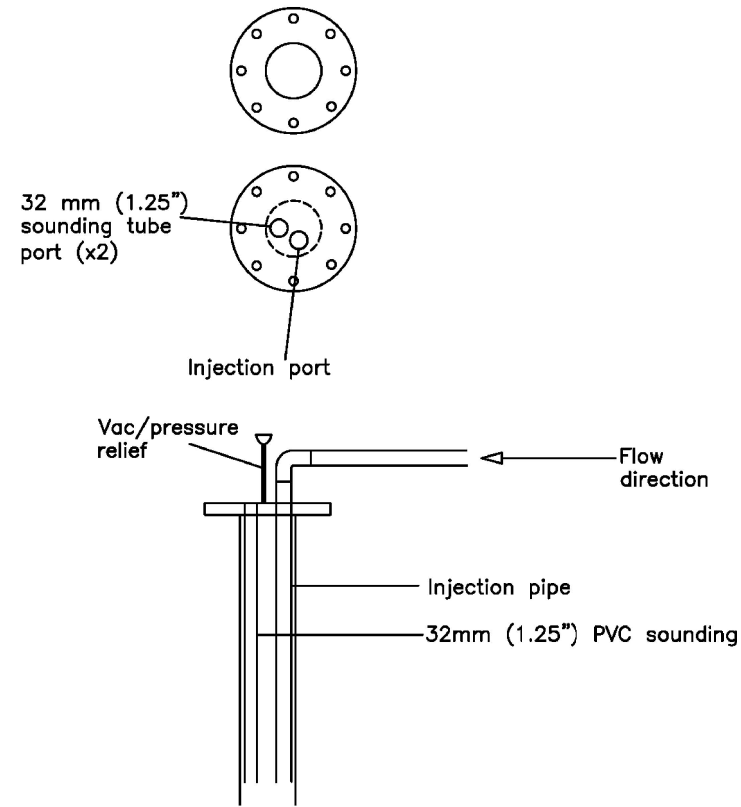


**REFERENCE**

Base Data - MNR NRVIS, obtained 2004, CANMAP v2008.4  
 Produced by Golder Associates Ltd under licence from  
 Ontario Ministry of Natural Resources, © Queens Printer 2008  
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17  
 Tributaries, trails, property boundary, setback, extraction limit and  
 site roads from Harrington McAvan Ltd  
 Imagery: Ikonos World Mosaic, dated 2000/04/23.


PROJECT		CBM - GRS TESTING FLAMBOROUGH	
TITLE		TEST AREA C	
PROJECT NO. 09-1112-6026		SCALE AS SHOWN	REV. 0.0
DESIGN	KD	19 Oct. 2009	<b>FIGURE: 6</b>
GIS	KD	23 Mar. 2010	
CHECK	GY	23 Mar. 2010	
REVIEW	JP	23 Mar. 2010	

G:\Projects\2009\09-1112-6026\_St\_Marys\_Flamborough\GIS\MXDs\DraftWellArea\_C.mxd



**REFERENCE**

Figure from Lotowater Technical Services Inc. dated 2009/11/27

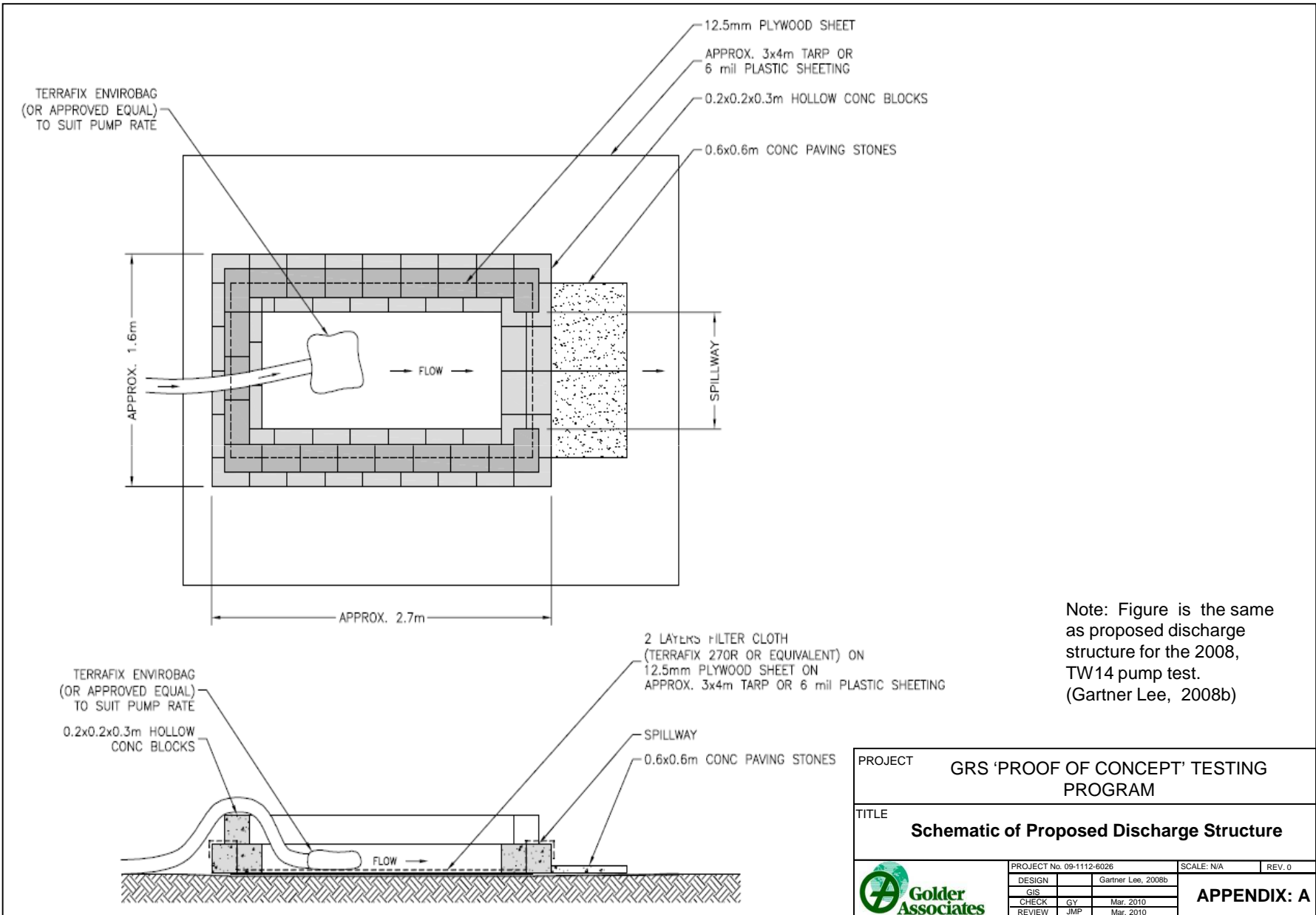
PROJECT	CBM - GRS TESTING FLAMBOROUGH		
TITLE	<b>CONCEPTUAL SCHEMATIC OF RECHARGE TEST SETUP</b>		
 Golder Associates Mississauga, Ontario	PROJECT NO.	09-1112-6026	SCALE AS SHOWN
	DESIGN	KD	19 Oct. 2009
	GIS	KD	16 Dec. 2009
	CHECK	GY	16 Dec. 2009
	REVIEW	JP	16 Dec. 2009
			<b>FIGURE: 7</b>



# APPENDIX A

## Discharge Structure

DRAFT



Note: Figure is the same as proposed discharge structure for the 2008, TW14 pump test. (Gartner Lee, 2008b)

PROJECT	GRS 'PROOF OF CONCEPT' TESTING PROGRAM		
TITLE	Schematic of Proposed Discharge Structure		
PROJECT No.	09-1112-6026	SCALE:	NA
DESIGN	GIS	Gartner Lee,	2008b
CHECK	GY	Mar.	2010
REVIEW	JMP	Mar.	2010
			<b>APPENDIX: A</b>





# APPENDIX B

## Notification Letter

DRAFT

TO BE ISSUED ON CBM LETTERHEAD....

August, 2010

**Recharge Test on St Marys Cement Property**

Dear Neighbour:

On April XX, 2010, the Ontario Ministry of the Environment (MOE) approved St Marys Cement Inc.'s (St Marys) application for a Permit to Take Water to carry out a pumping test on its property located at Lot 3, Concession 11, East Flamborough, City of Hamilton.

The permit requires that notification be provided to landowners within 1000 meters of the test site one week prior to commencement of the test. The pumping test is currently scheduled to begin on or above August XX, 2010 between 8:00 am to 6:00 pm and continuous pumping will continue for a maximum of 10 days. Site preparation activities will be ongoing over the course of this week by the team of licensed professionals who have been contracted to undertake the test. Daily updates related to the testing, including any change in the start date or time, will be posted by the St Marys website [www.flamboroughquarry.ca](http://www.flamboroughquarry.ca). Should you wish to be contacted by phone of any changes in the start date or time, please let us know.

We are committed to following the requirements set by the MOE in the Permit and to promptly respond to community questions or concerns during the testing. If you have any concerns, neighbours are asked to call 1-866-602-0080. This number will be monitored 24-hours a day during the testing. Please visit the website for new information.

Sincerely,

TO BE ISSUED ON CBM LETTERHEAD....

August, 2010

**Recharge Test on St Marys Cement Property**

Dear Neighbour:

On May XX, 2010, the Ontario Ministry of the Environment (MOE) approved St Marys Cement Inc.'s (St Marys) application for a Permit to Take Water to carry out a pumping test on its property located at Lot 3, Concession 11, East Flamborough, City of Hamilton.

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We are committed to following the requirements set by the MOE in the Permit and to promptly respond to community questions or concerns during the testing. If you have any concerns, neighbours are asked to call 1-866-602-0080. This number will be monitored 24-hours a day during the testing. Please visit the website for new information.

Sincerely,



# APPENDIX C

## Resolution of Private Well Complaints

DRAFT



P.O. Box 451  
Paris, ON N3L 3T5

92 Scott Avenue  
Paris, ON N3L 3R1  
T (519) 442-2086  
T (800) 923-6923  
F (519) 442 7242  
[www.lotowater.com](http://www.lotowater.com)

March 24, 2010

## **PROCEDURE FOR WELL INTERFERENCE COMPLAINTS**

### **Background**

The testing program at the CBM St Marys property located north of the village of Carlisle in the City of Hamilton (Former Flamborough Township) will involve three pumping tests, each to be completed over a 6 to 8 day period. During these tests, groundwater will be extracted from the bedrock aquifer using test wells installed in 2007. The purpose of the testing program is to simulate the future effects of quarry development on local groundwater resources and to evaluate the effectiveness of recharging the aquifer with extracted water to mitigate dewatering impacts.

As pumping occurs, it will lower water levels in the vicinity of the extraction wells. This is purposefully conducted to collect information on the extent and magnitude of the water level decline at the monitoring wells that have been installed around the test site and further away along the perimeter of the St Marys property. The bedrock aquifer's response to pumping provides a means by which the hydraulic properties of the aquifer can be established. This information is used in the development and calibration of a groundwater flow model and the model is in turn used as a tool, to simulate the effects of a quarry and to evaluate potential mitigation measures.

Pumping tests have the potential to interfere with the operation of adjacent water supply wells. This is related to a number of factors including the volume of water pumped, the duration of the test, distance to existing wells, depth and yield of these wells and climatic conditions. Well interference, if it occurs, is noted as a decline in the water level of the adjacent well such that the capacity of the adjacent well, as measured by its ability to supply water, is temporarily reduced. In an extreme case, the water level in the adjacent well could be drawn below the intake of the pump in the well, and the well essentially goes 'dry' (i.e. not able to produce water). More typically, the level is drawn down to a point where the well pump recycles more frequently. On occasion, pumping can also result in changes to water quality, due to an alteration in the water source, such as the upward intrusion of more mineralized water or downward movement of near surface groundwater and surface water.

[Note: Other factors not related to the testing, such as reduced precipitation, well fouling and condition of the existing pump can contribute to the failure of a well to meet supply requirements.]

## **Provincial Regulatory Requirements**

In order to undertake the testing, St Marys is required to obtain a Permit to Take Water (PTTW) from the Ontario Ministry of the Environment (MOE). The permit governs the maximum permitted rate at which the well(s) can be pumped, and provides the terms and conditions for the operation of the test well. One of the general conditions, relating to well interference, that is included with a PTTW when issued is as follows:

### *Interference with Other Water Supplies*

*The Permit holder shall immediately notify the Director of any complaint arising from the taking of water authorized by this Permit and shall report upon any action, which has been taken or is proposed with regard to such complaint.*

*For Ground-Water Takings, if the taking of water is forecast to interfere seriously, or is observed to interfere seriously with other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this Water taking, the Permit holder shall take such action as will make available to those affected a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of doing so or shall reduce the rate and amount of taking so as to prevent the forecast interference or alleviate the observed interference. Pending permanent restoration of the affected supplies, the Permit holder shall provide to those affected temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.*

Upon issuance of the PTTW, St Marys will assume the obligation to meet the conditions in the permit and investigate interference complaints and, where it is found to be responsible, take the appropriate actions to resolve the complaint.

## **Investigation of Well Interference Complaints**

Private well owners located in the vicinity of the St Marys property where the test will be undertaken, will be provided with advance notice of the pumping test and will receive a copy of this document, which outlines St Marys' obligations related to well interference and the role of the participating agencies (MOE and the City of Hamilton Public Health Services) in resolving well interference.

Lotowater Technical Services Inc. (Lotwater) has been retained by St Marys to handle the investigation of well interference complaints. Lotowater has professional geoscientists and licensed well technicians experienced in groundwater supply development, operation and maintenance. On receiving a well interference complaint, St Marys will authorize Lotowater to investigate the complaint. Lotowater will typically be able to respond within one hour depending on the time the complaint was received.

These professionals will collect and evaluate the following information in order to understand and resolve the complaint:

- details of the complaint – address/location, history of problem, nature of complaint;
- location of the well and proximity to the wells that are being tested;
- water well record (if available), depth of the well and depth of the water level in the well;
- type and condition of pump, depth of the pump intake and performance of the well's pumping system (pumping rate);
- presence of other high capacity wells in the area and locations of other adjacent wells;
- geologic and hydrogeologic setting; and
- water level response in nearest monitoring well(s) installed for the purposes of monitoring test response.

If the complaint is related to a perceived change in the quality of the water, a sample of the water will be collected and submitted to a commercial laboratory for chemical/bacteriological analysis (per the attached Table).

Lotowater will inform staff in the MOE Hamilton Office and the City of Hamilton Public Health Services of the interference complaint and provide them with copies of all correspondence related to the complaint. The cost of investigating the well interference regardless of the outcome will be borne by St Marys.

It should be noted that well problems may occur for a variety of reasons including drought conditions, low water levels, pump or plumbing problems, poor well construction, etc. Therefore a thorough investigation is required to assess the cause of the well interference complaint.

### **Results of the Well Interference Investigation**

If the results of the investigation identify an adverse impact on the complainant's well caused by the testing program, St Marys will immediately contact the MOE and the City of Hamilton Public Health Services and establish an appropriate action to rectify the situation.

The most immediate corrective response would be to offer the impacted well owner an alternative supply of potable water. The secondary response would be to reduce the pumping rate at the test wells. More details on the provision of a water supply are provided in the following section.

Any water quality complaints will be addressed in a similar way, with an initial investigation of the complaint undertaken to establish its cause. The response action will be coordinated with the MOE and with the City of Hamilton Public Health Services. Again, if requested, St Marys will provide a temporary water supply.

While it is expected that the groundwater levels and initial water source will become re-established on termination of the testing, any adverse water quality conditions such as turbidity, if identified, may require a response such as the chlorination of the impacted well according to prescribed MOE guidance.

Although it is unlikely that the water level decline associated with the testing will damage pumps in adjacent wells as a result of overheating, if this should occur, St Marys will replace the well pump at no expense to the complainant.

In cases where the results of the investigations are uncertain, St Marys will work with the well owner to reach an equitable solution.

St Marys will inform the MOE and the Hamilton Public Health Services in writing upon resolution of the well interference complaint. Copies of all related documents will be provided to these agencies.

### **Provision of a Temporary Water Supply**

St Marys is prepared to provide a temporary water supply to the owners of any wells that are affected by the testing. The following describes the process for providing such a supply:

- Immediately following the investigation of a complaint and the determination that the subject well has been adversely affected by the pumping test, Lotowater Technical Services Inc. will extend an offer to provide a temporary water supply.
- This will involve the delivery of a 500-gallon water tank to the residence and the connection of the tank to the existing residential water system. The tank may be connected directly to the owner's pressure tank or a pressure tank will be provided depending on the plumbing within the house.
- The tank will be filled with water from a list of acceptable suppliers obtained from the Hamilton Public Health Services.
- Once the tank is filled, the chlorine concentration of the water will be checked and, if necessary, adjusted. This may require that the tank be emptied and refilled using a supply of acceptable quality.

Following the test, water levels in the private well will be monitored until they have recovered sufficiently to allow the use of the pump. At this time, a water sample will be collected for the parameters indicated in the attached Table. Following review and

acceptance of the chemistry results (by the MOE and the Hamilton Public Health Services), the private system will be reestablished and the temporary water supply will be removed.

[Note: the Public Health Services will assist the MOE with assessing the microbiological quality of recovering water wells that are not regulated under the SDWA, as part of the process for resuming normal use of the affected groundwater supply.]

### **Contact Information**

Anyone experiencing either a loss in the water supply or a perceived alteration in the quality of the supply should contact St Marys Cement at (TO BE PROVIDED – toll free).

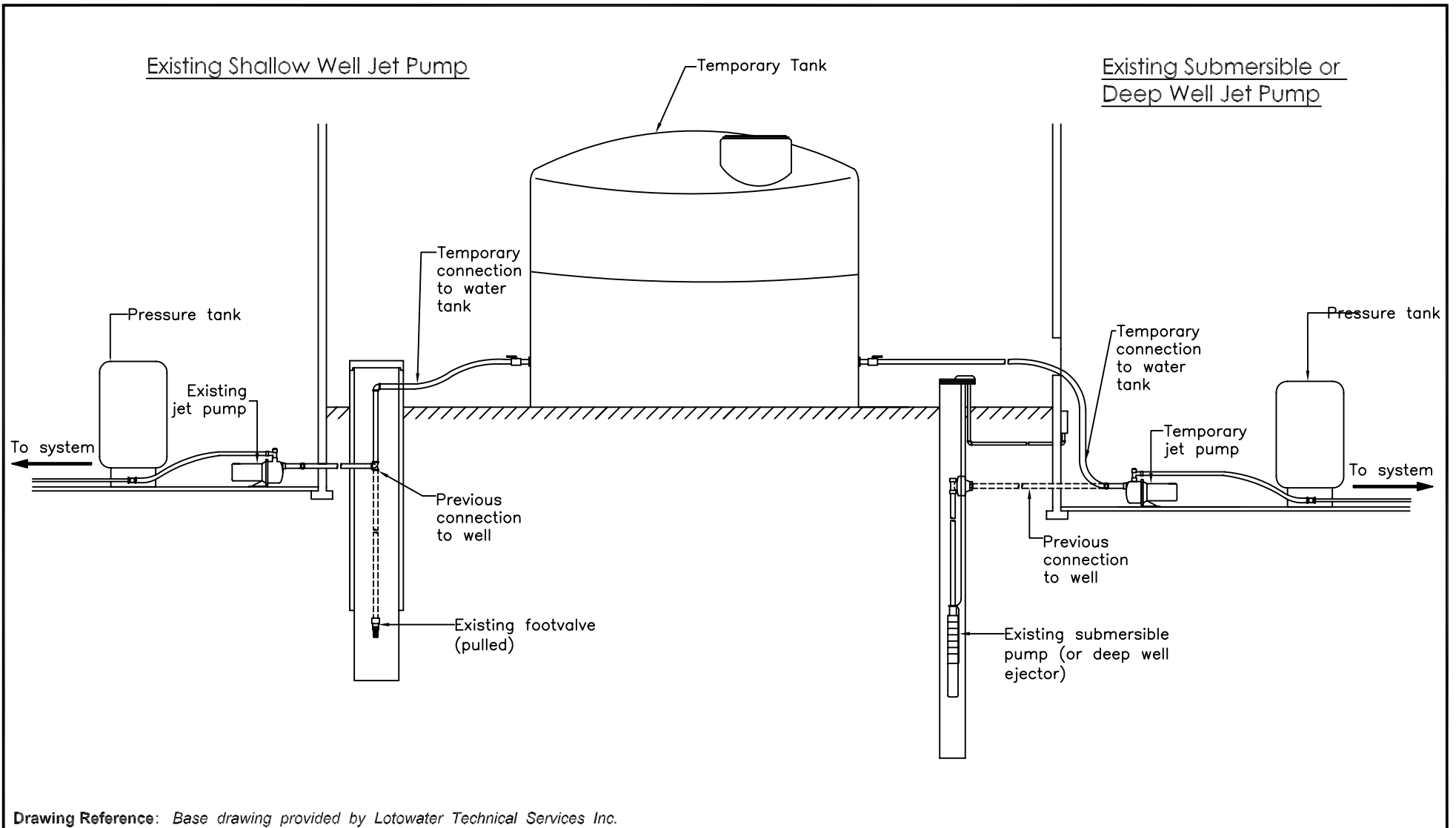
The call will be redirected to Lotowater Technical Services Inc., whom has been retained by St Marys to respond to any well interference complaints which are received.

Alternatively, the complainant may wish to contact the Hamilton office of the Ministry of the Environment at 905-521-7650 or the City of Hamilton Public Health Services' 'Safe Water Hotline' at 905-546-2424 Ext: 2189.


### Chemical Parameter List, Groundwater Sampling Program.

ANALYTE GROUPING	ANALYTE
<i>GENERAL INDICATORS</i>	pH* Conductivity* TDS (calculated) Temperature* Turbidity*
<i>MAJOR IONS</i>	Chloride Sulphate Alkalinity Calcium Sodium Magnesium Potassium
<i>MINOR IONS</i>	Ammonia** Nitrate Nitrite Fluoride Bromide Cyanide (Free)
<i>METALS</i>	Arsenic Barium Boron Cadmium Chromium Iron Lead Nickel Zinc Mercury
<i>BACTERIOLOGICAL PARAMETERS</i>	E. Coli Fecal Coliforms Fecal Streptococci Total Coliforms

*(\*) parameter to be measured in field using portable instruments, (\*\*) ammonia is incorporated into the shallow, weathered-zone monitoring.*



Drawing Reference: Base drawing provided by Lotowater Technical Services Inc.

NOTES			CLIENT	<b>CBM ST. MARYS CEMENT</b>	
			TITLE	<b>Temporary Water Supply (Proposed)</b>	
	PROJECT No.	<b>147-006</b>	G:\Lotowater Projects\147...\006 Carlisle Well Survey\Temporary Water Supply.dwg		<b>FIGURE 1</b>
DESIGN		REVISION No. DRAFT	SCALE <b>N.T.S.</b>		
DRAWN	<b>MO</b>			<b>08/04/03</b>	
CHECKED					

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DRAFT

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