PARKWAY WEST COMPRESSOR STATION
ENVIRONMENTAL REPORT

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Executive Summary

It is the intent of Union Gas Limited (Union Gas) to construct a Compressor Station (the Station) to ensure the continued reliable movement of natural gas by Union Gas to its customers, and to address the increased demands for natural gas at the existing Union Gas Parkway Compressor Station resulting from the changing dynamics in the flow of natural gas in North America. The Station site is situated on the east side of Eighth Line, southeast of Derry Road East and southwest of Highway 407 in the Town of Milton. Stantec Consulting Ltd. (Stantec) has been retained by Union Gas to complete an Environmental Report (ER) for the proposed Station which meets the intent of the Ontario Energy Board's (OEB) *Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario, 6th Edition (2011)*.

Initial consultation for the Station was undertaken as a component of an environmental study process for the proposed 42 inch diameter pipeline, approximately 500 m in length, between the Station site and the existing Union Gas Parkway Compressor Station. Consultation on the Station will continue as a component of the municipal approvals process. Environmental and socio-economic features at the Station site have been identified through technical studies completed for the municipal approvals process. A detailed review of the potential effects of construction and operation of the Station is provided in the ER. Based on the potential effects, Stantec has recommended mitigation and protective measures where appropriate. A cumulative effects analysis is also provided in the ER.

In the opinion of Stantec, the recommended program of standard mitigation and protective measures are considered sufficient to protect the features which may be impacted by the construction and operation of the Station. Monitoring and contingency measures will ensure mitigation and protective measures have been effective in both the short and long term. As such, any adverse residual environmental and/or socio-economic effects of this Project are not anticipated to be significant.

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1.0 Introduction

1.1 PROJECT DESCRIPTION

It is the intent of Union Gas Limited (Union Gas) to construct a Compressor Station (the Station) to ensure the continued reliable movement of natural gas by Union Gas to its customers, and to address the increased demands for natural gas at the existing Union Gas Parkway Compressor Station resulting from the changing dynamics in the flow of natural gas in North America. The Station site is situated on the east side of Eighth Line, southeast of Derry Road East and southwest of Highway 407 in the Town of Milton (see **Appendix A1**).

The Station site is currently an agricultural field. The proposed facility would consist of:

- two compressors (one to service future growth, and the other for loss of critical unit coverage);
- a pipeline network connecting the compressors;
- emergency power generators;
- two firewater pumps;
- measurement and control stations;
- connection to Union's Dawn-Parkway system;
- an administration area and building constructed near the entrance to the property from Eighth Line;
- potential berms along the north, south and west sides of the proposed facility; and,
- a road to and within the perimeter of the property.

1.2 STATION SITING

The location of the proposed Station was originally identified as being located on a site of approximately 84 acres, located north of Derry Road, west of Highway 407 in the Town of Milton. In order to connect the proposed Station with Union Gas's Dawn-Parkway System it would have been necessary to construct two NPS54, 1.5 kilometre long pipelines.

In the fall of 2012, Union Gas was able to obtain an option for a parcel of land south of the original location, directly across the 407 from the existing Parkway Compressor Station. The new location has eliminated the need for the NPS54 pipelines, and provides improved access to the Dawn-Parkway System.

1.3 REGULATORY OVERVIEW

The Environmental Report (ER) has been completed in accordance with the Ontario Energy Board's (OEB) *Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario, 6th Edition (OEB Environmental Guidelines) (2011)*, as well as relevant federal and provincial environmental guidelines and regulations. The ER will accompany Union Gas applications to the OEB for the proposed compressors. The principal objective of the ER is to ensure environmental mitigation and protection during construction and operation of the proposed Project, while meeting the intent of the *OEB Environmental Guidelines (2011)*. The ER will form the foundation for future environmental management activities related to the Project.

2.0 Consultation

Consultation and engagement is an essential requirement of the OEB *Environmental Guidelines (2011).* Consultation and engagement is the process of identifying interested and potentially affected parties and informing them about the Project, soliciting information about their values and the local environmental and socio-economic circumstances, and receiving advice about key Project decisions before those decisions are finalized.

Initial consultation for the Station was undertaken as a component of an environmental study process for the proposed 42 inch diameter pipeline, approximately 500 m in length, between the Station site and the existing Parkway Compressor Station. Details on this consultation, and how the Station was considered, is provided below. Consultation on the Station has been undertaken, and will continue, as a component of the municipal approvals process.

2.1 CONSULTATION AND COMMUNICATION

2.1.1 Identification

The identification of interested and potentially affected parties was undertaken using a variety of sources, including the OEB's *OPCC Members List (April 2011)*, the Ministry of the Environment's (MOE's) *Environmental Assessment Government Review Team Master Distribution List (January 11, 2011)*, sign-in sheets for the Information Session, correspondence received throughout the consultation program, guidance from relevant agencies, and the experience of Union Gas and Stantec.

The parties listed below were considered when identifying the initial Agency, First Nations and Métis Nation Contact List:

- Federal and provincial agencies and authorities with jurisdiction in the Study Area, including members of the OPCC;
- Municipal staff; and,
- First Nation communities and the Métis Nation of Ontario (MNO).

The final Agency, First Nations and Métis Nation Contact List is located in **Appendix B1**.

Members of the public who communicated with Project Staff were tracked on a Public Contact List. A Landowner Contact List was developed following selection of the Study Area. Landowners were identified through a review of property tax roll data available at each municipality. The public and landowner lists have not been provided for confidentiality reasons.

It is the opinion of Stantec that no additional parties are required to be notified for the Station site.

2.1.2 Consultation and Communication Methods

2.1.2.1 Newspaper Notices

A Notice of Initiation of Environmental Study was published in the Milton Canadian Champion newspaper on May 22, 2012, and a Notice of Information Session was published in the Milton Canadian Champion newspaper on July 19, 2012. Both notices provided maps that illustrated the original proposed Station site, and not the current location. The Study Area on both notices included the northern section of the current Station site.

A Notice of Neighbourhood Information Session for the compressor station was published in the Milton Canadian Champion on February 26, 2013. The notice provided a map and description of the proposed Station site.

Copies of all newspaper notices are included in **Appendix B2**.

2.1.2.2 Mailouts

Letters were mailed to the initial First Nations, Métis Nation and Agency Contact List on May 17, 2012 to provide the Notice of Initiation of Environmental Study. Letters were mailed to the First Nations, Métis Nation and Agency Contact List on July 17, 2012 to provide the Notice of Information Session. Letters were mailed to First Nations, Métis Nation, landowners, select agency and municipal contacts, and attendees of the pipeline Information Session, on February 25, 2013 to provide the Notice of Neighbourhood Information Session.

Generic copies of all mailouts are located in **Appendix B3**.

2.1.2.3 Newsletters, Display Boards and Exit Questionnaires

Display boards were prepared for exhibition at the pipeline Information Session. The display boards provided information on the pipeline environmental study, and included two displays on the proposed Compressor Station: the first provided general information about the Station, and the second outlined approvals for the facility. All mapping on the display boards provided a Study Area that included the northern section of the current Station site. Display boards were also prepared for the Neighbourhood Information Session to provide information on the Compressor Station and rezoning process.

A newsletter was also developed for distribution at the pipeline Information Session to summarize the content provided on display boards. A map on the newsletter provided a Study Area that included the northern section of the current Station site. A newsletter was also developed for distribution at the Neighbourhood Information Session to summarize the content provided on display boards.

An exit questionnaire was provided to pipeline Information Session attendees. The exit questionnaire did not request feedback on the proposed Compressor Station. An exit questionnaire was also provided to Neighbourhood Information Session attendees.

A copy of the newsletters, display boards and exit questionnaires can be found in **Appendix B4**.

2.2 RECEIVING INPUT

2.2.1 Public Input

One Information Session was held for the pipeline Project on Wednesday August 1, 2012 at the Milton Sports Centre. The event ran from 4:00 to 8:00 p.m.

The purpose of the Information Session was to provide attendees an opportunity to:

- View information about the pipeline Project;
- Ask questions and comment on the planning process followed; and
- Comment on the Preliminary Preferred Routes and/or Potential Alternate Routes.

Union Gas and Stantec representatives were present to provide information, answer questions, and receive comments during the Information Session. A newsletter and display boards (described in **Section 2.1.2.3**) were provided.

The event was attended by ten stakeholders. Attendees included elected officials, municipal staff, local landowners and other utility company staff. All attendees who registered their attendance had their contact information added to applicable contact lists to ensure they received future Project notices. An exit questionnaire was provided for attendees to submit questions and comments.

No written comments were received regarding the Station. Verbal comments and questions were expressed to Union Gas and Stantec representatives regarding the impact of the proposed Station on the local community (noise, air, visual, etc.).

Union Gas held an Information Session on Thursday March 7, 2013 at the Milton Sports Centre regarding the proposed Compressor Station and submission of a Zoning By-Law Amendment Application. The event ran from 4:30 to 8:30 p.m. Union Gas and Stantec representatives were present to provide information, answer questions, and receive comments about the Compressor Station. A newsletter and display boards (described in **Section 2.1.2.3**) were provided.

The event was attended by five stakeholders. Attendees included elected officials, local landowners and developers. All attendees who registered their attendance had their contact information added to applicable contact lists to ensure they received future Project notices. An exit questionnaire was provided for attendees to submit questions and comments.

No written comments were received at the Neighbourhood Information Session. Verbal comments and questions were expressed to Union Gas and Stantec representatives regarding the site plan, noise, odour, and potential impacts/constraints on future land development.

2.2.2 Agency Input

Four instances of agency input provided comments on the proposed Station:

1. The Region of Halton, in an email dated June 15, 2012, requested information on the site plan for the Station.
2. The Technical Standards and Safety Authority, in a letter dated July 16, 2012, provided information on their guidelines.
3. The City of Mississauga, in a letter dated January 21, 2013, provided questions on the 42 inch diameter pipeline, including a question regarding why a new Compressor Station is required.
4. The City of Mississauga, in an email dated February 28, 2013, provided questions about the OEB process and existing Compressor Station.

A copy of the above correspondence, and responses as applicable, are provided in **Appendix B5**.

2.2.3 First Nations and Métis Nation Input

Representatives of Union Gas have been engaging with the Mississaugas of the New Credit First Nation, Six Nations of the Grand River, Haudenosaunee Confederacy Chiefs Council, Chippewa's of Georgina Island and the MNO since August of 2012 regarding all aspects of the Parkway Project (Station and pipelines). Union Gas will continue engaging with First Nation communities and the MNO as the Parkway Project moves forward to identify potential impacts to traditional land uses.

3.0 Effects Assessment

3.1 METHODOLOGY

The potential effects of the Project have been assessed by comparing the environmental and socio-economic features on and surrounding the Station site against construction and operation activities. For most environmental and socio-economic features, mitigation and protective measures are recommended, including:

- Construction methods and timing;
- Environmental protection measures;
- Site-specific mitigation measures;
- Compensation measures; and,
- Contingency measures.

For most environmental and socio-economic features, mitigation and protective measures are anticipated to either obviate or lessen any potential impacts.

3.2 PHYSICAL FEATURES

3.2.1 Bedrock Geology

Potential Effects

The Station site overlies shale and limestone bedrock of the Queenston Formation, which geotechnical investigations have found is present between 1.0 to 7.8 m below the ground surface. Any bedrock encountered during construction would need to be excavated by hoe-ram, rock bucket or blasting. Where bedrock material is excavated by means of a hoe-ram or rock bucket, potential impacts would include noise and/or vibration. Where blasting is implemented, potential impacts would include flyrock, noise and/or vibration.

Mitigation and Protective Measures

If blasting is required, a blasting consultant should be hired. Blasting mats should be used to assist in controlling flyrock. Immediately after blasting, any flyrock should be collected.

Land agents with Union Gas should notify surrounding landowners in advance of any bedrock removal that may cause noise and/or vibration. Any activities that cause noise should comply with Town of Milton by-law 133-2012.

With the effective implementation of the above mitigation and protective measures, no adverse residual effects on or as a result of bedrock geology are anticipated.

3.2.2 Soil and Soil Capability

Potential Effects

The Station site is zoned as Agricultural (A1), and Canada Land Inventory mapping lists the Station site as Prime Agricultural Land (Classes 1-3).

It is anticipated that soil excavated during construction of the on-site stormwater pond (**Section 3.3.3**) will be used to construct berms, any on-site topsoil will be stripped and used during landscaping. During soil excavation and topsoil stripping high winds may lead to nuisance dust, and precipitation may lead to off-site erosion.

Mitigation and Protective Measures

An Agricultural Assessment entitled *Parkway West Agricultural Impact Assessment* was prepared by Stantec Consulting Ltd., dated January 2013, as part of a zoning by-law amendment for the Station site (**Appendix C1**). The Assessment provides an inventory of the agricultural resources of the surrounding lands. The Assessment concludes that within the local area there is no possibility of locating the proposed Compressor Station in an area not zoned as agricultural, and there is no possibility of locating the proposed Compressor Station in an area that is not designated as prime agricultural land.

During construction weather should be monitored in order to identify the potential onset of windy conditions. In the event that high winds do occur, the Contractor should implement protective measures as appropriate, such as:

- Suspend earth moving operations;
- Apply dust suppressants; and,
- Protect soil stockpiles with a barrier or windscreen.

In conjunction with the above measures, all materials and equipment required to implement the mitigation measures should be readily accessible and available for use as required. Should it be necessary to import soil for the construction of the landscaped berms, testing should occur for soil contamination.

Mitigation and protective measures for erosion are outlined in **Section 3.3.1**.

With the effective implementation of the above mitigation and protective measures, no significant adverse residual effects on soil and soil capability are anticipated.

3.3 AQUATIC FEATURES

3.3.1 Surficial Hydrology

Potential Effects

A Natural Environment Report entitled *Natural Environment Technical Report, Parkway West Project Lands* was prepared by Stantec Consulting Ltd., dated January 2013, as part of a zoning by-law amendment for the Station site (**Appendix C2**).

Field investigations undertaken in late 2012 determined that one water feature is located on the southwest corner of the Station site. It was determined that the water feature provides indirect habitat to downstream reaches. The development of the Station site will result in portions of the water feature being conveyed through culverts. Potential effects on downstream fish and fish habitat include reduced water quality as a result of sedimentation and/or spills.

Mitigation and Protective Measures

An additional field investigation will be undertaken in the spring of 2013 to confirm the categorization of the on-site water feature. Any works within the Regulated Limit of Conservation Halton will require a Permit pursuant to Ontario Regulation 162/06.

The requirement for and location of erosion and sediment control measures during construction should be determined by an Environmental Inspector, and should be maintained until site rehabilitation is completed.

Fuelling and lubrication of equipment should be carried out in a manner that minimizes the possibility of spills. On-site fuel tanks and generators should be situated in designated containment areas. Mobile construction equipment should be refueled a minimum of 30 m from the water feature. Refueling activities should be monitored at all times, and vehicles should not be left unattended while being refueled. All containers, hoses and nozzles on the right-of-way should be free of leaks. All fuel nozzles should be equipped with functional automatic shut-off devices.

During construction, an accidental spill of fluids may occur. Upon release of a hydrocarbon-based construction fluid, Union Gas should immediately determine the magnitude and extent of the spill, and rapidly take measures to contain it. Release of sediment should also be treated as a potential spill depending on the magnitude and extent. All spills should be immediately reported to the Chief Inspector. If spills are determined to have an impact upon the environment the MOE Spills Action Center should be notified at 1-800-268-6060.

A Spills Response Plan should be developed by the Contractor, reviewed with staff, and posted in the site trailer. Appropriate spill containment apparatus and absorbent materials should be readily available, especially near the water feature. Staff should be trained in the use of spill containment equipment and materials.

With the effective implementation of the above mitigation and protective measures, no adverse residual effects on surficial hydrology are anticipated.

3.3.2 Hydrogeology

Potential Effects

A Hydrogeological Evaluation entitled *Hydrogeological Assessment Parkway West Compressor Station Milton Ontario* was prepared by Stantec Consulting Ltd., dated February 2013, as part of a zoning by-law amendment for the Station site (**Appendix C3**).

Groundwater may be encountered during construction of the Station. As a result, it is anticipated that dewatering will be necessary during construction. Based on the positioning of local private wells relative to the Site and the anticipated dewatering volumes that will occur throughout the property, no interference impacts are anticipated to these wells as a result of on-site construction dewatering activities.

Once the Station has been constructed the site may undergo a groundwater recharge deficit, meaning a reduction in the amount of groundwater as a result of the Station's construction. Groundwater levels may occur above servicing levels in some areas of the Station site.

Given that water usage at the proposed onsite administration building is expected to be low (i.e., water supply for kitchen and washroom usage), it is reasonable to assume that an onsite water supply well constructed into the bedrock or the sandy deposits directly overlying the bedrock surface should be capable of meeting the water demand. In addition, results of the onsite groundwater quality sampling suggest that a water supply well constructed in the vicinity of the proposed administrative building would provide a potable source of drinking water.

If a spill occurs during construction, the spill has potential to enter into the groundwater. Groundwater flows occur in a southwesterly direction.

Mitigation and Protective Measures

A Permit to Take Water will be obtained prior to dewatering activities should dewatering activities exceed 50,000L per day. To reduce the potential for erosion and scouring at dewatering points, during dewatering appropriate and effective energy dissipation techniques and devices should be utilized. At all dewatering points, discharge piping should be free of leaks and should be properly anchored to prevent bouncing or snaking during surging. Discharge should be monitored to ensure no erosion or flooding occurs. Protective measures may include dewatering at low velocities, dissipating water energy by discharging into a filter bag or equivalent, and utilizing protective riprap or equivalent. If energy dissipation measures are found to be inadequate, the rate of dewatering should be reduced or dewatering discontinued until satisfactory mitigative measures are in place. An Environmental Inspector should monitor the dewatering and make adjustments as required.

To assess the potential for introduction of contaminated water at the discharge location, testing of discharged water should be considered. Testing requirements can be influenced by the

potential for trench water to be contaminated. Union Gas should consult with contamination and risk experts to determine what testing, if any, is necessary for the discharged water.

Additional mitigation and protective measures are recommended as follows:

- Groundwater recharge augmentation should occur if a groundwater deficit is encountered subsequent to Station construction;
- Should groundwater levels exceed service levels the installation of anti-seepage collars within the servicing trenches may be required to prevent the preferential movement of groundwater along the servicing alignments and, subsequently, prevent potential disruptions to pre-development groundwater flow patterns; and,
- Mitigation and protective measures for accidental spills are outlined in **Section 3.3.1**.

With the effective implementation of the above mitigation and protective measures, no adverse residual effects on groundwater are anticipated.

3.3.3 Stormwater Management

Potential Effects

Construction of the Station will alter surficial drainage at the Station site, potentially impacting both water quality and quantity.

Mitigation and Protective Measures

A Stormwater Management Report entitled *Union Gas Compressor Station Stormwater Management Report, Milton, Ontario* was prepared by Stantec Consulting Ltd., dated January 2013, as part of a zoning by-law amendment for the Station site (**Appendix C4**).

In preparing the Report, a drainage assessment and conceptual design of stormwater management (SWM) works associated with the proposed Compressor Station was completed. The Report documents the conceptual SWM strategy and design to mitigate against potential off-site water quality and quantity impacts.

The following conclusions have been drawn from the site based on the stormwater management assessment:

- Enhanced water quality control can be provided by wet pond SWM facilities. Adequate permanent pool and extended detention volumes would be provided to meet the MOE water quality requirements associated with wet ponds;
- The proposed SWM facilities would control post development peak flows to existing rates;
- A SWM block of approximately 2.1 ha is required to provide the required SWM controls for the entire site in one SWM Block; and,
- A total SWM block size of 2.4 ha is required to provide the required SWM controls for

the entire site in two separate SWM blocks.

A detailed design of the stormwater management facility would be developed at the Site Plan Application stage. With the effective development of the stormwater management facility, no adverse residual effects on surficial drainage are anticipated.

3.4 TERRESTRIAL FEATURES

3.4.1 Vegetation

Potential Effects

A Detailed Tree Inventory entitled *Union Gas Compressor Station, Parkway West – Site #2 Milton Ontario, Detailed Tree Inventory* was prepared by Stantec Consulting Ltd., dated January 2013 (**Appendix C5**), and a Natural Environment Report entitled *Natural Environment Technical Report, Parkway West Project Lands* was prepared by Stantec Consulting Ltd., dated January 2013 (**Appendix C2**). Both reports were prepared as part of a zoning by-law amendment for the Station site.

The Station site is an agricultural field with vegetation limited to patches of cultural meadow. The site contains no rare vegetation communities. A botanical inventory identified all of the natives species as ranked S5 (Secure in Ontario) and none of the species observed had a co-efficient of conservatism (CC) higher than 5, indicating that vegetation on site exhibits a low to moderate sensitivity to disturbance. No nationally or provincially rare, threatened or endangered species were observed.

Mitigation and Protective Measures

The limits of clearing should be surveyed and staked in the field, and the Contractor should ensure that no construction disturbance occurs beyond the permanent and temporary construction limits.

With the effective implementation of the above mitigation and protective measures, no adverse residual effects on vegetation are anticipated.

3.4.2 Wildlife and Wildlife Habitat

Potential Effects

A Natural Environment Report entitled *Natural Environment Technical Report, Parkway West Project Lands* was prepared by Stantec Consulting Ltd., dated January 2013, as part of a zoning by-law amendment for the Station site (**Appendix C2**).

During field investigations, incidental observations of wildlife or evidence of wildlife activity were recorded. Wildlife observations included various signs of mammal beds, trails, and scat (within the cultural meadow communities) and included Mourning Dove, Black-capped Chickadees, and Turkey Vulture.

A background review was conducted to determine the potential for species at risk to be located on the Station site; it was determined that twelve species at risk have the potential to be located at the Station site.

- One species at risk, Barn Swallow, was observed on the Station site in a small shed. Additional observations were made of potential past use of the area by Barn Swallow in an old trailer located on site. Foraging habitat is also present on site for this species;
- Although no incidental observations were made, habitat for Chimney Swift (e.g., chimneys) as well as Little Brown *Myotis* and Northern *Myotis* (e.g., outbuildings) for roosting and breeding are potentially present on the Station site;
- Potential habitat for Bobolink and Eastern Meadowlark is present at the Station site, associated with the agricultural field and cultural meadow habitats; and,
- Species and habitat for butternut, Jefferson's Salamander, Blanding's Turtle, Eastern Musk Turtle, Northern Map Turtle, and Eastern Ribbonsnake are considered absent from the Station site.

Potential effects on wildlife and wildlife habitat from Station construction include direct mortality from construction vehicles and habitat destruction through vegetation removal.

Mitigation and Protective Measures

Environmental mitigation and protective measures during construction include the following:

1. Of the sixty-five (65) species of vascular plants recorded during field investigations, 55% were exotic. Site landscaping will replace any cultural meadow vegetation communities removed and will seed berms with a native seed mixture, resulting in a net overall benefit to on-site wildlife habitat;
2. Grassland breeding surveys are recommended to document the potential presence of Bobolink and Eastern Meadowlark. Should the surveys identify species protected under the *Endangered Species Act (2007)* consultation should occur with the Ministry of Natural Resources (MNR) regarding any possible permitting requirements;
3. Additional investigations are required to further identify nesting structures for Barn Swallow, potential reptile hibernacula, and habitat for Chimney Swift, Little Brown *Myotis* and Northern *Myotis.* Should the surveys identify species protected under the *Endangered Species Act (2007)* consultation should occur with the MNR regarding any possible permitting requirements;
4. Personnel should be prohibited from harming, harassing or feeding wildlife;
5. Project-related wildlife deaths and nuisance animals should be immediately reported to Union Gas's Environmental Planner, who will report as necessary to the MNR and work with the Ministry to determine the necessity for additional site-specific mitigation measures;
6. Any wildlife and wildlife habitat, not previously identified through the field investigation, should be reported to Union Gas's Environmental Planner, who will report to the MNR as

relevant and work with the Ministry to determine the necessity for additional site-specific mitigation measures; and,

7. If clearing activities are required during the migratory bird nesting period (May 1 to July 31), nest surveys should be conducted by a qualified biologist to identify all nests under the Migratory Bird Convention Act using the following standard survey procedure: to the extent practical, tree and/or brush clearing should be completed prior to, or after, the breeding season for migratory birds (May 1 to July 31). Should clearing be required during the breeding bird season, prior to construction, surveys will be undertaken to identify the presence/absence of nesting birds or breeding habitat every 72 hours until clearing is complete or until July 31, whichever comes first. If a nest is located, a designated setback will be marked off within which no construction activity will be allowed while the nest is active. The radius of the setback width ranges from 5- 60 m depending on the species. Setback widths are based on the species sensitivity and on setback width recommendations that have been reviewed and approved by Environment Canada.

With the effective implementation of the above mitigation and protective measures, no adverse residual effects to wildlife and wildlife habitat are anticipated.

3.5 SOCIO-ECONOMIC ENVIRONMENT

3.5.1 Land Use

Potential Effects

Within 300m of the proposed Station, there are five occupied residential homes.

The Station will be a visual change to the current landscape. The Station may also impact nearby residential homes through noise and air emissions during construction and operation. During construction, noise and air emissions will be generated by the operation of equipment and vehicles. During operation, the primary sources of noise and air emissions will be the natural gas compressors, the emergency generators and the firewater pumps.

Mitigation and Protective Measures

The site will include a landscaped berm and potentially noise attenuation walls. The berm and walls are intended to provide screening of the facility. There will also be some perimeter landscaping provided to enhance the streetscape. The site will be organized with landscape berms along the perimeter of the site and the buildings and facilitates located central to the site. Onsite parking will also be screened from the street. The onsite buildings will be neutral in color in order to be compatible with the natural landscape and blend in with their surroundings due to their earth tone colour. Pole mounted lighting and lighting on buildings will be directed to manage off-site light spillage/pollution.

All design details will be confirmed during the municipal Site Plan Review process.

The proposed Station will require an amendment to the province-wide Environmental Compliance Approval (ECA) issued by the MOE. The formal ECA approval process, which has been initiated by Union Gas, will ensure that the facility can operate within limits that meet MOE criteria for noise, air and any other discharge concerns.

Mitigation and protective measures for noise and air emissions are outlined in **Sections 3.5.2 and 3.5.3**, respectively.

With the effective implementation of the above mitigation and protective measures, no significant adverse residual effects on surrounding land uses are anticipated.

3.5.2 Noise

Potential Effects

Within 300m of the proposed Station, there are five occupied residential homes. During construction, sound will be generated by the operation of equipment and vehicles. During operation, the primary sources of sound will be the natural gas compressors, the emergency generators and the firewater pumps.

A Noise Study entitled *Noise Impact Feasibility Study for the Proposed Union Gas Limited Parkway West Compressor Station, Town of Milton, Ontario* was prepared by HGC Engineering, dated January 2013, as part of a zoning by-law amendment for the Station site (**Appendix C6**).

The Noise Study uses predictive analysis to assess potential impacts of sound sources associated with the site with respect to guidelines of the MOE, which are acceptable to the Town of Milton. The analysis indicates that, with the noise control measures integral to the station design, sound emissions from the subject site will be within the applicable sound level limits of the MOE during all hours of operation.

Mitigation and Protective Measures

During construction, motorized construction equipment should be equipped with mufflers and/or silencers as available. Company and construction personnel should avoid idling of vehicles; vehicles or equipment should be turned off when not in use unless required for effective operation of the vehicle or equipment. To the greatest extent possible activities that could create noise should be restricted to daylight hours. Sources of continuous noise, such as portable generators, should be shielded as appropriate or located so as to minimize disturbance to local residents. Union Gas should consult with officials from the Town of Milton to ensure noise bylaw conformity.

The proposed Station will require an amendment to the province-wide ECA issued by the MOE. The formal ECA approval process, which has been initiated by Union Gas, will ensure that the facility can operate within limits that meet MOE criteria for noise and any other discharge

concerns. This application will include a formal Acoustic Assessment Report to demonstrate compliance with the MOE noise guidelines.

With the effective implementation of the above mitigation and protective measures, no significant adverse residual effects from noise are anticipated.

3.5.3 Air Quality

Potential Effects

During construction, exhaust will be generated by the operation of equipment and associated vehicular traffic. During operation, the primary sources of air emissions will be the natural gas compressors, the emergency generator and the firewater pump.

Mitigation and Protective Measures

The construction contractor should implement good site practices during construction in line with the document 'Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities' (Environment Canada, 2005), which may include:

- Maintaining equipment in good running condition and in compliance with regulatory requirements;
- Protecting stockpiles of friable material with a barrier or windscreen in the event of dry conditions and excessive dust;
- Dust suppression (e.g. water) of source areas; and
- Covering loads of friable materials during transport.

Watering for dust control must not result in the formation of puddles, rutting by equipment or vehicles, the tracking of mud onto roads or the siltation of watercourses.

An Air Emissions Study entitled *Emission Summary and Dispersion Modelling Report for Union Gas Ltd., Parkway West Compressor Station* is being prepared by ORTECH Environmental, as part of Union Gas's application to the MOE to amend the province-wide ECA.

The Air Emissions Study quantifies the emission rates for all significant sources of contaminants at the facility and compares them to MOE limits. The analysis indicates that the predicted maximum concentration of oxides of nitrogen (NO_X) at the facility from the maximum emission scenario is below the MOE NO_X 1-hour and 24-hour point-of-impingement limits. The analysis also indicates that all turbines subject to MOE Guideline A-5, Atmospheric Emissions from Stationary Combustion Turbines, must be tested to confirm compliance with NO_X, CO and SO_2 exhaust flow limits.

With the effective implementation of the above mitigation and protective measures, no significant adverse residual effects to air quality are anticipated.

3.5.4 Contamination

Potential Effects

There are no known landfills or contaminated sites at the Station site. However, there is the possibility that construction of the Station could encounter contaminated soil and/or groundwater.

Mitigation and Protective Measures

Union Gas is conducting environmental site assessments as part of a zoning by-law amendment for the Station site. Site investigations will be required where areas of potential contamination are suspected.

In the event that previously unknown contaminated soils are uncovered or suspected of being uncovered during construction, construction in the find location should cease immediately. In such an instance, Union Gas should retain expert advice on assessing and developing a soil sampling, handling and remediation plan. All contaminated materials should be managed in accordance with applicable sections of the *Environmental Protection Act* and *Ontario Regulation 347*.

With the effective implementation of the above contingency measure, no adverse residual effects from contamination are anticipated.

3.5.5 Waste Management

Potential Effects

Improper disposal of waste material generated during construction may result in contamination to soil, groundwater, and/or surface water resources on and off the Project location. Litter generated during construction may also become a nuisance to nearby landowners or consumed by wildlife if not appropriately contained.

Mitigation and Protective Measures

During construction, the construction contractor should implement a site-specific waste collection and disposal management plan, which may include site practices such as:

1. All waste materials and recycling transported off-site by private waste contractors licensed with a Certificate of Approval;
2. Contractors required to remove their excess materials from the site;
3. Labelling and proper storage of hazardous and liquid wastes in a secure area that would ensure containment of the material in the event of a spill;
4. Implementation of an on-going waste management program consisting of reduction, reuse, and recycling of materials; and,

5. Disposal of sanitary wastes would be the responsibility of a contracted third party that would ensure disposal in accordance with appropriate provincial legislation, standards and policies.

With the effective implementation of the above mitigation and protective, no adverse residual effects from waste management are anticipated.

3.5.6 Cultural Heritage Resources

Potential Effects

The development of the Station site has the potential to impact below-grade archaeological resources, built heritage features and cultural heritage landscapes.

Mitigation and Protective Measures

An Archaeological Stage 1 and 2 Evaluation entitled *Stage 1 and 2 Archaeological* Assessments at the Proposed Parkway West Station Lands (Orlando Property) – Progress *Report (MTCS Licence # P007, PIF #P007-388-2012 and #P007-411-2012)* was prepared by Archaeological Research Associates Ltd., dated January 14, 2013, as part of a zoning by-law amendment for the Station site (**Appendix C7**).

The northernmost portion of the property has been fully assessed (Stage 1 and 2) and only a partial Stage 1 assessment has been completed on the southernmost portion of the subject lands. The Stage 2 assessment of the northernmost portion of the property resulted in the discovery of three locations of archaeological materials. Of the three findspots, only one met the Ministry of Tourism, Culture and Sport's (MTCS) criteria requiring further work. It has been determined that a Stage 3 site specific assessment should be undertaken in the spring of 2013 when weather conditions permit.

The remaining Stage 1 and 2 assessments on the southernmost portion of the property will be carried out as soon as weather conditions improve and the field can be ploughed. Any previously un-assessed areas within the existing property with the potential to be impacted will also be examined for archaeological materials.

Despite the completion of archaeological assessments, it is possible that archaeological resources could be encountered during construction. Ground disturbance should cease immediately at the find location should previously unknown archaeological or historical resources be uncovered or suspected of being uncovered during construction. The MTCS and an archaeologist licensed in the Province of Ontario should be notified immediately. An appropriate response plan should then be employed following further investigation of the specific find. The response plan would indicate under which conditions the ground disturbance activity in the find location may resume.

In the event that human remains are uncovered or suspected of being uncovered during ground disturbance, the above measures should be implemented along with notifying local police, the coroner's office and the Cemeteries Regulation Unit of the Ontario Ministry Consumer Services (1-800-889-9768).

The MTCS has developed the document 'Screening for Impacts to Built Heritage and Cultural Heritage Landscapes' to help identify when projects could affect known or potential cultural heritage resources. As the development of the Station will involve the removal of existing structures, and a new above-ground facility, a Heritage Assessment will be necessary to assess the potential impact of the Station on built heritage features and cultural heritage landscapes.

With the effective implementation of the above mitigation, protective and contingency measures, no adverse residual effects on cultural heritage resources are anticipated.

3.5.7 First Nations and Métis Nation Interests

Potential Effects

The Station site may be a location of traditional use by First Nations and Métis and is within the Nanfan Treaty area.

Mitigation and Protective Measures

Union Gas has sought First Nations and Métis Nation input into the Project, and will continue engaging with First Nation communities and the Métis Nation of Ontario as the Project moves forward to identify potential impacts to traditional land uses. Union Gas will also continue to work with their respective Economic Development departments and Union Gas's contractors to find opportunities for their participation in providing goods and services during construction. Union Gas, through their archaeological consultant, has also engaged trained First Nation community members to undertake monitoring during the archeological assessment work planned for the spring of 2013.

3.5.8 Infrastructure

Potential Effects

The construction of the proposed Compressor Station has the potential to impact Eighth Line, as well as existing on-site natural gas pipelines.

Mitigation and Protective Measures

A pavement investigation entitled *Pavement Evaluation on Eighth Line, From Derry Road to approximately 1.1 km South, Milton* was prepared by Stantec Consulting Ltd., dated January 23, 2013, as part of a zoning by-law amendment process for the Station site (**Appendix C8**). The investigation determined that a portion of Eighth Line is in good condition, and that another portion requires rehabilitation or reconstruction. The investigation determined that consideration of management of approaches for heavier vehicles, which could be expected during the

construction period, may need to be considered in cooperation with the Town of Milton (e.g. Spring Load Restrictions).

The construction contractor will coordinate the location and exposing of all existing pipelines and utilities on the Station site.

With the effective implementation of the above mitigation and protective measures, no adverse residual effects on infrastructure are anticipated.

3.6 SUMMARY OF EFFECTS ASSESSMENT

Table 3.1 provides a summary of the potential effects and recommended mitigation and protective measures for the Project-specific issues identified in **Section 3.0**

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
Physical Features		
Bedrock Geology *Section 3.2.1*	• Noise and/or vibration resulting from bedrock excavation via mechanical breakup (e.g. hoe-ram or rock bucket). • Flyrock, noise and/or vibration resulting from bedrock excavation via blasting operations (if required).	• If blasting is required, it should be undertaken by a blasting consultant. • Blasting mats should be used to assist in controlling flyrock and immediately after blasting, any flyrock should be collected. • Land agents with Union Gas should notify surrounding landowners in advance of any bedrock removal that may cause noise and/or vibration. • Any activities that cause noise should comply with Town of Milton by-law 133-2012.
Soil and Soil Capability *Section 3.2.2*	• During soil excavation and topsoil stripping high winds may lead to nuisance dust, and precipitation may lead to off-site erosion.	• During construction activities weather should be monitored in order to identify the potential onset of windy conditions. Contractor should implement protective measures (suspend earth moving operations, apply dust suppressants, and protect stockpiles using a barrier or windscreen) during periods of high winds. • All materials and equipment required to implement the mitigation measures should be readily accessible and available for use as required. • Should it be necessary to import soil for construction of the landscapes berms, testing should occur for soil contamination. • Mitigation and protective measures for erosion are outlined in 'Surficial Hydrology'.
Aquatic Features		
Surficial Hydrology	• Reduced water quality as a	• Any works within the Regulated Limit of Conservation Halton will require a Permit pursuant to Ontario Regulation 162/06.

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
Section 3.3.1	result of sedimentation and/or spills.	• The requirement for and location of erosion and sediment control measures during construction should be determined by an Environmental Inspector, and should be maintained until site rehabilitation is completed. • Fuelling and lubrication of equipment should be carried out in a manner that minimizes the possibility of spills. • On-site fuel tanks and generators should be situated in designated containment areas. • Mobile construction equipment should be refueled a minimum of 30 m from the water features. • Refueling activities should be monitored at all times, and vehicles should not be left unattended while being refueled. • All containers, hoses and nozzles on the right-of-way should be free of leaks. • All fuel nozzles should be equipped with functional automatic shut-off devices. • Upon release of a hydrocarbon-based construction fluid, Union Gas should immediately determine the magnitude and extent of the spill, and rapidly take measures to contain it. Release of sediment should also be treated as a potential spill depending on the magnitude and extent. • All spills should be immediately reported to the Chief Inspector. If spills are determined to have an impact upon the environment the MOE Spills Action Center should be notified at 1-800-268-6060. • A Spills Response Plan should be developed by the Contractor, reviewed with staff, and posted in the site trailer. • Appropriate spill containment apparatus and absorbent materials should be available on-site, especially near the water feature. • Staff should be trained in the use of spill containment equipment and materials.
Hydrogeology *Section 3.3.2*	• It is anticipated that dewatering will be necessary during construction. • The site may undergo a groundwater recharge deficit. • Groundwater levels may occur above serving levels. • Spills have the potential to enter groundwater.	• A Permit to Take Water will be obtained prior to dewatering activities should dewatering exceed 50,000 L per day. • To reduce the potential for erosion and scouring at dewatering points, during dewatering appropriate and effective energy dissipation techniques and devices should be utilized. • At all dewatering points, discharge piping should be free of leaks and should be properly anchored to prevent bouncing or snaking during surging. • Discharge should be monitored to ensure no erosion or flooding occurs. • Protective measures may include dewatering at low velocities, dissipating water energy by discharging into a filter bag or equivalent, and utilizing protective riprap or equivalent. • If energy dissipation measures are found to be inadequate, the rate of dewatering should be reduced or dewatering discontinued until satisfactory mitigative measures are in place. • An Environmental Inspector should monitor the dewatering and make adjustments as required. • Testing of discharged water should be considered. Union Gas

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
		should consult with contamination and risk experts to determine what testing, if any, is necessary for the discharged water. • Groundwater recharge augmentation should occur if a groundwater deficit is encountered subsequent to Station construction. • Should groundwater levels exceed service levels the installation of anti-seepage collars within the servicing trenches may be required to prevent the preferential movement of groundwater along the servicing alignments and, subsequently, prevent potential disruptions to pre-development groundwater flow patterns. • Mitigation and protective measures for accidental spills are outlined in 'Surficial Hydrology'.
Stormwater Management *Section 3.3.3*	• Construction of the Station will alter surficial drainage at the Station site, potentially impacting both water quality and quantity.	• Enhanced water quality control can be provided by wet pond SWM facilities. • Adequate permanent pool and extended detention volumes would be provided to meet the MOE water quality requirements associated with wet ponds. • The proposed SWM facilities would control post development peak flows to existing rates. • A SWM block of approximately 2.1 ha is required to provide the required SWM controlsfor the entire site in one SWM Block. • A total SWM block size of 2.4 ha is required to provide the required SWM controls for the entire site in two separate SWM blocks. • A detailed design of the stormwater management facility would be developed at the Site Plan Application stage.
Terrestrial Features		
Vegetation *Section 3.4.1*	• Removal of vegetation.	• The limits of clearing should be surveyed and staked in the field. • The Contractor should ensure that no construction disturbance occurs beyond the permanent and temporary construction limits.
Wildlife and Wildlife Habitat *Section 3.4.2*	• Potential presence of five species at risk. • Direct mortality from construction vehicles. • Habitat destruction through vegetation removal.	• Site landscaping will replace any cultural meadow vegetation communities removed and will seed berms with a native seed mixture, resulting in a net overall benefit to on-site wildlife habitat. • Grassland breeding surveys are recommended to document the potential presence of Bobolink and Eastern Meadowlark. Should the surveys identify species protected under the *Endangered Species Act (2007)* consultation should occur with the Ministry of Natural Resources (MNR) regarding any possible permitting requirements. • Additional investigations are required to further identify nesting structures for Barn Swallow, potential reptile hibernacula, and habitat for Chimney Swift, Little Brown *Myotis* and Northern *Myotis.* Should the surveys identify species protected under the *Endangered Species Act (2007)* consultation should occur with the MNR regarding any possible permitting requirements. • Personnel should be prohibited from harming, harassing or feeding wildlife. • Project-related wildlife deaths and nuisance animals should be immediately reported to Union Gas's Environmental Planner, who will report as necessary to the MNR and work with the Ministry to determine the necessity for additional site-specific mitigation measures.

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
		• Any wildlife and wildlife habitat, not previously identified through the field investigation, should be reported to Union Gas's Environmental Planner, who will report to the MNR as relevant and work with the Ministry to determine the necessity for additional site-specific mitigation measures. • If clearing activities are required during the migratory bird nesting period (May 1 to July 31), nest surveys should be conducted by a qualified biologist to identify all nests under the Migratory Bird Convention Act using the following standard survey procedure: to the extent practical, tree and/or brush clearing should be completed prior to, or after, the breeding season for migratory birds (May 1 to July 31). Should clearing be required during the breeding bird season, prior to construction, surveys will be undertaken to identify the presence/absence of nesting birds or breeding habitat every 72 hours until clearing is complete or until July 31, whichever comes first. If a nest is located, a designated setback will be marked off within which no construction activity will be allowed while the nest is active. The radius of the setback width ranges from 5- 60 m depending on the species. Setback widths are based on the species sensitivity and on setback width recommendations that have been reviewed and approved by Environment Canada.
Socio-Economic Environment		
Land Use *Section 3.5.1*	• The Station will be a visual change to the current landscape. • The Station may impact nearby residential homes through noise and air emissions during construction and operation.	• The site will include a landscaped berm and potentially noise attenuation walls. The berm and walls are intended to provide screening of the facility. There will also be some perimeter landscaping provided to enhance the streetscape. • The site will be organized with landscape berms along the perimeter of the site and the buildings and facilitates located central to the site. Onsite parking will also be screened from the street. • The onsite buildings will be neutral in color in order to be compatible with the natural landscape and blend in with their surroundings due to their earth tone colour. • Pole mounted lighting and lighting on buildings will be directed to manage off-site light spillage/pollution. • All design details will be confirmed during the municipal Site Plan Review process. • The proposed Station will require an amendment to the province-wide ECA issued by the MOE. The formal ECA approval process, which has been initiated by Union Gas, will ensure that the facility can operate within limits that meet MOE criteria for noise, air and any other discharge concerns. • Mitigation and protective measures for noise and air emissions are outlined in 'Noise' and 'Air Quality', respectively.
Noise *Section 3.5.2*	• During construction sound will be generated by the operation of equipment and associated vehicular traffic.	• During construction, motorized construction equipment should be equipped with mufflers and/or silencers as available. • Company and construction personnel should avoid idling of vehicles; vehicles or equipment should be turned off when not in use unless required for effective operation of the vehicle or equipment. • To the greatest extent possible activities that could create noise

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
	• During operation, sound will be generated by the natural gas compressors, the emergency generators, and the firewater pumps.	should be restricted to daylight hours. • Sources of continuous noise, such as portable generators, should be shielded as appropriate or located so as to minimize disturbance to local residents. • Union Gas should consult with officials from the Town of Milton to ensure noise bylaw conformity. • The proposed Station will require an amendment to the province-wide ECA issued by the MOE. The formal ECA approval process, which has been initiated by Union Gas, will ensure that the facility can operate within limits that meet MOE criteria for noise and any other discharge concerns. This application will include a formal Acoustic Assessment Report to demonstrate compliance with the MOE noise guidelines.
Air Quality *Section 3.5.3*	• Exhaust during construction from equipment and vehicles. • Air emissions during operation from the compressors, emergency generators and firewater pumps.	• The construction contractor should implement good site practices during construction in line with the document 'Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities' (Environment Canada, 2005), which may include: maintaining equipment in good running condition and in compliance with regulatory requirements, protecting stockpiles of friable material with a barrier or windscreen in the event of dry conditions and excessive dust, dust suppression (e.g. water) of source areas, and covering loads of friable materials during transport. • Watering for dust control must not result in the formation of puddles, rutting by equipment or vehicles, the tracking of mud onto roads or the siltation of watercourses. • An Air Emissions Study is being prepared as part of Union Gas's application to the MOE to amend the province-wide ECA. The Air Emissions Study quantifies the emission rates for all significant sources of contaminants at the facility and compares them to MOE limits. The analysis indicates that the predicted maximum concentration of oxides of nitrogen (NO_X) at the facility from the maximum emission scenario is below the MOE NO_X 1-hour and 24-hour point-of-impingement limits. The analysis also indicates that all turbines subject to MOE Guideline A-5, Atmospheric Emissions from Stationary Combustion Turbines, must be tested to confirm compliance with NO_X, CO and SO_2 exhaust flow limits.
Contamination *Section 3.5.4*	• No effects anticipated.	• Union Gas is conducting environmental site assessments. • In the event that previously unknown contaminated soils are uncovered or suspected of being uncovered, construction in the find location should cease immediately. In such an instance, Union Gas should retain expert advice on assessing and developing a soil sampling, handling and remediation plan. • All contaminated materials should be managed in accordance with applicable sections of the Environmental Protection Act and O. Reg. 347.
Waste Management *Section 3.5.5*	• Soil, groundwater, and/or surface water contamination as a result of	• Construction Contractor should implement a site-specific waste collection and disposal management plan, which may include site practices such as: • All waste materials and recycling transported off-site by private waste contractors licensed with a Certificate of Approval; • Contractors required to remove their excess materials from the site;

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
	improper disposal of waste material generated during construction. • Litter may become a nuisance to nearby landowners or consumed by wildlife if not appropriately contained.	• Labelling and proper storage of hazardous and liquid wastes in a secure area that would ensure containment of the material in the event of a spill; • Implementation of an on-going waste management program consisting of reduction, reuse, and recycling of materials; and • Disposal of sanitary wastes would be the responsibility of a contracted third party that would ensure disposal in accordance with appropriate provincial legislation, standards and policies.
Cultural Heritage Resources *Section 3.5.6*	• Potential for construction to impact below-grade archaeological resources, built heritage features and cultural heritage landscapes.	• Archaeological assessments at the Station site are on-going. Prior to ground disturbance for Station construction, archaeological assessments will be completed and submitted to the Ministry of Tourism, Culture and Sport (MTCS) for their review and comment. • Despite the completion of archaeological assessments, it is possible that archaeological resources could be encountered during construction. Ground disturbance should cease immediately at the find location should previously unknown archaeological or historical resources be uncovered or suspected of being uncovered during construction. The MTCS and an archaeologist licensed in the Province of Ontario should be notified immediately. An appropriate response plan should then be employed following further investigation of the specific find. The response plan would indicate under which conditions the ground disturbance activity in the find location may resume. • In the event that human remains are uncovered or suspected of being uncovered during ground disturbance, the above measures should be implemented along with notifying local police, the coroner's office and the Cemeteries Regulation Unit of the Ontario Ministry Consumer Services (1-800-889-9768). • Prior to ground disturbance for Station construction, a Heritage Assessment will be completed to assess the potential impact of the Station on built heritage features and cultural heritage landscapes. The Heritage Assessment will be submitted to the MTCS for their review and comment.
First Nations and Métis Nation Interests *Section 3.5.7*	• The Station site may be a location of traditional use by First Nations and Métis, and is within the Nanfan Treaty area.	• Union Gas has sought First Nations and Métis Nation input into the Project. • Union Gas will continue engaging with First Nation communities and the MNO as the Project moves forward to identify potential impacts to traditional land uses. • Union Gas will also continue to work with their respective Economic Development departments and Union Gas's contractors to find opportunities for their participation in providing goods and services during construction. • Union Gas, through their archaeological consultant, has engaged trained First Nation community members to undertake monitoring during the archaeological assessment work planned for the spring of 2013.

Table 3.1: Summary of Potential Effects and Recommended Mitigation and Protective Measures

Environmental Feature(s)	Potential Effect(s)	Mitigation and Protective Measures
Infrastructure *Section 3.5.8*	• Travel on Eighth Line. • On-site natural gas pipelines.	• Management approaches for heavier vehicles may need to be considered in cooperation with the Town of Milton. • The construction contractor will coordinate the location and exposing of all existing pipelines and utilities on the Station site.

4.0 Cumulative Effects Assessment

The recognition of cumulative effects assessment as a best practice is reflected in many regulatory and guidance documents. With regard to development of hydrocarbon pipelines in Ontario, the OEB *Environmental Guidelines (2011)* note that cumulative effects of pipeline construction should be identified and discussed in the ER as an integral part of the assessment. The cumulative effects assessment refers to effects associated with construction and operation of the pipeline.

Building upon the intent of the OEB *Environmental Guidelines (2011)*, the OEB has specified that only those effects that are additive or interact with the effects that have already been identified as resulting from the Project are to be considered under cumulative effects. In such cases, it will be necessary to determine whether these effects warrant mitigation measures such as alterations in routing, timing of construction or other measures that can address the cumulative effects. The cumulative effects assessment has been prepared with consideration of this direction from the OEB.

4.1 METHODOLOGY

This cumulative effects assessment describes the potential cumulative effects resulting from the interaction of residual effects of Station construction and operation with the effects of other unrelated projects. The other projects assessed are those that are either existing or approved and that have a high likelihood of proceeding.

Cumulative effects include the temporal and spatial accumulations of change that occur within an area or system due to past, present, and future activities. Change can accumulate within systems in either an additive (*i.e.* cumulative) or interactive (*i.e.* synergistic) manner. By applying the principles of avoidance, minimization, and compensation to limit project-specific effects, potential adverse residual effects on environmental and socio-economic features have been greatly minimized prior to accounting for the effects of other unrelated projects. Positive residual effects, such as an increase in employment, increase in property taxes, security of natural gas supply, and ability to meet future natural gas demands, have not been assessed in the cumulative effects assessment.

Specifically, the cumulative effects assessment methodology is designed to evaluate and manage the additive and interactive effects from the following sources:

1. Existing infrastructure, facilities, and activities as determined from available data sets;
2. The proposed Project; and,
3. Future activities where the undertaking will proceed, or has a high probability of proceeding.

Although rare in occurrence, it is plausible that accidents or emergency events may arise due to an unforeseen chain of events during the Stations construction or operational life. As a result of the rarity and magnitude of such events, they have not been assessed here, as they are extreme in nature when compared to the effects of normal construction and operation activities, and require separate response plans. Station decommissioning and abandonment is another event that is beyond the temporal boundaries of the cumulative effects assessment and therefore has not been assessed.

4.2 STUDY BOUNDARIES

Spatial

To make conservative assumptions about the magnitude and probability of possible effects, a 100 m boundary around the Station site was used for the cumulative effects assessment.

Temporal

The temporal boundaries for the cumulative effects assessment reflect the nature and timing of Project activities, and the availability of information surrounding future projects with a high probability of proceeding. The Project schedule identifies three key milestone activities:

1. ER and technical design –2013;
2. Construction – 2015; and,
3. Operation - 2015 through 2065*.

*Fifty years of Station operation is used as an assumption, although the Station may be operational beyond fifty years.

Based upon these milestone activities, two time periods were selected for evaluation: 2015 and 2020. The year 2015 was selected to represent the construction period, and the year 2020 was selected to represent the operation and maintenance period. Forecasting beyond 2020 increases the uncertainty in predicting whether projects will proceed, and the effects associated with these projects.

4.3 ANALYSIS OF CUMULATIVE EFFECTS

Section 2 of the ER considers the potential effects of the Project on specific features and conditions, and proposes mitigation and protective measures to obviate or reduce the potential effects. The cumulative effects assessment evaluates the significance of residual effects (after mitigation) of the pipeline along with the effects of other unrelated projects.

Year 2015: Construction

The following resources were reviewed to identify those projects with a high probability of proceeding just prior to or concurrent with pipeline construction:

1. The Halton Region Roads Capital Projects (2012 to 2021) did not identify any road upgrades (widening, reconstruction, new roads, interchange, bridges and grade separations) within 100m of the Station site.
2. The Halton Region Capital Works Program (2012 to 2021) did not identify any water facility projects, water distribution projects or road upgrades within 100m of the Station site.
3. The Region of Peel Capital Budget (2012 – 2021) did not identify any road upgrades, bridge and culvert upgrades, environmental assessment study projects, water facility projects or water distribution projects within 100m of the Station site.

As a review of these resources identified no projects within 100m of the Station site, the potential for cumulative effects is not evaluated further. The only project identified within 100m of the Station site is the construction of a proposed 42 inch pipeline associated with the Project.

Significant effects associated with construction of the proposed Station have been minimized through the recommended mitigation and protective measures. By limiting the Project-specific effects, the potential interaction of effects from construction of the proposed Station with other unrelated projects has been considerably reduced. Potential cumulative effects resulting from Station construction and the proposed 42 inch pipeline are additive effects on soil, air quality and the acoustic environment.

Potential residual effects on soil include loss of prime agricultural land. As the construction of the proposed 42 inch pipeline will only lead to a temporary disturbance to soils, no additive effects are anticipated.

Potential residual effects on air quality associated with construction of the Project are an increase in air pollutants from operation of vehicles and equipment, and an increase in dust from construction activities. It is expected that activities from the proposed 42 inch pipeline will also lead to a temporary increase in pollutants and dust. Provided that mitigation measures outlined in this Report are properly implemented, cumulative effects will be of short duration, low magnitude, and reversible. Therefore adverse residual cumulative effects on air quality are not anticipated to be significant.

As construction of the Station and proposed 42 inch pipeline will cause noise, cumulative effects may occur. Provided that activities follow noise reduction practices outlined in this Report, cumulative effects will be of short duration, low magnitude, and reversible. Therefore adverse residual cumulative effects on the acoustic environment are not anticipated to be significant.

Year 2020: Operation and Maintenance

Development which has a probability of proceeding during operation and maintenance of the Project includes:

1. Road works: Future road rehabilitation and resurfacing, and bridge rehabilitation and replacement.
2. Water works: Future installation of water pipelines.
3. Electrical works: Future expansion of electrical transmission lines.
4. 407 works: Future expansion of the existing Highway 407 maintenance yard (located to the immediate north of the Station site).
5. Pipeline maintenance: Future maintenance activities on the 42 inch pipeline.

Potential cumulative effects resulting from Station operation and the above potential development and maintenance projects are additive effects on air quality and the acoustic environment, and visual impacts.

Potential residual effects on air quality associated with operation of the Project and unrelated development and maintenance projects are an increase in air pollutants from Station operation and the operation of vehicles and equipment. Provided that the Station operates within the conditions of its ECA from the MOE, and development and maintenance projects implement air emission reduction practices, cumulative effects will be of short duration and low magnitude. Therefore adverse residual cumulative effects on air quality are not anticipated to be significant

As operation of the Station and development and maintenance projects will cause noise, cumulative effects may occur. Provided that the Station operates within the conditions of its ECA from the MOE, and development and maintenance projects implement noise reduction practices, cumulative effects will be of short duration and low magnitude. Therefore adverse residual cumulative effects on the acoustic environment are not anticipated to be significant.

The development of the Station and unrelated development and maintenance projects will alter the existing visual landscape. Provided that landscaping mitigation is implemented at the Station, and that future unrelated above-ground projects are situated in the Parkway Belt West Plan area or within the vicinity of the existing Highway 407 maintenance yard, adverse residual cumulative effects on the visual landscape are not anticipated to be significant.

4.4 SUMMARY

The potential cumulative effects of the Project were assessed by considering projects/activities that have a high probability of commencing during construction of the proposed Project, or that may commence sometime in the future. A 100 m boundary was used to assess the potential for additive and interactive effects of the proposed Station and the other projects on environmental and socio-economic features. The cumulative effects assessment determined that, provided the mitigation and protective measures outlined for this Project are implemented, potential cumulative effects are not anticipated to be significant.

5.0 Conclusion

The ER investigated data on the physical, aquatic, terrestrial and socio-economic environment at the site of the proposed Parkway West Compressor Station. In the opinion of Stantec, the recommended program of standard mitigation and protective measures are considered sufficient to protect the features encountered. Monitoring and contingency measures will ensure mitigation and protective measures have been effective in both the short and long term.

With the implementation of the recommendations in the ER, on-going communication and consultation, and adherence to related permit, regulatory and/or legislative requirements, any adverse residual environmental and/or socio-economic effects of this Project are not anticipated to be significant.

STANTEC CONSULTING LTD



Mark Knight, MA, MCIP, RPP
Environmental Planner



Rob Rowland
Senior Project Manager

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Appendix A

Report Figures



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Revised: 2013-02-13 By: carobertson

Notes:
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthographic imagery provided by © Mapcon, 2012. Imagery taken in Spring 2010.

February, 2013
160960730

Stantec

Legend

- Orginal Study Area
- Expanded Study Area
- Proposed Parkway West Station
- Site of Existing Compressor Station (Parkway)
- Pipeline (Existing Union Gas System)
- Expressway/Highway
- Road
- Railway
- Watercourse
- Waterbody

Client/Project
Union Gas Limited
Parkway West Project - Natural Gas Pipeline

Figure No.
A-1

Title
Study Area

Appendix B

Consultation and Engagement

Appendix B1

First Nations, Métis Nation and Agency Contact List

Parkway West Natural Gas Pipeline Project
Agency Contact List

Title	First Name	Last Name	Agency	Department	Position	Address	City	Prov	Postal	Phone	Fax	Email
Federal Agencies												
Ms.	Louise	Knox	Canadian Environmental Assessment Agency	Ontario Region	Regional Director	55 St. Clair Avenue East - 9th Floor	Toronto	ON	M4T 1M2	416-952-1575	416-952-1573	louise.knox@ceaa-acee.gc.ca
Mr.	Dave	Reynolds	CN Rail	Engineering and Environmental Services	Manager	1 Administration Road PO Box 1000	Concord	ON	L4K 1B9	905 669 3119	905 760 3406	
Mr.	Rob	Dobos	Environment Canada	Environmental Protection Operations Division - Ontario Region	Manager, Environmental Assessment Section	867 Lakeshore Road PO Box 5050	Burlington	ON	L7R 4A6	905-336-4953	905-336-8901	rob.dobos@ec.gc.ca
Ms.	Sara	Eddy	Fisheries and Oceans Canada	Fish Habitat Management - Ontario-Great Lakes Area	Senior Habitat Biologist	867 Lakeshore Road PO Box 5050	Burlington	ON	L7R 4A6	905-336-4535	905-336-6285	sara.eddy@dfo-mpo.gc.ca
Mr.	Sean	Darcy	Indian and Northern Affairs Canada	Assessment & Historical Research Directorate	Research Manager	10 Wellington Street - Room 1310	Gatineau	QC	K1A 0H4	819-997-8155	819-994-1366	sean.darcy@ainc-inac.gc.ca
Ms.	Josée	Beauregard	Indian and Northern Affairs Canada		Team Leader, Eastern Litigation Directorate	10 Wellington Street	Gatineau	QC	K1A 0H4			
Mr.	Jeffrey	Betker	Indian and Northern Affairs Canada	Office for the Federal Interlocutor for Metis and Non-status Indians	Senior Policy Analyst	66 Slater Street – Room 1218	Ottawa	ON	K1A 0H4	613 992 7037		Jeffrey.betker@inac.gc.ca
Provincial Agencies and Authorities												
Ms.	Leah	Smith	Conservation Halton	Planning Services	Environmental Planner	2596 Britannia Road West	Burlington	ON	L7P 0G3	905 336 1158 xt 283		lsmith@hrca.on.ca
Mr.	David	Cooper	Ministry of Agriculture	Food Safety & Environmental	Manager, Environmental	1 Stone Road West - 3rd Floor	Guelph	ON	N1G 4Y2	519-826-3117	519-826-3109	david.cooper@ontari

Parkway West Natural Gas Pipeline Project
Agency Contact List

Title	First Name	Last Name	Agency	Department	Position	Address	City	Prov	Postal	Phone	Fax	Email
			Food & Rural Affairs	Policy Branch	& Land Use Policy							o.ca
Ms.	Jackie	Van de Valk	Ministry of Agriculture Food & Rural Affairs		Rural Planner – Central-West Ontario	6484 Wellington Road 7 – Unit 10	Elora	ON	N0B 1S0	519 846 3415		
Ms.	Donna	Mundie	Ministry of Agriculture, Food and Rural Affairs		Land Use Policy Specialist, Resources	1 Stone Road West	Guelph	ON	N1G 4Y2	1-519-826-3210		
Mr.	Chris	Schiler	Ministry of Culture	Culture Services Unit	Manager	400 University Ave, 4th Floor	Toronto	ON	M7A 2R9	416 314 7144		Chris.schiler@ontario.ca
Mr.	Tom	Chrzan	Ministry of Citizenship & Immigration Ministry of Culture Ministry of Tourism & Health Promotion	Central Region	Manager	180 Dundas Street West, Suite 502	Toronto	ON	M7A 2R9	416 314 6682	416 314 2024	tom.chrzan@ontario.ca
Mr.	Alan	Jenkins	Ministry of Energy & Infrastructure	Renewable & Clean Energy - Energy Supply & Competition Branch	Senior Policy Specialist	880 Bay Street - 3rd Floor	Toronto	ON	M7A 2C1	416-325-2926	416-325-6972	allan.jenkins@ontario.ca
Mr.	Harley	Springman	Ministry of Energy & Infrastructure	Strategic Policy Branch - Conservation & Strategic Policy Division	Senior Policy Advisor	880 Bay Street - 6th Floor	Toronto	ON	M7A 2C1	416-327-7276	416-327-7204	harley.springman@ontario.ca
Ms.	Jamie	Austin	Ministry of Energy & Infrastructure	Ontario Growth Secretariat	Manager, Growth Policy	777 Bay Street, 4th Floor, Suite 425	Toronto	ON	M5G 2E5	416 325 5794	416 325 7403	Jamie.austin@ontario.ca
	Sir or Madam		Ministry of the Environment	Halton-Peel District Office	District Manager	4145 North Service Road, Suite 300	Burlington	ON	L7L 6A3	905 319 3847	519-873-5020	

Parkway West Natural Gas Pipeline Project
Agency Contact List

Title	First Name	Last Name	Agency	Department	Position	Address	City	Prov	Postal	Phone	Fax	Email
Mr.	Dan	Panko	Ministry of the Environment	Central Region	MOE Regional Contact	5775 Yonge Street, 8th Floor	North York	ON	M2M 4J1	416 326 4835	416 325 6345	Dan.panko@ontario.ca
	Chunmei	Liu	Ministry of the Environment	Central Region	EA and Planning Coordinator	5775 Yonge St, 8th Floor	North York	Ontario	M2M 4J1	416 326 6700	416 325 6345	Chunmei.liu@ontario.ca
Ms.	Renee	Bowler	Ministry of Natural Resources	Land Use and Environmental Planning Section – Policy and Planning Coordination Branch		300 Water Street	Peterborough	ON	K9J 8M5	705 755 5870		Sharon.rew@ontario.ca
Mr.	Steve	Strong	Ministry of Natural Resources	Aurora District	District Planner	50 Bloomington Road West RR#2	Aurora	ON	L4G 3G8	905 713 7366	905 713 7360	Steven.strong@ontario.ca
Mr.	Jim	Boothby	Ministry of Natural Resources	Southern Region	Senior Planner	300 Water Street, Box 7000, 4th Floor	Peterborough	ON	K9J 3C7	705 755 3224	705 755 3289	Jim.boothby@ontario.ca
Mr.	Tony	Difabio	Ministry of Transportation			301 St. Paul Street, 2nd Floor	St. Catharines	ON	L2R 7R4	905 704 2916		Tony.difabio@ontario.ca
	Sir or Madam		Ministry of Transportation	Central Region Engineering Office	Manager	1201 Wilson Avenue, 5th Floor, Bldg D	Downsview	ON	M3M 1J8	416 235 5553	416 325 3436	
Ms.	Zora	Crnojacki	Ontario Energy Board	Applications & Regulatory Audit	Project Advisor	2300 Yonge Street, 26th floor PO Box 2319	Toronto	ON	M4P 1E4			
Mr.	Oscar	Alonso	Technical Standards and Safety Authority			3300 Bloor St W, 14th Floor, Centre Tower	Toronto	ON	M8X 2X4	416 734 3353	416 231 7525	oalonso@tssa.org
Mr.	Goran	Ciric	Ministry of Municipal Affairs and Housing	Provincial Planning Policy Branch	Senior Planner	777 Bay Street, 14th Floor	Toronto	ON	M5G 2E5	585 6246	585 6870	Goran.ciric@ontario.ca
Mr.	Jeff	Booker	407 ETR	Highway Engineering Services	Manager	6300 Steeles Avenue West	Woodbridge	ON	L4H 1J1	905 265 4070, xt 5485		jbooker@407etr.com

Parkway West Natural Gas Pipeline Project
Agency Contact List

Title	First Name	Last Name	Agency	Department	Position	Address	City	Prov	Postal	Phone	Fax	Email
Mr.	Dave	Bader	407 ETR	Highway Engineering Services	Highway Engineering Technician	6300 Steeles Avenue West	Woodbridge	ON	L4H 1J1			dbader@407etr.com
Municipal Staff												
Mr.	Troy	McHarg	Town of Milton		Deputy Clerk	150 Mary St	Milton	ON	L9T 6Z5	905 878 7252 xt 2131	905 876 5022	
Mr.	Bill	Mann	Town of Milton	Planning and Development	Director, Planning and Development	150 Mary St	Milton	ON	L9T 6Z5	905 878 7252 xt 2398		bill.mann@milton.ca
Mr.	Andrew	Siltala	Town of Milton	Economic Development	Senior Manager, Economic Development	150 Mary St	Milton	ON	L9T 6Z5	905 878 7252		
Mr.	Paul	Cripps	Town of Milton	Engineering Services	Director, Engineering Services	150 Mary St	Milton	ON	L9T 6Z5	905 878 7252		
Ms.	Karyn	Bennett	Halton Region		Regional Clerk	1151 Bronte Road	Oakville	ON	L6M 3L1	905 825 6000		
Mr.	John	Davidson	Halton Region	Economic Development	Director of Economic Development	1151 Bronte Road	Oakville	ON	L6M 3L1	905 925 6000 xt 7828		
Mr.	Tim	Dennis	Halton Region	Public Works	Director of Transportation Services	1151 Bronte Road	Oakville	ON	L6M 3L1	905 825 6000 xt 7775		
Mr.	Ron	Glenn	Halton Region	Planning Services	Director of Planning Services & Chief Planning Official	1075 North St. Rd West Unit 27	Oakville	ON	L6M 2G2	905 825 6000 xt 7966		
Ms.	Shelley	Partridge	Halton Region	Legislative & Planning Services Department	Senior Planner	1151 Bronte Road	Oakville	ON	L6M 3L1	905-825-6000 ext. 7180	905-825-8822	

Parkway West Natural Gas Pipeline Project
Agency Contact List

Title	First Name	Last Name	Agency	Department	Position	Address	City	Prov	Postal	Phone	Fax	Email
Ms.	Denise	Clement	Halton Region	Public Works	District Works Clerk	1151 Bronte Road	Oakville	ON	L6M 3L1	905 825 6000 xt 7667		Denise.clement@halton.ca
Ms.	Crystal	Greer	City of Mississauga	Office of the City Clerk	City Clerk	300 City Centre Dr	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	Crystal.greer@mississauga.ca
Ms.	Wendy	Alexander	City of Mississauga	Transportation and Infrastructure Planning	Director	201 City Centre Dr.	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	
Ms.	M.	Ball	City of Mississauga	Development and Design	Director, Development and Design	300 City Centre Dr	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	
Mr.	J.	Calvert	City of Mississauga	Policy Planning	Director, Policy Planning	300 City Centre Dr	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	
Mr.	Frank	Marzo	City of Mississauga	Policy Planning	Planner	300 City Centre Dr	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	Frank.Marzo@mississauga.ca
Mr.	E.	Sajecki	City of Mississauga	Planning and Building	Commissioner, Planning and Building	300 City Centre Dr	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	
Mr.	Larry	Petovello	City of Mississauga	Economic Development	Director, Economic Development	300 City Centre Dr	Mississauga	ON	L5B 3C1	905 615 3200	905 615 4081	

Parkway West Natural Gas Pipeline Project
First Nations and Métis Nation Contact List

Title	First Name	Last Name	Community	Address	City	Prov	Postal Code	Cc	Notes
Chief	William	Montour	Six Nations of the Grand River	1695 Chiefswood Road	Ohsweken	ON	N0A 1M0		
	Lonny	Bomberry	Six Nations of the Grand River	1695 Chiefswood Road	Ohsweken	ON	N0A 1M0		
Chief	Bryan	LaForme	Mississaugas of New Credit	2789 Mississauga Road RR # 6	Hagersville	ON	N0A 1H0		
Environmental Assessment Coordinator	Caroline	King	Mississaugas of New Credit	2789 Mississauga RoadRR#6	Hagersville	ON	N0A 1H0		
Ms.	Melanie	Paradis	Métis Nation of Ontario	500 Old St. Patrick St., Unit D	Ottawa	ON	K1N 9G4		
Executive Director	Hazel	Hill	Haudenosaunee Development Institute	16 Sunrise Court Suite 417	Ohsweken	ON	N0A 1M0	Chief Allen MacNaughton, Haudenosaunee, Confederacy Chiefs Council	
Chief	Allen	MacNaughton	Haudenosaunee Confederacy Chiefs Council	16 Sunrise Court Suite 417	Ohsweken	ON	N0A 1M0	Hazel Hill, Haudenosaunee Development Institute	
Chief	Donna	Big Canoe	Chippewas of Georgina Island	RR2, PO Box 13	Sutton West	ON	L0E 1R0		Federal recommendation.

Appendix B2

Newspaper Notices

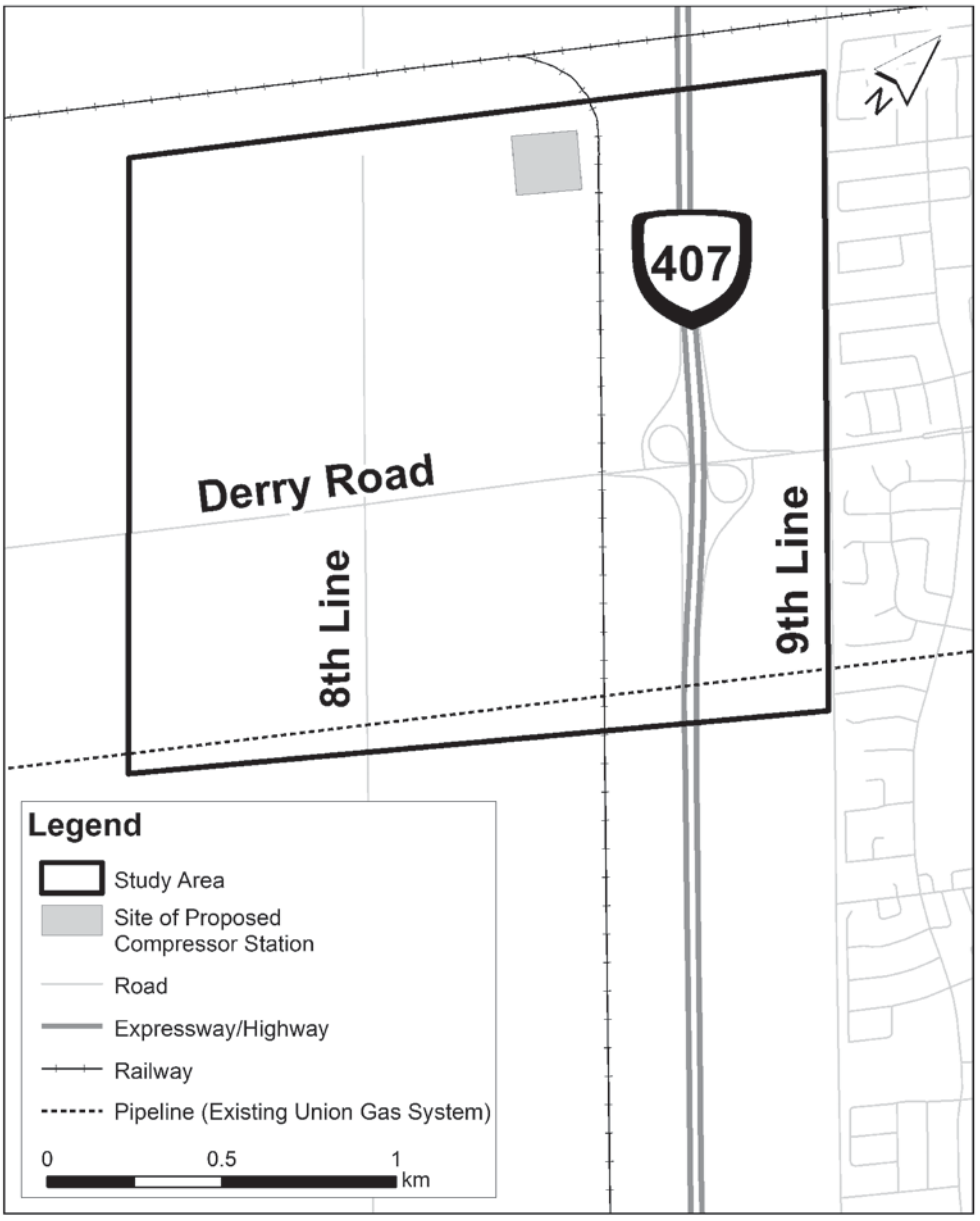
NOTICE OF INITIATION OF ENVIRONMENTAL STUDY
Union Gas Limited - Proposed Parkway West Project

To ensure the continuation of safe, reliable natural gas service, Union Gas Limited (Union Gas) plans to build a new compressor station in the vicinity of Derry Road and Highway 407 in the Town of Milton, Ontario. Construction of two 54 inch diameter natural gas pipelines approximately 1.2 kilometers in length, are required to connect the new compressor facility to the existing Union Gas pipeline system. Please see adjacent figure showing the study area.

As part of the planning process, Union Gas has commissioned Stantec Consulting Ltd. (Stantec) to undertake an environmental study for the proposed pipelines. The compressor station will follow a separate Municipal review and approval process.

The environmental study will fulfill the requirements of the Ontario Energy Board's (OEB) "Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario (2011)". The environmental study process will include consultation and engagement with landowners, First Nations, the Métis Nation, government agencies and other local stakeholders. Consultation and engagement will be instrumental in various aspects of the study such as defining mitigation measures to minimize the effects of constructing and operating the proposed pipelines.

It is anticipated that an Environmental Report for the study will be completed in the fall of 2012 at which time Union Gas will file an application for the proposed pipelines to the OEB. The OEB's review and approval is required before construction of the proposed natural gas pipelines can proceed. If approved, and if plans for the new compressor station also proceed, construction of the pipelines could begin in the summer of 2014.



For questions regarding the environmental study process or this project, please contact Stantec Consulting Ltd. at 519-569-4338.

uniongas
A Spectra Energy Company

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NOTICE OF INFORMATION SESSION
Union Gas Limited - Parkway West Project - Natural Gas Pipeline

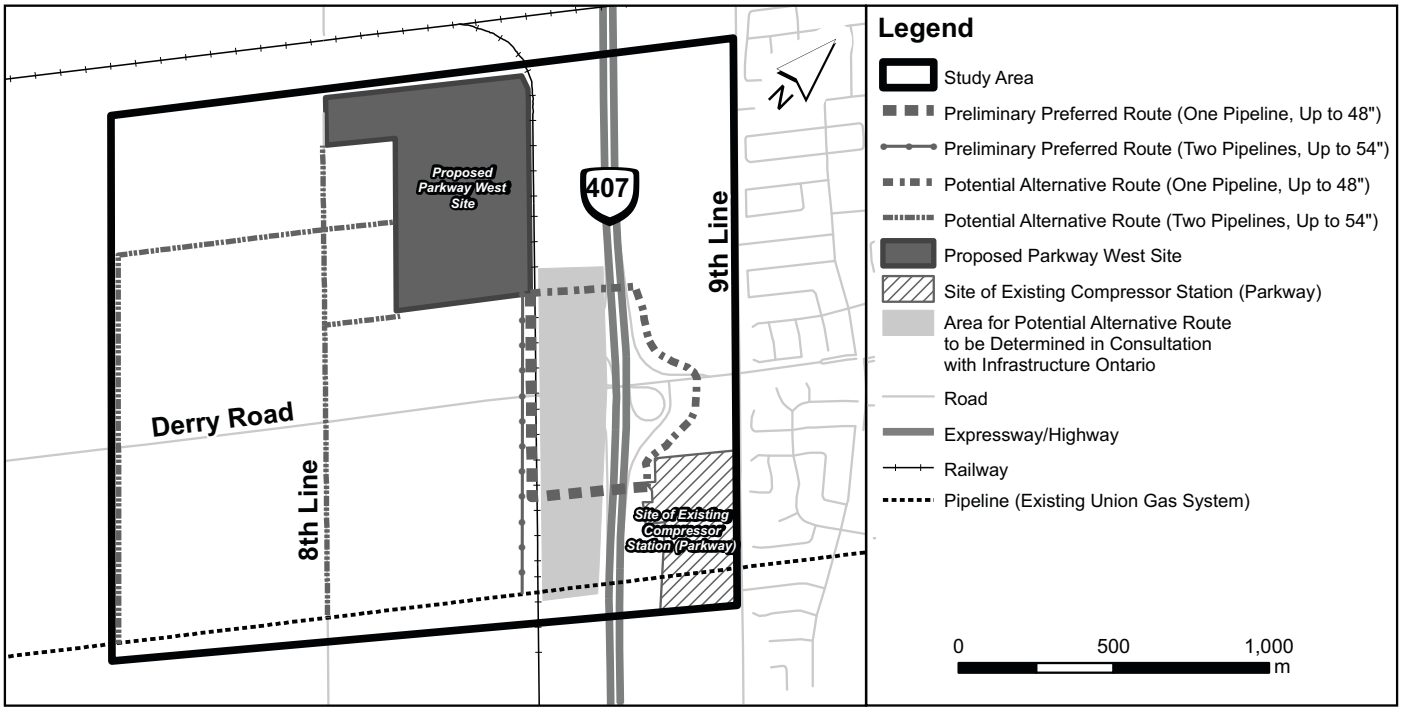
To ensure continued safe reliable natural gas service, Union Gas proposes to construct two new pipelines that will be up to 54 inches in diameter and approximately 1.2 km each in length along with a third new pipeline that will be up to 48 inches in diameter and approximately 1.4 km in length. The pipelines are required to connect a new proposed compressor facility in the vicinity of Derry Road and Highway 407 to existing Union Gas pipeline systems and facilities, all located in the Town of Milton, and City of Mississauga, Ontario.

As part of the planning process, Union Gas has commissioned Stantec Consulting Ltd. to undertake an environmental study for the proposed pipelines. The compressor station will follow a separate Municipal review and approval process.

As part of the study process, a Preliminary Preferred Route and Potential Alternative Routes for each of the proposed natural gas pipelines have been identified. The Routes follow existing linear features where feasible, such as railway easements, road right-of-ways and property lines. Please see map.

An Information Session regarding the Project, the Preliminary Preferred Routes and Potential Alternative Routes will be held as follows:

Milton Sports Centre
605 Santa Maria Blvd
Milton, ON
August 1, 2012
4:00 p.m. to 8:00 p.m.



The Information Session will be a drop-in centre where representatives from Union Gas and Stantec will be available to discuss the Project and respond to questions or comments. Comments received at the Information Session will be instrumental in evaluating the Preliminary Preferred Routes and Potential Alternative Routes. Comments will also be used to help develop site-specific protection and mitigation measures.

It is anticipated that an Environmental Report will be completed in the fall of 2012 at which time Union Gas will file an application for the proposed pipelines to the Ontario Energy Board (OEB). The OEB's review and approval is required before the proposed natural gas pipeline project can proceed. If approved, the Project will be in service by November 2014.

For questions regarding the study process or this Project, please contact Stantec Consulting at 1-519-569-4338.

uniongas
A Spectra Energy Company

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NOTICE OF NEIGHBOURHOOD INFORMATION SESSION
Union Gas Limited – Parkway West Project – Proposed Compressor Station

Compression facilities are essential to the movement of natural gas to homes and businesses in Ontario.

Union Gas Limited is proposing to construct a natural gas Compressor Station fronting on Eighth Line, southeast of Derry Road East and southwest of Highway 407 in Milton, Ontario.

The facility would consist of compression facilities, valves, measurement and regulation facilities, and a pipeline network. An administration area and building would be constructed near the entrance to the property from Eighth Line. Earth berms would be constructed along the north, south and west sides of the facility and a site service road would be constructed within the perimeter of the facility property.

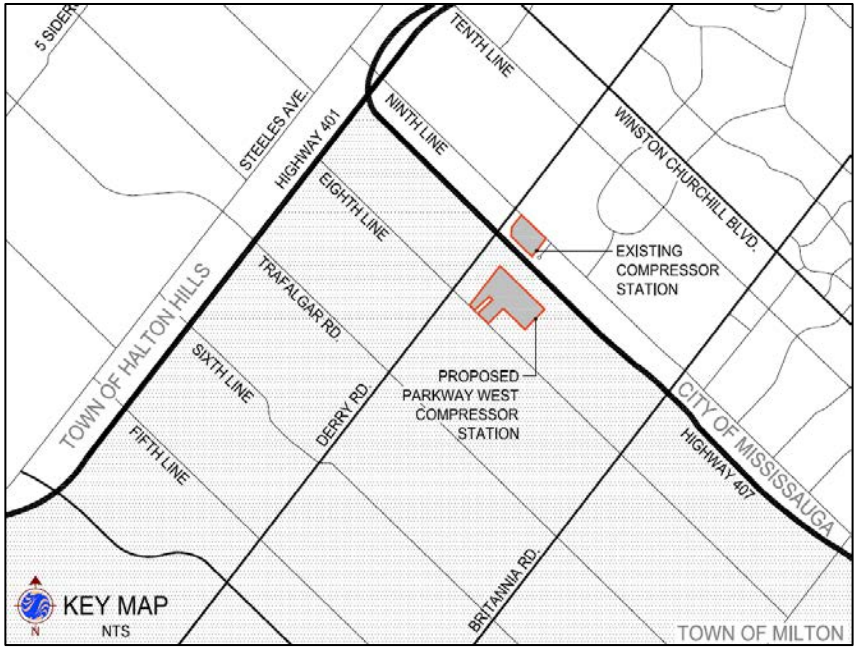
As part of the planning process, Union Gas Limited has commissioned Stantec Consulting Ltd. to pursue applications for the required Municipal approvals including a Zoning By-Law Amendment and Site Plan Approvals. Union Gas Limited would like to have the Compressor Station, pending approvals, in service by late 2015.

An Information Session regarding the Zoning By-Law Amendment Application for the Compressor Station, will be held as follows:

Milton Sports Centre
605 Santa Maria Blvd
Milton, ON
March 7, 2013
4:30 p.m. to 8:30 p.m.
Meeting Room #4

Representatives from Union Gas Limited and Stantec Consulting Ltd. will be available at the drop-in session to discuss the Project and respond to questions or comments. Comments received will be taken into account as the Zoning By-Law Amendment request is processed and site design begins.

For questions regarding the study process or this Project, please contact Stantec Consulting Ltd. at 1-519- 585-7267 or jacqueline.hannemann@stantec.com



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Appendix B3

Mailouts

Stantec Consulting Ltd.
Suite 1 - 70 Southgate Drive
Guelph ON N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

May 17, 2012
File: 160960730

Agency
Address
City, Prov PostalCode

Attention: **Title. First_Name Last_Name, Position**

Dear Title. Last_Name:

Reference: **Union Gas Limited – Proposed Parkway West Project – Initiation of Environmental Study**

To ensure the continuation of safe, reliable natural gas service, Union Gas Limited (Union Gas) plans to build a new compressor station in the vicinity of Derry Road and Highway 407 in the Town of Milton, Ontario. Construction of two 54 inch diameter pipelines approximately 1.2 kilometers in length are required to connect the new compressor facility to the existing Union Gas pipeline system – see enclosed figure.

As part of the planning process, Union Gas has commissioned Stantec Consulting Ltd. (Stantec) to undertake an environmental study for the proposed pipelines. The compressor station will follow a separate Municipal review and approval process.

The environmental study will fulfill the requirements of the Ontario Energy Board's (OEB) "Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario (2011)". The environmental study process will include consultation and engagement with landowners, First Nations, the Métis Nation, government agencies and other local stakeholders. Consultation and engagement will be instrumental in various aspects of the study such as defining mitigation measures to minimize the effects of constructing and operating the proposed pipelines.

It is anticipated that an Environmental Report for the study will be completed in the fall of 2012 at which time Union Gas will file an application for the proposed pipelines to the OEB. The OEB's review and approval is required before construction of the proposed natural gas pipelines can proceed.

If approved, and if plans for the new compressor station also proceed, construction of the pipelines could begin in the summer of 2014.

Stantec is presently compiling an environmental and socio-economic inventory of the pipeline study area. As an agency with jurisdiction or a potential interest in developments in the study area, you are invited to provide comments, or coordinate comments, regarding the proposed pipelines. Specifically for within the study area, Stantec is seeking information that may affect construction and operation of the proposed pipeline including: background environmental and socioeconomic information, planning principles or guidelines implemented by your agency, and other proposed developments to assess potential cumulative effects. Please contact us to discuss the most efficient way to obtain this information.

Stantec

May 17, 2012

Reference: Union Gas Limited – Proposed Parkway West Project – Initiation of Environmental Study

For any questions or concerns regarding the environmental study process or this project, please do not hesitate to contact the undersigned.

Sincerely,

STANTEC CONSULTING LTD.



Julia Kossowski
Project Manager
Tel: (519) 569 4338
Fax: (519) 579 6733
julia.kossowski@stantec.com

Attachment: Figure 1 - Study Area

c. Doug Schmidt, Union Gas Limited

Stantec Consulting Ltd.
Suite 1 - 70 Southgate Drive
Guelph ON N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

May 17, 2012
File: 160960730

Community
Address
City, Prov PostalCode

Attention: **Title. First_Name Last_Name**

Dear Title. Last_Name:

Reference: **Union Gas Limited – Proposed Parkway West Project – Initiation of Environmental Study**

To ensure the continuation of safe, reliable natural gas service, Union Gas Limited (Union Gas) plans to build a new compressor station in the vicinity of Derry Road and Highway 407 in the Town of Milton, Ontario. Construction of two 54 inch diameter pipelines approximately 1.2 kilometers in length are required to connect the new compressor facility to the existing Union Gas pipeline system – see enclosed figure.

As part of the planning process, Union Gas has commissioned Stantec Consulting Ltd. (Stantec) to undertake an environmental study for the proposed pipelines. The compressor station will follow a separate Municipal review and approval process.

The environmental study will fulfill the requirements of the Ontario Energy Board's (OEB) "Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario (2011)". The environmental study process will include consultation and engagement with First Nations and the Métis Nation of Ontario. Consultation and engagement will be instrumental in various aspects of the study such as defining mitigation measures to minimize the effects of constructing and operating the proposed pipelines.

It is anticipated that an Environmental Report for the study will be completed in the fall of 2012 at which time Union Gas will file an application for the proposed pipelines to the OEB. The OEB's review and approval is required before construction of the proposed natural gas pipelines can proceed.

If approved, and if plans for the new compressor station also proceed, construction of the pipelines could begin in the summer of 2014.

Stantec is presently compiling an environmental and socio-economic inventory of the project study area. The *«Community»* is invited to provide comments regarding the proposed project. Specifically within the study area, Stantec is seeking comment on: the potential for construction of the compressor and pipelines and operation of these facilities to impact treaty rights and traditional land uses, background environmental and socio-economic conditions, and other proposed developments to assess potential cumulative effects. Please contact us to discuss the most efficient way to obtain this information.

Stantec

May 17, 2012

Reference: Union Gas Limited – Proposed Parkway West Project – Initiation of Environmental Study

For any questions or concerns regarding the environmental study process or this project, please do not hesitate to contact the undersigned.

Sincerely,

STANTEC CONSULTING LTD.



Julia Kossowski
Project Manager
Tel: (519) 569 4338
Fax: (519) 579 6733
julia.kossowski@stantec.com

Attachment: Figure 1 - Study Area

c. Doug Schmidt, Union Gas Limited

Stantec Consulting Ltd.
70 Southgate Drive, Suite 1
Guelph, Ontario, N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

July 17, 2012
File: 160960730

Agency
Address
City, Prov
Postal

Attention: Title. FirstName LastName

Reference: Union Gas Limited – Parkway West Project - Natural Gas Pipeline
Notice of Information Session

Dear Title. LastName

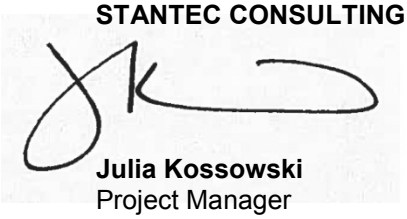
Union Gas has commissioned an independent environmental consulting firm, Stantec Consulting Ltd., to undertake an environmental study of the construction and operation of three proposed natural gas pipelines for a proposed compressor station in the vicinity of Derry Road and Highway 407 in the Town of Milton, Ontario. As part of the study process, Preliminary Preferred Routes and several Potential Alternative Routes have been identified for the proposed natural gas pipelines.

Please find enclosed the Notice of Information Session for the above-referenced Project with a figure which identifies the Preliminary Preferred Routes and Potential Alternative Routes. As outlined in our letter of June 13, 2012 you are invited to provide comments regarding the proposed pipelines. Stantec is also seeking background environmental and socioeconomic information on the study area, planning principles or guidelines implemented by your agency, and proposed developments in the study area to assess potential cumulative effects.

We hope that you can attend the Information Session described in the attached Notice. Alternatively, for any questions or concerns regarding the study process or this Project, please do not hesitate to contact the undersigned.

Sincerely,

STANTEC CONSULTING LTD.



Julia Kossowski
Project Manager
Tel: (519) 569 4338
julia.kossowski@stantec.com

Attachment: Notice of Information Session
Parkway West Study Area Figure

c. Doug Schmidt, Union Gas Limited

Stantec Consulting Ltd.
70 Southgate Drive, Suite 1
Guelph, Ontario, N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

July 17, 2012
File: 160960730

Community
Address
City, Prov
PostalCode

Attention: Title. FirstName LastName

Reference: **Union Gas Limited – Parkway West Project – Natural Gas Pipeline**
Notice of Information Session

Dear Title. LastName:

To ensure continued safe reliable natural gas service, Union Gas proposes to construct two new pipelines that will be up to 54 inches in diameter and approximately 1.2 km each in length along with a third new pipeline that will be up to 48 inches in diameter and approximately 1.4 km in length. The pipelines are required to connect a new proposed compressor in the vicinity of Derry Road and Highway 407 to existing Union Gas pipeline systems and facilities, all located in the Town of Milton, and City of Mississauga, Ontario.

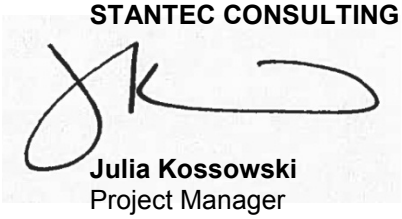
Union Gas has commissioned an independent environmental consulting firm, Stantec Consulting Ltd., to undertake an environmental study of the construction and operation of the proposed natural gas pipelines. As part of the study process, Preliminary Preferred Routes and Potential Alternative Routes have been identified. The Routes follow existing linear features where feasible, such as railway easements, road right-of-ways and property lines.

As outlined in our letter of June 13, 2012, you are invited to provide comments regarding the proposed project. Stantec is seeking comments on: the potential for construction of the compressor and pipelines and operation of these facilities to impact treaty rights and traditional land uses, background environmental and socio-economic conditions, and other proposed developments to assess potential cumulative effects.

Please find enclosed the Notice of Information Session for the above-referenced Project with a figure which identifies the Preliminary Preferred Routes and Potential Alternative Routes for each pipeline. We hope that you can attend the Information Session described in the attached Notice. Alternatively, for any questions or concerns regarding the study process or this Project, please do not hesitate to contact the undersigned or John Bonin, Union Gas Limited, 519-539-8509 ext 5021063, JBonin@uniongas.com.

Sincerely,

STANTEC CONSULTING LTD.



Julia Kossowski
Project Manager
Tel: (519) 569 4338
julia.kossowski@stantec.com

Attachment: Notice of Information Session

c. John Bonin, Union Gas Limited; Doug Schmidt, Union Gas Limited

Stantec Consulting Ltd.
70 Southgate Drive, Suite 1
Guelph, Ontario, N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

July 17, 2012
File: 160960730

Dear Landowner:

Reference: Union Gas Limited –Parkway West Project - Natural Gas Pipeline
Notice of Information Session

To ensure continued safe reliable natural gas service, Union Gas proposes to construct two new pipelines that will be up to 54 inches in diameter and approximately 1.2 km each in length along with a third new pipeline that will be up to 48 inches in diameter and approximately 1.4 km in length. The pipelines are required to connect a new proposed compressor in the vicinity of Derry Road and Highway 407 to existing Union Gas pipeline systems and facilities, all located in the Town of Milton, and City of Mississauga, Ontario.

Union Gas has commissioned an independent environmental consulting firm, Stantec Consulting Ltd., to undertake an environmental study of the construction and operation of the proposed natural gas pipelines. A notice concerning the commencement of the study was published in local newspapers in May of 2012.

As part of the study process, Preliminary Preferred Routes and several Potential Alternative Routes for the proposed natural gas pipelines have been identified. The Routes follow existing linear features where feasible, such as railway easements, road right-of-ways and property lines.

You have received this letter as you own property on or near the proposed Routes. Please find enclosed the Notice of Information Session for the Project with a figure which identifies the Preliminary Preferred Routes and Potential Alternative Routes.

We hope that you can attend the Information Session. Alternatively, for any questions or concerns regarding the study process or this Project, please do not hesitate to contact the undersigned.

Sincerely,

STANTEC CONSULTING LTD.



Julia Kossowski
Project Manager
Tel: (519) 569 4338
julia.kossowski@stantec.com

Attachments: Notice of Information Session

c. Doug Schmidt, Union Gas Limited

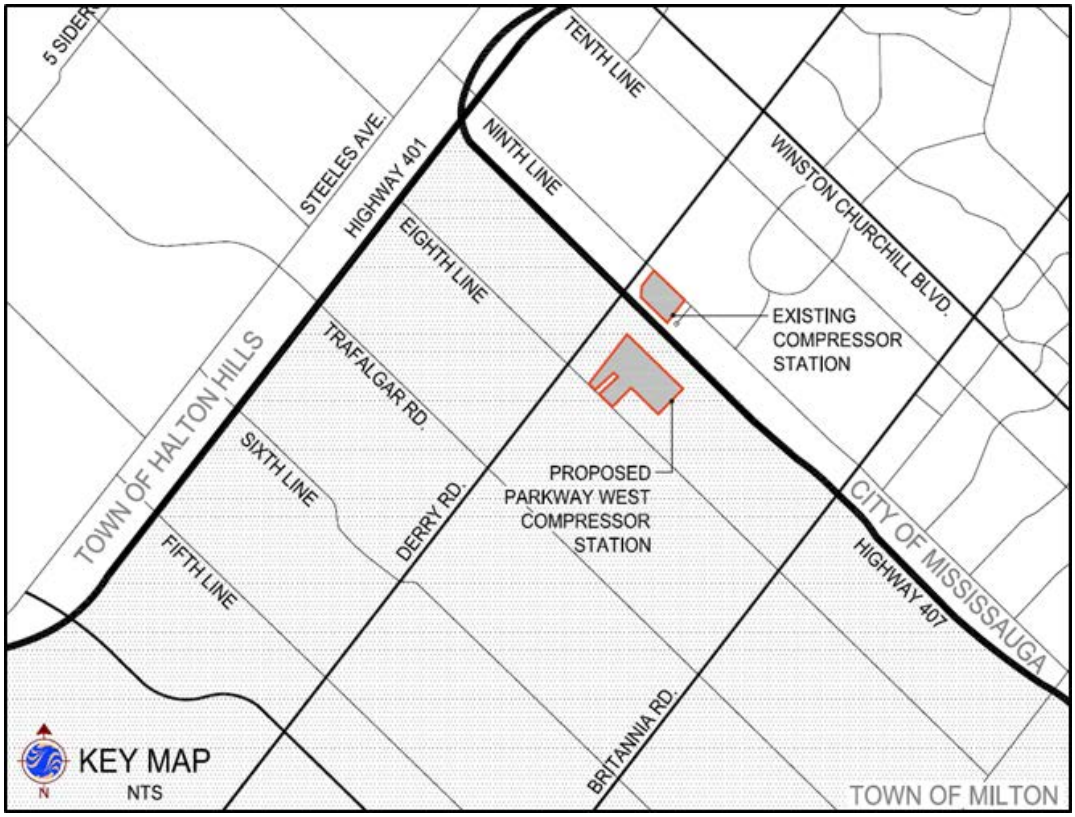
Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410
Fax: (519) 579-6733

February 25, 2013
File: 160311376

<Title>
<FN/MNO>
<Address>
<City>, <PC>

Reference: Union Gas Limited – Parkway West Project – Proposed Compressor Station: Neighbourhood Information Session

Compression facilities are essential to the movement of natural gas to homes and businesses in Ontario. Union Gas Limited is proposing to construct a natural gas Compressor Station fronting on Eighth Line, southeast of Derry Road East and southwest of Highway 407 in Milton, Ontario. Please refer to location figure below.



Reference: Union Gas Limited – Parkway West Project – Proposed Compressor Station: Neighbourhood Information Session

The facility would consist of compression facilities, valves, measurement and regulation facilities, and a pipeline network. An administration area and building would be constructed near the entrance of the property from Eighth Line. Berms would be constructed along the north, south, and west sides of the facility and a site service road would be constructed within the perimeter of the facility property.

As part of the planning process, Union Gas Limited has commissioned Stantec Consulting Ltd. to pursue applications for the required Municipal approval process including a Zoning By-Law Amendment and Site Plan Approvals. Union Gas Limited would like to have the Compressor Station, pending approvals, in service by late 2015.

On behalf of Union Gas Limited, we invite you to attend an Information Session in order to provide you with further information in regards to the proposed Compressor Station facility. Representatives from Union Gas Limited and Stantec Consulting Ltd. will be available at the drop-in session to discuss the Project and respond to questions or comments. Comments received will be taken into account as the Zoning By-Law Amendment is processed and site design begins.

The neighbourhood Information Session regarding the proposal will be held as follows:

Milton Sports Centre
605 Santa Maria Blvd.
Milton, ON
March 7, 2013
4:30pm to 8:30pm
Meeting Room #4

We hope that you can attend the Information Session. If you are unable to attend the session and would like to provide your thoughts/feedback on the proposal, or, for any questions or concerns regarding the Municipal approval process or this Project, please to contact the undersigned or John Bonin, Union Gas Limited, 519-539-8509 ext. 5021063, JBonin@uniongas.com.

Regards,

STANTEC CONSULTING LTD.



Jacqueline Hannemann, BES
Planner
Tel: 519-585-7267
Fax: 519-579-8664
jacqueline.hannemann@stantec.com

c. Mr. John Bonin, Union Gas Limited
Mr. Doug Schmidt, Union Gas Limited

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
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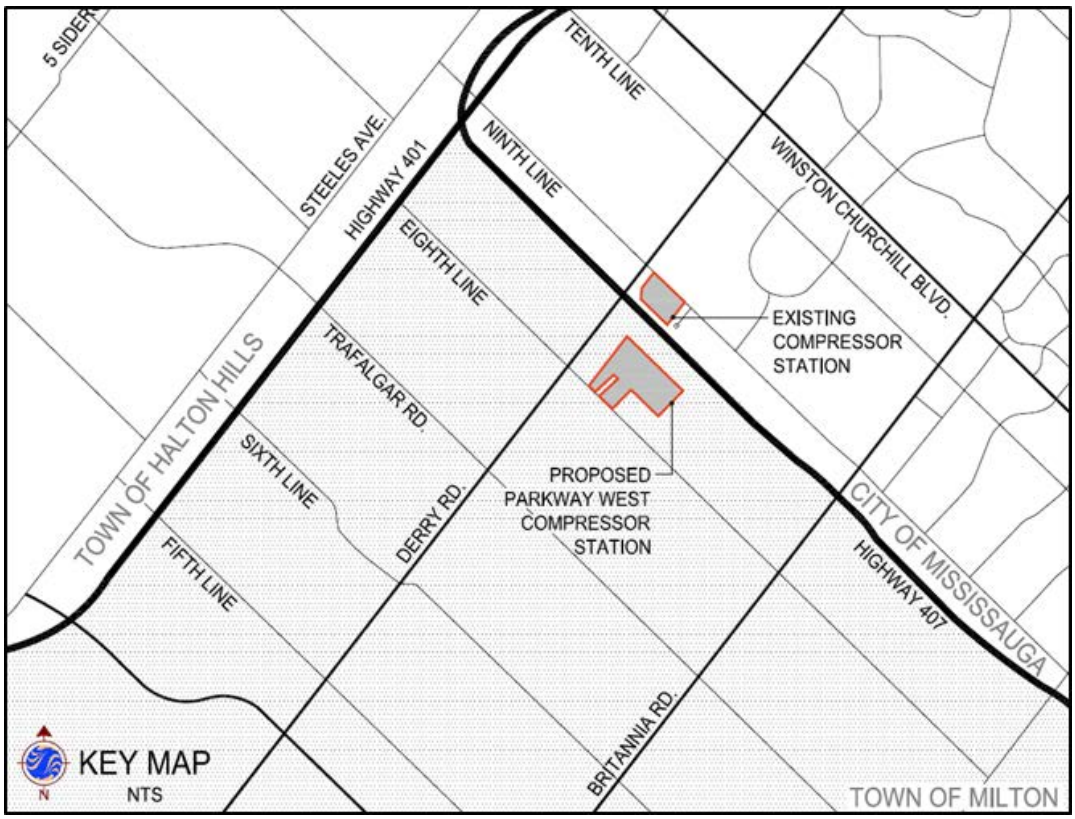
February 25, 2013
File: 160311376

<Title>
<Agency>
<Address>
<City>, <PC>

Dear <Title> <Last Name>,

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Regards,

STANTEC CONSULTING LTD.



Jacqueline Hannemann, BES
Planner
Tel: 519-585-7267
Fax: 519-579-8664
jacqueline.hannemann@stantec.com

c. Mr. Ashleigh Barnwell, Union Gas Limited
Mr. Doug Schmidt, Union Gas Limited
Mr. Merv Weishar, Union Gas Limited

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410
Fax: (519) 579-6733

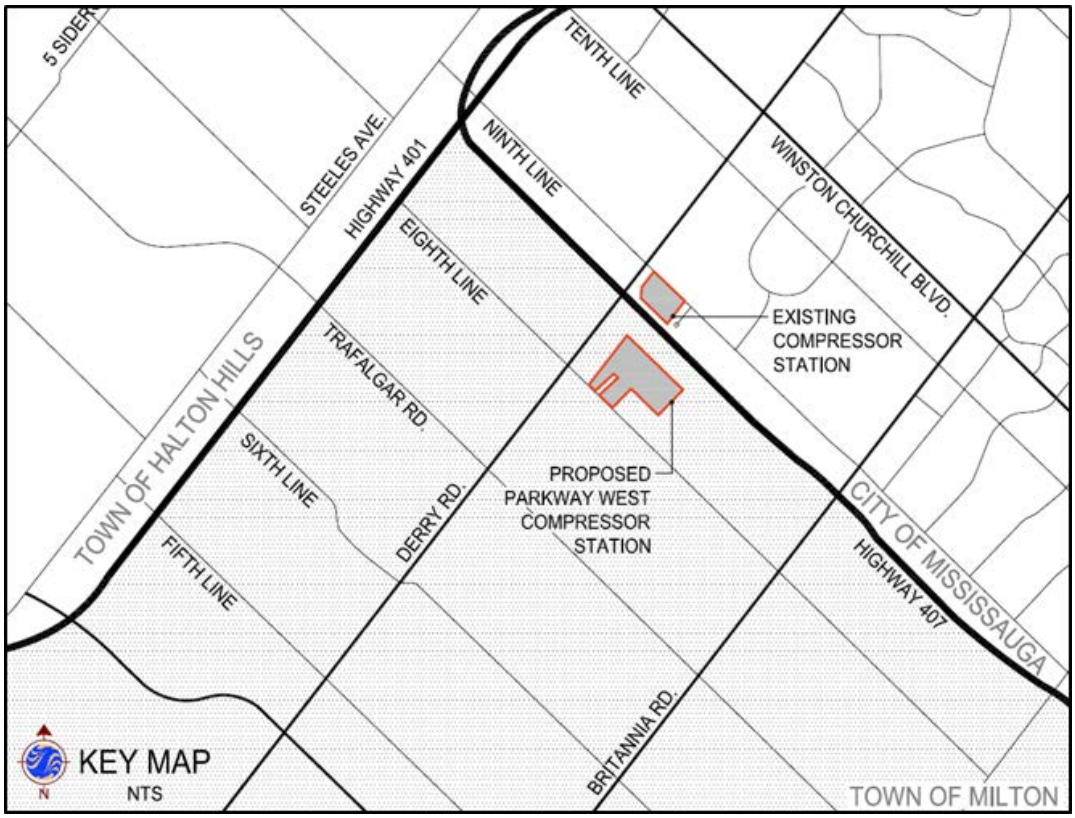
February 26, 2013
File: 160311376

<Interested Party>
<Address>
<City>, <PC>

Dear <Title> <Last Name>,

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Jacqueline Hannemann, BES
Planner
Tel: 519-585-7267
Fax: 519-579-8664
jacqueline.hannemann@stantec.com

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Mr. Doug Schmidt, Union Gas Limited

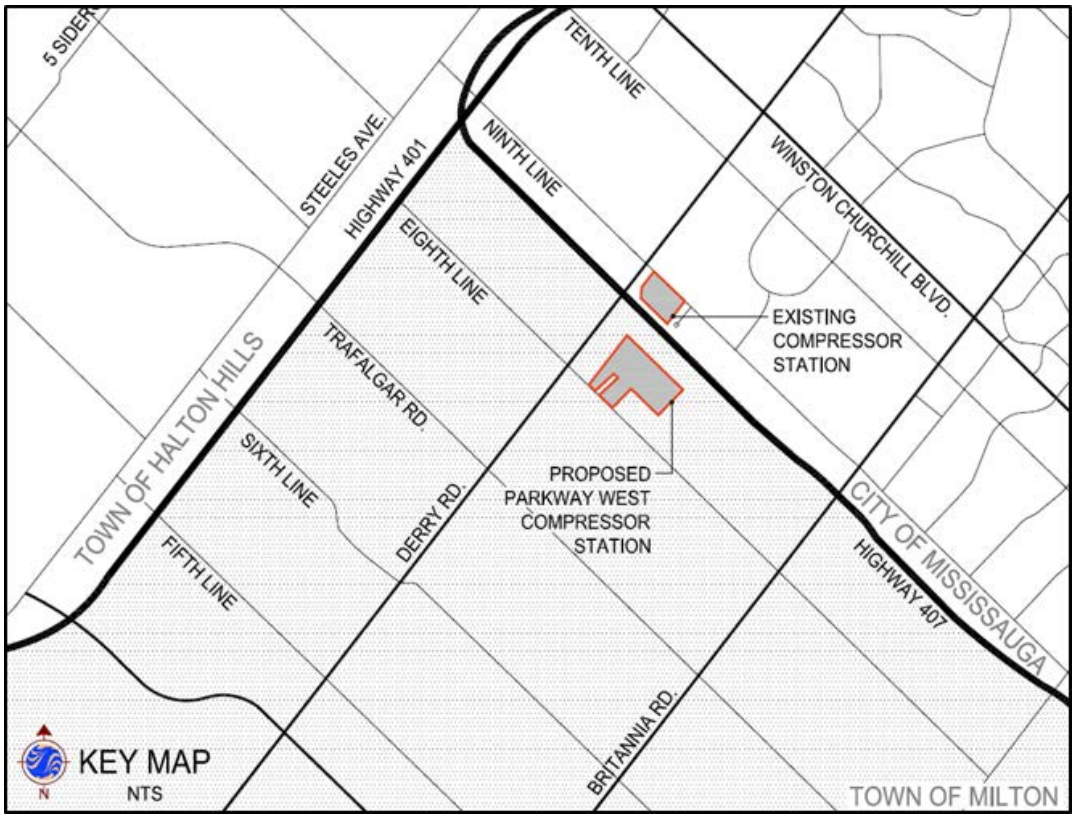
Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410
Fax: (519) 579-6733

February 25, 2013
File: 160311376

Dear Landowner,

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Regards,

STANTEC CONSULTING LTD.



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Planner
Tel: 519-585-7267
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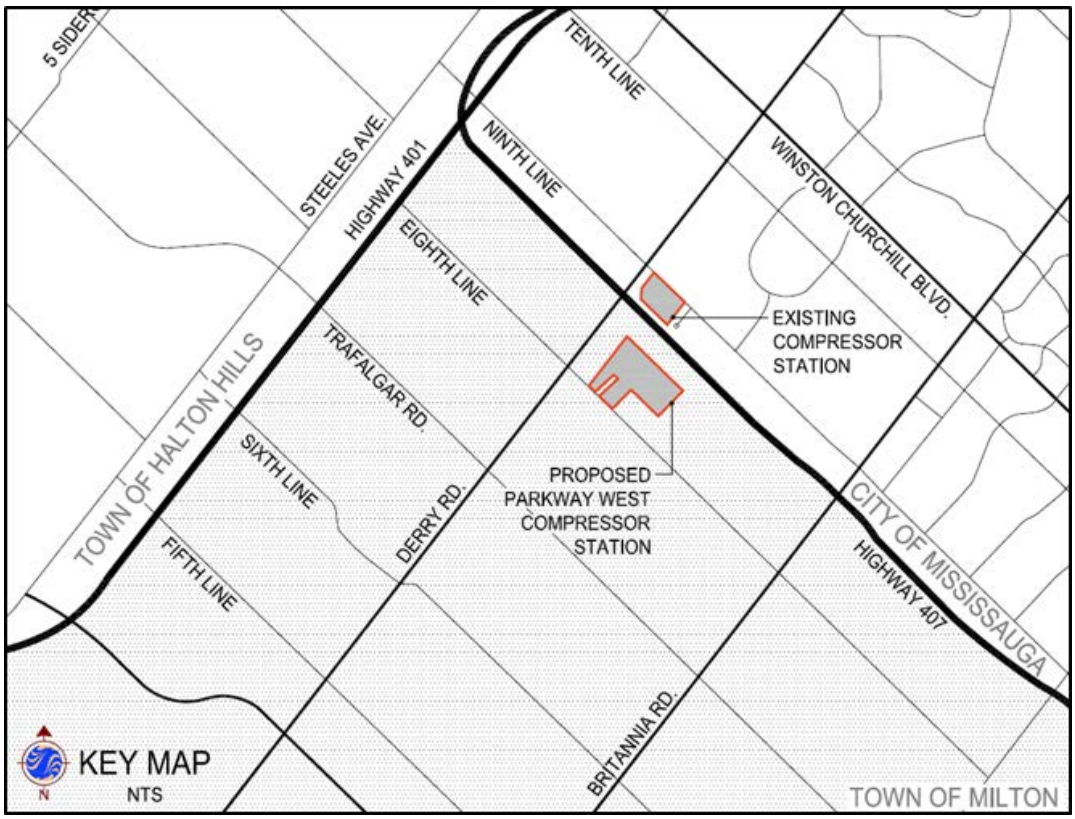
February 26, 2013
File: 160311376

<Title>
<Municipality>
<Address>
<City>, <PC>

Dear <Title> <Last Name>,

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Regards,

STANTEC CONSULTING LTD.



Jacqueline Hannemann, BES
Planner
Tel: 519-585-7267
Fax: 519-579-8664
jacqueline.hannemann@stantec.com

c. Mr. Ashleigh Barnwell, Union Gas Limited
Mr. Doug Schmidt, Union Gas Limited

Appendix B4

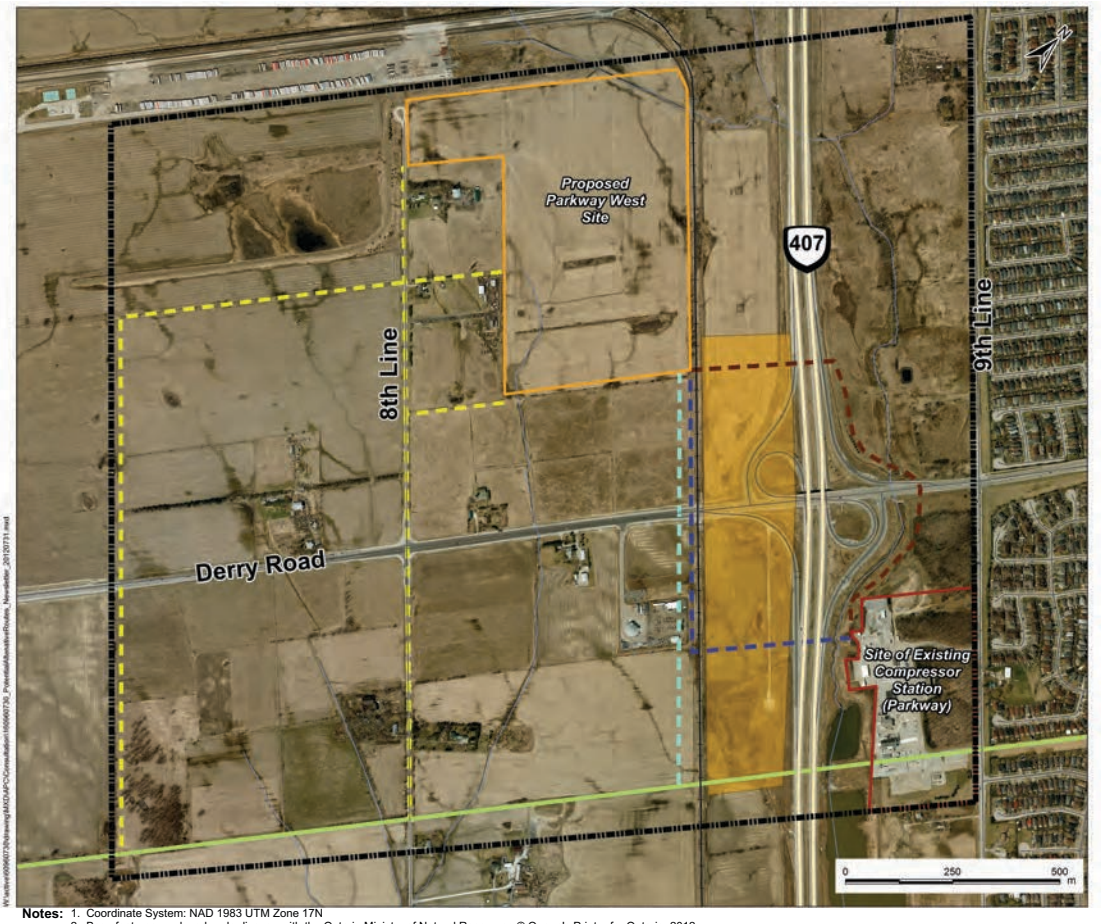
Newsletter, Display Boards and Exit Questionnaire

Union Gas Limited
Parkway West Project - Natural Gas Pipeline

Information Newsletter

Project Overview

The proposed project involves the construction of two new pipelines that will be up to 54 inches in diameter as well as another pipeline that will be up to 48 inches in diameter. The pipelines are required to connect a proposed compressor station in the vicinity of Derry Road and Highway 407 to the existing Union Gas pipeline system. The pipelines will be constructed within new easements on private property and/or along road right-of-ways.



Notes: 1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthographic imagery provided by © Mapcon, 2012. Imagery taken in Spring 2010.

July, 2012
160960730

Legend

- Study Area
- Proposed Parkway West Site
- Site of Existing Compressor Station (Parkway)
- Pipeline (Existing Union Gas System)
- Area for Potential Alternative Route to be Determined in Consultation with Infrastructure Ontario
- Preliminary Preferred Route (One Pipeline, Up to 48")
- Preliminary Preferred Route (Two Pipelines, Up to 54")
- Potential Alternative Route (One Pipeline, Up to 48")
- Potential Alternative Route (Two Pipelines, Up to 54")
- Expressway/Highway
- Road
- Railway
- Watercourse

Project Context

The purpose of the project is to ensure the continuation of safe, reliable natural gas supply to the Greater Toronto Area (GTA) and to other markets beyond the GTA. Union Gas is proposing to build the Parkway West Compressor Station along the transmission system close to Derry Road and Highway 407.

Union Gas Limited has commissioned Stantec Consulting Ltd. to undertake an environmental study of the construction and operation of two natural gas pipelines up to 54" in diameter as well as another pipeline up to 48" in diameter. The pipelines are required to connect the proposed site of the Parkway West Compressor Station to Union Gas's existing pipeline system south of Derry Road.

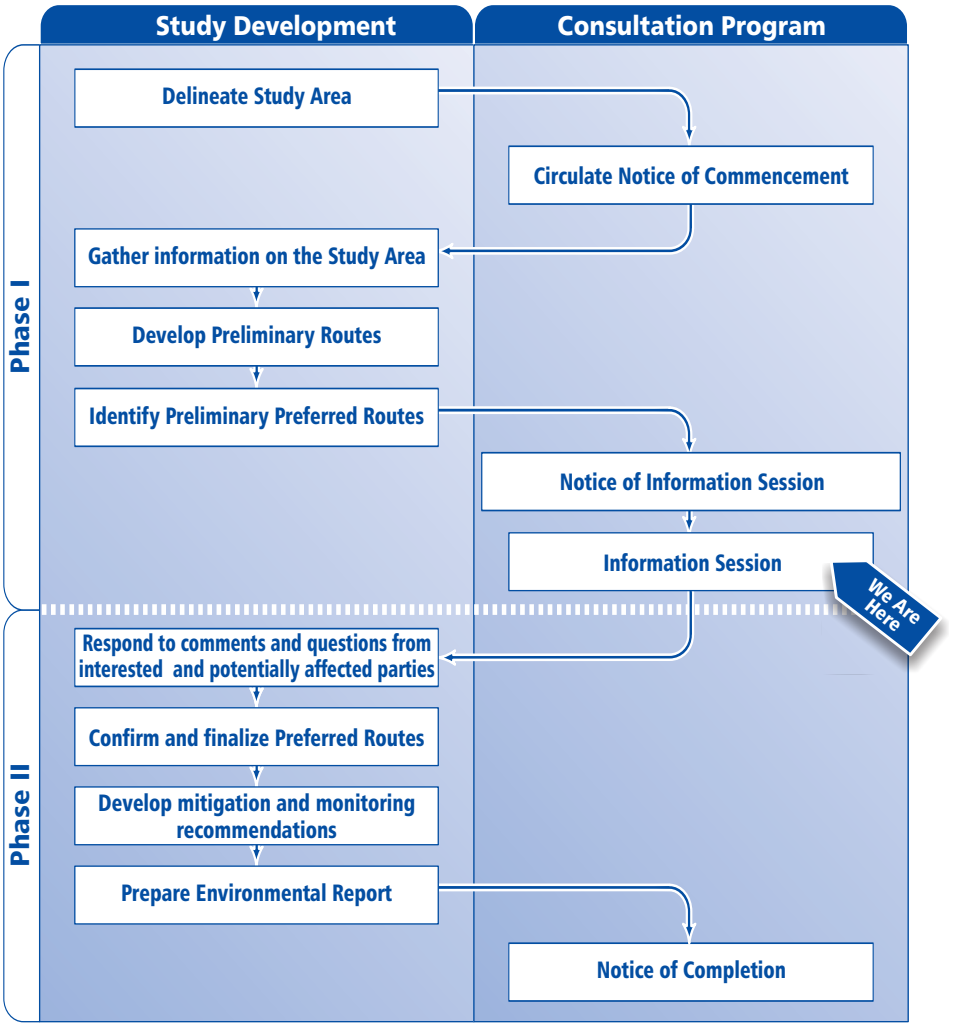
The new Parkway West Compressor Station will follow a separate review and approval process under municipal, regional and provincial jurisdictions as applicable.

Next Steps

After this Information Session, the following will be carried out:

1. Respond to comments/questions received.
2. Confirm study findings to-date based on comments received.
3. Continue data collection and route assessment.
4. Confirm the Preferred Routes.
5. Prepare the Environmental Report, summarizing consultation, route selection, potential impacts and mitigation measures.
6. Prepare an Application for 'Leave to Construct' to the OEB.

Environmental Study Process



Project Schedule

- Completion of Environmental Study for Pipeline
  Fall 2012
- File Application with the Ontario Energy Board
  Fall 2012
- Ontario Energy Board Review and Decision
  Spring 2013
- Pipeline Construction and Clean-Up
  as early as Summer and Fall 2013
- Pipeline Project In-Service
  2014



Let Us Know What You're Thinking

On behalf of the Project Team, thank you for attending this Information Session. We appreciate your involvement in the consultation process and we would like to hear from you. Please fill out the Exit Questionnaire. Include your name and contact information so that a Project Team member can respond to your inquiry.

If you have any further comments or questions please contact us.

Julia Kossowski
Project Manager
Stantec Consulting Ltd.
70 Southgate Dr., Suite 1
Guelph ON N1G 4P5
Ph: 519-569-4338
Email: julia.kossowski@stantec.com

WELCOME

to the

Parkway West Project - Natural Gas Pipeline

Information Session

A Union Gas Pipeline Project

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uniongas
A Spectra Energy Company

Union Gas Limited - Parkway West Project - Natural Gas Pipeline

WELCOME

Thank you for coming.
We invite you to view the display boards, speak to members of Union Gas Limited and/or Stantec Consulting Ltd., and complete a questionnaire providing your questions and comments.



Please sign in at the front desk to have your attendance recorded as part of the environmental study process, and to receive future project updates.

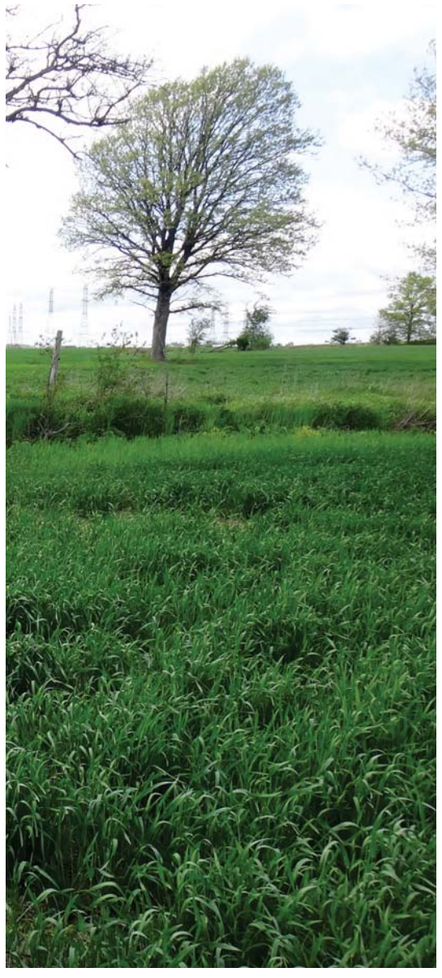
uniongas
A Spectra Energy Company

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Purpose of the Information Session

The purpose of this Information Session is to:

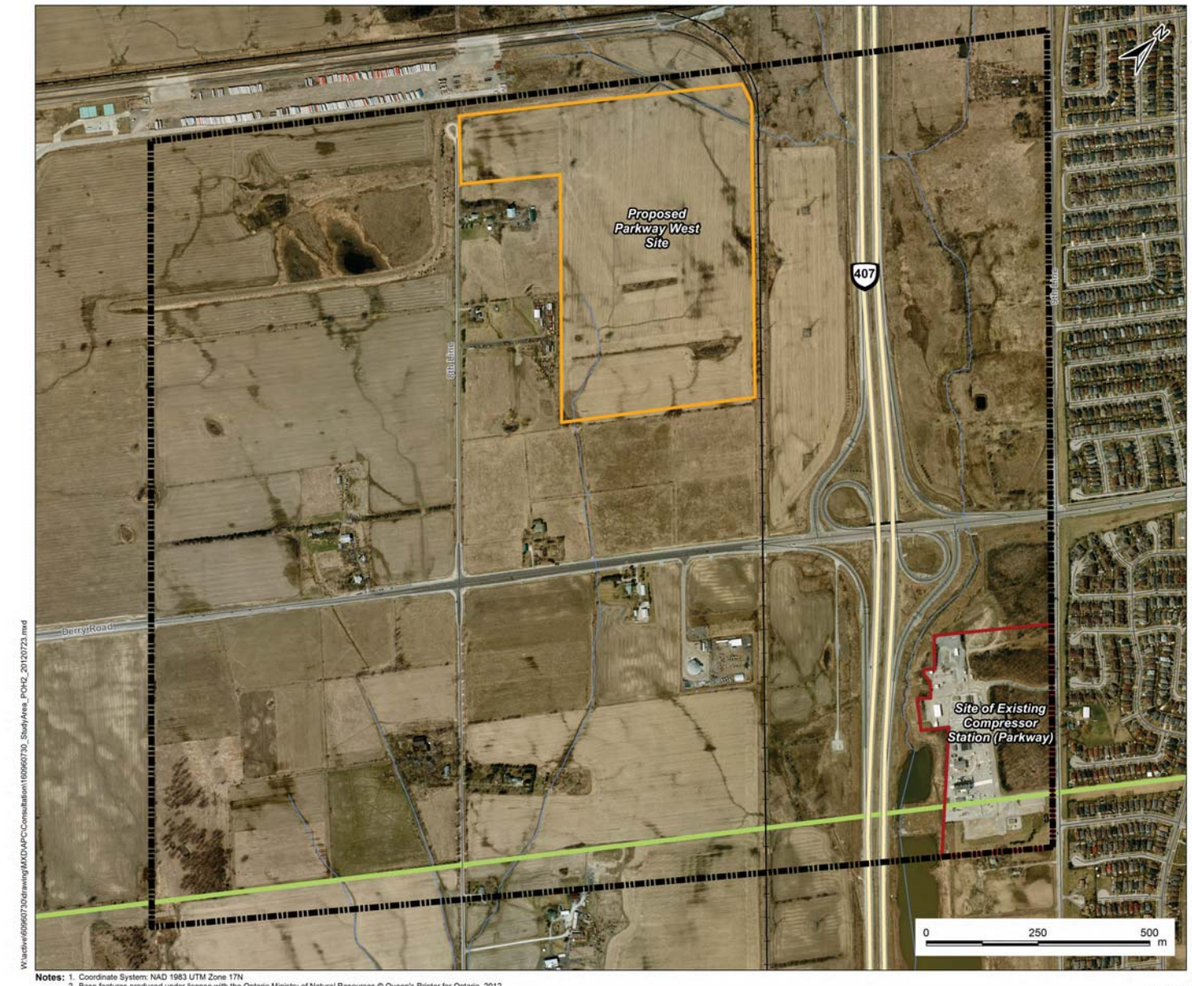
- Introduce the Project to the Community and any interested and potentially affected parties.
- Inform and educate about Project details such as routing evaluation, Project planning, Project construction and next steps.
- Create an atmosphere that will facilitate positive consultation in regards to this Project.
- Respond to questions from interested parties.



Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Project Overview

The proposed project involves the construction of two new pipelines that will be up to 54 inches in diameter as well as another pipeline that will be up to 48 inches in diameter. The pipelines are required to connect a proposed compressor station in the vicinity of Derry Road and Highway 407 to the existing Union Gas pipeline system. The pipelines will be constructed within new easements on private property and/or along road right-of-ways.



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Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Project Context

The purpose of the project is to ensure the continuation of safe, reliable natural gas supply to the Greater Toronto Area (GTA) and to other markets beyond the GTA. Union Gas is proposing to build the Parkway West Compressor Station along the transmission system close to Derry Road and Highway 407.



Union Gas Limited has commissioned Stantec Consulting Ltd. to undertake an environmental study of the construction and operation of two natural gas pipelines up to 54” in diameter as well as another pipeline up to 48” in diameter. The pipelines are required to connect the proposed site of the Parkway West Compressor Station to Union Gas's existing pipeline system south of Derry Road.

The new Parkway West Compressor Station will follow a separate review and approval process under municipal, regional and provincial jurisdictions as applicable.

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Environmental Study

The environmental study for the pipelines will be completed as per the Ontario Energy Board's (OEB) **"Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario (2011)"**.

The environmental study will:

- Be conducted during the earliest phase of the Project
- Identify potential impacts of the construction and operation of the proposed pipelines to environmental and socio economic features
- Identify an environmentally acceptable route for the proposed pipelines
- Undertake consultation and engagement to understand the interests and concerns of interested and potentially affected parties

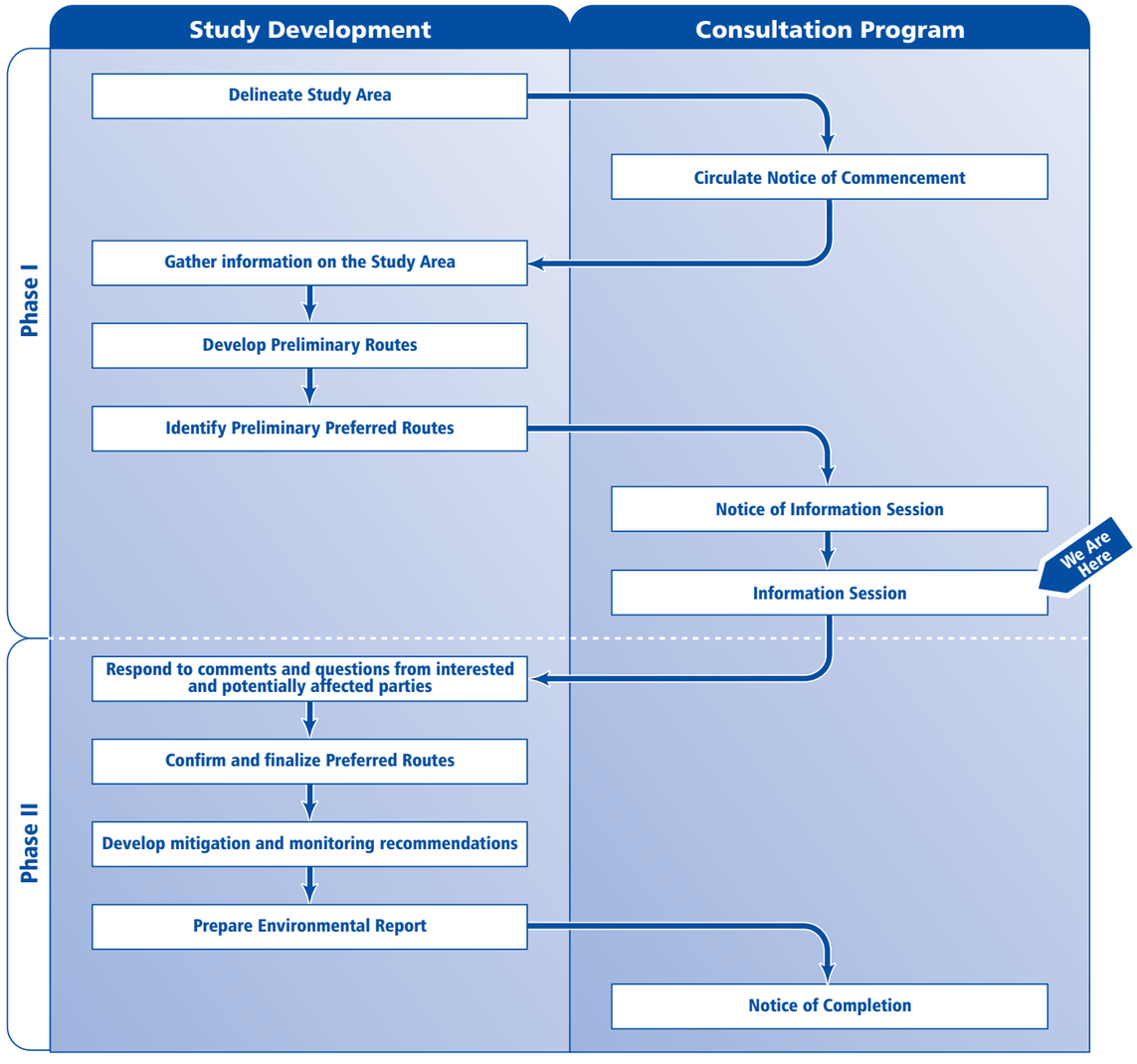


- Assess the potential cumulative effects of the pipelines with other projects that are planned for the area
- Develop mitigation and protective measures to avoid or minimize impacts
- Develop an appropriate inspection, monitoring and follow-up program for the pipeline construction, to ensure the success of mitigation and protective measures

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Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Environmental Study Process



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uniongas
A Spectra Energy Company

Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Ontario Energy Board
Review and Approval Process

The Ontario Energy Board (OEB) is the body that regulates the natural gas industry in Ontario, in the public's interest. The OEB's approval is required before the pipelines can be constructed.

Union Gas plans to submit an application for this project to the OEB in the fall of 2012. This application will include comprehensive information on the project including: a complete project description, the need for the project, facility alternatives, project costs and economics, pipeline design, pipeline construction, environmental mitigation measures, land requirements, and aboriginal consultation and engagement.

The OEB will then hold a public hearing to review the project. This will include notices in local newspapers, letters to directly affected landowners, the opportunity for the general public and landowners to ask questions and submit questions regarding the project, a formal hearing, and a written decision regarding the project.

If after this review the OEB finds the project is in the public interest it will approve construction of the pipelines. If the project is approved the OEB normally attaches conditions to the approval which Union Gas will comply with during the construction and restoration process.

Additional information about the OEB process and information about how to participate in the OEB hearing process can be found at: http://www.ontarioenergyboard.ca

Submit application Public hearing Approval Construction

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Preliminary Preferred Route and Potential Alternative Routes

The route selection process was based on the following principles:

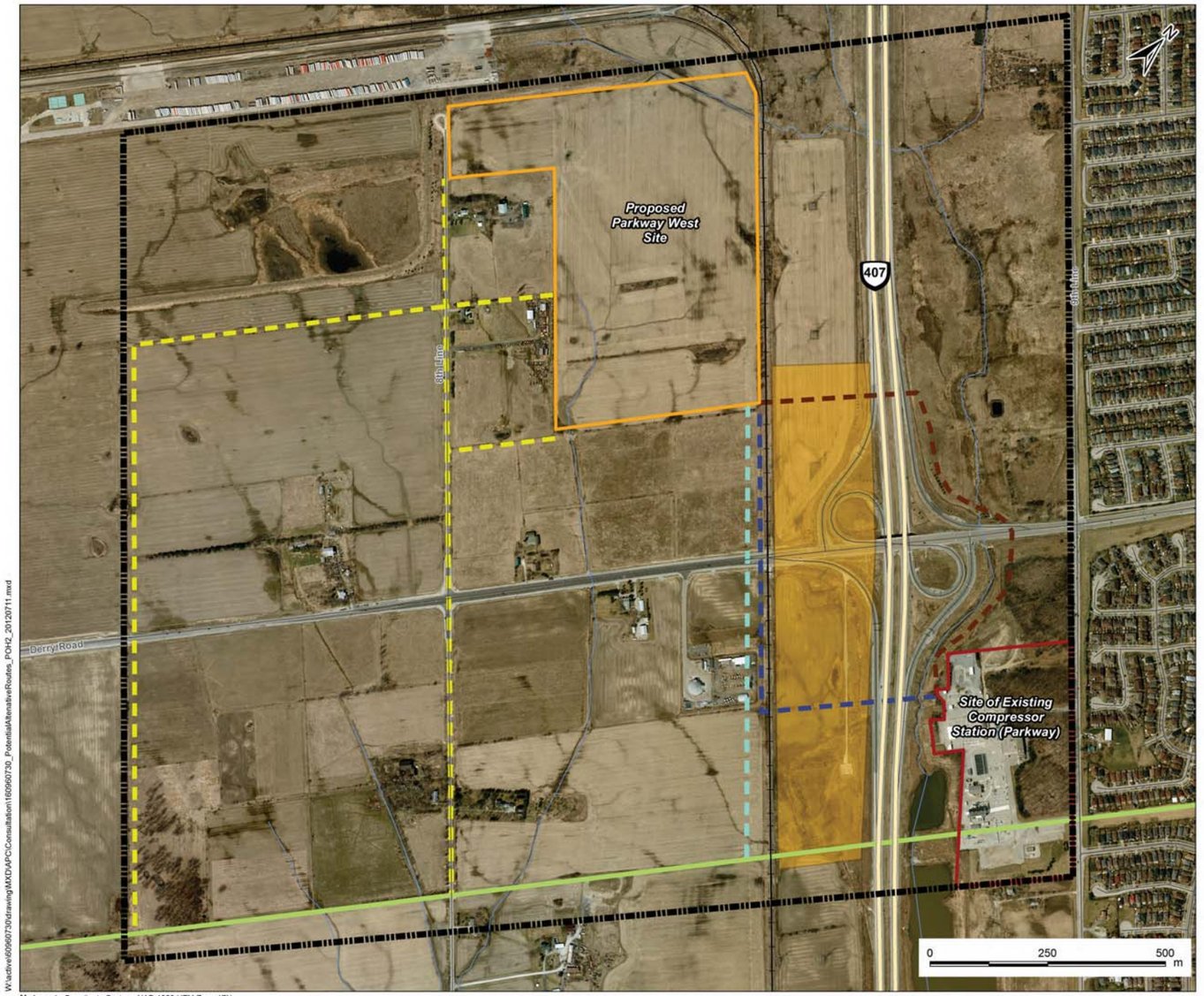
- Avoidance of sensitive socio-economic and environmental features;
- Avoidance of areas which may present construction difficulties or the potential for long-term maintenance/remedial work;
- Paralleling to the extent feasible existing linear infrastructure, such as electrical transmission lines, pipelines and rail lines;
- The length of the pipeline and associated costs of construction and operation may influence route generation; and,
- Routes should follow a reasonably direct path between start and end points

Several potential route alternatives were considered which are shown on the next board. The Preliminary Preferred Routes were selected based on the above principles, the potential for future development, land availability, landowner preference and environmental considerations.

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Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Preliminary Preferred Route and Potential Alternative Routes



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Notes: 1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthographic imagery provided by © Mapcon, 2012. Imagery taken in Spring 2010.

July, 2012
160960730

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Legend

- Study Area
- Proposed Parkway West Site
- Site of Existing Compressor Station (Parkway)
- Pipeline (Existing Union Gas System)
- Area for Potential Alternative Route to be Determined in Consultation with Infrastructure Ontario
- Preliminary Preferred Route (One Pipeline, Up to 48")
- Preliminary Preferred Route (Two Pipelines, Up to 54")
- Potential Alternative Route (One Pipeline, Up to 48")
- Potential Alternative Route (Two Pipelines, Up to 54")
- Expressway/Highway
- Road
- Railway
- Watercourse

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Filepath: W:\active\60960730\drawing\CorelDisplayPanels\2012-07_POH1\60960730_2012-07_POH1_10PreliminaryPreferredRoute_MAP.cdr

Existing Conditions

Data on existing features for the Study Area has been collected from a number of external sources including but not limited to regulatory agencies, aerial photography and official plan mapping.

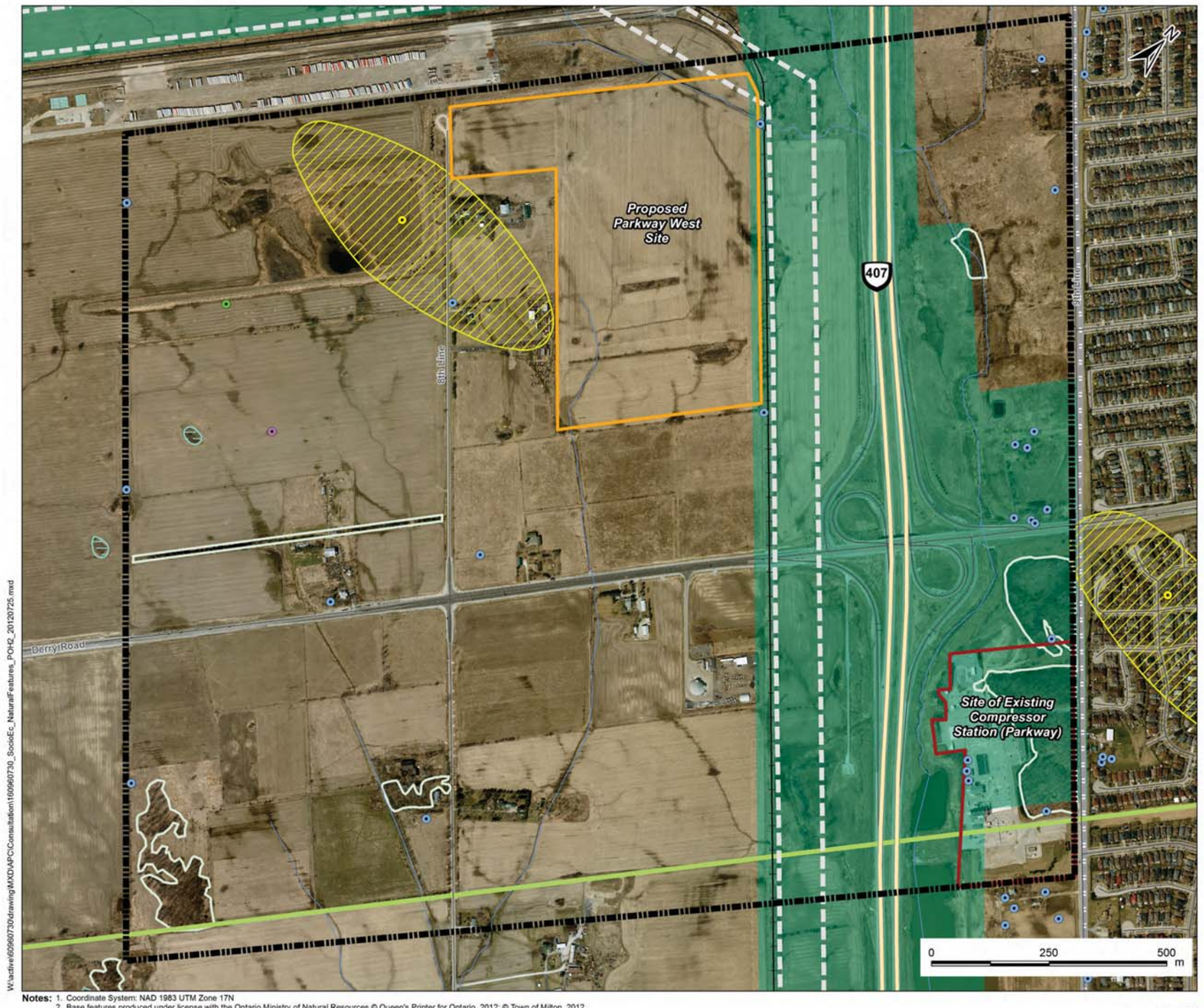
Additional data collection and agency consultation will continue after this Information Session to evaluate the Preliminary Preferred Routes and Potential Alternative Routes and to assist in the confirmation of the final Preferred Routes.

Environmental and socio-economic features within the Study Area, relevant to pipeline planning, construction and operation, have been outlined on the following map. The Preliminary Preferred Route avoids sensitive environmental and socio-economic features where feasible. Where features cannot be avoided, mitigation and protection measures will be employed during pipeline construction and operation.



Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Natural Environment and Socio-Economic Environment



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Notes: 1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012; © Town of Milton, 2012.
3. Orthographic imagery provided by © Mapcon, 2012. Imagery taken in Spring 2010.

July, 2012
160960730

Stantec

Legend

- Study Area
- Proposed Parkway West Site
- Site of Existing Compressor Station (Parkway)
- Pipeline (Existing Union Gas System)
- Expressway/Highway
- Road
- Railway
- Hydro Line
- Watercourse
- WetlandUnit_LIO
- Wooded Area
- Municipal Boundary
- Parkway Belt West Plan Area
- Water Well Record

Petroleum Resources (OGSR)

- Natural Gas Well - Abandoned
- Gas Show - Abandoned
- Oil & Gas Show - Suspended
- Gas Pool - Abandoned

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Natural Gas

Natural gas is an environmentally preferred fuel.

Natural gas is a reliable compliment to the intermittent nature of renewable energy such as wind and solar. It is always available when you need it.

Natural gas is a domestic source of energy that can help reduce reliance on imported foreign fuels, and can create local jobs.

Domestic supply is abundant and able to meet our energy demand for decades to come.



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Natural Gas Safety

Union Gas is an experienced pipeline operator with an enviable safety and reliability record, delivering natural gas to customers around the province through more than 60,000km of pipelines.

Pipelines and facilities are designed, constructed and maintained to meet or exceed the stringent safety codes and requirements of:

- Ontario Energy Board Act
- Canadian Standards Association
- Technical Standards and Safety Authority

Pipelines used to transport natural gas are monitored 24 hours a day. Operators can remotely shut off pipeline valves to completely stop the flow of gas.



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Environmental Planning and Management

In an effort to protect the natural and socio-economic environment, Union Gas and their consultants will conduct environmental planning and monitoring:

Pre-Construction

- An environmental study is being undertaken to assess potential environmental and socio-economic impacts along the preferred pipeline routes.
- The study will identify the need for field investigations (E.g., species at risk, etc.).

Construction

- An Environmental Inspector will be the Company representative responsible for ensuring construction activities are conducted in compliance with environmental commitments (E.g., environmental study report, environmental regulatory permits, OEB conditions, etc.).

Post-Construction

- A monitoring program will follow construction during the first and/or second complete growing season
- The objective:
  - to ensure that mitigation and protective measures are successful and continue to be effective
  - Where deficiencies are identified, prescribe the appropriate mitigations

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Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Construction

Union Gas' environmental management practices are aimed at addressing potential impacts from construction activities. Such practices relevant to this Project include:

- Pre-construction environmental planning to avoid, to the extent possible, impacts to environmental and socio-economic features;
- Environmental management practices to address potential impacts to geophysical features, soil, vegetation, water, wildlife, air quality, noise and socio-economic features;
- Contingency plans in the unlikely event of spills, fires, extreme weather conditions, and the discovery of previously unknown heritage resources and/or contaminated soils; and
- Post construction monitoring and follow-up.



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Consultation

Union Gas is committed to creating opportunities for meaningful input on this project from all stakeholders through this Information Session and publishing updates in local newspapers.

A key element of this Project will be consultation and engagement with:

- Municipal Staff and Elected Officials
- Landowners
- First Nations
- The Métis Nation of Ontario
- Government Agencies
- Special Interest Groups
- Members of the Public

Consultation with these groups is also instrumental in the identification of the various mitigation and protective measures that will be employed to minimize the effects of the construction and operation of the proposed pipeline project.

If you wish to discuss the Project privately, please speak to a Union Gas or Stantec representative, who can make appropriate arrangements.



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Landowner Relations

For the construction of this Project, Union Gas will be seeking land purchases and permanent easements, plus a number of temporary easements for construction working areas and topsoil storage. The specific location and area of the permanent easements and temporary easements will be finalized after the OEB approves the Project and issues a “Leave to Construct” order.

Union Gas will enter into Option Agreements with individual landowners for all required land rights. Union Gas will offer a form of Easement which has been previously approved by the OEB, along with a standard compensation package which includes payment for the easement, temporary land use, crop loss and a disturbance payment, based upon current market values.

During construction, Union Gas will have a Lands Relations Agent available to keep landowners informed about the Project and to answer questions or concerns.



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Parkway West Compressor Station

The Project pipelines are required to service the Parkway West Compressor Station proposed to be located off of Eighth Line close to Derry Road and the 407. The proposed site for Parkway West Compressor Station is of sufficient size to provide for future expansion to the GTA and markets beyond. Please reference the study area map on the board titled "Project Overview". The construction of this station would further support the flow of natural gas to the Greater Toronto Area and markets beyond the GTA and reduce the risk of outages during peak gas flow by providing Loss of Critical Unit protection.

The station and site would include:

- One compressor unit (47,000 HP)
- Valve site connection to the existing pipeline system
- New metering and interconnect controls
- Second connection to the Enbridge Gas Distribution System.
- A measurement upgrade to provide custody transfer measurement
- Buildings including an administrative building
- Parking for staff
- Berm

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Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Approvals Process for the Parkway West Compressor Station

The Parkway West Compressor Station will require municipal, regional and provincial approvals (Halton Region and Ministry of the Environment, for example), whereas the Parkway West Pipeline Project will require approval from the Ontario Energy Board. A separate consultation program will be conducted for the Parkway West Compressor Station with approvals targeted for completion by Summer 2013. Construction and clean-up of the Compressor Station would be conducted through Spring, Summer and Fall 2014 with an in-service date of Fall 2014.



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Project Schedule and Next Steps

Completion of Environmental Study for Pipeline	Fall 2012
File Application with the Ontario Energy Board	Fall 2012
Ontario Energy Board Review and Decision	Spring 2013
Pipeline Construction and Clean-Up	as early as Summer and Fall 2013
Pipeline Project In-Service	2014

After this Information Session, the following will be carried out:

1. Respond to comments/questions received.
2. Confirm study findings to-date based on comments received.
3. Continue data collection and route assessment.
4. Confirm the Preferred Routes.
5. Prepare the Environmental Report, summarizing consultation, route selection, potential impacts and mitigation measures.
6. Prepare an Application for 'Leave to Construct' to the OEB.

Filepath: W:\active\60960730\drawing\CorelDisplayPanels\2012-07_POH1\60960730_2012-07_POH1_21ProjectScheduleNextSteps.cdr

Union Gas Limited - Parkway West Project - Natural Gas Pipeline

Thank You!

On behalf of the Project Team, thank you for attending this Information Session. We appreciate your involvement in the consultation process and we would like to hear from you. Please fill out the Exit Questionnaire, located at the front desk. Include your name and contact information so that the Project Team can provide a response.

If you have any further comments or questions please contact us through the contact information provided in the handouts.



Filepath: W:\active\60960730\drawing\CorelDisplayPanels\2012-07_POH1\60960730_2012-07_POH1_22ThankYou.cdr

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Union Gas Limited
Parkway West Project - Natural Gas Pipeline

INFORMATION SESSION QUESTIONNAIRE – August 1, 2012

Please read the newsletter and look over the displays, and then take a few moments to answer the following questions. Comments are appreciated. If you require any assistance or clarification while completing the questionnaire please speak with a Union Gas or Stantec representative.

Completed questionnaires can be returned to a Stantec representative or mailed to Stantec Consulting Ltd. by August 17, 2012. Postage paid, self-addressed envelopes are available at the sign-in table.

1. What is your interest in this project?

☐ Directly affected landowner
☐ Adjacent landowner
☐ Interested citizen
☐ Member of interest group
☐ Government official
☐ Other: _____

2. Please identify any features within the Study Area which are either incorrectly mapped, omitted or that you feel are important to consider during the study (please state your reasons).

3. Considering the locations of the Preliminary Preferred Routes and the Potential Alternative Routes shown on the displays, please indicate whether there are any potential effects to you, your property, or your business that you would like addressed.

INFORMATION SESSION QUESTIONNAIRE – August 1, 2012

4. Which of the identified Routes do you feel will have the least environmental and socio-economic impact? Why?

5. Which factors do you feel are most important to compare and evaluate Preliminary Routes for the proposed pipelines (i.e., protected natural areas, residential properties, etc.)?

6. Do you have any other questions/concerns about this Project that you would like to bring to our attention?

7. Did the Information Session meet your information needs?

☐ Yes ☐ No

Please comment:

INFORMATION SESSION QUESTIONNAIRE – August 1, 2012

8. Did the organization of the Information Session meet your needs (i.e. location, date, time)?

_____
_____
_____
_____
_____
_____

Thank you for completing this questionnaire.

If you would like someone to contact you about any items identified above please provide us with your contact information.

Please Print Clearly

Name: _____

Address: _____

Email: _____

Phone: _____

Do you consent to these comments being included in the public record?

☐ Yes ☐ Yes, but anonymously ☐ No

Signature: _____ Date: _____

Union Gas Limited – Parkway West Project – Proposed Compressor Station
Neighbourhood Information Session Newsletter

PROJECT CONTEXT

The purpose of the project is to ensure the continuation of safe, reliable natural gas supply to the Greater Toronto Area (GTA) and to other markets beyond the GTA and to address the growing demand for natural gas at the existing Union Gas Parkway Compressor Station resulting from the changing dynamics in the flow of natural gas in North America.

PROJECT OVERVIEW

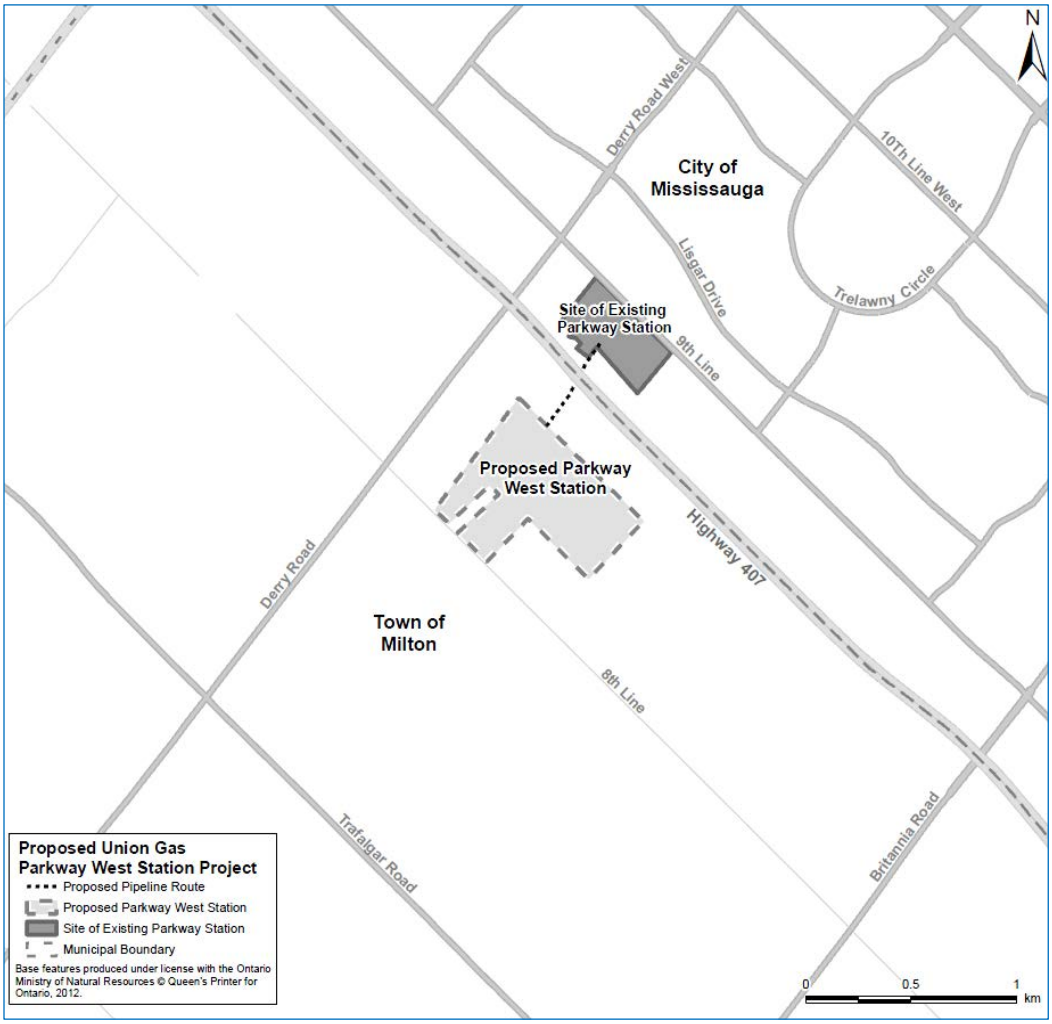
The proposed Project involves the Application for Zoning By-Law Amendment and Site Plan approval for the construction of a natural gas Compressor Station on Eighth Line, Town of Milton, along the existing Union Gas transmission system south of Derry Road and West of Highway 407.

The facility would consist of compression facilities, valves, measurement and regulation facilities, and a pipeline network.

A request for a Site Specific Zoning By-Law Amendment to permit the Compressor Station use on the subject lands has been submitted to the Town of Milton.

The Project will also require the construction of one 42 inch (1219 mm) diameter steel natural gas pipeline, approximately 750 metres in length, to connect the proposed Parkway West Compressor Station to Union Gas' existing Parkway Compressor Station on Ninth Line, Mississauga.

The proposed Compressor Station and pipeline are also subject to Ontario Energy Board approval.



ZONING BY-LAW AMENDMENT PROCESS

1. Pre-Consultation Meeting with Town of Milton
2. Submit Complete Application
3. Posting of Public Notice Sign on the Property
4. Notice of Formal/Statutory Public Meeting
5. Preparation of Planning Staff Report (Town of Milton)
6. City Council Meeting
7. Approval of Amending By-Law

ZONING BY-LAW AMENDMENT REQUEST

The proposed Application for Zoning By-Law Amendment is a request for a Site Specific Zoning By-Law Amendment to permit the Compressor Station use on the subject lands. The zoning regulations which are proposed to apply to the compressor station as part of the proposed Site Specific Zoning By-Law are tailored from, and in keeping with, the Town of Milton's Industrial Zoning categories, reflecting the nature of the use.

March 7, 2013
Milton Sports Centre

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Union Gas Limited – Parkway West Project – Proposed Compressor Station
Neighbourhood Information Session Newsletter

LET US KNOW WHAT YOU ARE THINKING

On behalf of the Project Team, thank you for attending this Information Session. We appreciate your involvement in the consultation process and we would like to hear from you. Please fill out a Comment Sheet.

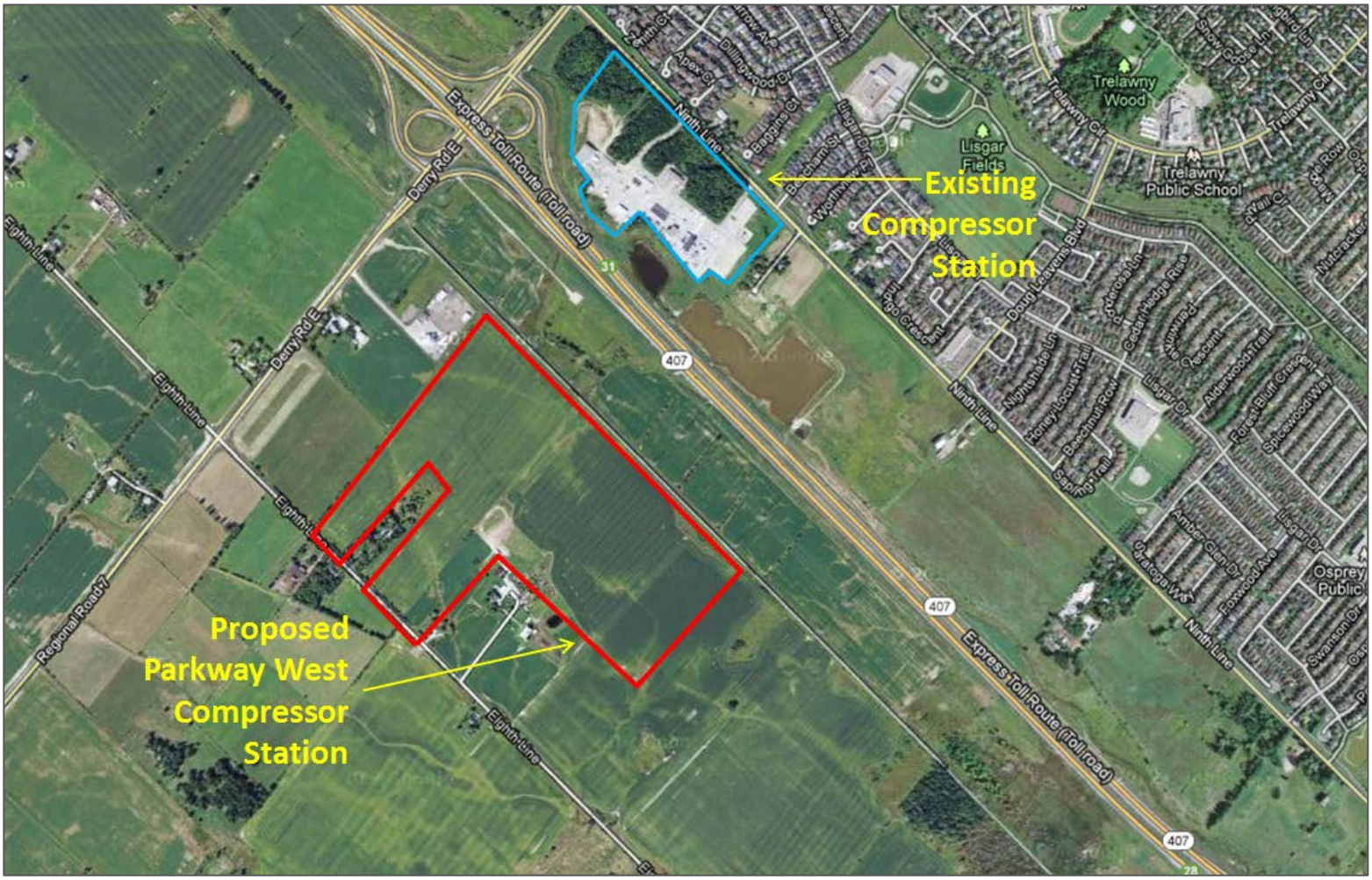
Include your name and contact information so that a Project Team member can respond to your inquiry.

If you have further comments or questions please contact us.

Jacqueline Hannemann
Planner
Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Ph: 519-585-7267
Email: jacqueline.hannemann@stantec.com

PROJECT SCHEDULE

- Filed Reliability Application with the Ontario Energy Board - **January 2013**
- Zoning By-Law Amendment Application for Compressor Station Submission – **February 2013**
- File Growth Application with the Ontario Energy Board – **March 2013**
- OEB Decision Expected – **Summer 2013**
- Site Plan Design and Approval – **Fall 2013** (Contingent on Zoning By-Law Amendment Approval)
- Earthworks/Grading – **Fall 2013**
- Plant Construction – **Spring 2014 through to Fall 2015**
- Pipeline Construction – **Spring/Summer 2015**
- Pending Approvals, Parkway West Project in service by **late 2015**



March 7, 2013
Milton Sports Centre

WELCOME

To the

Parkway West Project – Proposed Compressor Station

Neighbourhood Information Session

A Union Gas Project



Please sign in at the front desk to have your attendance recorded and to receive future project updates.

PURPOSE OF THE NEIGHBOURHOOD INFORMATION SESSION

To continue to communicate with its neighbours, Union Gas Limited is holding a second informal neighbourhood meeting to inform the community of the proposed Parkway West project and to answer questions and obtain feedback.



PROJECT OVERVIEW

The purpose of the project is twofold:

1. **Reliability** - to ensure the continuation of safe, reliable natural gas supply to the Greater Toronto Area (GTA) and to other markets beyond the GTA.
2. **Growth** - to address the growing demand for natural gas at the existing Union Gas Parkway Compressor Station resulting from the changing dynamics in the flow of natural gas in North America.

For these reasons Union Gas is proposing to build the Parkway West Compressor Station along its transmission system south of Derry Road and West of Highway 407.

The facility would consist of compression facilities, valves, measurement and regulation facilities, and a pipeline network.

As part of the planning process, Union Gas Limited has commissioned Stantec Consulting Ltd. to pursue applications for the required Municipal approvals including a Zoning By-Law Amendment and Site Plan Approvals. Union Gas Limited would like to have the Compressor Station, pending approvals, in service by late 2015.

WHO IS UNION GAS?

- Major Canadian Natural Gas storage, transmission and distribution company
- Over 100 years of safe, reliable service to customers
- Serving about 1.4 million customers
- In over 400 communities across Ontario

For More information please visit the Union Gas website at:
www.uniongas.com



BENEFITS OF NATURAL GAS

Natural Gas is… Affordable

- Prices are lower than a decade ago
- Costs significantly less than electricity, fuel oil or propane
- Experts forecasts prices will stay affordable for decades to come

Natural Gas is… Clean

- Less than half of the emissions of coal and oil
- Reducing Ontario's carbon footprint by replacing coal-fired electricity generation
- The ideal partner for intermittent renewable energy sources like wind and solar power which rely heavily on the weather

Natural Gas is… Driving Economic Growth

Natural gas works hard for Ontario, generating electricity, powering manufacturing plants, providing raw material for a range of products, heating homes and fuelling transportation. According to Statistics Canada, the natural gas industry contributes almost $29 billion to Canada's economy, in terms of jobs and GDP.

Today's low prices mean average annual energy savings for Ontario households and industry of about $4 billion. That's more money available for consumers to spend in the local community and it allows Ontario Businesses to be more competitive.

Natural Gas does far more than keep you warm and generate electricity to keep the lights on. Visit www.cleanandaffordable.ca today to find out more about why clean-burning and abundant natural gas is the best for Ontario's future.

Union Gas Limited – Parkway West Project – Proposed Compressor Station

GENERAL LOCATION MAP

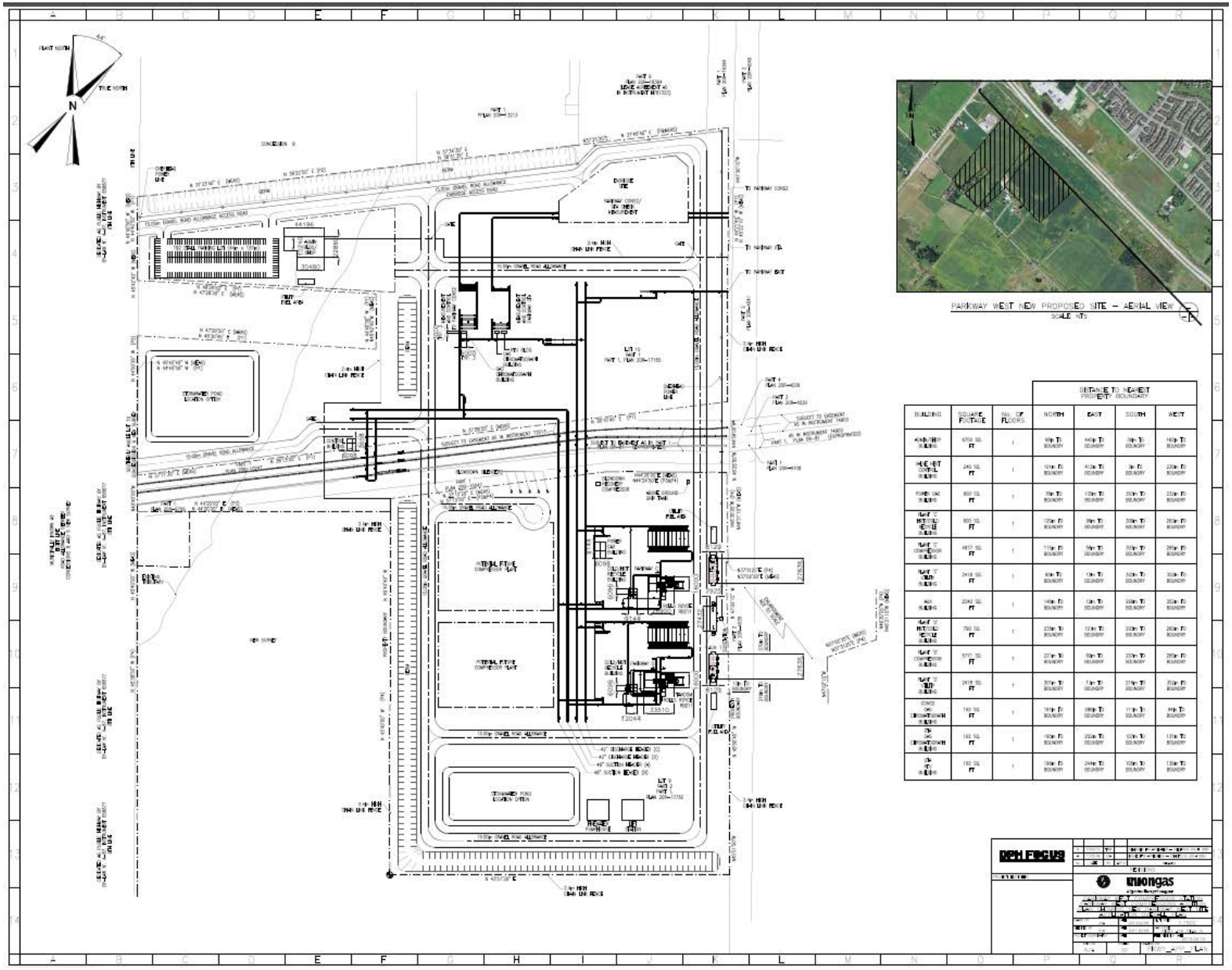


Union Gas Limited – Parkway West Project – Proposed Compressor Station

LOCATION MAP



GENERAL LAYOUT PLAN



PARKWAY WEST NEW PROPOSED SITE – AERIAL VIEW
SCALE: NTS

BUILDING	SQUARE FOOTAGE	NO. OF FLOORS	DISTANCE TO NEAREST PROPERTY BOUNDARY			
			NORTH	EAST	SOUTH	WEST

Union Gas Limited – Parkway West Project – Proposed Compressor Station

ZONING BY LAW AMENDMENT PROCESS

1. Pre-Consultation Meeting with Town of Milton
Before the submission of an Application, a formal Pre-Consultation with the Planning Department and other relevant agencies (eg. Conservation Authority) is required. The purpose of the meeting is to determine information/reports/studies that are required to support the application and deem it complete.

2. Submit the Application
Submission of a Complete Application for Zoning By-Law Amendment including: application fees, supporting information, studies, and reports. When the application is deemed complete by the Town it is circulated to prescribed agencies (eg. Region of Halton, Conservation Halton). A notice of the application to amend the Zoning By-Law will be circulated to landowners (within 120 m of the Site).

WE ARE HERE
To communicate early with it's neighbours, Union Gas Limited have decided to hold an informal neighbourhood meeting to inform the community of the proposed project and to answer questions and obtain feedback.

3. Posting of Public Notice Sign on the Property
The applicant is required to post a Public Notice Sign, with prescribed information on the subject lands.

4. Notice of Formal/Statutory Public Meeting
Notice of a Public Meeting will be sent to prescribed persons, public bodies advising of the Public Meeting for the proposed Amendment.

5. Preparation/Completion of Planning Staff Report
The Planning Division will give a short presentation and recommendation to the Committee. The public and applicant are given the opportunity to comment on the proposed Amendment. The Committee vote on the recommendation made by the Planning Division. This recommendation is forwarded to City Council along with the Amending By-Law.

6. City Council Meeting
The Planning Division's Report containing recommendation is submitted to Council for a decision. Council can approve, deny or amend the recommendation or defer the proposed amendment with direction for further assessment and consideration.

7. Approval of Amending By-Law
If and after Council approve the Zoning By-Law Amendment in principal as per Staff Report (in Step 6), a formal Zoning By-Law Amendment is adopted by Council after which there will be a 20 day Appeal Period. Any person who has signed a register at a Public Meeting held by the Town of Milton or who has requested in writing to be informed of the passing of a By-Law will be sent notice of the adoption of the By-Law . If no appeals are received, the Zoning By-Law Amendment will come into effect.

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APPROVAL REQUEST

The proposed Application for Zoning By-Law Amendment is a request for a Site Specific Zoning By-Law Amendment to permit the Compressor Station use on the subject lands. The zoning regulations which are proposed to apply to the compressor station as part of the proposed Site Specific Zoning By-Law are tailored from, and in keeping with, the Town of Milton's Industrial Zoning categories, reflecting the nature of the use. See chart below:

REQUESTED ZONING
Minimum Lot Frontage – 40.0m
Minimum Lot Area – 0.8 ha
Maximum Lot Coverage – 35%
Minimum Front Yard Setback – 9.0m
Minimum Rear Yard Setback – 12.0m
Minimum Side Yard Setback – 3.0m
Maximum Building Height – 18.0m
Landscaped Open Space – 5% of Lot Area
Minimum Landscape buffer abutting a street line – 4.5m
Loading Spaces – one (1) off-street loading space shall be provided.
Parking areas will be permitted in all yards provided that no part of any parking area, other than ingress or egress points, is located closer than 4.5m to any street line and no closer than 1.5m to any other lot line and provided that no part of any parking area is located in a minimum landscape buffer adjacent to a street line as required by the Town of Milton Zoning By-law. Parking will be calculated for the floor space in sum total of all buildings on the lands to which this By-Law applies as follows: i. For the first 1000m², one (1) parking space per 30m² of gross floor area shall be provided. ii. For any additional gross floor area in excess of 1000m², required parking shall be calculated in addition to the above provision and provided in accordance with the following rates: 1) For gross floor areas between 1,000m² to 5000m² shall be provided at the rate of one (1) parking space per 100m² of gross floor area. 2) For gross floor areas in excess of 5000m² parking shall be provided at the rate of one (1) parking space per 200m² of gross floor area.
Bicycle Parking - 5 Bicycle Parking Spaces will be provided on site.

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REPORTS/STUDIES COMPLETED IN SUPPORT OF THE ZONING BY-LAW AMENDMENT APPLICATION

- Archaeological Assessment
- Agricultural Land Assessment
- Land Use Compatibility Assessment (MOE D-6 Guidelines)
- Natural Environment Report
- Site Screening Questionnaire And Environmental Site Assessment
- Stormwater Management Report
- Tree Inventory and Preservation Study
- Hydrogeological Evaluation In Support of Private Services
- Traffic Impact Analysis
- Pavement Evaluation of Eighth Line
- Noise And Vibration Analysis
- Planning Justification Report

PHOTOS OF EXISTING COMPRESSOR STATIONS



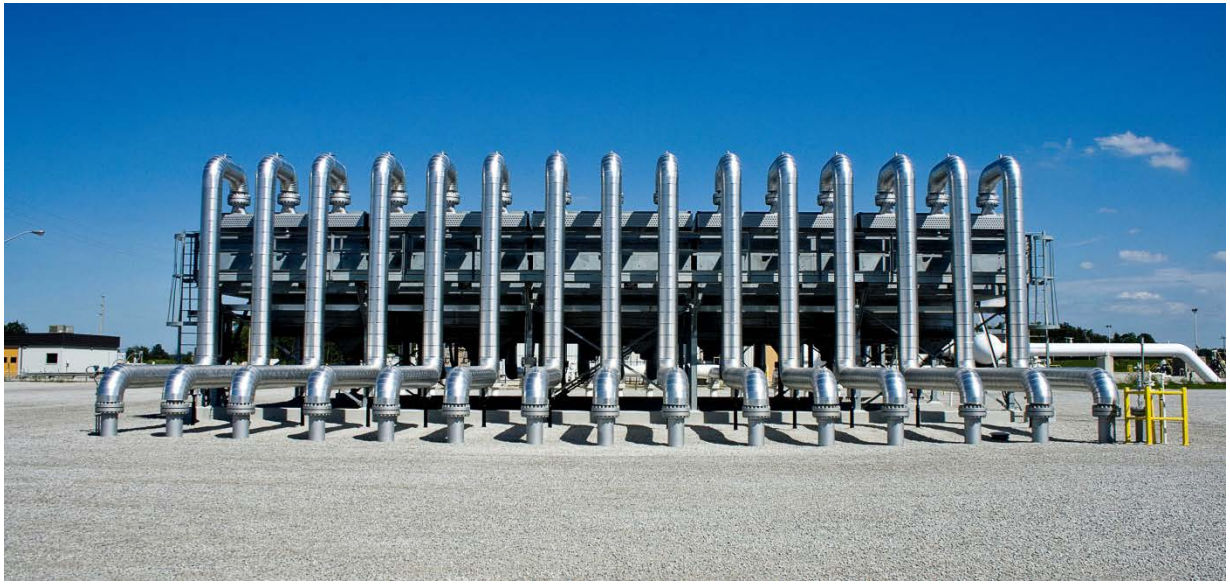




PHOTOS OF EXISTING COMPRESSOR STATIONS





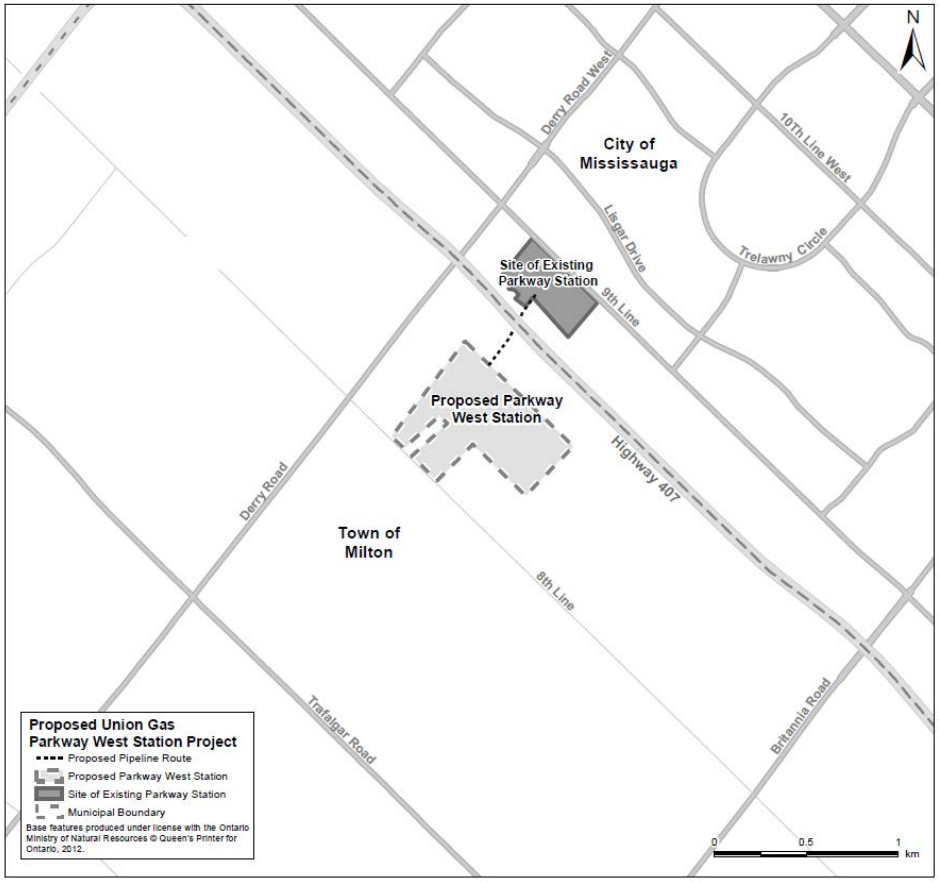


PARKWAY WEST NATURAL GAS PIPELINE

The Project will also require the construction of one 42 inch (1219 mm) diameter steel natural gas pipeline, approximately 750 metres in length, to connect the proposed Parkway West Compressor Station to Union Gas' existing Parkway Compressor Station on Ninth Line, Mississauga.

The natural gas pipeline will be located within the Parkway Belt West utility corridor. The pipeline will be installed by open trench with bores underneath existing infrastructure (a railway, a pipeline, and Highway 407).

Field investigations for aquatics, archaeology, vegetation and wildlife are planned for 2013. Provincial and municipal permits and approvals will be sought for the construction and operation of the pipeline, as appropriate.



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ONTARIO ENERGY BOARD APPROVAL PROCESS FOR THE PARKWAY WEST PROJECT

The Ontario Energy Board (OEB) is the body that regulates the natural gas industry in Ontario, in the public's interest. The OEB's approval is required before the project can be constructed.

Union Gas will file two applications to the OEB for this project. The first was submitted in January 2013 addressing the reliability component of the project and the second application, to be filed in March 2013 will address the growth component of the project. Both applications include comprehensive information on the project including:

- a complete project description;
- the need for the project;
- facility alternatives;
- project costs and economics;
- pipeline design;
- pipeline construction;
- environmental mitigation measures;
- land requirements; and,
- aboriginal consultation and engagement.

The OEB is holding a public hearing to review the project. This will include notices in local newspapers, letters to directly affected landowners, the opportunity for the general public and landowners to ask questions and submit questions regarding the project, a formal hearing, and a written decision regarding the project.

If after this review the OEB finds the project is in the public interest it will approve construction of the pipeline and the Compressor Station Facilities. If the project is approved the OEB normally attaches conditions to the approval which Union Gas will comply with during the construction and restoration process.

Additional information about the OEB process and information about how to participate in the OEB hearing process can be found at: http://www.ontarioenergyboard.ca

NATURAL GAS SAFETY

Union Gas Limited is an experienced pipeline and Compressor Station operator with an enviable safety and reliability record, delivering natural gas to customers around the province through more than 60,000 km of pipelines and multiple Stations of different sizes.

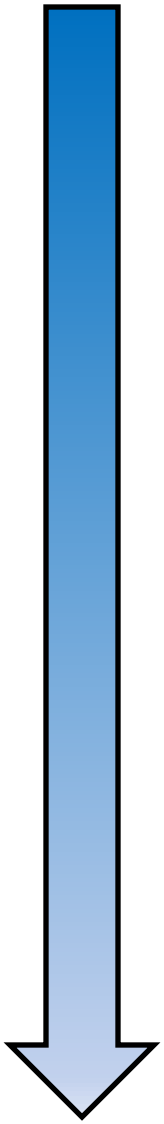
Pipelines and Station Facilities are designed, constructed and maintained to meet or exceed the stringent safety codes and requirements of:

- Ontario Energy Board Act
- Canadian Standards Association
- Technical Standards and Safety Authority
- Ontario Building Code
- Ontario Health and Safety Act



Pipelines used to transport natural gas are monitored 24 hours a day. Operators can remotely shut off pipeline valves to completely stop the flow of gas.

PROJECT SCHEDULE



- Filed Reliability Application with the Ontario Energy Board in January 2013
- Zoning By-Law Amendment Application for Compressor Station Submission – February 2013
- File Growth Application with the Ontario Energy Board March 2013
- OEB Decision Expected – Summer 2013
- Site Plan Design and Approval - Fall 2013 (Contingent on Zoning By-Law Amendment Approval)
- Earthworks/Grading – Fall 2013
- Plant Construction – Spring 2014 through to Fall 2015
- Pipeline Construction – Spring/Summer 2015
- Pending Approvals, Parkway West Project in service by late 2015

Union Gas Limited – Parkway West Project – Proposed Compressor Station
Neighbourhood Information Session Comment Sheet

Please look over the display boards, and read the newsletter, and then take a few moments to answer the following questions. Comments are appreciated. If you require any assistance or clarification while completing the comment sheet please speak to a Union Gas or Stantec representative.

Completed comment sheets can be returned to a Stantec representative or mailed/emailed to Stantec Consulting Ltd. to the attention of Jacqueline Hannemann.

Jacqueline Hannemann
49 Frederick Street
Kitchener ON N2H 6M7
519-585-7267
jacqueline.hannemann@stantec.com

1. What is your interest in this project?

   ☐ Directly affected landowner
   ☐ Adjacent landowner
   ☐ Interested citizen
   ☐ Member of an interest group
   ☐ Government official
   ☐ Other: _____

2. Do you have any questions or concerns about this project that you would like to bring to our attention?

   _____
   _____
   _____
   _____
   _____
   _____

3. Did the information session meet your needs?

   ☐ Yes ☐ No

   Please comment:

   _____
   _____
   _____
   _____
   _____
   _____

Union Gas Limited – Parkway West Project – Proposed Compressor Station
Neighbourhood Information Session Comment Sheet

Thank you for completing the comment sheet.

If you would like someone to contact you about any items identified above please provide us with your contact information.

Please Print Clearly

Name: _____

Address: _____

Email: _____

Phone: _____

Do you consent to these comments being included in public record?

☐ Yes ☐ Yes, but anonymously ☐ No

Signature: _____ Date: _____

Appendix B5

Agency Input

Kossowski, Julia

From: Partridge, Shelley <Shelley.Partridge@halton.ca>
Sent: Monday, June 18, 2012 10:01 AM
To: Kossowski, Julia
Subject: RE: Union Gas Limited Environmental Study Circulation Questions

Julia:

Thanks so much for the further information. With respect to Regional contacts, I would appreciate you adding my name to the list, in addition to Ron Glenn's contact information. In the longer term, I will be replacing my name with another staff person's contact information as I will be leaving on parental leave part way through September, but those staffing changes are not yet confirmed. I will keep you updated on that information as the Fall draws closer.

Thanks again,

Shelley Partridge, MPl, MCIP, RPP
Senior Planner, Community Planning
Legislative & Planning Services Department
Halton Region
1151 Bronte Road, Oakville, Ontario L6M 3L1
Tel: 905-825-6000 ext. 7180
Toll Free: 1-866-442-5866
Fax: 905-825-8822
E-mail: shelley.partridge@halton.ca
Web: www.halton.ca

Office location: 1075 North Service Road, Unit 27
Mailing address: 1151 Bronte Road, Oakville, ON L6M 3L1

From: Kossowski, Julia [mailto:Julia.Kossowski@stantec.com]
Sent: Friday, June 15, 2012 3:31 PM
To: Partridge, Shelley
Subject: RE: Union Gas Limited Environmental Study Circulation Questions

Hello Shelley,

Thank you for your email. Here are my responses to your initial questions.

- When do you need comments on this circulation package?
  - *In order to maintain our submission schedule, we would appreciate your comments by mid-August.*
- With respect to the site where the new compressor station is proposed, can you give me an idea of how much of the site would be required for this use? We didn't want to assume that the entire site would be needed.
  - *Unfortunately I do not have any information about the size of the new compressor station at this time. This study is with respect to the pipeline only. I will try to get some information regarding the station. Please note that a Zoning By Law Amendment and Site Plan approval for the compressor station will be overseen by the Town of Milton which I believe will include consultation with the Halton Region as well.*

- There is reference made in the circulation package that two pipelines would be needed to connect the new compressor facility to the existing Union Gas pipeline system. At this point, are there any proposed routes for the pipeline to take. This will potentially impact the types of comments we would provide i.e there is a crossing of a Regional Road anticipated and there are prime agricultural lands to be considered. If it is too early in the process, we could just provide comments on the whole of the indicated study area.
    - *We will have a figure showing preliminary proposed routes distributed in early July as part of an invitation to a Public Information Session. You might find this figure helpful in developing comments. Currently I have included Mr. Ron Glenn, Director of Planning Services at Halton Region, on the distribution list for this documentation. Shall I include your name on the list as well as, or in lieu of, Ron?*

Regards,

Julia

Julia Kossowski
Project Manager
Stantec
49 Frederick Street
Kitchener ON N2H 6M7
Ph: (519) 569-4338
Fx: (519) 579-6733
Cell: (226) 989-5259
julia.kossowski@stantec.com
stantec.com

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Please consider the environment before printing this email.

From: Partridge, Shelley [mailto:Shelley.Partridge@halton.ca]
Sent: Friday, June 15, 2012 2:44 PM
To: Kossowski, Julia
Subject: Union Gas Limited Environmental Study Circulation Questions

Ms. Kossowski:

I was just forwarded today your circulation package to Halton Region with respect to the Union Gas Initiation of an Environmental Study for the Proposed Parkway West Project. I have a few questions for you - the following will give you an idea of the types of questions I have thus far.

- When do you need comments on this circulation package?
- With respect to the site where the new compressor station is proposed, can you give me an idea of how much of the site would be required for this use? We didn't want to assume that the entire site would be needed.
- There is reference made in the circulation package that two pipelines would be needed to connect the new compressor facility to the existing Union Gas pipeline system. At this point, are there any proposed routes for the pipeline to take. This will potentially impact the types of comments we would provide i.e there is a crossing of a Regional Road anticipated and there are prime agricultural lands to be considered. If it is too early in the process, we could just provide comments on the whole of the indicated study area.

Please feel free to respond either through e-mail or by phone at the number provided below. Thanks very much.

Shelley Partridge, MPl, MCIP, RPP
Senior Planner, Community Planning
Legislative & Planning Services Department
Halton Region
1151 Bronte Road, Oakville, Ontario L6M 3L1
Tel: 905-825-6000 ext. 7180
Toll Free: 1-866-442-5866
Fax: 905-825-8822
E-mail: shelley.partridge@halton.ca
Web: www.halton.ca

Office location: 1075 North Service Road, Unit 27
Mailing address: 1151 Bronte Road, Oakville, ON L6M 3L1

_ _

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Thank you

_ _

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Thank you

14th Floor, Centre Tower
3300 Bloor Street West
Toronto, Ontario
Canada M8X 2X4
Tel.: 416.734.3300
Fax: 416.231.1626
Toll Free: 1.877.682.8772

www.tssa.org

July 26, 2012

File: CF

Ms. Julia Kossowski,
Project Manager
Stantec Consulting Ltd.
70 Southgate Drive, Suite 1
Guelph, ON N1G 4P5

Dear Ms. Kossowsi:

Re: Union Gas Limited – Parkway West Project – Natural Gas Pipeline. Your File 160960730.

This is in response to your letter of July 17, 2012 about the referenced project.

According to the aerial photograph of the potential preferred route included in your letter, the site for the proposed compressor station appears to be located in an area of low population density. However, please be aware of the attached guidelines suggesting that compression stations should be situated to provide a minimum setback of 100 metres from dwellings intended for human occupancy.

Should you have any questions, please call me.

Yours truly,

Oscar Alonso, P. Eng.
Fuels Safety Engineer

Attachment

c: Ms. Zora Crnojacki, Chairperson, OPCC, Ontario Energy Board, 2300 Yonge St., 26th Floor, Suite 2601, Toronto, ON M4P 1E4

I\users\fsesb\oa\Kossowski 1.doc

FUELS SAFETY DIVISION

August 1998
PI-98/01

GUIDELINES FOR LOCATING NEW OIL AND GAS PIPELINE FACILITIES

CRITERIA

The following guidelines pertain to the installation of new steel oil and gas pipeline systems designed to operate at hoop stresses of 40% or more of the specified minimum yield strength.

DEFINITIONS

Category II Pipe means a pipe with requirements for proven pipe body notch toughness in the form of energy absorption and fracture appearance.

Maximum Operating Pressure (MOP) means the maximum operating pressure to which a pipeline system may be qualified in accordance with the requirements of the Canadian Standards Association CSA-Z662 Oil and Gas Pipeline Systems standard.

Notch Toughness means the resistance of the steel to fracture under suddenly applied loads at the notch.

Specified Minimum Yield Strength (SMYS) means the minimum yield strength prescribed by the specification or standard under which the pipe material is purchased.

Yield Strength means the stress at which a material exhibits the specified limiting offset or produces a specified total elongation under load in a tensile test as specified in the specification or standard under which the material is purchased.

MINIMUM SETBACKS

Pipelines shall be aligned to provide a minimum setback of 20 metres from their centerline to dwellings intended for human occupancy. A 200 metre setback shall be maintained from the centerline of the pipeline to institutions where rapid evacuation may be difficult, such as hospitals, nursing homes, penal institutions, and institutions for the physically and mentally handicapped. Where these distances are not practicable, the following measures shall be implemented to reduce the minimum respective setbacks to 5 metres and 90 metres respectively:

1. The use of Category II Pipe with proven notch toughness characteristics as specified by CSA-Z662, and

2. Minimum cover of at least 1.5 metres over the pipeline or where 1.5 metres of cover is not practicable, suitable means of identifying and protecting the pipeline may be used as an alternative.

PUMPS AND COMPRESSORS

Pumps and Compressors shall be situated to provide a minimum setback of 100 metres from dwellings intended for human occupancy.

Transportation and Works Department

City of Mississauga
201 City Centre Drive, Suite 800
MISSISSAUGA ON L5B 2T4

www.mississauga.ca

Leading today for tomorrow

January 21, 2013

Mr. D.F. (Doug) Schmidt, Principal Environmental Planner
Union Gas Limited
50 Keil Drive North
Chatham, ON
N7M 5M1

Dear Mr. Schmidt,

Re: City of Mississauga Comments
Union Gas Limited – Parkway West Pipeline Project – Environmental Report

Following receipt of the Parkway West Natural Gas Pipeline Project Environmental Report, prepared by Stantec Consulting Ltd., dated November 2012 (File No. 160960730), the City of Mississauga provides the following comments from the respective departmental sections for your consideration:

Emergency Management Office (Community Services Department)

1. Section 4.1, Cumulative Effects Assessment Methodology, of the Environmental Report states that "Although rare in occurrence, it is plausible that accidents or emergency events may arise due to an unforeseen chain of events during the pipelines construction or operational life. As a result of the rarity and magnitude of such events, they have not been assessed here, as they are extreme in nature when compared to the effects of normal construction and operation activities, and require separate response plans. Pipeline decommissioning and abandonment is another event that is beyond the temporal boundaries of the cumulative effects assessment and therefore has not been assessed."

    - Provide the City with a copy of the emergency plan specific to the Parkway West Natural Gas Pipeline Project;
    - Confirm whether other affected municipalities will be receiving the emergency plan;
    - Confirm the location(s) of the emergency teams.

Environmental Services Section, Transportation and Infrastructure Planning Division (Transportation and Works Department)

Environmental Engineering

2. What is the Dawn Trafalgar Transmission Pipeline System?

3. Why are compressor stations required on either side of Hwy 407?

4. Please confirm that the best available technology will be utilized for this project in terms of the following:
   - Pipeline material and thickness;
   - Corrosion protection coatings;
   - Cathodic protection;
   - Sensors and emergency shut-off valves.

5. What will be Union Gas's Emergency plan during construction if any spill occurs during the installation of the pipeline?

6. Please confirm the type and frequency of inspections, which will be undertaken for the proposed pipeline, both prior to commissioning and as the pipe ages.

7. How will the proposed new pipeline be incorporated in to Union Gas's Emergency Response Plan?

8. Have the issues of air quality, dust control and noise been considered? If so, what are the proposed mitigation measures?

Capital Programming

9. Section 3.1 states that "As the Project lands are all designated for future development, potential effects will occur in a landscape that will be highly modified in the near future".

   Please provide details regarding future development plans within the extents of the study area that are located within the City of Mississauga.

   Additionally, please confirm the future operational status of the Existing Compression Station (Parkway) and any future land use changes for the current site location.

10. Section 3.1.1 states that "Any bedrock encountered during pipeline construction would need to be excavated by hoe-ram, rock bucket or blasting" and "Where blasting is implemented, potential impacts would include flyrock, noise and/or vibration".

    Please provide details to confirm that should blasting of bedrock occur, existing municipal infrastructure and nearby residential properties would not be negatively impacted.

Thank you for the opportunity to provide comments on this project. Should you have any questions or comments, please do not hesitate to contact me at (905) 615-3200 Ext. 3491.

Yours truly,



Anthony Di Giandomenico, P.Eng.
Watercourse Management Coordinator
Environmental Services Section

C.C.: Core Team Members, City of Mississauga (via e-mail)

February 22, 2013

Mr. Anthony Di Giandomenico, P. Eng.
Watercourse management Coordinator
Environmental Services Section
City of Mississauga
201 City Centre Drive, Suite 800
Mississauga, ON L5B 2T4

Re: City of Mississauga Comments (January 21, 2013)
Union Gas Limited – Parkway West Pipeline Project

Thank you for your comments regarding the Union Gas Parkway West Project and the Environmental Report prepared by Stantec Consulting. Below please find responses to your questions raised in your letter dated January 21, 2013.

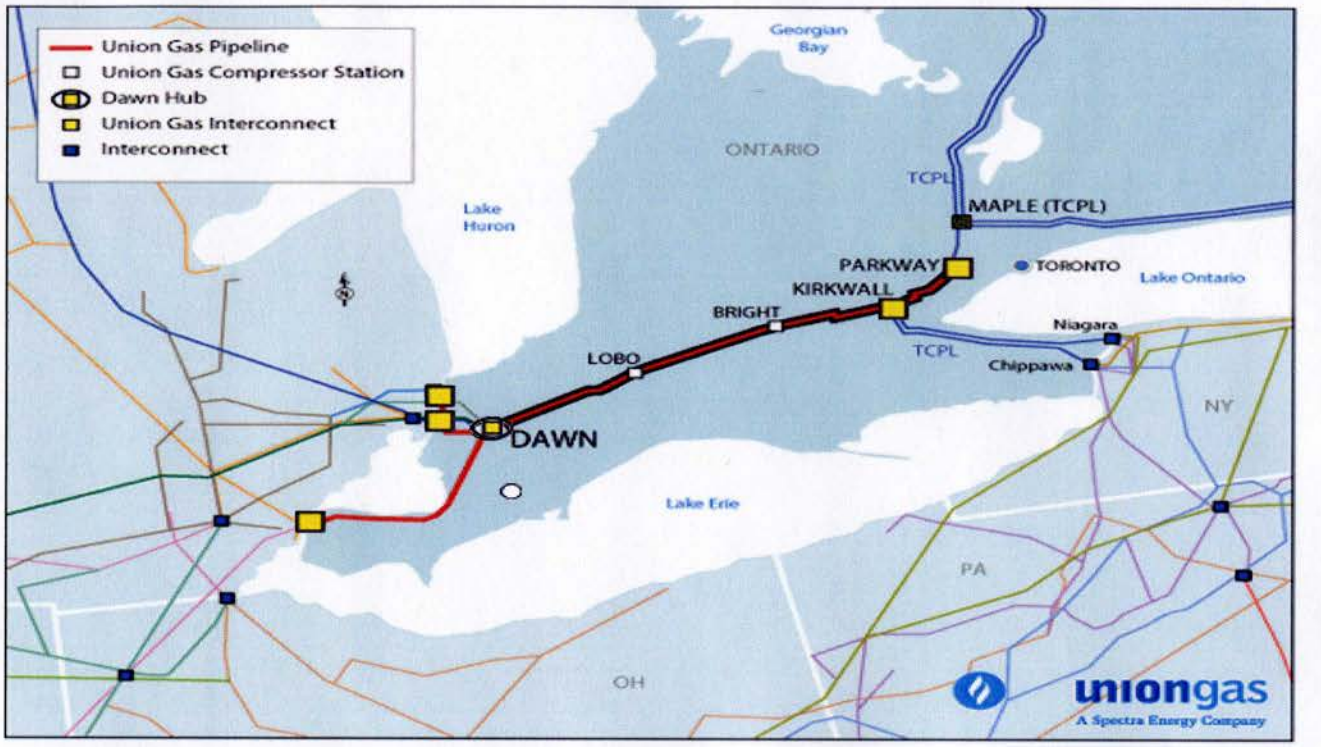
1. ***Section 4.1, Cumulative Effects Assessment Methodology, of the Environmental Report states that "Although rare in occurrence, it is plausible that accidents or emergency events may arise due to an unforeseen chain of events during the pipelines construction or operational life. As a result of the rarity and magnitude of such events, they have not been assessed here, as they are extreme in nature when compared to the effects of normal construction and operation activities, and require separate response plans. Pipeline decommissioning and abandonment is another event that is beyond the temporal boundaries of the cumulative effects assessment and therefore has not been assessed."***
    - ***Provide the City with a copy of the emergency plan specific to the Parkway West Natural Gas Pipeline Project;***
    - ***Confirm whether other affected municipalities will be receiving the emergency plan;***
    - ***Confirm the location(s) of the emergency teams.***

    Union's Emergency Response Plan (ERP) is a controlled document and is not distributed for security reasons. Union Gas local management does meet with municipal emergency response personnel periodically to provide information about the emergency response protocols that are in place as well as other municipal specific information. Union has personnel located at its Parkway compressor site that would provide emergency response for any incident.

2. ***What is the Dawn Trafalgar Transmission Pipeline System?***

    Union owns and operates the "Dawn Trafalgar System", now referred to as the "Dawn-Parkway System", which includes an integrated network of natural gas transmission pipelines and compressors.The Dawn-Parkway System transports natural gas between the Dawn Compressor Station ("Dawn") near Sarnia at the west end of Union's southern franchise area and the Parkway Compressor Station ("Parkway") located in Mississauga at the east end of

Union's southern franchise area. The Dawn-Parkway System consists of four major pipelines, ranging in size from 26 inches to 48 inches in diameter. Between the Dawn and Parkway compressor stations, Union operates two additional compressor stations on the Dawn-Parkway System: i) the Lobo Compressor Station ("Lobo") located near London; and ii) the Bright Compressor Station ("Bright") located between Woodstock and Kitchener.



3. *Why are compressor stations required on either side of Highway 407?*

Continued growth on the Dawn-Parkway system and changing gas supply dynamics in North America have increased the usage and reliance on compression at the existing Parkway station.As a result, Union Gas has identified the need for reserve horsepower to cover an unplanned outage of one of the Parkway compressors and maintain gas supply during peak winter months. Additionally, Enbridge has identified the need for an alternate feed into the GTA to maintain supply to residential, commercial, and industrial customers in the event of an unplanned outage at the existing Parkway station.

Municipal development has been extremely rapid in the western portion of the GTA, and Parkway is now bordered on two sides by existing or planned residential development and on one side by Highway 407, as shown in the Figure below. Due to this rapid development, there is no room to expand on the existing Parkway footprint. The proposed "Parkway West" site, located directly across the 407, will allow for a new compressor station, an additional feed to Enbridge, and an interconnecting pipeline between Parkway and Parkway West. The new site will also allow for future growth compressors and an appropriate buffer zone between the Parkway West facility and future development in the area. Locating the site

across the 407 also provides adequate separation between the facilities to ensure an outage at one site will not impact the other.



4. ***Please confirm that the best available technology will be utilized for this project in terms of the following:***
    - ***Pipeline material and thickness;***
    - ***Corrosion protection coatings;***
    - ***Cathodic protection***
    - ***Sensors and emergency shut-off valves.***

Union will use the best available technology and materials in accordance with CSA Z662-11.

5. ***What will be Union Gas's Emergency plan during construction if any spill occurs during the installation of the pipeline?***

Contingency measures for accidental spills are outlined in Section 3.2.1 of the Environmental Report. Union Gas also requires that the construction contractor has a spill response plan in place prior to construction.

6. ***Please confirm the type and frequency of inspections, which will be under taken for the proposed pipeline, both prior to commissioning and as the pipe ages.***

Pre-operation (during construction), Union will have a team of inspectors on site full time during every phase of construction. Their role will be to ensure the contractor fulfills its contractual obligations and to conduct quality assurance inspections of all work and materials.

Once constructed, the proposed pipeline will be included in Union's overall pipeline integrity program. The type and frequency of inspection will be driven by the program. In addition, Union will complete leak surveys, aerial patrols, and corrosion control system monitoring as prescribed by standard operating practices.

7. ***How will the proposed new pipeline be incorporated in to Union Gas's Emergency Response Plan?***

   Union's ERP covers approximately 63000 km of distribution pipeline and approximately 4800 km of transmission pipeline. Information within the plan that is specific to the Storage and Transmission Operations group, who will have operational accountability for the Parkway West Pipeline, will be updated as necessary.

8. ***Have the issues of air quality, dust control and noise been considered? If so, what are the proposed mitigation measures?***

   Air quality, dust control and noise are considered in Section 3.4.1 of the Environmental Report, including mitigation and protective measures.

9. ***Section 3.1 states that "As the Project lands are all designated for future development potential effects will occur in a landscape that will be highly modified in the near future".***

   Please provide details regarding future development plans within the extents of the study area that are located within the City of Mississauga.

   Within the City of Mississauga the Project will entail the installation of approximately 150 m of 42 inch pipeline between Highway 407 and the existing Parkway Compressor Station. It is Union Gas's understanding that the portion of the pipeline in the City of Mississauga is within the 'Ninth Line Corridor' Study for which the City is establishing a planning framework to guide future development.

   Additionally, please confirm the future operational status of the Existing Compression Station (Parkway) and any future land use changes for the current site location.

   The existing Parkway Compressor Station will remain in operation; there are no immediate plans for any land use changes at this site.

10. ***Section 3.1.1 states that "Any bedrock encountered during pipeline construction would need to be excavated by hoe-ram, rock bucket or blasting" and "Where blasting is implemented, potential impacts would include flyrock, noise and/or vibration".***

    Please provide details to confirm that should blasting of bedrock occur, existing municipal infrastructure and nearby residential properties would not be negatively impacted.

Union can now confirm that any rock encountered will be removed by mechanical means and that no negative impacts to existing infrastructure or nearby residential properties are expected.

Yours truly,

UNION GAS LIMITED

D.F. (Doug) Schmidt
Principal Environmental Planner
1 866-949-1595, Ext. 76954
dschmidt@uniongas.com

Knight, Mark

From: Knight, Mark
Sent: Friday, March 08, 2013 11:55 AM
To: Knight, Mark
Subject: FW: Union Gas Parkway West Project - Neighbourhood Information Session - Proposed Compressor Station

---

From: Anthony DiGiandomenico [mailto:Anthony.DiGiandomenico@mississauga.ca]
Sent: Thursday, February 28, 2013 12:08 PM
To: Hannemann, Jacqueline
Subject: RE: Union Gas Parkway West Project - Neighbourhood Information Session - Proposed Compressor Station

Thank you Jacqueline. I appreciate your quick response.
Anthony

From: Hannemann, Jacqueline [mailto:jacqueline.hannemann@stantec.com]
Sent: 2013/02/28 12:03 PM
To: Anthony DiGiandomenico
Cc: dschmidt@uniongas.com; Romanick, Greg
Subject: RE: Union Gas Parkway West Project - Neighbourhood Information Session - Proposed Compressor Station

Good Afternoon Anthony,

Thanks you for your response.

It is my understanding that Union Gas is undertaking the preparation of an Environmental Report to meet the intent of the OEB Environmental Guidelines. This Report is anticipated to be completed shortly.

An application for Zoning By-Law Amendment for the Proposed Parkway West Compressor Station has been submitted to the Town of Milton. The Existing Compressor Station (located on Ninth Line & Derry Road) is not included in this project and no work is planned for on this site. The Existing Compressor Station was illustrated on the Notice to show the locational context and relationship between the two stations.

Hope this answers your questions. Let me know if you require anything further.

Regards,

Jacqueline Hannemann, BES
Planner
Stantec
49 Frederick Street
Kitchener ON N2H 6M7
Ph: (519) 585-7267
Fx: (519) 579-6733
jacqueline.hannemann@stantec.com
stantec.com

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From: Anthony DiGiandomenico [mailto:Anthony.DiGiandomenico@mississauga.ca]
Sent: Thursday, February 28, 2013 10:53 AM
To: Hannemann, Jacqueline
Subject: RE: Union Gas Parkway West Project - Neighbourhood Information Session - Proposed Compressor Station

Hello Jacqueline,

Thank you for the notification of the neighbourhood information session and for keeping us informed on the project. I have a couple questions regarding the project as follows:

- From the notice, I understand the project is currently going through the required Municipal approval process including a Zoning By-Law Amendment and Site Plan Approvals. Will this project also be required to complete an environmental report to meet the intent of the OEB Environmental Guidelines for the Location, Construction and Operation of Hydrocarbon Pipelines and Facilities in Ontario?

- Is the Existing Compressor Station (at Ninth Line & Derry Road) shown in the notice included in this project, and if so, could you please outline the planned works for the site.

Thank you again,
Anthony

Anthony Di Giandomenico, P.Eng.
Watercourse Management Coordinator

Environmental Services Section | Transportation and Works Department
City of Mississauga | 201 City Centre Drive, Suite 800
Mississauga, ON | L5B 2T4 | (905) 615-3200 Ext. 3491
anthony.digiandomenico@mississauga.ca

From: Hannemann, Jacqueline [mailto:jacqueline.hannemann@stantec.com]
Sent: 2013/02/28 10:11 AM
To: Anthony DiGiandomenico
Cc: dschmidt@uniongas.com; Romanick, Greg
Subject: Union Gas Parkway West Project - Neighbourhood Information Session - Proposed Compressor Station

Good Morning Anthony,

You have previously expressed interest in the Union Gas Parkway West Pipeline Project. It is our intent to keep you informed on the Project.

As such please find attached a Notice of Neighbourhood Information Session for the proposed Parkway West Compressor Station. The Information Session will be held on March 7, 2013 at the Milton Sports Centre. Please refer to the attachment for further details.

A hard copy of the notice will be sent to you by mail.

Many thanks,

Jacqueline Hannemann, BES
Planner
Stantec
49 Frederick Street
Kitchener ON N2H 6M7
Ph: (519) 585-7267
Fx: (519) 579-6733
jacqueline.hannemann@stantec.com

Appendix C

Technical Studies

Appendix C1

Agricultural Impact Assessment

PARKWAY WEST AGRICULTURAL IMPACT ASSESSMENT

File No. 160311376
January 2013

Prepared for:

Union Gas Ltd.
50 Keil Drive North
Chatham, ON N7M 5K1

Prepared by:

Stantec Consulting Ltd.
1-70 Southgate Drive
Guelph ON N1E 7B8

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Appendix A Figures

Figure 1: Site location
Figure 2: Agricultural Use and MDS Map

1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by Union Gas Ltd. to conduct an Agricultural Impact Study for the proposed location of the new Parkway West Site. (see **Figure 1.0**, Appendix A)

1.1 PURPOSE OF REPORT

This study presents the existing agricultural conditions and assesses the significance and sensitivity of these resources in the context of the proposed use by Union Gas Ltd. In order to determine the potential for agricultural impact associated with the proposed facility, an inventory of the agricultural resources of the surrounding lands was conducted. This inventory included a review of the agricultural land capability for agriculture, and patterns of agricultural and non-agricultural buildings and calculation of Minimum Distance Separation (MDS) from livestock facilities. Based upon Stantec's site observations and soil capability for agriculture, land use and MDS maps were prepared for these lands.

2.0 Agricultural Policy

2.1 PROVINCIAL POLICY STATEMENT

Section 2.3.3.3 of The Provincial Policy Statement, 2005 (PPS) states that:

> *"New land uses, including the creation of lots, and new or expanding livestock facilities shall comply with the minimum distance separation formulae."*

2.2 MINIMUM DISTANCE SEPARATION (MDS) FORMULAE – IMPLEMENTATION GUIDELINES

The MDS Implementation Guideline 6 states that:

> *"MDS I is applied to all livestock facilities reasonably expected to be impacted by the proposed development".*

Since the proposed facility and surrounding area is in an area designated as an agricultural area (A1) by the Town of Milton Official Plan, an MDS I study is required.

2.3 OTHER AGRICULTURAL POLICIES

The Greenbelt Plan (2005) does not apply as the proposed location of the Parkway West Site will not be located within the Greenbelt designated lands. According to Greenbelt Plan Map 78, the Greenbelt boundary is located southwest of the proposed location of the Parkway West Site.

3.0 Agricultural Resources

3.1 SOIL / SOIL CAPABILITY

The published Canada Land Inventory (CLI) Agricultural Capability mapping indicates that the proposed location of the Parkway West Site and most of the surrounding area is mapped as an area in which prime agricultural lands predominate. Except for steep landscape along the edge of Sixteen Mile Creek, all the remaining landscape has been mapped as prime (CLI Agricultural Capability 1 to 3) land.

3.2 AGRICULTURAL LAND USE

Agricultural land use patterns for a study area of approximately a two km surrounding the proposed location of the Parkway West Site was conducted on September 27, 2012 and January 09, 2013. The survey showed that the area west of Ninth Line consists of open land with many non-farm residences, some remnant farms, some cash crop operations, nurseries, a kennel, a golf course, some solitary drive sheds with no associated residence, and several buildings used for commercial, industrial, and institutional and religious purposes. The area east of Ninth Line mainly consists of the edge of the built up portion of the City of Mississauga. (see **Figure 2.0**, Appendix A)

Since the proposal for the subject lands is for a natural gas compressor facility, a Type B study area (two km) was used. All the potential agricultural enterprises, with or without livestock, are identified on **Figure 2.0**.

There were more than 25 non-farm residences located within the two km study area, west of Ninth Line. Ten commercial or industrial land uses were identified within the two km study area. These consisted of mainly construction type business or facilities, with one carpentry business and one garden centre. Two churches were identified within the two km study area, one at 6156 Ninth Line and one at 6150 Trafalgar Road. One large golf course was also identified on the east side of Trafalgar Road. Two solitary drive sheds with no associated residence were also identified, one along Trafalgar Road, and one Britannia Road

The reconnaissance land use evaluation identified nine potential agricultural enterprises within the two km study area, of which two potentially contained livestock operations. The seven remaining potential agricultural enterprises were classified as potential cash crop operations. At these locations, there was no visible evidence of livestock activity, and all the adjacent fields were used for cash crop production.

Four remnant farms were also identified in the study area. In this report, a remnant farm is defined group of buildings that were once an active agricultural enterprise, but the barn is now either been modified for other uses, in a state of disrepair, or the property is no longer used for agricultural production. Two of these were adjacent to the proposed location of the Parkway

West Site. The one located at 6689 Eighth Line is on a small severed lot. The area around the barn at 6689 is landscaped and well maintained and is no longer used for agricultural production. The other remnant farm located at 6692 Eighth Line has a barn that is in a state of disrepair. There is mortar missing from the stone foundation at several locations. Several of the main support beams inside the barn are decayed and broken. The current land owner is a developer and he stated that once he obtains a demolition permit from the Town of Milton, he will tear down the wooden barn barn.is on a small severed lot. One dog kennel was identified along Eighth Line in the southern portion of the study area.

Several nurseries were identified on or west of Trafalgar Road. These nurseries are mainly in use for the production of shrubs, trees and ornamental plants

3.3 MDS I AND ADJACENT AGRICULTURAL OPERATIONS

Minimum Distance Separation I (MDS I) was determined for livestock operations in the vicinity of the subject lands. Information related to the number of farm animals, type of manure system, animal type, and potential capacity was gathered through roadside observation and air photography.

A total of two livestock facilities were identified in the study area. However, according to MDS Implementation Guideline 12:

> *"Where there are four, or more, existing non-farm uses closer to the subject livestock facility and in immediate proximity to the current application, MDS I will not be applied. The current application must not be located closer to the livestock facility than the four, or more, existing non-farm uses."*

The agricultural operation at 6404 Trafalgar Road appeared to be a horse farm. It had a good structurally sound barn and board horse style fencing around the paddock area. However, since there are more than four non-farm residences between the barn / stable and the proposed location of the Parkway West Site, MDS I was not applied.

The agricultural operation at 12805 Derry Road appeared to be a horse farm. It had a good structurally sound barn and board horse style fencing around the paddock area. However, since there are more than four non-farm residences between the barn / stable and the proposed location of the Parkway West Site, MDS I was not applied.

3.4 DISCUSSION

No MDS I arcs from the actual and potential livestock operations within the two kilometer study area were required. All the actual and potential agricultural operations in close proximity to the proposed location of the Parkway West Site were shown to be either cash crop operations or remnant former livestock enterprises..

4.0 Summary

The foregoing analysis has resulted in the following general conclusions:

- The proposed location of the Parkway West Site and the surrounding area are located in an area designated as agricultural (A1). In the local area, there is no possibility of locating the proposed Parkway West Site on an area not designated as agricultural;
- The proposed location of the Parkway West Site and the surrounding area is mapped as an area in which prime agricultural lands predominate). In the local area, there is no possibility of locating the proposed Parkway West Site on an area not designated as prime agricultural land (CLI Classes 1 to 3);
- The proposed location of the Parkway West Site and the surrounding area, which is located between the built up portion of the Town of Milton and City of Mississauga, indicates a reduced potential for livestock enterprises and mainly cash crop operations as the main agricultural uses of the land; and
- Of the two livestock operations identified in the two km study area, none required MDS I analysis.

STANTEC CONSULTING LTD.

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Land Evaluation and Rehabilitation

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Senior Planner

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Appendix A

Figures



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Revised: 2013-01-23 By: carobertson

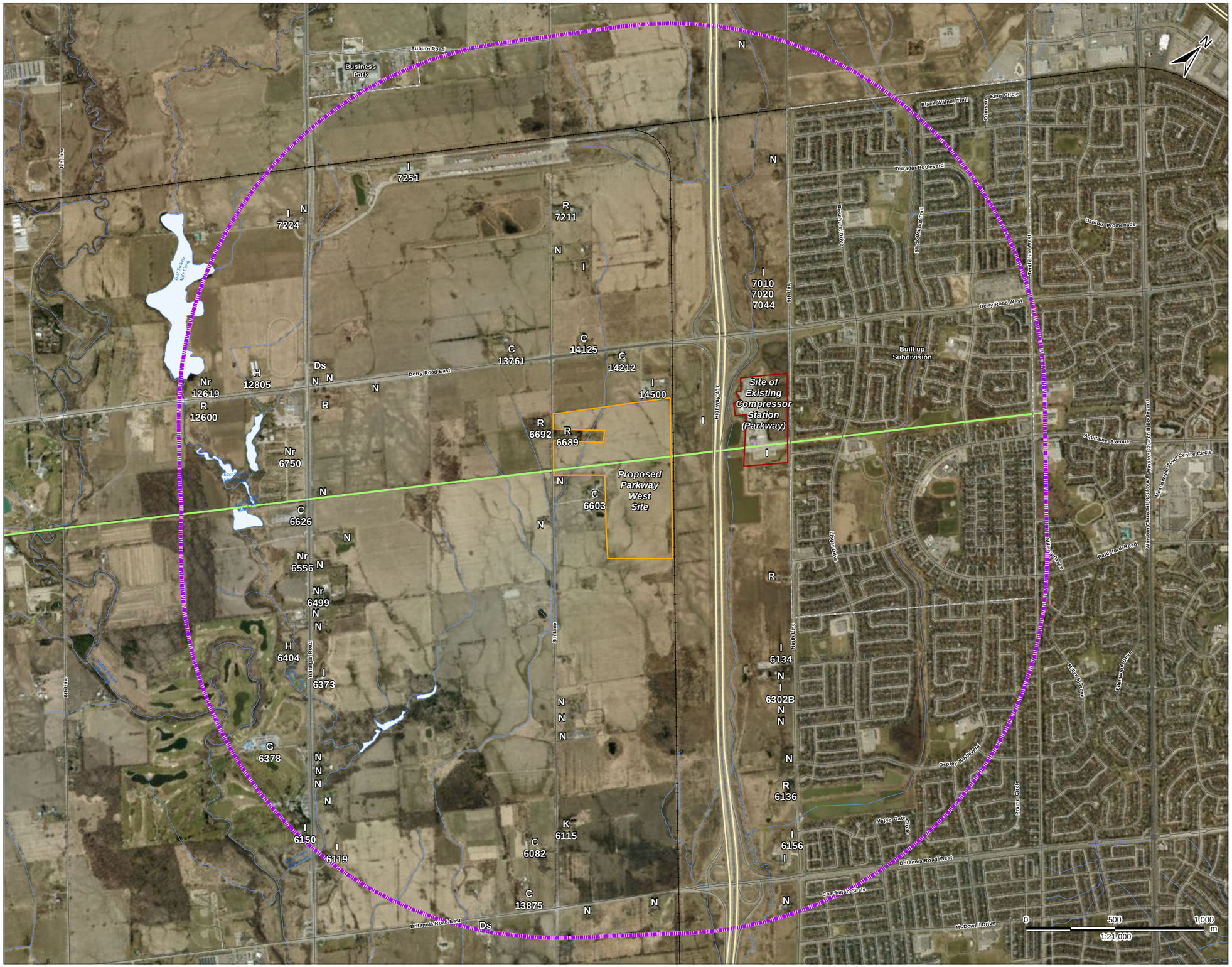
January 2013
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Client/Project
Union Gas Limited
Parkway West

Figure No.
1

Title
Site Location



Legend

- Proposed Parkway West Site
- Site of Existing Compressor Station (Parkway)
- 2km Buffer from Study Area
- Expressway / Highway
- Road
- Pipeline (Existing Union Gas System)
- Railway
- Watercourse
- Waterbody

Building Use

N	Non Farm Residential
R	Remnant Farm (original farm house, non-livestock outbuildings)
C	Cash Crop
B	Beef
H	Horse
K	Kennel
Nr	Nursery
Ds	Solitary drive shed with no associated residence
I	Commercial / Industrial / Institutional/ Religious
G	Golf Course

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthoimagery © First Base Solutions, Halton Region, 2010.

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January 2013
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Client/Project
Union Gas Limited
Parkway West

Figure No.
2

Title
Agricultural Use and MDS Map

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Revised: 2013-01-23 By: carobertson

Appendix C2

Natural Environment Technical Report

NATURAL ENVIRONMENT TECHNICAL REPORT
PARKWAY WEST PROJECT LANDS

File: 160960730
Date: January 2013

Prepared for:

Union Gas

Prepared by:

Stantec Consulting Ltd.
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Table 3.2: Plant List

Table 3.3: Potential Species at Risk

1.0 Introduction

1.1 REPORT OVERVIEW

Stantec Consulting Ltd. has been retained by Union Gas Limited (Union Gas) to complete a Natural Environment Technical Report to present the terrestrial and aquatic field surveys that have been undertaken to-date at the site of the proposed Parkway West Station – see **Figure 1.0 (Appendix A)** for the approximate survey boundary (hereafter referred to as the 'Study Area').

2.0 Methodology

2.1 BACKGROUND REVIEW

A variety of background documents information made available through on-line resources were reviewed during the preparation of this report:

- The Natural Heritage Information Centre (NHIC) database was searched to obtain historic records of provincially rare, endangered, threatened or special concern species within the vicinity of the Study Area. Provincial wildlife atlases were also consulted for birds, mammals and reptiles and amphibians species (including those at risk) known to occur in the area.
- The Halton Region Official Plan was consulted to identify any municipally designated natural areas, significant woodlands and/or significant valleylands (HR, 2006).
- The Ministry of Natural Resources' (MNR) Land Information Ontario (LIO) database was used to gather information on the presence of provincially significant and unevaluated wetlands, Areas of Natural and Scientific Interest (ANSIs), conservation areas and parks, as well as thermal regime and fish presence in the Study Area.
- Air photo interpretation and MNR mapping was utilized to identify watercourses in the Study Area.
- Department of Fisheries and Oceans (DFO) Species at Risk (SAR) mapping was used to identify any SAR that may reside in the Study Area.
- Drainage Guidelines from Credit Valley Conservation Authority (CVCA) and Toronto Region Conservation Authority (TRCA) were used to evaluate water features in the Study Area.

2.2 FIELD INVESTIGATIONS

Detailed habitat assessments for wildlife and vegetation community mapping, according to the Ecological Land Classification (ELC) system (Lee et al., 1998), were confirmed and completed for the Study Area. Additionally, botanical inventories within each ELC community (both natural and cultural communities) and hedgerows were conducted to identify the presence of all plant species. Detailed wildlife habitat assessments were completed for the Study Area to determine presence/absence of critical habitat components required to support various wildlife groups, including SAR. Evidence of wildlife (including SAR), as well as direct wildlife observations, were recorded during all field investigation visits. One site visit was conducted on October 10, 2012.

Aquatic field investigations were undertaken to provide a preliminary assessment of aquatic features in the Study Area. Two site visits were conducted: October 11, 2012 and November 2, 2012.

3.0 Field Investigation Results

3.1 TERRESTRIAL FEATURES

The Study Area is located in an agricultural landscape consisting of limited vegetation communities and wildlife habitat. The results of the ELC survey and fall botanical inventory are outlined below.

3.1.1 Vegetation Community Assessment

Vegetation communities, based on the ELC system for Southern Ontario, are shown on **Figure 1.0 (Appendix A)**. The Study Area is part of an agricultural landscape with disturbed and isolated vegetation communities (e.g., old field). Vegetation community types are described in **Table 3.1 (Appendix B)**.

No rare vegetation communities were identified in the Study Area.

3.1.2 Botanical Inventory

Plant species were recorded regardless as to whether the plants were identified within a natural feature or a cultural community; this included those species within hedgerows and edges of communities. One inventory was completed during the fall growing season.

Sixty-five (65) species of vascular plants were recorded from the Study Area. Of that number, 29 species, or 45%, were native and 36 species, or 55%, were exotic. All of the natives species are ranked S5 (Secure in Ontario) and none of the species observed had a co-efficient of conservatism (CC) higher than 5, indicating the vegetation on site exhibits a low to moderate sensitivity to disturbance – see **Table 3.2 (Appendix B)**.

No nationally or provincially rare, threatened or endangered species were observed in the Study Area.

3.1.3 Wildlife

During field investigations, incidental observations of wildlife or evidence of wildlife activity were recorded. Wildlife observations included various signs of mammal beds, trails, and scat (within the CUM1-1 communities) and included Mourning Dove, Black-capped Chickadees, and Turkey Vulture.

The Study Area could provide foraging and cover habitat for snake species as abundant cover is available in the automobile scrap yard and various brush piles located in the CUM communities and around the perimeter of the property; however, no evidence of hibernacula sites was observed.

3.1.4 Species at Risk

Habitat assessments and/or species specific surveys were conducted for SAR (e.g., listed provincially as threatened or endangered) noted during background review. Twelve SAR have the potential to be located in the Study Area. The twelve species, their habitat, and the potential for the Study Area to support these species are discussed in **Table 3.3 (Appendix B)** and include the following species:

- One plant (Butternut): considered absent from the Study Area;
- One amphibian (Jefferson Salamander): species and suitable habitat considered absent from the Study Area;
- Four reptiles (Blanding's Turtle, Eastern Musk Turtle; Northern Map Turtle, Eastern Ribbonsnake): species and suitable habitat considered absent from the Study Area;
- Four birds (Chimney Swift, Barn Swallow, Eastern Meadowlark, Bobolink): suitable habitat potentially present for Chimney Swift, Eastern Meadowlark, and Bobolink, species and habitat present for Barn Swallow; and,
- Two mammals (Little Brown *Myotis*, Northern *Myotis*): suitable habitat considered possibly present in the Study Area.

One SAR, Barn Swallow, was observed in the Study Area. An active nest was observed in a small shed near the perimeter of the scrap yard and is shown on **Figure 1.0 (Appendix A)**. Additional observations were made of potential past use of the area by Barn Swallow in an old trailer located in the southwestern-most patch of CUM1-1 (i.e. mud patches on the walls that appeared to be left over from old nests). Barn Swallow may be using other buildings on site. Foraging habitat is also present on site for this species.

Although no incidental observations were made, habitat for Chimney Swift (e.g., chimneys) as well as Little Brown *Myotis* and Northern *Myotis* (e.g., outbuildings) for roosting and breeding are potentially present in the Study Area.

Potential habitat for Bobolink and Eastern Meadowlark is present in the Study Area and associated with the fallow agricultural field and cultural meadow habitats. Grassland breeding bird surveys are recommended below (**Section 4.0**) in accordance with current MNR guidelines to determine presence/absence.

Species and habitat for butternut, Jefferson's Salamander, Blanding's Turtle, Eastern Musk Turtle, Northern Map Turtle, and Eastern Ribbonsnake are considered absent from the Study Area.

3.2 AQUATIC FEATURES

The Study Area is located in the Lake Ontario drainage basin. The 16 Mile Creek watershed covers 357 km^2 and incorporates portions of Milton, Oakville, Mississauga and Halton Hills (MNR, 2011b). Conservation Halton is the authority for this watershed. Tributaries to East 16 Mile Creek are the major watercourses in the Study Area. The main branch of East 16 Mile Creek is located approximately 2 km west of the Study Area.

3.2.1 Aquatic Habitats

Based on LIO mapping (MNR, 2011b) and air photo interpretation, four potential water features were identified in the Study Area. MNR mapping indicates that a watercourse is present near the southwest edge of the property, and flows generally parallel to the property line and 8th Line, prior to converging with the roadside ditch at the farm lane located on 8th Line, approximately 800 m southeast of Derry Road. Air photo interpretation suggests the possibility of a water feature located approximately 350 m southeast of the same farm lane, flowing generally southwest and converging with the roadside ditch. The other two tributaries are in the southeastern portion of the Study Area, south of Highway 407.

Field investigations indicate that the watercourse mapped by MNR (2009) possesses channel definition, but that it contains intermittent flow and dense terrestrial vegetation. The shallow channel (approximately 0.15 m deep) decreases in width from approximately 1.0 m where it exits a residential property located 400 m southeast of Derry Road, to approximately 0.4 m wide at the farm lane. Upstream (northwest) of the residential property, channel conditions were variable, but on October 11, conditions were similar to those observed between the residential property and the farm lane. On November 2, it was observed that the farmer had recently ploughed the channel, resulting in enhanced definition and field drainage. Downstream (southeast) of the farm lane, the channel has been historically altered substantially and consists of a roadside ditch containing dense herbaceous terrestrial vegetation. During field investigations, the channel was dry throughout. This watercourse was classified as Simple Contributing Habitat according to the *Evaluation, Classification and Management of Headwater Drainage Features: Interim Guidelines* (CVC and TRCA, 2009). This means that the watercourse provides indirect habitat to downstream reaches. More specifically, Simple Contributing Habitat is the result of ephemeral surface flows (CVC and TRCA, 2009).

The water feature identified by air photo interpretation, and located 350 m southeast of the farm lane was not observed during field investigations. The feature corresponds to one of several low-lying areas that may convey surface flows during spring freshet and large precipitation events, but no channel definition or flow was observed at the location during field investigations on October 11 or November 2.

Air photo interpretation also revealed that the two tributaries in the southeastern portion of the Study Area are agricultural swales.

3.2.2 Fish Species

The four tributaries of Sixteen Mile Creek in the Study Area converge with the main branch of Sixteen Mile Creek approximately 3 km south near the Town of Drumquin. Three reservoirs are located in the watershed. The reservoirs are used for flood control, low flow augmentation and recreation (HRCA, 2012). East 16 Mile Creek and its tributaries ultimately drain into Lake Ontario in the City of Oakville approximately 600m west of Trafalgar Road.

According to the LIO database (MNR, 2011b), the tributary in the northeast corner of the Study Area possesses a warmwater thermal regime and the three tributaries in the southern portion of the Study Area possess a coolwater thermal regime.

Background fish community data were requested from MNR on May 8, June 4, and July 31 but, to date, no data have been received.

Background fish community data were collected from Conservation Halton which identified nine fish species in the subwatershed East Branch Lisgar-16 of the East 16 Mile Creek including (CH, 2012):

- Bluegill, Lepomis macrochirus
- Bluntnose minnow, Pimephales notatus
- Brook stickleback, Culaea inconstans
- Brown bullhead, Ameiurus nebulosus
- Carps and minnows, Cyprinidae
- Fathead minnow, Pimephales promelas
- Largemouth bass, Micropterus salmoides
- Mimic shiner, Notropis volucellus
- Pumpkinseed, Lepomis gibbosus

3.2.3 Aquatic Species at Risk

According to the NHIC database (MNR, 2011a) no aquatic SAR have been recorded in the Study Area. However, Redside Dace has been recorded approximately 1.5 km south of the Study Area within the tributary that crosses the northeast corner of the study area boundary. Based on DFO's aquatic SAR mapping for Conservation Halton (DFO, 2012), no aquatic SAR have been recorded in the Study Area.

4.0 FURTHER FIELD INVESTIGATIONS

4.1 TERRESTRIAL INVESTIGATIONS

Based on the culturally modified nature of the Study Area, a single season of botanical surveys is likely sufficient, as species common to these types of habitat (e.g., goldenrods and asters) are best surveyed at this time of year.

Grassland breeding surveys are recommended to document the potential presence of Bobolink and Eastern Meadowlark. Should the surveys identify species protected under the *Endangered Species Act (2007)* consultation should occur with the MNR regarding permitting requirements. Surveys will be undertaken the last week of May, mid-June, and at the end of June.

Additional investigations are required in the scrap yard shown on **Figure 1.0 (Appendix A)** to further identify nesting structures for Barn Swallow, potential reptile hibernacula, and habitat for Chimney Swift, Little Brown *Myotis* and Northern *Myotis.* Should the surveys identify species protected under the *Endangered Species Act (2007)* consultation should occur with the MNR regarding permitting requirements. Surveys will be undertaken in the time period of May and June.

If clearing activities are required during the migratory bird nesting period (May 1 to July 31), nest surveys should be conducted by a qualified biologist to identify all nests under the Migratory Bird Convention Act using the following standard survey procedure: to the extent practical, tree and/or brush clearing should be completed prior to, or after, the breeding season for migratory birds (May 1 to July 31). Should clearing be required during the breeding bird season, prior to construction, surveys will be undertaken to identify the presence/absence of nesting birds or breeding habitat every 72 hours until clearing is complete or until July 31, whichever comes first. If a nest is located, a designated setback will be marked off within which no construction activity will be allowed while the nest is active. The radius of the setback width ranges from 5- 60 m depending on the species. Setback widths are based on the species sensitivity and on setback width recommendations that have been reviewed and approved by Environment Canada.

4.2 AQUATIC INVESTIGATIONS

Based on preliminary field investigations, the watercourse mapped by MNR (2009) would be considered Simple Contributing Habitat, according to the *Evaluation, Classification and Management of Headwater Drainage Features: Interim Guidelines* (CVC and TRCA, 2009). This means that the watercourse provides indirect habitat to downstream reaches. More specifically, Simple Contributing Habitat is the result of ephemeral surface flows (CVC and TRCA, 2009). To refine this determination, a fisheries and aquatic habitat field investigation in early spring (April or May) should be conducted according to the criteria set out in CVC and TRCA, 2009.

5.0 CLOSURE

The Natural Heritage Technical Report has been prepared by Stantec Consulting Limited for the Parkway West project lands as specified by Union Gas Limited. This report has been prepared by Stantec Consulting Limited for the sole benefit of Union Gas Limited, and may not be used by any third party without the express written consent of Union Gas Limited.

STANTEC CONSULTING LTD.



Mark Knight, MA, MCIP, RPP
Environmental Planner

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Appendix A

Figures

RES
DIST/CUM1-1
AG-clover
8th Line
Lawn
RES
AG-soy
RES
OA
AG-soy
DIST
AG-soy
AG-fallow
CUM1-1
CUM1-1
0
100
200
m
1:4,000

\\cd1220-f02\01609\active\160960730\drawing\MXD\Terrestrial\InternalMaps\160960730_Orlando_ELC_20121030.mxd
Revised: 2013-01-22 By: carobertson

Notes:
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthographic imagery provided by © Mapcon, 2012. Imagery taken in Spring 2010.

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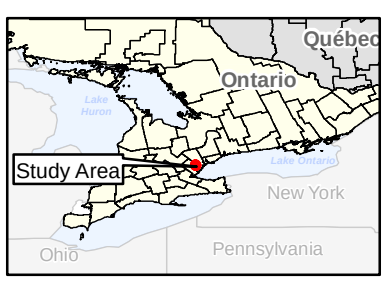
Legend

- Survey Boundary (approximate)
- Road
- Barn Swallow Nest Observation
- ELC Boundary

Cultural(CU)
CUM1-1 Dry-Moist Old Field Meadow

Additional Units

AG	Agriculture
DIST	Disturbed
OA	Open Aquatic
RES	Residential



Client/Project
Union Gas Limited
Parkway West Project - Natural Gas Pipeline

Figure No.
1.0

Title
Study Area
ELC and Species at Risk Occurrences

Appendix B

Tables

Table 3.1 Ecological Land Classification (ELC) Vegetation Types

ELC TYPE	Community Description
Cultural (CU)	
Cultural Meadow (CUM)	
CUM1-1 Dry-Moist Old Field Meadow	There were three main patches of old field meadow habitat on site. Composition and structure was generally typical of such communities, and consisted of a dense herbaceous layer composed of various grasses (representing the largest proportion of the ground layer), tall goldenrod, white-panicled aster, scarlet strawberry, and New-England aster. Teasel, avens species, grass-leaved goldenrod, and common St. John's-wort occurred occasionally. Woody regeneration, occupying less than 25% of the area of each patch, consisted primarily of young tree species such as bur oak and green ash, and shrubs such as buckthorn. The patch located along the eastern edge of the property also contained a small patch of young to mid-age trembling aspen and a small inclusion of young green ash cultural thicket. Portions of the ground layer in the northernmost patch of old field meadow were mowed.

*ELC code not included in the First Approximation of ELC for Southern Ontario

Table 3.2: Plant List														
LATIN NAME	LOCAL STATUS SOURCE LAST UPDATE/ INITIALS	COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS	GLOBAL STATUS	LOCAL STATUS HALTON Crins et al., 2006	LOCAL STATUS HALT VARGA 2000 July 2002/KH	LOCAL STATUS PEEL VARGA 2000 July 2002/KH	LOCAL STATUS Site District 7E-4 VARGA 2000 July 2002/KH	AUTHOR
PTERIDOPHYTES		**FERNS & ALLIES**												
GYMNOSPERMS		**CONIFERS**												
Pinaceae		**Pine Family**												
Picea	*abies*	Norway Spruce		5	-1	SE3			G?	X	XSR	X	X	(L.) Karsten
DICOTYLEDONS		**DICOTS**												
Amaranthaceae		**Amaranth Family**												
Amaranthus	*retroflexus*	Green Amaranth		2	-1	SE5			G?	X	X	X	X	L.
Atriplex	*patula*	Spreading Atriplex	0	-2		S5			G5	X	X	X	X	L.
Chenopodium	*album* var. *album*	Lamb's Quarters		1	-1	SE5			G5T5	X	X	X	X	L.
Apiaceae		**Carrot or Parsley Family**												
Daucus	*carota*	Wild Carrot		5	-2	SE5			G?	X	X	X	X	L.
Apocynaceae		**Dogbane Family**												
Asclepias	*syriaca*	Common Milkweed	0	5		S5			G5	X	X	X	X	L.
Asteraceae		**Composite or Aster Family**												
Ambrosia	*artemisiifolia*	Common Ragweed	0	3		S5			G5	X	X	X	X	L.
Arctium	*minus*	Common Burdock		5	-2	SE5			G?T?	X	X	X	X	(Hill) Bernh.
Cichorium	*intybus*	Chicory		5	-1	SE5			G?	X	X	X	X	L.
Cirsium	*arvense*	Canada Thistle		3	-1	SE5			G?	X	X	X	X	(L.) Scop.
Cirsium	*vulgare*	Bull Thistle		4	-1	SE5			G5	X	X	X	X	(Savi) Ten.
Erigeron	*philadelphicus var. philadelphicus*	Philadelphia Fleabane	1	-3		S5			G5T?	X	X	X	X	L.
Euthamia	*graminifolia*	Flat-topped Bushy Goldenrod	2	-2		S5			G5	X	X	X	X	(L.) Nutt.
Inula	*helenium*	Elecampane		5	-2	SE5			G?	X	X	X	X	L.
Solidago	*altissima ssp. altissima*	Tall Goldenrod	1	3		S5				X	X	X	X	L.
Sonchus	*arvensis* ssp. *arvensis*	Field Sow-thistle				SE5			G?T?	X	X	X	X	L.
Sonchus	*oleraceus*	Common Sow-thistle		3	-1	SE5			G?	X	X	X	X	L.
Symphyotrichum	*ericoides var. ericoides*	White Heath Aster				S5			G5T5	X	X	X	X	(L.) G.L. Nesom
Symphyotrichum	*lanceolatum ssp. lanceolatum*	White Panicled Aster	3	-3		S5			G5T5	X	X	X	X	(Willdenow) G.L. Nesom
Symphyotrichum	*lateriflorum var. lateriflorum*	Calico Aster	3	-2		S5			G5T5	X	X	X	X	(L.) Á. Löve & D. Löve
Symphyotrichum	*novae-angliae*	New England Aster	2	-3		S5			G5	X	X	X	X	(L.) G.L. Nesom
Taraxacum	*officinale*	Common Dandelion		3	-2	SE5			G5	X	X	X	X	G. Weber
Tripleurospermum	*perforata*	Scentless Chamomile		5	-1	SE?			G?	X	X	X	X	(Merat) M. Lainz
Brassicaceae		**Mustard Family**												
Alliaria	*petiolata*	Garlic Mustard		0	-3	SE5			G5	X	X	X	X	(M. Bieb.) Cavara & Grande
Armoracia	*rusticana*	Horseradish		0	-1	SE4			G?	X	X	X	X	(Lam.) P. Gaertn., Meyer & Scherb.

Table 3.2: Plant List														
LATIN NAME	LOCAL STATUS SOURCE LAST UPDATE/ INITIALS	COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS	GLOBAL STATUS	LOCAL STATUS HALTON Crins et al., 2006	LOCAL STATUS HALT VARGA 2000 July 2002/KH	LOCAL STATUS PEEL VARGA 2000 July 2002/KH	LOCAL STATUS Site District 7E-4 VARGA 2000 July 2002/KH	AUTHOR
Capsella	*bursa-pastoris*	Shepherd's Purse		1	-1	SE5			G?	X	X	X	X	(L.) Medik.
Caprifoliaceae		**Honeysuckle Family**												
Lonicera	*tatarica*	Tartarian Honeysuckle		3	-3	SE5			G?	X	x	X	X	L.
Convolvulaceae		**Morning-glory Family**												
Convolvulus	*arvensis*	Field Bindweed		5	-1	SE5			G?	X	x	X	X	L.
Cornaceae		**Dogwood Family**												
Cornus	*foemina* ssp. *racemosa*	Red Panicled Dogwood	2	-2		S5			G5?	X	x	X	X	Miller
Dipsacaceae		**Teasel Family**												
Dipsacus	*fullonum* ssp. *sylvestris*	Wild Teasel		5	-1	SE5			G?T?	X	x	X	X	L.
Fabaceae		**Pea Family**												
Medicago	*lupulina*	Black Medick		1	-1	SE5			G?	X	x	X	X	L.
Medicago	*sativa* ssp. *sativa*	Alfalfa		5	-1	SE5			G?T?	X	x	X	X	L.
Trifolium	*pratense*	Red Clover		2	-2	SE5			G?	X	x	X	X	L.
Vicia	*cracca*	Tufted Vetch		5	-1	SE5			G?	X	x	X	X	L.
Fagaceae		**Beech Family**												
Quercus	*macrocarpa*	Bur Oak	5	1		S5			G5	X	x	X	X	Michx.
Guttiferae		**St. John's-wort Family**												
Hypericum	*perforatum*	Common St. John's-wort		5	-3	SE5			G?	X	x	X	X	L.
Malvaceae		**Mallow Family**												
Abutilon	*theophrasti*	Velvet-leaf		4	-1	SE5			G?	X	x	X	X	Medik.
Oleaceae		**Olive Family**												
Fraxinus	*pennsylvanica*	Red Ash	3	-3		S5			G5	X	x	X	X	Marshall
Syringa	*vulgaris*	Common Lilac		5	-2	SE5			G?	X	x	X	X	L.
Onagraceae		**Evening-primrose Family**												
Epilobium	*species*	Willow-herb speices												
Plantaginaceae		**Plantain Family**												
Plantago	*lanceolata*	Ribgrass		0	-1	SE5			G5	X	x	X	X	L.
Plantago	*major*	Common Plantain		-1	-1	SE5			G5	X	x	X	X	L.
Rhamnaceae		**Buckthorn Family**												
Rhamnus	*cathartica*	Common Buckthorn		3	-3	SE5			G?	X	x	X	X	L.

Table 3.2: Plant List														
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Rosaceae		**Rose Family**												
Crataegus	*species*	Hawthorn species												
Fragaria	*virginiana* ssp. *virginiana*	Scarlet Strawberry	2	1		SU			G5T?	X	x	X	X	Miller
Geum	*species*	Avens species												
Malus	*pumila*	Common Crabapple		5	-1	SE5			G5	X	x	X	X	Miller
Prunus	*virginiana* ssp. *virginiana*	Choke Cherry	2	1		S5			G5T?	X	x	X	X	L.
Rosa	*species*	Rose species												
Rubus	*idaeus* ssp. *strigosus*	Wild Red Raspberry	0	-2		S5			G5T5	X	x	X	X	(Michaux) Focke
Salicaceae		**Willow Family**												
Populus	*tremuloides*	Trembling Aspen		0		S5			G5	X	x	X	X	Michx.
Salix	*species*	Willow species												
Salix	*bebbiana*	Long-beaked Willow	4	-4		S5			G5	X	x	X	X	Sarg.
Sapindaceae		**Maple Family**												
Acer	*negundo*	Manitoba Maple	0	-2		S5			G5	X	X	X	X	L.
Acer	*saccharinum*	Silver Maple	5	-3		S5			G5	X	X	X	X	L.
Scrophulariaceae		**Figwort Family**												
Linaria	*vulgaris*	Butter-and-eggs		5	-1	SE5			G?	X	x	X	X	Miller
Verbascum	*thapsus*	Common Mullein		5	-2	SE5			G?	X	x	X	X	L.
Solanaceae		**Nightshade Family**												
Solanum	*dulcamara*	Bitter Nightshade		0	-2	SE5			G?	X	x	X	X	L.
Tiliaceae		**Linden Family**												
Tilia	*americana*	American Basswood	4	3		S5			G5	X	x	X	X	L.
Ulmaceae		**Elm Family**												
Ulmus	*americana*	White Elm	3	-2		S5			G5?	X	x	X	X	L.
Verbenaceae		**Vervain Family**												
Verbena	*hastata*	Blue Vervain	4	-4		S5			G5	X	x	X	X	L.
Vitaceae		**Grape Family**												
Parthenocissus	*inserta*	Inserted Virginia-creeper	3	3		S5			G5	X	x	X	X	(A. Kern.) Fritsch
Vitis	*riparia*	Riverbank Grape	0	-2		S5			G5	X	x	X	X	Michx.
MONOCOTYLEDONS		**MONOCOTS**												
Cyperaceae		**Sedge Family**												

Table 3.2: Plant List

LATIN NAME	LOCAL STATUS SOURCE LAST UPDATE/ INITIALS	COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS	GLOBAL STATUS	LOCAL STATUS HALTON Crins et al., 2006	LOCAL STATUS HALT VARGA 2000 July 2002/KH	LOCAL STATUS PEEL VARGA 2000 July 2002/KH	LOCAL STATUS Site District 7E-4 VARGA 2000 July 2002/KH	AUTHOR
Carex	*species*	Sedge species												
Juncaceae		**Rush Family**												
Juncus	*effusus* ssp. *solutus*	Soft Rush	4	-5		S5			G5T?	X	x	X	X	L.
Poaceae		**Grass Family**												
Grass	*species*	Grass species												
Bromus	*inermis* ssp. *inermis*	Awnless Brome		5	-3	SE5			G4G5T?	X	x	X	X	Leyss.
Echinochloa	*crus-galli*	Common Barnyard Grass		-3	-1	SE5			G?	X	x	X	X	(L.) P. Beauv.
Phalaris	*arundinacea*	Reed Canary Grass	0	-4		S5			G5	X	x	X	X	L.
Setaria	*viridis var. viridis*	Green Foxtail			-1	SE5			G?	X	x	X	X	(L.) P. Beauv.
Typhaceae		**Cattail Family**												
Typha	*angustifolia*	Narrow-leaved Cattail	3	-5		S5			G5	X	x	X	X	L.
Typha	*latifolia*	Broad-leaved Cattail	3	-5		S5			G5	X	x	X	X	L.
FLORISTIC SUMMARY & ASSESSMENT														
Species Diversity														
Total Species:		**65**												
Native Species:		**29**	45%											
Exotic Species		**36**	55%											
Regionally Significant Species		enter manually												
Locally Significant Species		enter manually												
S1-S3 Species		0	0%											
S4 Species		0	0%											
S5 Species		28	100%											
Co-efficient of Conservatism and Floristic Quality Index														
Co-efficient of Conservatism (CC) (average)		**2.2**												
CC 0 to 3	*lowest sensitivity*	21	78%											
CC 4 to 6	*moderate sensitivity*	6	22%											
CC 7 to 8	*high sensitivity*	0	0%											
CC 9 to 10	*highest sensitivity*	0	0%											
Floristic Quality Index (FQI)		**11**												
Presence of Weedy & Invasive Species														
mean weediness		**-1.5**												
weediness = -1	*low potential invasiveness*	22	63%											
weediness = -2	*moderate potential invasiveness*	8	23%											
weediness = -3	*high potential invasiveness*	5	14%											
Presence of Wetland Species														
average wetness value		**1.1**												
upland		17	27%											

Table 3.2: Plant List														
LATIN NAME	LOCAL STATUS SOURCE LAST UPDATE/ INITIALS	COMMON NAME	COEFFICIENT OF CONSERVATISM	WETNESS INDEX	WEEDINESS INDEX	PROVINCIAL STATUS	OMNR STATUS	COSEWIC STATUS	GLOBAL STATUS	LOCAL STATUS HALTON Crins et al., 2006	LOCAL STATUS HALT VARGA 2000 July 2002/KH	LOCAL STATUS PEEL VARGA 2000 July 2002/KH	LOCAL STATUS Site District 7E-4 VARGA 2000 July 2002/KH	AUTHOR
facultative upland		13	21%											
facultative		12	19%											
facultative wetland		17	27%											
obligate wetland		3	5%											

Table 3.3: Potential Species at Risk

Common Name	Scientific Name	SRANK	Provincial Status (COSSARO)	National Status (COSEWIC)	Source	Habitat Protection (ESA)	Species Requirements/ Limitations	Assessment of Study Area
Plants								
Butternut	*Juglans cinera*	S3?	END	END	TC	General Habitat	This medium-sized tree is commonly found in riparian habitats, as well as a variety of substrates such as rich, moist, well-drained loams, and well-drained gravels of limestone origin (COSEWIC 2003). Butternut is intolerant of shade and occurs singly or in small groups with a variety of associates (Farrar, 1995).	Based on ELC assessments and botanical inventory, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**
Amphibians								
Jefferson's Salamander	*Ambystoma jeffersonianum*	S2	END	END	NHIC	Regulated Habitat	The Jefferson Salamander is terrestrial during the adult stage and inhabits upland deciduous forests with suitable breeding areas including limestone sinkhole ponds, kettle ponds, vernal pools and other natural basins. Breeding areas are often ephemeral and are fed by spring runoff, groundwater, or springs. In Canada, the species is associated with mature, Carolinian forests. Suitable habitat is often only available in fragmented deciduous woodlots of marginal agricultural land (COSEWIC, 2010).	Based on habitat assessments, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**
Reptiles								
Blanding's Turtle	*Emydoidea blandingi*	S3	THR	THR	HA	General Habitat	Blanding's Turtles frequent lakes, ponds, and marshes, and prefer shallow water with abundant aquatic vegetation and a soft bottom (MacCulloch, 2002). Adults usually occupy open or partially vegetated sites, whereas juveniles occupy areas with thick vegetation. Nesting occurs in dry conifer or mixed hardwood forests, up to 410 m from any body of water, in loose substrates including sand, organic soil, gravel and cobblestone. Nesting may also occur along gravel roadways (COSEWIC, 2005).	Based on habitat assessments, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**
Eastern Musk Turtle	*Sternotherus odoratus*	S3	THR	SC	HA	General Habitat	The Eastern Musk Turtle, also known as Stinkpot, is a small, aquatic freshwater turtle. The Eastern Musk Turtle require aquatic habitats of soft substrate and shallow water with little to no current. Nesting occurs in areas close to the water with direct exposure to sunlight, eggs are laid on the open ground or in shallow excavations in decaying vegetation and rotting wood, nests have also been found in shallow gravel or rock crevices. This species is highly aquatic, and rarely leaves the water (COSEWIC, 2002).	Based on habitat assessments, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**
Northern Map Turtle	*Graptemys geographica*	S3	SC	SC	HA	-	Map turtles are highly aquatic and inhabit slow moving, large rivers and lakes with soft bottoms and abundant aquatic vegetation. Basking sites include rocks and deadheads adjacent to deep water (COSEWIC 2002) Nesting occurs in soft sand or soil and at a distance from the water, hibernation is communal and occurs at the bottoms of lakes (MacCulloch, 2002). Females leave the water in June to nest (MacCulloch, 2002).	Based on habitat assessments, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**
Eastern Ribbonsnake	*Thamnophis sauritus*	S3	SC	SC	HA	-	The Eastern Ribbonsnake is restricted to southern Ontario, where it is quite local, and is usually found close to water (Lamond, 1994). They often frequent the edge of shallow ponds, streams, marshes, swamps, or bogs with dense vegetation nearby that provides cover, with abundant exposure to sunlight and upland areas for nesting (COSEWIC, 2002). Ontario ribbonsnakes have been found to hibernate in animal burrows or rock crevices (Lamond, 1994).	Based on habitat assessments, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**

Table 3.3: Potential Species at Risk

Common Name	Scientific Name	SRANK	Provincial Status (COSSARO)	National Status (COSEWIC)	Source	Habitat Protection (ESA)	Species Requirements/ Limitations	Assessment of Study Area
Birds								
Chimney Swift	*Chaetura pelagica*	S4B, S4N	THR	THR	OBBA	General Habitat	Chimney Swift use chimneys for roosting and breeding, as well as walls, rafters, or gables of buildings and, less frequently, natural structures such as hollow trees, tree cavities and cracks in cliffs (Cadman et al., 2007).	ELC site investigations did identify woodland habitat to support the presence of Chimney Swifts within the vicinity of the Study Area. Residences and other buildings may include chimneys that are suitable for Chimney Swift. **Species considered potentially present in the Study Area.**
Barn Swallow	*Hirundo rustica*	S4B	THR	THR-NS	OBBA	General Habitat	As their name suggests, Barn Swallows nest in walls or ledges of barns, as well as on other human-made structures such as bridges, culverts or other buildings (Cadman et al., 2007). Where suitable nesting structures occur, Barn Swallows often form small colonies, sometimes mixed with Cliff Swallows. Barn Swallows feed on aerial insects while foraging in open habitat (Cornell Lab of Ornithology, No date). They are generally considered grassland species, foraging over meadows, hay, pasture or even mown lawn. They will also frequently forage in woodland clearings, over wetland habitats or open water where insect prey are abundant.	Based on incidental observations during botanical surveys, active nest(s) are present in the Study Area and shown on **Figure 1.0** (though not affected by Project). **Species and habitat considered present in the Study Area.**
Bobolink	*Dolichonyx oryzivorus*	S4B	THR	THR	OBBA	General Habitat	The Bobolink is generally referred to as an “area-sensitive grassland species” that typically prefers habitat patches greater than 10 ha (Bollinger and Gavin 1992). It nests primarily in forage crops with a mixture of grasses and broad-leaved forbs, predominantly hayfields and pastures. Preferred ground cover species include grasses such as Timothy and Kentucky bluegrass and forbs such as clover and dandelion (COSEWIC 2010). Bobolink is an area-sensitive species, with reported lower reproductive success in small habitat fragments (Kuehl and Clark 2002; Winter et al. 2004).	Based on habitat assessments, the species and its habitat were not identified in the Study Area. **Considered absent from the Study Area.**
Eastern Meadowlark	*Sturnella magna*	S4B	THR	THR-NS	OBBA	General Habitat	Meadowlarks are ground nesting birds (Harrison, 1975), which are often associated with human-modified habitats where they sing from prominent perches such as roadside wires, trees and fence posts. As a grassland species the Eastern Meadowlark typically occurs in meadows, hayfields and pastures. However, it will utilize a wider range of habitats than most grassland species, including mown lawn (e.g. golf course, parks), wooded city ravines, young conifer plantations and orchards (Peck and James 1983). The Eastern Meadowlark is generally tolerant of habitat with early succession of trees or shrubs. As with other grassland species, current threats are primarily the result of expanding urbanization and intensive farming practices (Cadman et al., 2007).	Based on habitat assessment, this species and its habitat may be present within the Study Area in the CUM1-1 habitat. No species observations were made incidentally, and habitat is small, fragmented and suboptimal. **Considered potentially present in the Study Area.**

Table 3.3: Potential Species at Risk

Common Name	Scientific Name	SRANK	Provincial Status (COSSARO)	National Status (COSEWIC)	Source	Habitat Protection (ESA)	Species Requirements/ Limitations	Assessment of Study Area
Mammals								
Little Brown Myotis	*Myotis lucifugus*	S5	END	END-NS	AMO	-	This species up until recently was considered the most common bat species in Ontario, and most frequently found bat species in North America. The recent change in status is due to significant declines in recent years attributed to a condition referred to as White-nose Syndrome (WNS). A widespread species, the Little Brown Bat is commonly found near waterbodies in buildings, attics, roof crevices and loose bark on trees or under bridges (Eder, 2002).	This species is known from the general region as recorded in the Ontario Mammal Atlas. Habitat restricted to anthropogenic structures (e.g., houses, sheds) that will not be impacted by development. **Species considered potentially present in the Study Area.**
Northern Myotis	*Myotis septentrionalis*	S5	END	END-NS	AMO	-	The Northern Long-eared Bat is a resident bat of upland forests of eastern North America, typically foraging for aerial insects in the forest understory. Maternity roosts are located under bark or in buildings with young born in June and July while hibernating colonies typically reside in cave crevices (Reid, 2006).	This species is known from the general region as recorded in the Ontario Mammal Atlas. Habitat restricted to anthropogenic structures (e.g., houses, sheds) that will not be impacted by development. **Species considered potentially present in the Study Area.**

END – Endangered - a species facing imminent extinction or extirpation
THR – Threatened - a species that is at risk of becoming endangered
SC - Special Concern - a species with characteristics make it sensitive to human activities or natural events
S4 – Apparently secure. Uncommon but not rare: some cause for long-term concern due to declines or other factors.
S3 – Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread
S2 – Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or on from the nation or state/province.
S1 - Critically Imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as
S? – Rank Uncertain
B – Breeding migrants/vagrants
N – Non-breeding
OBBA - Ontario Breeding Bird Atlas (Cadman et al., 2007)
MA - Mammal Atlas (Dobbyn, 1997)
HA - Ontario Herpetofaunal Atlas
TC - Tree in Canada (Fararar, 1995)

Appendix C3

Hydrogeological Assessment

HYDROGEOLOGICAL ASSESSMENT, PARKWAY WEST COMPRESSOR STATION, TOWN OF MILTON, HALTON REGION, ONTARIO

Prepared for:
Union Gas

Prepared by:
Stantec Consulting Ltd
49 Frederick Street
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February 2013
160311376

Sign-off Sheet

Stantec

This document entitled HYDROGEOLOGICAL ASSESSMENT, PARKWAY WEST COMPRESSOR STATION, TOWN OF MILTON, HALTON REGION, ONTARIO was prepared by Stantec Consulting Ltd. for the account of Union Gas. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by Union Gas Limited to complete a hydrogeological assessment for three adjacent (3) parcels of land immediately to the east of Eighth Line, on Lots 9 and 10, Concession 10, in the Town of Milton, Halton Region (Figure 1) (Site). The Site covers an area of approximately 38 ha and is bounded to the north by a farm and associated agricultural lands and a Highway 407 ETR maintenance yard, to the east by a CNR railway line and an adjacent corridor of hydro transmission lines, and to the south and west by several private properties and agricultural fields. Union Gas Limited is proposing to construct a Compressor Station on the Site, with the facility consisting of an onsite network of pipes that will be connected to compressors for the purpose of transporting gas off the property. The development will also consist of an administrative building constructed in the northwestern area of the Site near Eighth Line, with this building being serviced by a private water supply well and subsurface sewage disposal system.

The Site is currently zoned for Agricultural (A1) land use and, as a result, Stantec has prepared the following hydrogeological assessment in support of the application for Zoning By-Law Amendment to permit the Compressor Station to be built and operated on the property. The focus of the hydrogeological assessment was to evaluate the suitability of the Site for the proposed development. Specifically, the key objectives of the hydrogeological assessment were to:

1. Characterize the current geological and hydrogeological conditions throughout the Site, including an evaluation of the seasonal variations in groundwater conditions (i.e., water table fluctuations and groundwater flow direction) across the Site and the determination of what constraints these conditions may have on the proposed development.

2. Determine the groundwater recharge function of the Site under the pre-development condition and determine the impact that proposed land use changes could potentially have on this function under the post-development condition.

3. Assess whether storm sewer and/or gas pipeline servicing will intercept the groundwater table and determine what mitigation measures could be employed to minimize any potential disturbances to groundwater levels and pre-development flow patterns.

4. Assess whether the proposed development could notably interfere with the operation of local private wells.

5. Evaluate the feasibility of establishing an onsite well to meet the water demands of the proposed administration building.

6. Propose other strategies that could be used at the Site to mitigate any of the potential impacts mentioned above.

This report is arranged into seven sections, including this introduction. Section 2.0 provides background information on the regional setting of the Site. Section 3.0 discusses the methods that were used to complete the site specific assessment of hydrogeological conditions at the Site, with Section 4.0 presenting the results of this assessment. Section 5.0 presents the potential impacts of the proposed development on the hydrogeological form and function of the property and the suggested measures that could be employed to mitigate these impacts. Section 6.0 provides the conclusions of the report, with Section 7.0 providing a listing of cited references. All figures and tables referenced in this report are presented in Appendices A and B, respectively. Appendices C to F present the Borehole Logs and MOE Water Well Records, Laboratory Certificate of Analysis, Hydraulic Conductivity Testing Analytical Solutions, and Climate Data Normals, respectively.

2.0 Background

2.1 PHYSIOGRAPHY

The Site is located within the physiographic region classified by Chapman and Putnam (1984) as the Peel Plain. The region consists of a beveled till plain, underneath which lies a layer of silt to clay till containing shale and limestone fragments affiliated with the underlying Queenston and Georgian Bay Formations. Extensive varved clay formations have also been found in this region, stretching from Milton (Lester B. Pearson International Airport) to Oakville.

As shown in Figure 2, the topography of the Site is rolling, with existing ground surface slopes ranging from 0.6 to 1.7%. Mapping provided by the Ministry of Natural Resources (MNR) indicates that a watercourse flows in a northwest to southeast direction across the southwestern portions of the Site (Figure 1). This watercourse receives runoff from the southwestern portions of the property, with this drainage being directed offsite to a ditch running parallel to the Eighth Line. Field investigations found this watercourse to possess channel definition, but that it is characterized by intermittent flow and dense terrestrial vegetation (Stantec, 2013a). Near the eastern limits of the Site, drainage moves offsite via an existing ditch that runs beneath the CNR line. This ditch turns south and runs parallel to Highway 407 towards Britannia Road, eventually discharging to the East Branch of Sixteen Mile Creek. Existing drainage from external lands enters the Site along the northern boundary of the property and is conveyed south through the Site to the aforementioned east and southwest drainage outlets. In general, the property slopes to the south-southwest, from a high elevation of 200 m AMSL along the northern property boundary (adjacent to the CNR line) to the low elevation of 196.5 m AMSL in the most southern corner of the property and along the banks of the onsite tributary.

2.2 REGIONAL GEOLOGY AND HYDROSTRATIGRAPHY

Geological conditions throughout the region have been documented in investigations completed by Johnson *et al.* (1992), Holysh (1995), Ecoplans (2012) and the Halton-Hamilton Source Protection Committee (2012). In summary, the following key geological formations are noted throughout the general study area, with these units being listed from youngest to oldest:

Peel Plain Sediments: Varved layers of silts and clays formed in a low-energy glaciolacustrine environment. These sediments represent the bottom of the former glacial Lake Peel, which formed between an ice front to the north, the Niagara Escarpment to the west and the Trafalgar Moraine located to the south-southeast (Figure 3, Unit 8b).

Halton Till: A dense, silty diamicton that is clast poor and reddish brown in colour that often is interbedded with silt, clay, sand and gravel (Figure 3, Unit 5d). The Halton Till is thought to originate from ice-

marginal sediments from the late glacial advance of the Laurentide Ice Sheet in the Lake Ontario basin, resulting in a dense till with a drumlinized surface (Sharpe and Russel, 2007). The Halton Till is typically 3 m to 6 m thick, but locally can range from 15 m to 30 m in thickness.

Queenston Shale: Dense, thinly bedded reddish-brown shale of Upper Ordovician age, containing frequent layers of hard, grey limestone and occasional clay and siltstone layers. Highly weathered near the top of the formation that often blending into the overburden deposits above. Below this weathered layer, the shale is not highly fractured and, as a result, is not considered to be a high yielding aquifer system.

Georgian Bay Formation: A regionally extensive unit of blue-grey to green-grey shale of Upper Ordovician age. Frequent interbedded layers of fossiliferous sandstone, siltstone, and grey limestone are common at the top of the formation.

Both the Peel Plain sediments and the Halton Till unit are considered to represent a regional aquitard; with the reported horizontal hydraulic conductivity of the Halton Till being in the range of 10^{-7} m/s (Kassenaar and Wexler, 2006). The Queenston Shale formation, although composed of dense, thinly layered fine-grained materials, provides a poorly conductive aquifer in the upper 3 m to 6 m portion of the bedrock unit that is highly weathered and fractured. Hydraulic conductivities within the weathered portion of the Queenston Shale are reported to be in the range of 10^{-5} m/s, with the deeper less fractured sections of this bedrock unit being in the range of 10^{-8} m/s (Ecoplans, 2012).

2.3 REGIONAL HYDROGEOLOGY

According to the Assessment Report for the Halton Region Source Protection Area (HHSPC, 2012), the water table throughout the region in which the Site is located is generally encountered at a depth of approximately 3 m BGS within the shallow bedrock and/or slightly above the bedrock surface within the overlying overburden deposits. Water table mapping presented in the Assessment Report (HHSPC, 2012) indicates that groundwater flows through the Halton Till, sand layers and the weathered zone of the Queenston Shale in the vicinity of the Site to the southwest towards Lake Ontario.

The majority of private domestic wells located within the Source Protection Area to the east of the Niagara Escarpment obtain their potable water supply from sand and gravel deposits interbedded within the Halton Till or from the upper weathered portion of the Queenston Shale (HHSPC, 2012). In general, those wells completed into the Queenston Shale are relatively shallow and low yielding; however, the fracture system is sufficient enough to transmit water at a rate required to provide adequate yields for individual domestic supplies. Although the

aforementioned hydrostratigraphic units are considered to represent poor aquifers, they are locally important due to absence of a higher yielding geologic unit (HHSPC, 2012).

Figure 3 presents the location of water supply wells in the general vicinity of the Site, which were positioned using UTM coordinates provided in MOE Water Well Records (WWR) (Appendix C). These well locations have not been verified by Stantec in the field. Theoretical yields are also presented for those wells where the accompanying WWR provided the results of pumping tests completed on the wells at the time of their installation. Using the pumping rate, duration and resulting drawdown provided for a given well at the time of its testing, a specific capacity was calculated for the well, which was then used to calculate the maximum theoretical yield based on the available drawdown within the well. The available drawdown was calculated to be the distance from the static water level to the top of the pump, assuming that the pump is located 2 m above the bottom of the well. For those wells located within 500 m of the Site and completed into the sandy overburden deposits that overlie the bedrock surface, calculated yields ranged from 0.3 L/s to 0.8 L/s, for an average of 0.6 L/s. For those wells completed into the upper portion of the Queenston Shale, calculated yields were found to range from 0.1 L/s to 3.2 L/s, for an average of 0.9 L/s.

No Wellhead Protection Area (WHPA) currently extends beneath the Site, with the closest WHPA being located approximately 14 km to the west-southwest of the property (i.e., Kelso Municipal Wells 3/6, 4 and 5) (Earthfx, 2010).

3.0 Methodology

This section provides the methodology used to obtain the data required to complete the hydrogeological assessment of the Site. The major components of the investigation were as follows:

- Borehole Advancement;
- Monitoring Well Installations;
- Groundwater Level Monitoring;
- Groundwater Sampling and Testing; and,
- Hydraulic Response Testing.

The sections below provide detailed descriptions of these study components.

3.1 BOREHOLE ADVANCEMENT

From December 10 to 14, 2012 a total of 19 boreholes were advanced at the Site as part of the hydrogeological investigation and concurrent geotechnical investigation (exp., 2012), with nine (9) of these boreholes being equipped with monitoring wells (MW101-12 to MW109-12) (Figure 1). The installation of these monitoring wells is described in Section 3.2. The boreholes were strategically located across the Site to obtain spatially representative soil and groundwater samples beneath the property, as well as determine the local groundwater flow direction.

Malone's Soil Samples Co. Ltd. was retained to drill all of the boreholes and install the monitoring wells. The boreholes were drilled using a track mounted CME55 drill rig equipped with a hollow stem auger drilling system. Stantec personnel observed the drilling of each borehole. Soil samples were collected at roughly equal intervals using a 0.61 m long, stainless steel split spoon sampler and classified by Stantec personnel using the ASTM guideline for visual manual description and identification of soils (ASTM D2488 00). The boreholes were advanced to depths ranging from 3.1 m to 9.3 m below ground surface (BGS). Borehole logs were prepared for each drilling location, containing descriptions (where relevant and possible) of soil type, texture, colour, structure, consistency, plasticity, moisture content, and other observations. Copies of the borehole logs are provided in Appendix C. The ground surface elevation at each borehole was surveyed to a geodetic benchmark by J.D. Barnes Limited.

3.2 MONITORING WELL INSTALLATIONS

All monitoring wells were installed into the boreholes advanced at the Site in accordance with Ontario Regulation 903 (MOE, 1990). Installation details for each of the monitoring wells are summarized in Table 1 and on the borehole logs in Appendix C. The monitoring wells were

constructed with 51 mm inside diameter, Schedule 40 PVC pipe, with a No. 10 slot screen (0.01 inch slot) measuring 1.52 m in length. The annular space between the monitoring well pipes and surrounding geological formation were backfilled with No.3 grade silica sand to an average height of 1.3 m above the top of screen. The remainder of the annular space at each monitoring well location was then filled with grout and/or granular bentonite to prevent a hydraulic connection from occurring between the geological formations along the length of the casing. The monitoring wells were encased within above ground lockable protective steel casings that were cemented into place. The pipe stick-up of each monitoring well was measured by Stantec personnel. The elevation of the existing grade at each monitoring well was surveyed to a geodetic benchmark by J.D. Barnes Limited.

3.3 GROUNDWATER LEVEL MONITORING

As part of the hydrogeological assessment, groundwater levels were monitored at all monitoring well locations using a combination of automated and manual measurement methods. All Stantec installed monitoring wells were instrumented with either Solinst® Gold or Solinst® Edge Leveloggers® (Levelogger). Solinst® Gold Leveloggers were installed in MW105-12, MW106-12, MW107-12 and MW108-12. Solinst® Edge Leveloggers were installed in MW101-12, MW102-12, MW103-12, MW104-12 and MW109-12. The Leveloggers, consisting of a pressure transducer and datalogger, were suspended into the water column within the wells and set to record water level fluctuations at 15 minute intervals. Leveloggers are not vented to the atmosphere and, therefore, record total pressure (atmospheric + height of water column). Consequently, data obtained from the Leveloggers were corrected for atmospheric pressure using data obtained from Solinst® Barologgers®, which were suspended in the air within MW102-12 (Solinst® Edge Logger) and MW106-12 (Solinst® Gold Logger).

Manual groundwater levels were periodically measured at the monitoring wells (MW101-12 to MW109-12) from December 2012 to January 2013. The groundwater level measurements were recorded in meters to the nearest 0.01 m using a battery operated Heron™ water level indicator. Measurements were obtained by lowering the electrode, attached to a graduated polyethylene tape, slowly into the well until the buzzer sounded. The water level measurements were then converted to elevations above mean sea level (AMSL). Manual groundwater level measurements were used to calibrate and check the accuracy of the data recorded by the Leveloggers. Manual groundwater levels obtained from the monitoring wells are summarized in Table 2.

3.4 GROUNDWATER SAMPLING AND TESTING

On December 19 and 20, 2012 Stantec obtained water samples from each of the monitoring wells (MW101-12 to MW109-12) for the purpose of evaluating pre-development groundwater quality conditions beneath the Site. The groundwater samples were obtained from the monitoring wells using a dedicated inertial lift Waterra™ sampling pump. The Waterra™ sampling pump was constructed of 16 mm diameter high density polyethylene (HDPE) tubing connected to a Waterra™ Delrin foot valve. Efforts were made to remove at least 10 casing

volumes from the well prior to sampling to remove stagnant water from the well casing. However, in wells that were very slow to recover (MW103-12, MW104-12, MW105-12, and MW109-12) a minimum of 5 casing volumes was purged over a period of several days prior to sample collection. A casing volume is defined as the volume of water stored inside the well casing. Prior to sample collection, the Waterra™ sampling system was lowered to approximately 0.5 m from the bottom of the well.

Following purging, the groundwater sample from each monitoring well was collected by pouring water directly from the HDPE tubing into the appropriate pre labeled sample containers. Each groundwater sample for metals analysis was field filtered using disposable in-line 0.45 μm (micron) filters attached to the HDPE tubing. Consequently, the metals analysis results for the groundwater sample obtained from the monitoring wells represent dissolved concentrations.

The groundwater samples were packed carefully into a sample cooler, which was refrigerated using freezer packs, and delivered to Maxxam Analytics Inc. for laboratory analyses. The groundwater samples were analyzed for general inorganic parameters and metals. Chain of custody forms were completed and included with the samples. The results of the groundwater quality testing completed as a part of the investigation are presented in Table 3, with a copy of the laboratory Certificates of Analysis being provided in Appendix D.

3.5 HYDRAULIC RESPONSE TESTING

To estimate the horizontal hydraulic conductivity of the hydrostratigraphic units located beneath the Site, Stantec performed in-situ hydraulic response testing at MW101-12 through MW109-12. The testing was completed on December 19 and 20, 2012 and consisted of creating an instantaneous change in the well water level by removing a known volume of water from the well, which was followed by recording the time taken for the resulting water level to return to static conditions (i.e., rising head / bail test). The results were analyzed using the Bouwer and Rice (1976) solution for confined aquifers as provided in the software package AQTESOLV™. This solution was used to determine the horizontal hydraulic conductivity of the aquifer sediments within the immediate vicinity of the screened interval of each tested monitoring well. The results of hydraulic response testing are summarized in Table 1, with the analytical solutions for the data being presented in Appendix E.

4.0 Local Geology and Hydrogeology

4.1 GEOLOGY

Figure 3 presents the surficial geology in the vicinity of the Site as mapped by the OGS (2003). This mapping indicates that the northern half of the site is covered with silty to clayey till of glaciolacustrine origin, which is interpreted to represent the Halton Till. In the southern and westerly portions in the property, the mapping indicates that glaciolacustrine deposits of silts and clays cover the surface, which is interpreted to be the varved clays of the Peel Plain Sediments. Soils information obtained from the onsite boreholes drilled in these areas of the Site as a part of the current investigation (Appendix C) indicate that the entire site is covered by silt till (i.e., Halton Till), followed by a silty sand to sandy silt layer of variable thickness that overlies the bedrock surface, with the bedrock consisting of red shale (Queenston Shale) having interbedded limestone seams.

Figure 1 shows the locations of Cross Section A-A' (Figure 4), B-B' (Figure 5), and C-C' (Figure 6), which were constructed using geological information obtained from onsite drilling results (Appendix C). Results of the onsite drilling indicates that a 0.25 m to 0.38 m thick layer of topsoil covers the Site, with the clayey silt till unit being encountered beneath the topsoil. The clayey silt deposits, representing a combination of the Peel Plain Sediments and Halton Till, were found to extend from ground surface to depths ranging from 1.0 m to 4.6 m across the Site. In the majority of the onsite boreholes, these clayey silt deposits were underlain by deposits of sandy silt to silty sand that in turn directly overlie the bedrock surface, which was encountered at depths ranging from 1.1 m BGS (MW106-12) to 7.7 m BGS (MW103-12) (from 190.6 m AMSL to 197.6 m AMSL). However, at some borehole locations, the clayey silt was found to directly overlie the bedrock surface (i.e., MW101-12, MW105-12 and MW106-12). All boreholes were terminated within the Queenston Shale, with total depths ranging from 3.1 m BGS to 9.3 m BGS (from 188.3 m AMSL to 196.2 m AMSL). Overall, the bedrock is found to be deepest in northern portions of the Site, becoming shallower towards the southern end of the property (Figures 4 and 6).

4.2 HYDROGEOLOGY

4.2.1 Groundwater Levels and Flow

Table 2 provides a summary of manual groundwater level measurements obtained from the onsite monitoring wells from December 2012 to January 2013, with hydrographs presenting the continuous water level measurements collected by the Leveloggers being shown on Figures 7 and 8. Beneath the Site, the groundwater table was encountered within the Queenston Shale unit in the majority of the wells, and in the overlying sandy water-bearing units in MW102-12, MW103-12, MW104, and MW109-12.

As shown in Figure 9, groundwater elevation data collected from the onsite monitoring wells indicate that horizontal flow through the shallow water-bearing overburden and bedrock deposits beneath of the Site is to the southwest towards the Eighth Line.

The Site is characterized by a shallow water table, with groundwater levels ranging from -0.48 m BGS (artesian condition) to 1.33 m BGS over the monitoring period (mid-December 2012 to early January 2013) (Table 2; Figures 7 and 8). Over portions of the Site, the shallow groundwater system appears to be under confined conditions, with water levels being measured above the existing grade at MW103-12, MW104-12 and MW109-12. Based on the moisture and colour characteristics of the deposits noted in the boreholes, the groundwater table may be encountered at depths up to 3.0 m BGS at these monitoring locations. Stantec notes that the groundwater level measurements were obtained during the winter and, subsequently, it is possible that water levels across the property could be higher during seasonally wet conditions (i.e. spring).

The amount of infiltration occurring throughout the Site is expected to be limited given that the subsurface predominantly consists of clayey silt till that is typically characterized by low groundwater recharge potential. Calculated hydraulic conductivities in the sandy silt to silty sand deposits and Queenston shale underlying the clayey silt till ranged from 10^{-7} m/s to 10^{-8} m/s (Table 1; Appendix E), with the hydraulic conductivity measured in a weathered portion of the shale at MW101-12 being in the range of 10^{-5} m/s. Consequently, it is reasonable to assume that the overlying Halton Till will have hydraulic conductivities in this range of aforementioned values (i.e., 10^{-7} m/s to 10^{-8} m/s), if not lower, given that this till unit is comprised of clayey silt.

4.2.2 Groundwater Quality

Groundwater samples were collected from each monitoring well (MW101-12 to MW109-12) between December 19 and 20, 2012 for the analysis of general chemical parameters and metals. The samples were compared to Ontario Drinking Water Standards (ODWS) for health and non-health related parameters (MOE, 2003a). In general, groundwater sampled from across the Site is bicarbonate-magnesium to bicarbonate-calcium type water (Figure 10). Overall, no analyzed chemical parameters in the groundwater samples were detected above applicable ODWS health related parameters, with the exception of nitrate in some monitoring wells located in the eastern portion of the property (i.e., MW105-12 to MW107-12) (Table 4).

Hardness, total dissolved solids, and manganese concentrations exceeded or were close to exceeding the ODWS in all groundwater samples (Table 4). Hardness, total dissolved solids, and manganese are classified as aesthetic parameters related to appearance and taste and are not a health-related risk under the ODWS. Overall, the presence of these elevated parameter concentrations is typical of groundwater in southern Ontario and not considered to be a concern.

Groundwater nitrate concentrations in samples collected from MW105-12 to MW107-12 ranged from 14 mg/L to 16 mg/L, exceeding the ODWS of 10 mg/L, with elevated concentrations also being detected in the samples obtained from MW101-12 (5.9 m/L) and MW108-12 (4.1 mg/L). At the remaining monitoring wells (MW102-12, MW103-12, MW109-12), groundwater nitrate concentrations did not exceed the laboratory estimated quantitation limit (EQL) of 0.1 mg/L). In southern Ontario, the natural background concentration of nitrate in overburden aquifers is typically less than 1.0 mg/L (MOE, 2001). The presence of elevated nitrate concentrations in the shallow groundwater system beneath the Site is not unexpected, given that the property has been historically used for agricultural purposes (i.e., fertilizer applications).

Chloride concentrations ranging from 4 mg/L to 31 mg/L were detected in the groundwater samples, remaining well below the ODWS of 250 mg/L, with the exception of MW104-12 where a concentration of 210 mg/L was detected. Based on the groundwater flow mapping presented on Figure 9, elevated chloride concentration at MW104-12 may a reflection of groundwater, which has been impacted by road salting related activities, flowing to this monitoring well location from either Highway 407 (where road salts are applied) or the Highway 407 maintenance yard (where road salts are stored).

No groundwater samples were found to exceed ODWS Aesthetic Objective for sodium (200 mg/L); however, samples from select locations were found to exceed the Medical Officer of Health Report Limit of 20 mg/L for sodium. Samples exceeding this limit were obtained from MW101-12, MW102-12, MW103-12, MW104-12, and MW109-12. Sodium concentrations exceeding 20 mg/L could be a concern for individuals on sodium-restricted diets using this groundwater as a potable water supply source.

Overall, the results of the groundwater quality sampling suggest that a water supply well constructed in the vicinity of the proposed administrative building would provide a potable source of drinking water. This is supported by the water quality results obtained from MW109-12, where the sample had no health related parameters that exceeded the ODWS.

4.2.3 Pre-Development Groundwater Recharge Condition

Monthly water balance calculations were completed for the Site under pre-development and projected post-development conditions based on the method of Thornthwaite and Mather (1955). The Thornthwaite and Mather model is essentially an accounting procedure that analyzes the allocation of water among various components of the hydrologic system. Monthly values of precipitation (rainfall plus snowmelt) and potential evapotranspiration rates are input to the model to estimate actual rates of evapotranspiration and the surplus water that would be available for runoff and groundwater recharge.

Precipitation averages for the region from 1971-2000 were obtained from the Environment Canada website for the Toronto Lester B. Pearson International Airport Climate Station (LBPCS). The LBPCS is located approximately 17 km to the northeast of the Site and Stantec has assumed that the monthly average precipitation collected at the LBPCS is reflective of the precipitation trends that have historically occurred at the Site. These data were used to

determine the saturation vapour pressure (e_{sat}) and, subsequently, the monthly rates of potential evapotranspiration (PET) occurring across the Site using the following formulae (Dingman, 2002):

$$e_{sat} = 6.11\exp(17.3T/(T+237.3)),$$

where T is temperature in degrees Celsius and e_{sat} is given in mb; and

$$PET=0.409(e_{sat}*10),$$

where PET is given in mm .

The following assumptions were made as part of the water balance calculations:

- It was assumed that no runoff, infiltration or evapotranspiration occurred in months where the average daily temperature was below 0°C, which was the case for the months of December through March at the Site;
- Precipitation during freezing months (i.e., December to March) was assumed to accumulate as snow and result in additional precipitation in the first warm month where the average temperature was greater than 0°C (i.e., April);
- The water balance assumes that the soil moisture capacity is at its maximum (saturated conditions) in April; and,
- Infiltration factors used to determine runoff and groundwater recharge in the aforementioned sub-areas of the Site were calculated using corresponding MOE (2003b) published values.

To determine the actual soil moisture content (S_m) at the end of each month, the following approach was used (Dingman, 2002):

When precipitation was greater than PET,

$$S_m= \min\{[(Precip_m-PET_m)+S_m-1], S_{max}\}$$

When precipitation was less than PET

$$S_m= S_m-1 + (Precip_m - PET_m)$$

The actual evapotranspiration (ET) was in turn calculated as follows:

$$ET_m= PET_m,$$

when Precip > PET, or

$$ET_m = Precip_m + S_m\text{-}1 - S_m,$$

when Precip < PET.

The monthly surplus of water available for runoff and groundwater recharge was determined by subtracting monthly values of actual evapotranspiration from corresponding precipitation normals. This calculation assumes that no surplus water is available for runoff and recharge during those months where water losses from actual evapotranspiration exceed precipitation inputs. Monthly groundwater recharge for each surface water catchment was determined by applying the calculated infiltration factor to the surplus, with the runoff being calculated by subtracting this resulting groundwater recharge value from the surplus. Subsequently, the recharge volumes for each surface water catchment were then added together to provide an overall recharge volume for the entire Site.

The Site is characterized by subsurface deposits of clayey silt till, rolling to hilly topography, with the vegetation cover consisting predominantly of cropland. Based on average annual precipitation and potential evapotranspiration values of 792 mm and 529 mm, respectively, approximately 264 mm of surplus water is available for runoff and groundwater recharge across the study area under the pre-development condition (Table 4). As shown in Table 4, annual groundwater recharge rates calculated for the existing property were estimated at 124 mm, with the remaining 140 mm of the surplus water is expected to occur as runoff. The calculated groundwater recharge value of 124 mm is within the lower range of annual recharge rates published by the MOE (1995) for silt based soils. Overall, a total water volume of 47,097 m^3 is expected to annually recharge the groundwater system throughout the Site under the pre-development condition, with this volume representing approximately 16% of the total volume of precipitation that falls over these lands in a given year (Table 4).

5.0 Impact Assessment and Mitigation Measures

5.1 POST-DEVELOPMENT GROUNDWATER RECHARGE CONDITION

Under the post-development condition, the rolling to hilly topography characterizing the property will be graded, although Stantec has assumed that this grading will not significantly alter the overall existing topographic profile of the Site. Stantec has assumed that fill used across the Site for re-grading purposes will consist of re-worked clayey silt till that currently covers the property. The proposed development is to consist of multiple compressor buildings and associated equipment, pipeline extensions to various areas of the property, and associated internal roadways, parking areas and walkways. The development will also include at least one stormwater management (SWM) pond. Using projected post-development impervious cover estimates provided by in the Stormwater Management Report (Stantec, 2013b), it is expected that approximately 70% of the total Site area will be converted to impervious surfaces under the post-development condition, with a total pervious area of approximately 11.4 ha remaining for groundwater recharge purposes. The vegetation cover of the remaining pervious area is expected to consist of urban lawns.

The total annual groundwater recharge predicted to occur throughout the Site based on the aforementioned post-development characteristics of the property is 13,292 m^3 (Table 5). Assuming that no groundwater recharge augmentation measures are employed at the Site, the resulting annual recharge deficit that would occur after developing these lands would be 33,805 m^3 (Table 5). Consequently, the implementation of groundwater recharge augmentation measures, where possible, will be required at the Site in order to potentially achieve pre-development recharge rates under the post-development condition.

A common post-development groundwater recharge augmentation measure is to construct an onsite infiltration trench designed to return clean runoff to the subsurface to mitigate the groundwater recharge deficits associated with converting a greater proportion of a given property to impervious surfaces. This type of measure does not appear to be a feasible option for the Site, largely due to the impermeable nature of the deposits that characterize the subsurface of the property and relatively high groundwater elevations. In addition, the MOE (2003b) indicates that attempting to infiltrate water from a large post-development area into a relatively small and centralized location associated with an infiltration trench does not reflect the natural hydrological cycle and can lead to issues such as trench clogging and potential groundwater mounding. An alternative measure to be considered would be to direct rooftop water to a subsurface network of perforated pipes, with the stormwater eventually discharging to the proposed onsite SWM pond. The runoff would flow through this pipe network and allow the water an opportunity to infiltrate over a large portion of the property rather than at one centralized location and, as a result, more closely mimic the pre-development groundwater recharge function of these lands. The feasibility of implementing this mitigation measure could be explored during the next design stage of the project.

In addition to the use of perforated pipes, other groundwater recharge augmentation options that could be potentially available for use across the Site to assist in maximizing infiltration under the post-development condition are as follows:

Bioretention Swales (Bioswales) - Precipitation runoff from other impervious areas such as the driveways could be directed to a series of on-site bioswales. Bioswales are generally depressions in the land surface consisting of permeable constructed subsoils planted with vegetation that is tolerant of a wide range of moisture conditions. The volume of surface water runoff directed to the bioswales is temporarily stored in these features and allowed to infiltrate to the subsurface, with excess volumes during large storm events typically overflowing to the storm sewer;

Pervious Pavement - Pervious paving is a surface layer that allows rainfall to percolate into an underlying reservoir base, with the precipitation subsequently being infiltrated to the underlying soils. Rather than directing runoff from the impermeable surfaces to bioswales, these surfaces (e.g., driveways, walkways) could potentially be paved with pervious asphalt; and/or,

Reduced Grading - This construction technique minimizes the slope of the post-development ground surface to reduce surface runoff and, subsequently, promote groundwater infiltration.

Overall, it is reasonable to conclude that the application of some or all of the aforementioned recharge augmentation measures at the Site will assist in achieving the maximum groundwater recharge possible throughout the property under the post-development condition.

5.2 SITE SERVICING

The proposed development for the Site is to consist of multiple compressor buildings and their associated equipment, stormwater management facilities and subsurface storm sewers, gas pipeline extensions, internal roadways, parking areas and walkways. Storm sewers are generally constructed to depths ranging from 1.5 m to 2.0 m BGS, with the depths of the gas pipelines being expected to be constructed to depths ranging from 0.7 m to 2.6 m BGS. Depending on where the storm sewers and gas pipelines are constructed on the Site, the trench excavations could potentially extend into the wet sandy silt to silty sand deposits that overlie the bedrock surface, or within the shale bedrock itself. As a result, Stantec anticipates that construction dewatering may be required in order to complete the installation of new piping network proposed for the Site.

5.2.1 Construction Dewatering and Private Well Interference

Overall, dewatering of storm sewer and gas pipeline trenches may be required to manage the following events:

- Groundwater seepage into the excavation;

- Precipitation within construction area and subsequent runoff into the excavation; and

- Accumulated groundwater within the excavation following a prolonged construction delay.

The type and extent of dewatering system to be used at the excavations will be the responsibility of the Construction Contractor and may include the use of a vacuum well point system, sump/trash pumps located within the excavation, or a similar type system.

Dewatering activities are expected to be completed on an as-required basis, with the rate of this dewatering being dictated by the amount of construction activity occurring across the Site at a given time, the type of subsurface material and groundwater elevations encountered in the excavations, and the elevation at which the groundwater table has to be lowered to install the storm sewer and gas pipeline network. Calculations of the construction dewatering rates that could be required throughout at the Site is provided in the sections below, with these rates being largely determined using hydrogeological information obtained from the current investigation.

The Dupuit-Forchheimer Flow Equation was used to calculate what level of dewatering could be required to lower groundwater elevations throughout the Site for the purposes of excavating the trenches for the servicing installations. The input parameters required for the Dupuit-Forchheimer Flow Equation include the following: length of the open trench, horizontal hydraulic conductivity of the subsurface material, the base elevation of the hydrostratigraphic unit being pumped, the static groundwater elevation, and the targeted groundwater dewatering elevation. Each of the aforementioned input parameters used to predict the pumping volume potentially needed to dewater a servicing trench is discussed below:

- An assumption that 250 m of servicing trench will be open at one time;

- Based on onsite testing, the average in-situ horizontal hydraulic conductivity of the silty sand to sandy silt deposits and shale bedrock beneath the Site is 2.0×10^{-7} m/s. For those areas of the Site where excavations may intersect the upper weathered portions of the shale bedrock, a hydraulic conductivity value of 3.2×10^{-5} m/s was used in the calculation, with this value having been recorded in the weathered shale encountered at MW101-12 (Table 1; Appendix E). The use of this conservative hydraulic conductivity value is to account for the possibility that weathered shale bedrock may be encountered during the installation of the storm sewer and/or gas pipelines, resulting in a greater volume of groundwater flowing into the trench requiring removal;

- The base of the aquifer to be dewatered was assumed to be 1 m below the bottom of the excavation, which was set to a depth of 2.6 m below the existing grade. Using information obtained from the onsite monitoring well installations (i.e., MW101-12 to MW109-12), the base elevation of the aquifer was determined to range from 191.8 m AMSL to 195.8 m AMSL throughout the Site;

- For conservative estimation purposes, the highest groundwater levels observed in MW101-12 to MW109-12 over the monitoring period were used in the calculation; and,

- Based on the aforementioned information, groundwater elevations will potentially have to be lowered by 1.8 m to 2.6 m in order for the installation of the underground storm sewer and/or gas pipelines to proceed.

Based the above range of input parameters, the Dupuit-Forchheimer Flow Equation predicts that the typical pumping rate that will be required to remove the volume of groundwater seeping into excavations completed into the silty sand to sandy silt deposits and/or shale bedrock over a 300 m stretch of open trench could range of 26,500 L/day to 28,300 L/day (Table 6). However, under the worst case scenario where the full length of the open trench were to be excavated into a highly fractured / weathered portion of the shale bedrock, the projected maximum day dewatering rate would be in the range of 358,400 L/day (Table 6). Consequently, the Construction Contractor should obtain a Ministry of the Environment (MOE) Permit to Take Water (PTTW) in anticipation that construction dewatering at the Site could potentially exceed 50,000 L/day. As such, if dewatering volumes are projected to exceed 50,000 L/day throughout the Site, but remain below 400,000 L/day (as predicted) over 30 consecutive days of pumping, the resulting PTTW would be classified as a Category 2 Water Taking, given that this water taking will be short-term and non-recurring.

The above assumptions are considered conservative and are based on available Site data. It is the Contractors responsibility to confirm dewatering conditions prior to construction, and to design and implement an appropriate dewatering system to manage discharge during the excavation activities.

One of the key issues of concern with the performing of groundwater dewatering activities for the purposes of construction is the potential impact that pumping water from the groundwater system could have on local private water well supplies. A review of the MOE Water Well Record (WWR) database indicates that there are a total of 18 well listings located within 500 m of the Site that are used for domestic (14 wells) and commercial (4 wells) purposes. The base elevation at which these private wells are completed into the subsurface range from 169.5 m AMSL to 189.2 m AMSL, with the nearest private wells to the Site (i.e., Wells 4905332 and 282690; Figure 1) having base elevations of 188.4 m AMSL and 187.4 m AMSL, respectively. The base elevations of these wells will be at least 4.3 m lower than the dewatering elevation predicted to occur on the Site (i.e. 192.7 m AMSL at the lowest point on the Site). In addition, dewatering calculations suggest that that the maximum horizontal extent of pumping drawdown around a given trench is not expected to exceed 22 m based on anticipated dewatering volumes (Table 6). Subsequently, this dewatering zone of influence would not intercept the nearest private well to the Site (i.e., Well 4905332), which is located approximately 55 m to the west of the western property boundary (Figure 1). Therefore, it is reasonable to assume that no interference impacts are anticipated at local private wells as a result of onsite construction dewatering activities, in the event that such measures are required.

5.2.2 Post-Development Groundwater Flow

Since groundwater levels may occur above servicing levels in some areas of the Site, efforts may be required to minimize the disturbance that this servicing may have on pre-development groundwater flow patterns. Typically, the most common mitigation measure is the installation of anti-seepage collars in trenches to prevent the preferential movement of groundwater along the servicing alignments. An assessment for the total number and exact placements of the anti-seepage collars to be installed along the servicing alignments can be explored in more detail during the next design phase of the project.

6.0 Conclusions

Based on the hydrogeological assessment, the following conclusions are provided:

1. The Site is predominantly characterized by surficial deposits of clayey silt till that is interpreted to represent the Halton Till, a regionally extensive aquitard unit. The Halton Till was found to range from 0.4 m and 4.2 m thick across the property, overlying a relatively continuous deposit of sandy silt to silty sand covering the bedrock surface. The bedrock surface is encountered from 1.0 m BGS and 7.8 m BGS (between 190.60 m AMSL and 197.60 m AMSL) beneath the property, consisting of Queenston Shale, a regionally extensive bedrock unit consisting of reddish-brown, finely bedded shale with interbedded seams of hard grey limestone.

2. The Site is characterized by a shallow water table, with groundwater levels ranging from -0.48 m BGS (artesian condition) to 1.33 m BGS over the monitoring period (mid-December 2012 to early January 2013). Over portions of the Site, the shallow groundwater system appears to be under confined conditions, with water levels being measured above the existing grade; however, based on the moisture and colour characteristics of the deposits noted in the boreholes where these conditions exist, the groundwater table may be encountered at depths up to 3.0 m BGS. Stantec notes that the groundwater level measurements were obtained during the winter and, subsequently, it is possible that water levels across the property could be higher during seasonally wet conditions (i.e. spring).

3. Groundwater elevation data collected from the onsite monitoring wells indicates that horizontal flow beneath of the subject property is to the southwest.

4. Water balance calculations indicate that approximately 47,097 m^3 of groundwater recharge occurs across the Site on an annual basis. Under the post-development condition, land use changes together with the construction of impervious surfaces is projected to reduce to the total annual volume of groundwater recharging the subsurface to 13,292 m^3, equating to an annual groundwater recharge deficit of 33,805 m^3. Subsequently, the implementation of groundwater recharge augmentation measures, where possible, will be required at the subject property in order to potentially achieve pre-development recharge rates under the post-development condition.

5. Construction dewatering is anticipated for the installation of storm sewers and/or gas pipelines throughout the Site. Conservative dewatering calculations suggest that the pumping rate required to remove the volume of groundwater seeping into excavations completed into the bedrock and/or overlying sandy deposits over a 250 m stretch of open trench will exceed 50,000 L/day and, as a result, it is anticipated that the Construction Contractor will need to obtain a Ministry of the Environment (MOE) Permit to Take Water (PTTW) in order to complete these dewatering activities.

6. Based on the positioning of local private wells relative to the Site and the anticipated dewatering volumes that will occur throughout the property, no notable interference impacts are anticipated to occur at these wells as a result of on-site construction dewatering activities.

7. Since groundwater levels may occur above servicing levels in some areas of the Site, the installation of anti-seepage collars within the servicing trenches may be required to prevent the preferential movement of groundwater along the servicing alignments and, subsequently, prevent potential disruptions to pre-development groundwater flow patterns under the post-development condition.

8. Given that water usage at the proposed onsite administration building is expected to be low (i.e., water supply for kitchen and washroom usage), it is reasonable to assume that an onsite water supply well constructed into the bedrock or the sandy deposits directly overlying the bedrock surface should be capable of meeting the water demands for that facility based on the theoretical yields calculated for nearby offsite wells completed into these geological units. In addition, results of the onsite groundwater quality sampling suggest that a water supply well constructed in the vicinity of the proposed administrative building would provide a potable source of drinking water.

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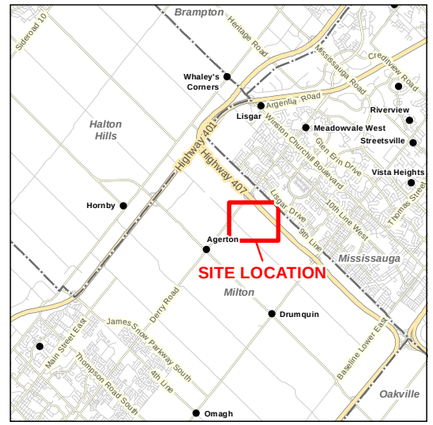
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APPENDIX A

FIGURES

Legend

- Monitoring Well (Stantec, 2012)
- Borehole (exp., 2012)
- MOE Water Well
- Site Boundary
- Cross-Section Location
- Topographic Contour
- Watercourse
- Waterbody



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthoimagery © First Base Solutions, 2010.
4. MOE water well locations are approximate and have been positioned based on published UTM coordintes.

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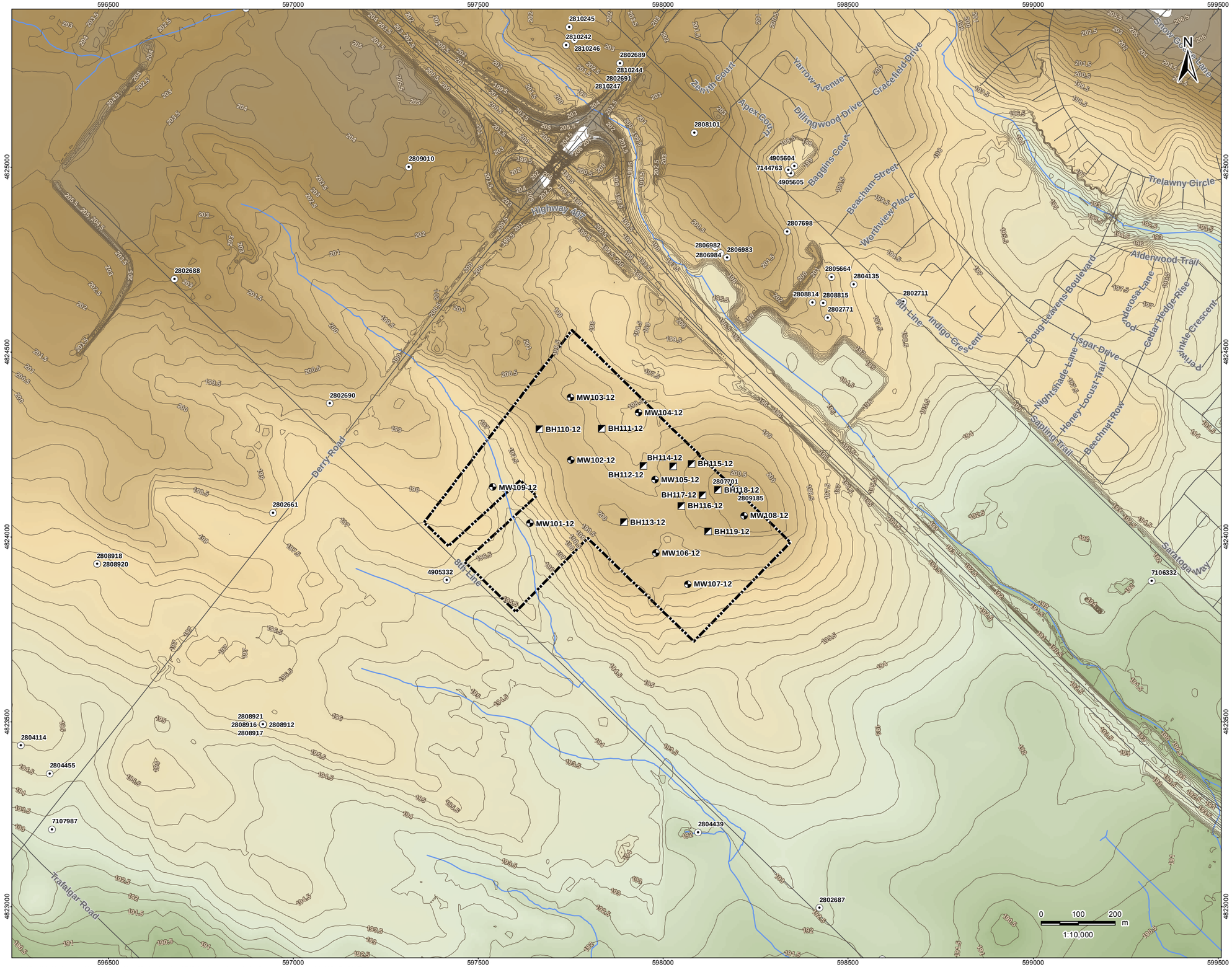
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Figure No.
1

Title
Site Plan

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Revised: 2013-02-12 By: ccoghlan



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Topography derived from the Southwestern Ontario Orthophotography Project (2010) - Digital Elevation Model © Queen's Printer for Ontario, 2010.
4. MOE water well locations are approximate and have been positioned based on published UTM coordintes.

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Figure No.
2

Title
Topography

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Revised: 2013-02-12 By: ccoghlan



Legend

- Monitoring Well (Stantec, 2012)
- Borehole (exp., 2012)
- MOE Water Well
- Site Boundary
- Watercourse
- Waterbody

Surficial Geology

- 5d: Glaciolacustrine-derived silty to clayey till (Halton Till)
- 8b: Fine-textured glaciolacustrine deposits (Peel Plain sediments, silt and clay)
- 9c: Coarse-textured glaciolacustrine deposits (Foreshore-basinal deposits)
- 19: Modern alluvial deposits

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Surficial geology produced by the Ontario Geological Survey 2003. Surficial geology of Southern Ontario; Ontario Geological Survey, MRD 128.
4. MOE water well locations are approximate and have been positioned based on published UTM coordintes.

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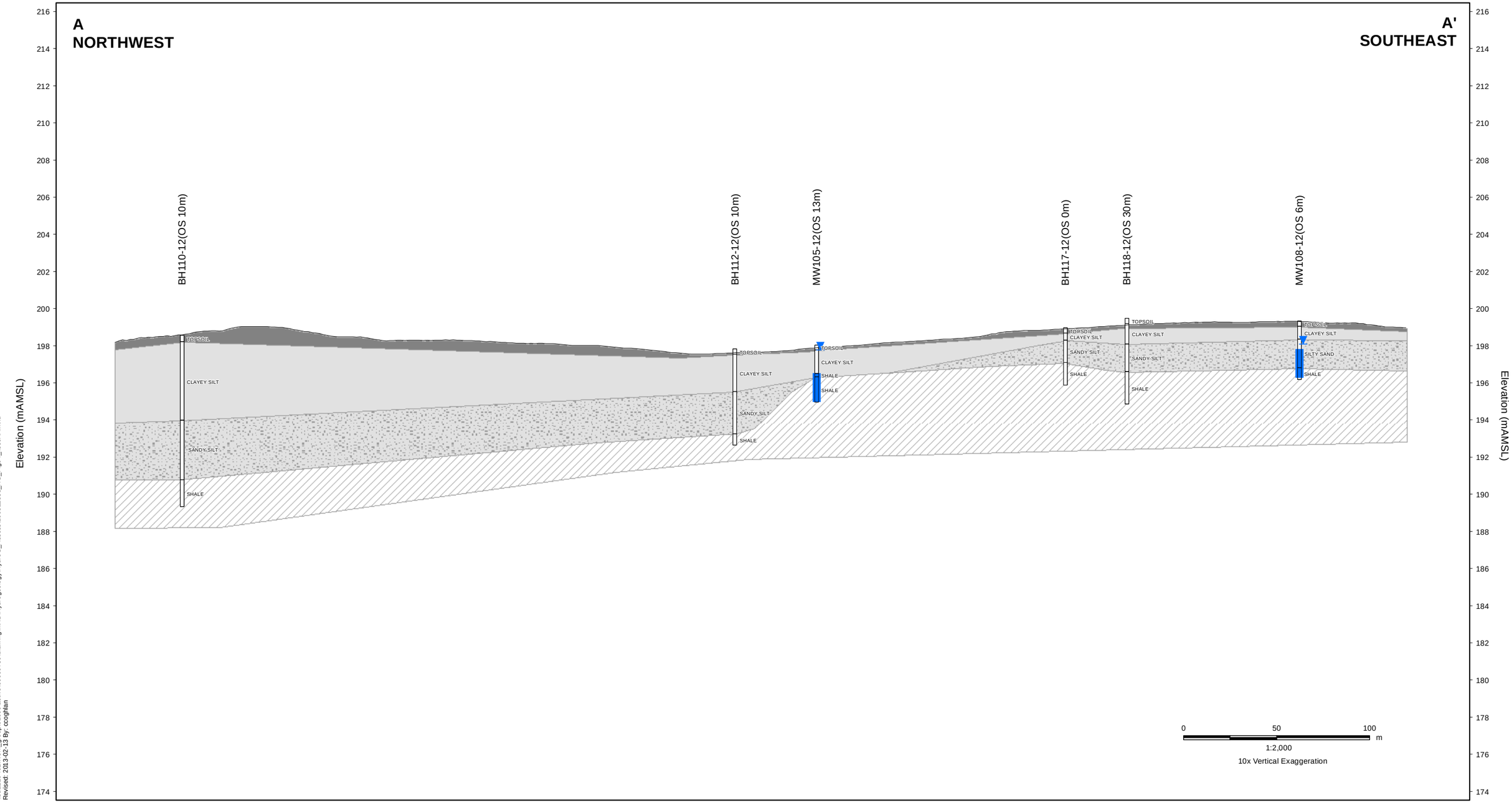
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Union Gas
Parkway West Compressor Station
Hydrogeological Assessment

Figure No.
3

Title
Surficial Geology

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Revised: 2013-02-13 By: ccoghlan

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Legend

MW101-12 (OS m)
Sand
Well ID (Offset)
Stratigraphy
Water Level (December 29, 2012)
Well Screen

Ground Surface
Topsoil
Silt and Clay (Peel Plain Sediments and Halton Till)
Silty Sand to Sandy Silt
Bedrock (Queenston Shale)

Notes

1. Groundwater elevations shown obtained from leveloggers on December 29, 2012.

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Parkway West Compressor Station
Hydrogeological Assessment

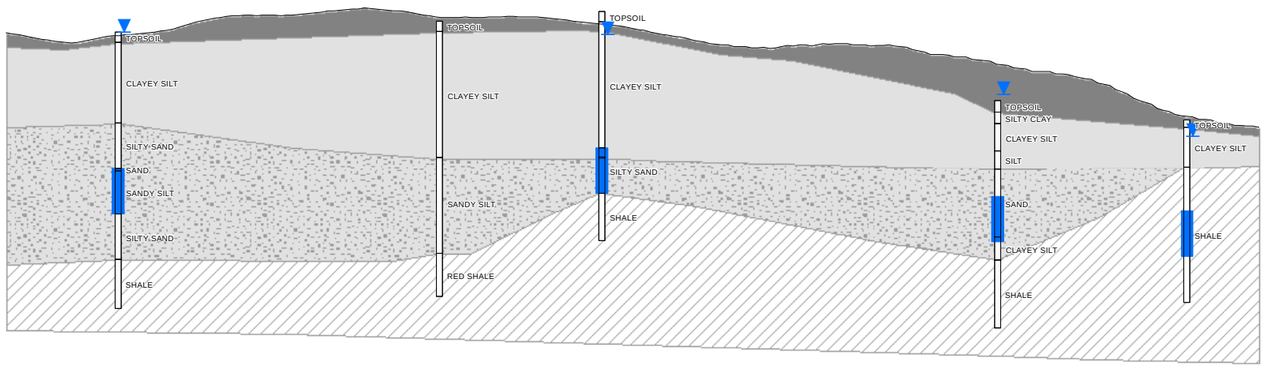
Figure No.
4

Title
Cross-Section A-A'

B
NORTH

B'
SOUTH

MW103-12(OS 14m)
BH110-12(OS 70m)
MW102-12(OS 37m)
MW109-12(OS 144m)
MW101-12(OS 19m)



Elevation (mAMSL)

216 214 212 210 208 206 204 202 200 198 196 194 192 190 188 186 184 182 180 178 176 174

0 50 100 m

1:2,000

10x Vertical Exaggeration

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Legend

MW101-12 (OS m)

Well ID (Offset)

Sand

Stratigraphy

Water Level (December 29, 2012)

Well Screen

- Ground Surface
- Topsoil
- Silt and Clay (Peel Plain Sediments and Halton Till)
- Silty Sand to Sandy Silt
- Bedrock (Queenston Shale)

Notes

1. Groundwater elevations shown obtained from leveloggers on December 29, 2012.

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Parkway West Compressor Station
Hydrogeological Assessment

Figure No.

5

Title

Cross-Section B-B'

C
NORTH

C'
SOUTH

Elevation (mAMSL)

MW104-12(OS 0m)
BH112-12(OS 27m)
BH114-12(OS 50m)
MW105-12(OS 7m)
BH116-12(OS 42m)
MW106-12(OS 60m)
MW107-12(OS 1m)

TOPSOIL
CLAYEY SILT
SILTY SAND
SHALE
SANDY SILT
SANDY CLAYEY SILT
SILTY SAND
CLAYEY SILT

0 50 100 m
1:2,000
10x Vertical Exaggeration

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160311338

Legend

MW101-12 (OS m)
Well ID (Offset)
Sand
Stratigraphy
Water Level (December 29, 2012)
Well Screen

Ground Surface
Topsoil
Silt and Clay (Peel Plain Sediments and Halton Till)
Silty Sand to Sandy Silt
Bedrock (Queenston Shale)

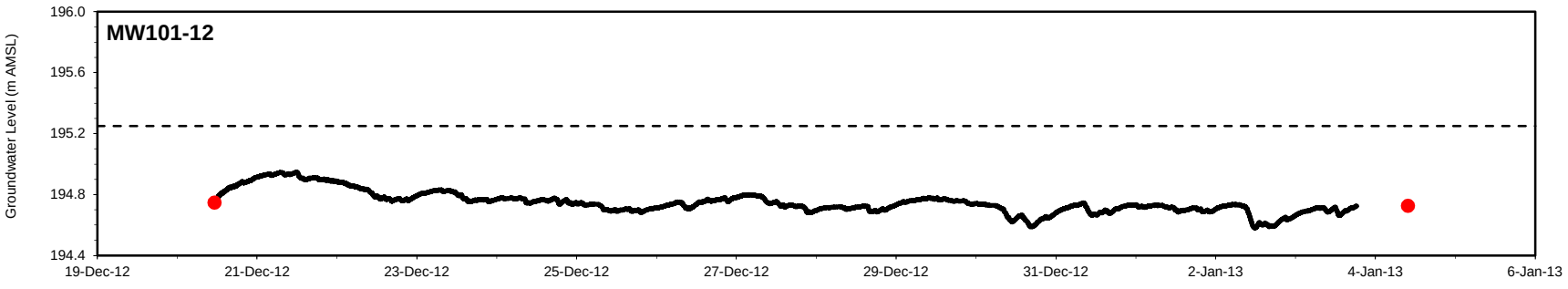
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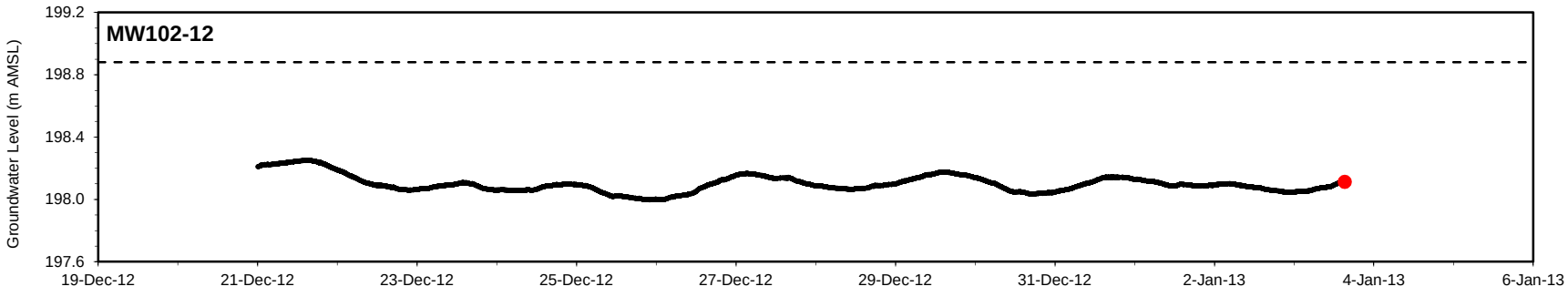
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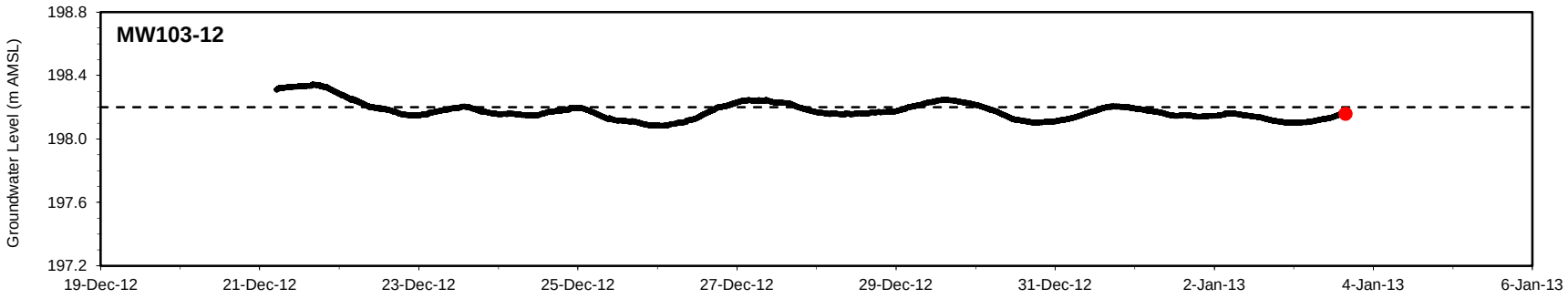
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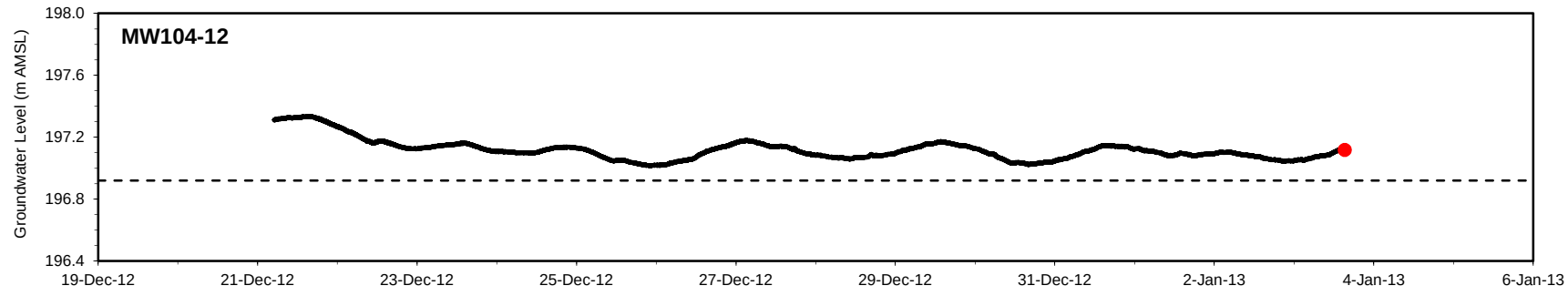
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6

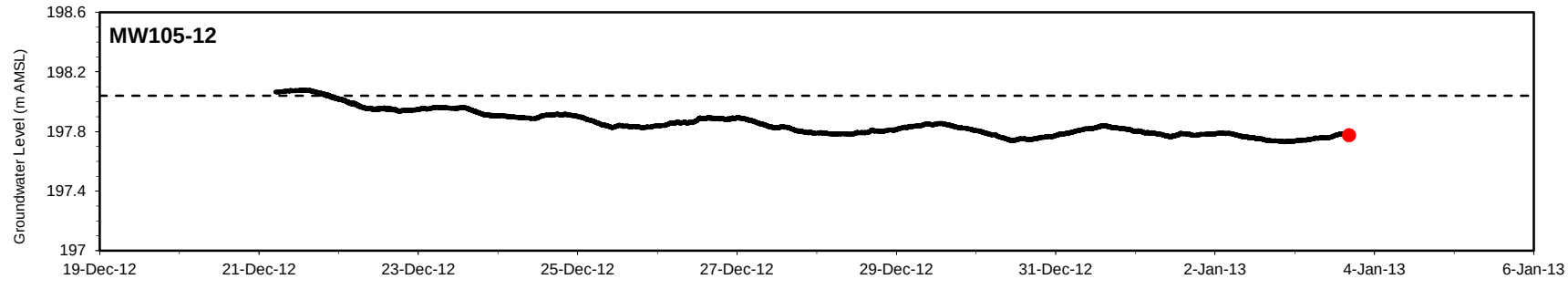
Title
Cross-Section C-C'











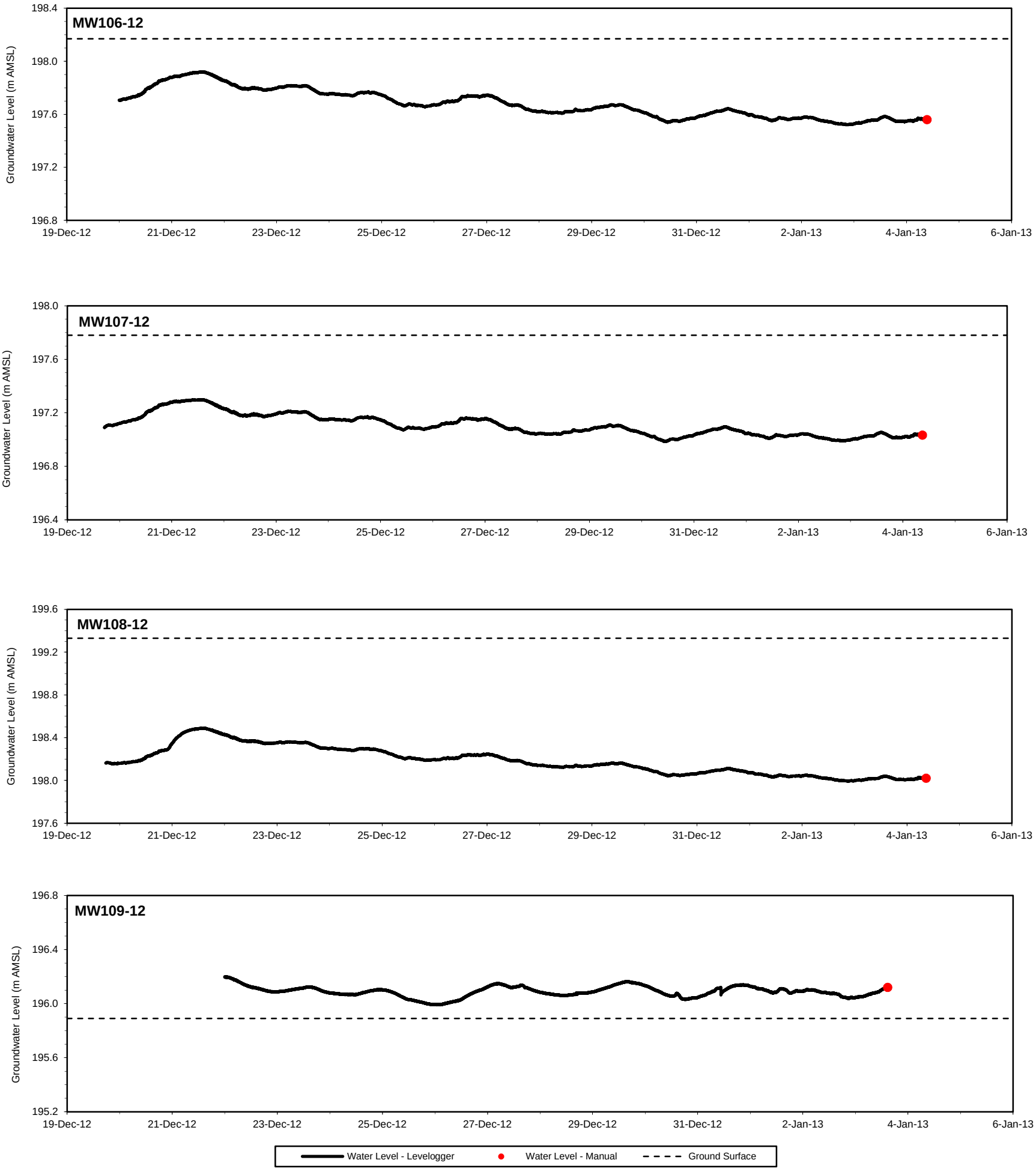
Note: Total precipitation data obtained from Toronto Lester B. Pearson Airport Climate Station

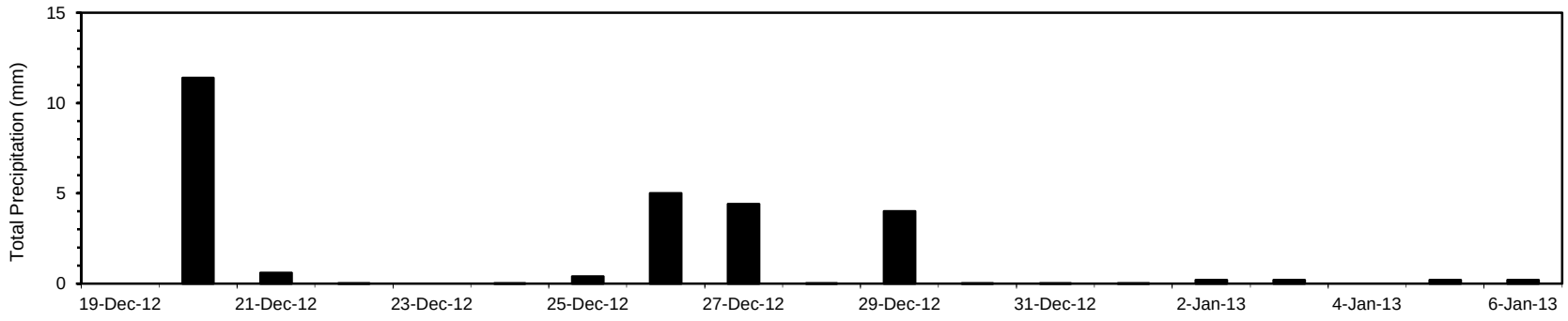
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Figure No.
7

Title **WATER LEVEL HYDROGRAPHS - MW101-12 to MW105-12**





Note: Total precipitation data obtained from Toronto Lester B. Pearson Airport Climate Station

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Parkway West Compressor Station
Hydrogeological Assessment

Figure No.
8

Title **WATER LEVEL HYDROGRAPHS - MW106-12 to MW109-12**



Legend

- Monitoring Well (Stantec, 2012)
- Borehole (exp., 2012)
- MOE Water Well
- Site Boundary
- 197.54 Groundwater Elevation (mAMSL)
- Groundwater Contour (mAMSL)
- Interpretted Direction of Groundwater Flow
- Topographic Contour
- Watercourse
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.
3. Orthoimagery © First Base Solutions, 2010.
4. MOE water well locations are approximate and have been positioned based on published UTM coordintes.
5. Groundwater elevations shown were measured on December 29, 2012.

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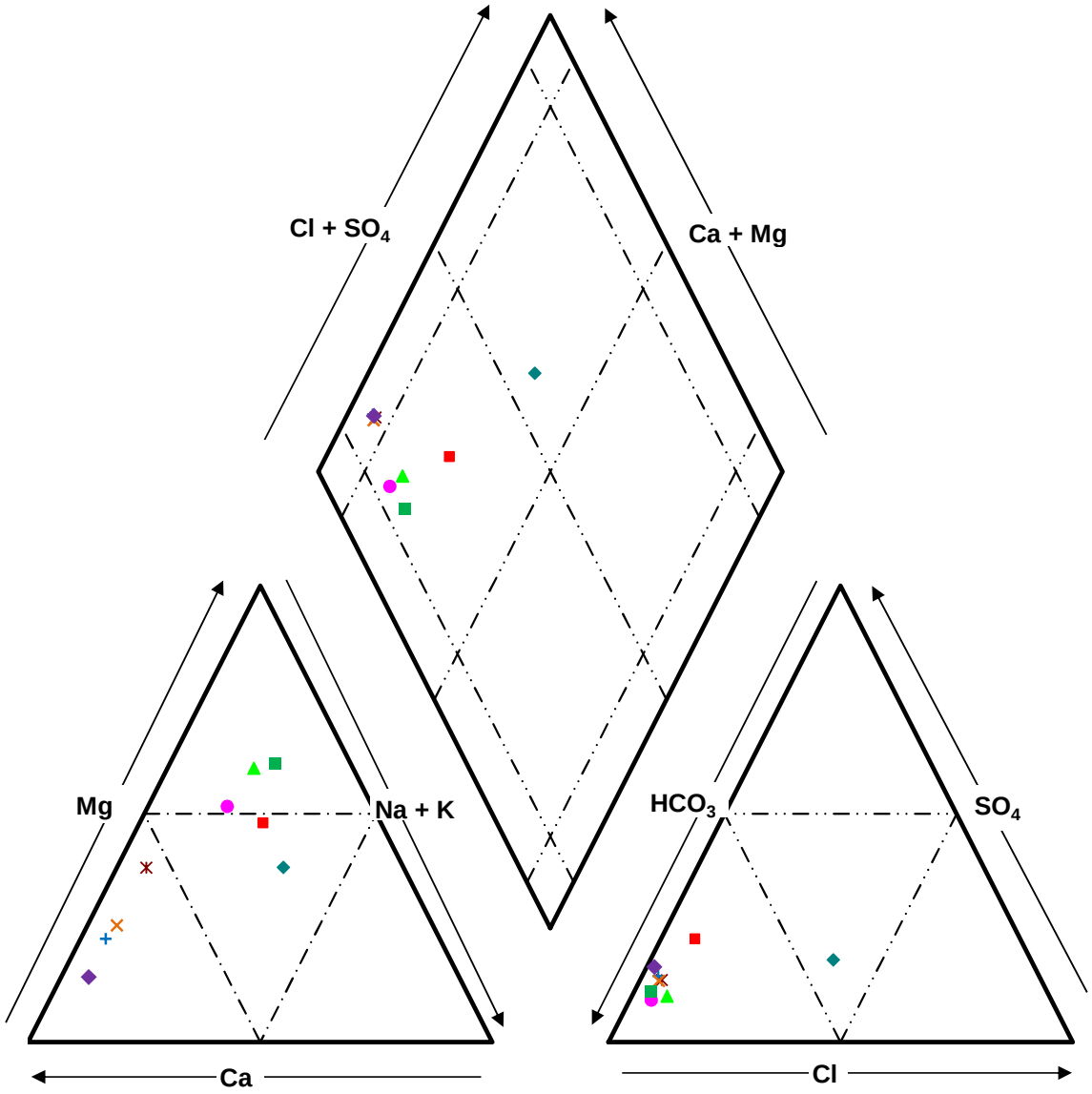
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Figure No.
9

Title
Groundwater Flow

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Revised: 2013-02-12 By: ccoghlan



	Stantec	UNION GAS WEST PARKWAY COMPRESSOR STATION HYDROGEOLOGICAL ASSESSMENT			
		PIPER DIAGRAM			
		DATE: 13-Feb-13	SCALE: not to scale	PROJECT No. 160311376	FIGURE No. FIGURE 10

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APPENDIX B

TABLES

TABLE 1
WELL CONSTRUCTION DETAILS

Well ID	UTM Coordinates		Elevations		Well Stick-up (m)	Well Depth (m BTOC)	Well Depth (m BGS)	Well Base Elevation (m AMSL)	Screened Interval				Screened Material Description [a]	Hydraulic Conductivity [b] (m/s)
	Easting	Northing	Top of Casing (m AMSL)	Ground Surface (m AMSL)					Top Elevation (m BGS)	Top Elevation (m AMSL)	Bottom Elevation (m BGS)	Bottom Elevation (m AMSL)		
Stantec Monitoring Wells														
MW101-12	597640	4824038	196.13	195.25	0.88	5.290	4.41	190.84	2.89	192.36	4.41	190.84	Queenston Shale	3.2E-05
MW102-12	597751	4824209	199.88	198.88	1.00	6.880	5.88	193.00	4.36	194.53	5.88	193.00	Silty Sand	5.4E-07
MW103-12	597750	4824379	199.16	198.20	0.96	7.100	6.14	192.06	4.62	193.58	6.14	192.06	Sandy Silt / Silty Sand	4.9E-08
MW104-12	597934	4824337	197.82	196.92	0.90	5.340	4.44	192.48	2.92	194.00	4.44	192.48	Silty Sand / Queenston Shale	8.7E-08
MW105-12	597978	4824155	198.94	198.04	0.90	3.980	3.08	194.96	1.56	196.48	3.08	194.96	Queenston Shale	2.0E-07
MW106-12	597981	4823957	199.08	198.17	0.91	4.555	3.65	194.52	2.12	196.05	3.65	194.52	Queenston Shale	2.9E-07
MW107-12	598066	4823873	198.65	197.78	0.87	4.355	3.49	194.30	1.96	195.82	3.49	194.30	Silty Sand / Queenston Shale	7.6E-07
MW108-12	598219	4824058	200.21	199.33	0.88	3.900	3.02	196.31	1.50	197.83	3.02	196.31	Silty Sand / Queenston Shale	7.0E-07
MW109-12	597539	4824135	196.91	195.89	1.02	6.170	5.15	190.74	3.63	192.26	5.15	190.74	Sand / Clayey Silt	3.4E-08
													GEOMEAN (Excluding MW101-12) =	**2.0E-07**

Notes:

(a) Refer to **Appendix C** for borehole and well construction logs

(b) Refer to **Appendix E** hydraulic conductivity analytical solutions

m AMSL = meters above mean sea level
m BGS = meters below ground surface
m BTOC = meters below top of well casing

TABLE 2
GROUNDWATER LEVEL DATA - MONITORING WELLS

Well ID	Date	Time	Total Depth (mbTOC)	Well Depth (mBGS)	Top of Casing Elevation (m AMSL)	Ground Surface Elevation (m AMSL)	Pipe Stick-up (m)	Groundwater Level		
								(m BGS)	(m BTOC)	(m AMSL)
MW101-12	17-Dec-12	2:52 PM	5.29	4.41	196.13	195.25	0.88	0.46	1.34	194.79
	20-Dec-12	9:52 AM						0.50	1.38	194.75
	29-Dec-12	2:00 PM						0.48	1.36	194.77
	4-Jan-13	9:46 AM						0.52	1.40	194.73
MW102-12	17-Dec-12	10:34 AM	6.88	5.88	199.88	198.88	1.00	0.71	1.71	198.18
	18-Dec-12	12:14 PM						0.69	1.69	198.20
	19-Dec-12	9:10 AM						0.79	1.79	198.10
	20-Dec-12	11:36 AM						0.78	1.78	198.11
	29-Dec-12	2:00 PM						0.71	1.71	198.18
	3-Jan-13	3:13 PM						0.77	1.77	198.11
MW103-12	17-Dec-12	11:06 AM	7.10	6.14	199.16	198.20	0.96	-0.01	0.95	198.20
	18-Dec-12	12:32 PM						-0.03	0.93	198.23
	19-Dec-12	8:28 AM						0.05	1.01	198.14
	20-Dec-12	12:16 PM						0.06	1.02	198.13
	3-Jan-13	3:38 PM						0.04	1.00	198.16
	29-Dec-12	2:00 PM						-0.05	0.91	198.25
MW104-12	17-Dec-12	11:35 AM	5.34	4.44	197.82	196.92	0.90	-0.26	0.64	197.18
	18-Dec-12	12:53 PM						-0.28	0.62	197.20
	19-Dec-12	8:38 AM						-0.18	0.72	197.10
	20-Dec-12	12:32 PM						-0.18	0.72	197.10
	29-Dec-12	2:00 PM						-0.25	0.65	197.17
MW105-12	17-Dec-12	12:15 PM	3.98	3.08	198.94	198.04	0.90	0.05	0.95	197.99
	18-Dec-12	1:13 PM						0.04	0.94	198.00
	19-Dec-12	8:55 AM						0.10	1.00	197.93
	20-Dec-12	12:43 PM						0.05	0.95	197.99
	29-Dec-12	2:00 PM						0.19	1.09	197.85
	3-Jan-13	4:21 PM						0.26	1.16	197.77
MW106-12	17-Dec-12	12:38 PM	4.56	3.65	199.08	198.17	0.91	0.35	1.26	197.82
	18-Dec-12	1:32 PM						0.35	1.26	197.81
	19-Dec-12	1:15 PM						0.44	1.35	197.73
	29-Dec-12	2:00 PM						0.50	1.41	197.67
	4-Jan-13	9:25 AM						0.61	1.52	197.56
MW107-12	17-Dec-12	1:10 PM	4.36	3.49	198.65	197.78	0.87	0.54	1.41	197.25
	18-Dec-12	1:52 PM						0.56	1.43	197.23
	19-Dec-12	2:54 PM						0.63	1.50	197.15
	29-Dec-12	2:00 PM						0.68	1.55	197.10
	4-Jan-13	9:03 AM						0.75	1.62	197.03
MW108-12	17-Dec-12	1:15 PM	3.90	3.02	200.21	199.33	0.88	0.93	1.81	198.40
	18-Dec-12	3:51 PM						1.04	1.92	198.29
	19-Dec-12	3:43 PM						1.12	2.00	198.21
	29-Dec-12	2:00 PM						1.17	2.05	198.16
	4-Jan-13	8:45 AM						1.31	2.19	198.02
MW109-12	17-Dec-12	9:50 AM	6.17	5.15	196.91	195.89	1.02	-0.32	0.70	196.21
	18-Dec-12	11:57 AM						-0.05	0.97	195.94
	19-Dec-12	8:08 AM						0.53	1.55	195.36
	20-Dec-12	11:15 AM						0.22	1.24	195.67
	29-Dec-12	2:00 PM						-0.27	0.75	196.16

TABLE 3 - GROUNDWATER QUALITY RESULTS

Sample Location			MW101-12	MW102-12	MW103-12	MW104-12	MW105-12	MW106-12	MW107-12	MW108-12	MW109-12
Sample Date			20-Dec-12	20-Dec-12	20-Dec-12	20-Dec-12	20-Dec-12	19-Dec-12	19-Dec-12	19-Dec-12	20-Dec-12
Sample ID			WG-160311338-20121220-AMD-001	WG-160311338-20121220-AMD-002	WG-160311338-20121220-AMD-003	WG-160311338-20121220-AMD-004	WG-160311338-20121220-AMD-005	WG-160311338-20121219-AMD-006	WG-160311338-20121219-AMD-007	WG-160311338-20121219-AMD-008	WG-160311338-20121220-AMD-009
Sampling Company			STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC	STANTEC
Laboratory			MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX	MAXX
Laboratory Work Order			B2K1199	B2K1199	B2K1199	B2K1199	B2K1199	B2K1199	B2K1199	B2K1199	B2K1199
Laboratory Sample ID			QB2909	QB2910	QB2911	QB2912	QB2913	QB2914	QB2915	QB2916	QB2917
Sample Type	Units	ODWS									
General Chemistry											
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	420	410	400	320	270	230	250	280	430
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	3.2	4.1	5.1	3.0	1.7	< 1.0	1.3	1.8	6.8
Alkalinity, Total (as CaCO3)	mg/L	30-500[E]	420	420	410	320	270	230	250	280	440
Ammonia (as N)	mg/L	n/v	0.18	0.35	0.40	0.39	0.18	0.061	0.14	0.12	0.49
Anion Sum	meq/L	n/v	12.4	9.66	9.89	15.1	7.56	6.53	7.25	7.13	10.4
Cation Sum	meq/L	n/v	13.2	10.5	10.3	17.0	8.21	7.86	8.04	7.64	10.8
Chloride	mg/L	250[D]	31	16	27	210	11	7	9	4	13
Dissolved Organic Carbon (DOC)	mg/L	5[D]	1.0	0.72	0.60	0.58	0.84	0.98	0.85	1.3	0.98
Electrical Conductivity, Lab	µmhos/cm	n/v	1100	850	880	1600	700	1500	690	650	900
Hardness (as CaCO3)	mg/L	80-100[E]	**490[E]**	**430[E]**	**420[E]**	**540[E]**	**380[E]**	**370[E]**	**380[E]**	**360[E]**	**420[E]**
Ion Balance	%	n/v	3.00	4.08	2.07	5.97	4.12	9.29	5.15	3.48	1.99
Langelier Index (at 20 C)	none	n/v	0.860	0.987	0.912	0.923	0.771	0.543	0.713	0.936	0.934
Langelier Index (at 4 C)	none	n/v	0.613	0.740	0.665	0.677	0.522	0.294	0.465	0.688	0.686
Nitrate (as N)	mg/L	10.0_d[B]	5.9	< 0.10	< 0.10	< 0.10	**14[B]**	**14[B]**	**16[B]**	4.1	< 0.10
Nitrate + Nitrite (as N)	mg/L	10.0_d[B]	5.9	< 0.10	< 0.10	< 0.10	**14[B]**	**14[B]**	**16[B]**	4.1	< 0.10
Nitrite (as N)	mg/L	1.0_d[B]	< 0.010	< 0.010	< 0.010	< 0.010	0.038	< 0.010	< 0.010	< 0.010	< 0.010
Orthophosphate(as P)	mg/L	n/v	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
pH	S.U.	6.5-8.5[E]	7.91	8.02	8.14	8.00	7.84	7.57	7.72	7.85	8.22
Saturation pH (at 20 C)	none	n/v	7.05	7.04	7.22	7.08	7.07	7.03	7.01	6.91	7.29
Saturation pH (at 4 C)	none	n/v	7.30	7.28	7.47	7.32	7.31	7.28	7.26	7.16	7.53
Sulfate	mg/L	500_h[D]	130	43	48	130	43	39	39	54	55
Total Dissolved Solids (Calculated)	mg/L	500[D]	**683[D]**	**511[D]**	**521[D]**	**873[D]**	430	399	429	401	**532[D]**
Turbidity, Lab	ntu	$5_{i,j}$[D,E]	**1800[D]**	**2100[D]**	**930[D]**	**440[D]**	**1900[D]**	**500[D]**	**3700[D]**	**1800[D]**	**1300[D]**
Metals											
Aluminum	mg/L	0.1[E]	0.0058	0.014	< 0.0050	0.0052	0.0081	0.050	0.031	0.0059	< 0.0050
Antimony	mg/L	0.006[A]	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
Arsenic	mg/L	0.025[A]	< 0.0010	0.011	0.0020	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Barium	mg/L	1[B]	0.034	0.12	0.072	0.077	0.067	0.12	0.12	0.036	0.24
Beryllium	mg/L	n/v	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
Boron	mg/L	5[A]	0.58	0.079	0.21	0.75	0.064	0.025	0.042	0.019	0.33
Cadmium	mg/L	0.005[B]	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Calcium	mg/L	n/v	67	66	44	88	91	110	110	120	35
Chromium (Total)	mg/L	0.05[B]	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Cobalt	mg/L	n/v	< 0.00050	< 0.00050	< 0.00050	0.0012	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
Copper	mg/L	1[D]	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0012	< 0.0010
Iron	mg/L	0.3[D]	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Lead	mg/L	0.01_c[B]	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
Magnesium	mg/L	n/v	77	66	75	79	38	21	25	13	80
Manganese	mg/L	0.05[D]	0.040	0.043	0.029	**0.16[D]**	0.020	0.016	0.019	**0.052[D]**	**0.071[D]**
Molybdenum	mg/L	n/v	0.0073	0.0041	0.0036	0.0099	0.0025	0.0010	0.00099	0.0016	0.0031
Nickel	mg/L	n/v	0.0022	< 0.0010	< 0.0010	0.0028	< 0.0010	< 0.0010	< 0.0010	0.0012	< 0.0010
Phosphorus	mg/L	n/v	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Potassium	mg/L	n/v	13	5.6	12	17	4.3	3.2	5.0	1.4	9.0
Selenium	mg/L	0.01[B]	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Silicon	mg/L	n/v	5.9	13	16	11	4.7	4.3	5.1	4.8	11
Silver	mg/L	n/v	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Sodium	mg/L	20_g[C] 200_g[D]	**73[C]**	**38[C]**	**37[C]**	**130[C]**	9.5	7.7	8.8	9.4	**51[C]**
Strontium	mg/L	n/v	7.7	1.7	3.2	10	1.4	0.57	0.87	0.21	4.9
Thallium	mg/L	n/v	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
Titanium	mg/L	n/v	< 0.0050	0.0067	0.0092	0.0051	< 0.0050	< 0.0050	< 0.0050	< 0.0050	0.0057
Uranium	mg/L	0.02[B]	0.0067	0.0016	0.00015	0.0011	0.0037	0.0016	0.0023	0.00077	0.00057
Vanadium	mg/L	n/v	< 0.00050	< 0.00050	< 0.00050	< 0.00050	0.00055	0.00053	0.00050	< 0.00050	< 0.00050
Zinc	mg/L	5[D]	0.0078	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	0.038	< 0.0050

Notes:

ODWS	Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, June 2003, Revised June 2006
A	ODWS Table 2 - Chemical Standards, Interim Maximum Acceptable Concentration
B	ODWS Table 2 - Chemical Standards, Maximum Acceptable Concentration
C	ODWS Table 4 - Medical Officer of Health Reporting Limit
D	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Aesthetic Objectives
E	ODWS Table 4 - Chemical/Physical Objectives and Guidelines, Operational Guidelines
6.5[A]	Concentration exceeds the indicated standard.
15.2	Concentration was detected but did not exceed applicable standards.
< 0.50	Laboratory estimated quantitation limit exceeded standard.
< 0.03	The analyte was not detected above the laboratory estimated quantitation limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
c	This standard applies to water at the point of consumption. Since lead is a component in some plumbing systems, first flush water may contain higher concentrations of lead than water that has been flushed for five minutes.
d	Where both nitrate and nitrite are present, the total of the two should not exceed 10 mg/L (as nitrogen).
CD g	The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.
h	When sulfate levels exceed 500 mg/L, water may have a laxative effect on some people.
i	Applicable for all waters at the point of consumption.
j	The operational guidelines for filtration processes are provided as performance criteria in the Procedure for Disinfection of Drinking Water in Ontario.

TABLE 4
PRE-DEVELOPMENT MONTHLY WATER BALANCE

Monthly Water Balance Analysis - Thornthwaite and Mather model
PRE-DEVELOPMENT
Union Gas Parkway West Compressor Station, Milton, Ontario

Total Site Area (ha)	38.00		
Land Description Factors	**Sub-Area A**		
Topography	0.17		
Soils	0.20		
Cover	0.10		
Sum (Infiltration Factor)	0.47		
Soil Moisture Capacity (mm)	200		
Site Area	38.00		
Percentage of Total Site Area	100%		

100%

Area	Topography	Cover	Soils
Area A	Rolling to Hilly Land (0.6% to 1.7%)	Moderately Rooted Crops	Clayey Silt to Silt Till

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from Toronto Lester B. Pearson International Airport, Ontario via Environment Canada Website - Climate Normals from 1971-2000)														
Average Daily Temperature (°C)	-6.3	-5.4	-0.4	6.3	12.9	17.8	20.8	19.9	15.3	8.9	3.2	-2.9	**7.5**	Daily average temperature in each month
Precipitation (mm)	52.2	42.6	57.1	68.4	72.5	74.2	74.4	79.6	77.5	64.1	69.3	60.9	**792.7**	
Evapotranspiration Analysis														
Saturation Vapour Pressure (mb)	3.8	4.1	5.9	9.6	14.9	20.4	24.6	23.3	17.4	11.4	7.7	4.9		
PET (Malstrom, 1969) (mm/month)	0	0	0	39	61	84	101	95	71	47	31	0	**529**	
Precipitation - PET (mm)	52	43	57	29	12	-9	-26	-16	6	17	38	61		
Soil Moisture Capacity (mm)	200	200	200	200	200	200	200	200	200	200	200	200		
Weighted Soil Storage Capacity (mm)	200	200	200	200	200	191	164	149	155	172	200	200		Assume April soil moisture is at max capacity (i.e., saturated)
Change in Soil Moisture (mm)	0	0	0	0	0	-9	-26	-16	6	17	28	0		
Actual Evapotranspiration (mm)	**0**	**0**	**0**	**39**	**61**	**84**	**101**	**95**	**71**	**47**	**31**	**0**	**529**	

Recharge/Runoff Analysis: Sub-Area A (Active Cropland)														
Area (ha)	38.00													
Surplus (mm)	52	43	57	29	12	0	0	0	0	0	10	61	**264**	
Deficit (mm)	0	0	0	0	0	0	0	0	0	0	0	0		
Infiltration Factor	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47		Based on MOE SWM Manual (2003)
Runoff (mm)	**0**	**0**	**0**	**128**	**6**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**140**	Assume no runoff in sub-zero months
Groundwater Recharge (mm)	**0**	**0**	**0**	**114**	**5**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**124**	
Evapotranspiration (m^3)	*0*	*0*	*0*	*14,854*	*23,170*	*31,754*	*38,286*	*36,213*	*27,079*	*17,748*	*11,954*	*0*	*201,058*	
Runoff (m^3)	*0*	*0*	*0*	*48,761*	*2,321*	*0*	*0*	*0*	*0*	*0*	*2,027*	*0*	*53,109*	
Groundwater Recharge (m^3)	*0*	*0*	*0*	*43,241*	*2,059*	*0*	*0*	*0*	*0*	*0*	*1,797*	*0*	*47,097*	

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	L/year
Precipitation	19,836	16,188	21,698	25,992	27,550	28,196	28,272	30,248	29,450	24,358	26,334	23,142	301,264	301,264,000
Actual Evapotranspiration	0	0	0	14,854	23,170	31,754	38,286	36,213	27,079	17,748	11,954	0	201,058	201,058,059
Runoff	0	0	0	48,761	2,321	0	0	0	0	0	2,027	0	53,109	53,109,149
Groundwater Recharge	**0**	**0**	**0**	**43,241**	**2,059**	**0**	**0**	**0**	**0**	**0**	**1,797**	**0**	**47,097**	**47,096,792**
													0	Balance Check
													0	Recharge Check
													0	Runoff Check

Annual Recharge Rate (L/s)	*Recharge Percentage of Precipitation*
1.49	*15.6%*

MOE SWMPP Manual (2003), Water Balance Parameter Estimates

Baseline Data	**Soil Moisture Capacity (mm)**
Urban Lawns/Shallow Rooted Crops	
Fine Sand	50
Fine Sandy Loam	75
Silt Loam	125
Clay Loam	100
Clay	75
Moderately Rooted Crops	
Fine Sand	75
Fine Sandy Loam	150
Silt Loam	200
Clay Loam	200
Clay	150
Pasture and Shrubs	
Fine Sand	100
Fine Sandy Loam	150
Silt Loam	250
Clay Loam	250
Clay	200
Mature Forests	
Fine Sand	250
Fine Sandy Loam	300
Silt Loam	400
Clay Loam	400
Clay	350

Infiltration Factors

TOPOGRAPHY	Flat Land, average slope < 0.6 m/km (<0.1%)	0.30
	Rolling Land, average slope 2.8 m to 3.8 m/km (0.3%)	0.20
	Hilly Land, average slope 28 m to 47 m/km (5%)	0.10
SOILS	Fine sand	0.40
	Fine sandy loam	0.30
	Silt loam	0.20
	Clay loam / shale	0.15
	Clay	0.10
COVER	Urban lawns / Shallow rooted crops	0.05
	Moderately rooted crops	0.10
	Pasture and shrubs	0.15
	Mature forest	0.20

TABLE 5
POST-DEVELOPMENT MONTHLY WATER BALANCE

Monthly Water Balance Analysis
POST-DEVELOPMENT
Union Gas Parkway West Compressor Station, Milton, Ontario

Total Site Area (ha) 38.00

Land Description Factors	Remaining Pervious Surfaces: Pervious Area			Total Impervious Area
Topography	0.17			
Soils	0.20			
Cover	0.05			
Sum (Infiltration Factor)	0.42			
Soil Moisture Capacity (mm)	125			
Site area (ha)	38.00			
Coversion to Impervious Area (ha)	26.60			26.60
Remaining Pervious Area (ha)	11.40			
Total Site Area (ha)	11.40			26.60
Percentage of Total Site Area	30%			70%

38.00 ha
100%

Notes
(1) Assumed that fill used across the Site for re-grading purposes will consist of reworked onsite soils (i.e., clayey silt to silt till) and that post-development cover will comprise predominantly of urban lawns.

(2) Total area of property that is projected to be converted to impervious surfaces (i.e., roadways, sidewalks, rooftops) under the post-development condition = 70%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Comment
Climate Data (Data from Toronto Lester B. Pearson International Airport, Ontario via Environment Canada Website - Climate Normals from 1971-2000)														
Average Daily Temperature (°C)	-6.3	-5.4	-0.4	6.3	12.9	17.8	20.8	19.9	15.3	8.9	3.2	-2.9	**7.5**	Daily average temperature in each month
Precipitation (mm)	52.2	42.6	57.1	68.4	72.5	74.2	74.4	79.6	77.5	64.1	69.3	60.9	**792.7**	
Evapotranspiration Analysis														
Saturation Vapour Pressure (mb)	3.8	4.1	5.9	9.6	14.9	20.4	24.6	23.3	17.4	11.4	7.7	4.9		
PET (Malstrom, 1969) (mm/month)	0	0	0	39	61	84	101	95	71	47	31	0	**529**	
Precipitation - PET (mm)	52	43	57	29	12	-9	-26	-16	6	17	38	61		
Weighted Soil Storage Capacity (mm)	38	38	38	38	38	38	38	38	38	38	38	38		
Actual Soil Moisture (mm)	38	38	38	38	38	28	2	0	6	24	38	38		Assume April soil moisture is at maximum capacity
Change in Soil Moisture (mm)	0	0	0	0	0	-9	-26	-2	6	17	14	0		
Actual Evapotranspiration (mm)	**0**	**0**	**0**	**39**	**61**	**84**	**101**	**81**	**71**	**47**	**31**	**0**	**515**	
Recharge/Runoff Analysis - Remaining Pervious Surfaces														
Total Site Area (ha)	11.40													
Surplus (mm)	52	43	57	29	12	0	0	0	0	0	24	61	**278**	
Deficit (mm)	0	0	0	0	0	0	0	-14	0	0	0	0		
Infiltration Factor	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42		Based on published MOE SWM Manual (2003) values
Runoff (mm)	**0**	**0**	**0**	**140**	**7**	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**161**	Assume no runoff in sub-zero months
Groundwater Recharge (mm)	**0**	**0**	**0**	**102**	**5**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**117**	
Recharge/Runoff Analysis - Total Impervious Area														
Total Site Area (ha)	26.60													
Precipitation (mm)	52	43	57	68	73	74	74	80	78	64	69	61	**793**	Assume all precipitation is converted to runoff
Runoff (mm)	**0**	**0**	**0**	**281**	**73**	**74**	**74**	**80**	**78**	**64**	**69**	**0**	**793**	Assume no runoff in sub-zero months
Groundwater Recharge (mm)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Precipitation	19,836	16,188	21,698	25,992	27,550	28,196	28,272	30,248	29,450	24,358	26,334	23,142	301,226	
Post-Development														
Evapotranspiration	0	0	0	4,456	6,951	9,526	11,486	9,278	8,124	5,324	3,586	0	58,731	*Recharge Percentage*
Runoff	0	0	0	90,807	20,047	19,737	19,790	21,174	20,615	17,051	20,019	0	229,241	*of Precipitation*
Groundwater Recharge	**0**	**0**	**0**	**11,592**	**552**	**0**	**0**	**0**	**0**	**0**	**1,148**	**0**	**13,292**	*4.4%*
Pre-Development Groundwater Recharge	0	0	0	43,241	2,059	0	0	0	0	0	1,797	0	47,097	*Annual Recharge*
Post-Development Groundwater Recharge	0	0	0	11,592	552	0	0	0	0	0	1,148	0	13,292	*Rate Loss (L/s)*
Groundwater Recharge Deficit	**0**	**0**	**0**	**-31,649**	**-1,507**	**0**	**0**	**0**	**0**	**0**	**-649**	**0**	**-33,805**	*-1.07*
Pre-Development Runoff	0	0	0	48,761	2,321	0	0	0	0	0	2,027	0	53,109	*Runoff Percentage*
Post-Development Runoff	0	0	0	90,807	20,047	19,737	19,790	21,174	20,615	17,051	20,019	0	229,241	*of Precipitation*
Runoff Surplus	0	0	0	42,047	17,726	19,737	19,790	21,174	20,615	17,051	17,992	0	176,131	*58.5%*

TABLE 6 - DEWATERING CALCULATIONS

Dupuit Forcheimer Equation - Trench/Linear Excavation

To calculate flow from a line source in an unconfined aquifer using a derivation of the Dupuit Forcheimer equation, and assuming a trench with flow from both sides:

$$Q = \frac{2xK\left(H^2 - {h_w}^2\right)}{2L}$$

Where:

Q = pumping rate in m3/s
K = hydraulic conductivity in m/s
H = hydraulic head of the original water table (m)
h_w = hydraulic head at the base of the trench (m)
R_o = radius of influence of Well or Point Source (m)
L = equivalent radius of influence for a line source (m)
x = length of the trench (m)

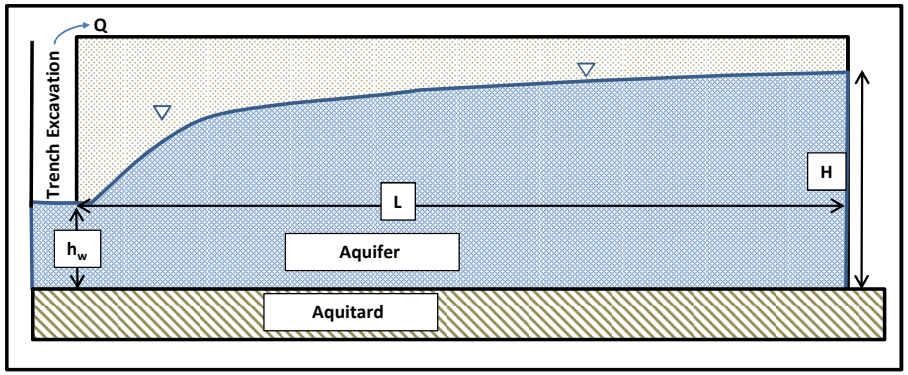
The equivalent radius of influence for a point source (R_o) is approximated using the Sichart and Kryieleis method:

$$R_o = 3000(H - h_w)\sqrt{K}$$

and from R_o, the equivalent radius of influence for a line source (L) can be approximated by:

$$L = \frac{R_o}{2}$$

Conceptual Drawdown



Calculations:

K =	2.0E-07	m/s	Q=	3.1E-04 m^3/s
H =	3.2	m		26 m^3/day
h_w =	0.9	m		**26,403 L/day**
R_o =	3.1	m		
L =	1.5	m		
x =	250	m		

Base of Aquifer	191.8	m AMSL
High Water Level	195	m AMSL
Elevation requiring dewatering	192.7	m AMSL

Notes:

1) Horizontal hydraulic conductivity values calculated from in-situ testing of onsite monitoring wells used in dewatering calculations
2) Assume that base of servicing trench containing NPS 48" pipeline will be completed to a depth of 2.6 m below ground surface (BGS)
3) Assume that 250 m of trench will be open at one time

Equations obtained from Powers, J.P., A.B. Corwin, P.C. Schmall, and W.E. Kaeck, 2007. Construction Dewatering and Groundwater Control, New Methods and Applications. John Wiley & Sons, Inc., 3rd Edition.

Location	GS Elev.	High Water Level		Equation Parameters (m AMSL)			Total Water Level Drop	Radius of Pumping Influence (m)		Pumping Volume (L/day)	Radius of Pumping Influence (m)		Pumping Volume (L/day)
	(m AMSL)	(m BGS)	(m AMSL)	Base	HWL	Dewater	(m)	R_o	L	K = 2.0x10^{-7} m/s	R_o	L	K = 3.2x10^{-5} m/s
MW101-12	195.3	0.3	195.0	**191.8**	**195.0**	**192.7**	2.3	3.1	1.5	26,403	39.0	19.5	333,981
MW102-12	198.9	0.6	198.3	**195.4**	**198.3**	**196.3**	2.0	2.7	1.3	24,472			
MW103-12	198.2	0.0	198.2	**194.7**	**198.2**	**195.6**	2.6	3.6	1.8	27,691			
MW104-12	196.9	0.0	196.9	**193.4**	**196.9**	**194.3**	2.6	3.5	1.7	28,335			
MW105-12	198.0	0.0	198.0	**194.5**	**198.0**	**195.4**	2.6	3.5	1.7	28,335	44.1	22.1	358,418
MW106-12	198.2	0.3	197.9	**194.7**	**197.9**	**195.6**	2.3	3.1	1.5	26,403	39.0	19.5	333,981
MW107-12	197.8	0.5	197.3	**194.3**	**197.3**	**195.2**	2.1	2.8	1.4	25,116	35.6	17.8	317,689
MW108-12	199.3	0.8	198.5	**195.8**	**198.5**	**196.7**	1.8	2.4	1.2	23,184	30.5	15.3	293,251
MW109-12	195.9	0.0	195.9	**192.4**	**195.9**	**193.3**	2.6	3.5	1.7	28,335			
									AVERAGE =	**26,475**			**327,464**
									MAXIMUM =	**28,335**			**358,418**

Stantec

APPENDIX C

BOREHOLE LOGS AND MOE WATER WELL RECORDS

Log of Borehole BH110-12

Project No. BRM-00601567-C0 Drawing No. 11

Project: Supplementary Sheet No. 1 of 2

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 10, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 / Shear Strength kPa 100 200	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Sample	Natural Unit Weight kN/m³
		~350 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, occasional boulder fragments, sand seams, brown with reddish brown pockets, oxidized zones, moist, hard	198.56	0	3			18.5
				1	27			21.8
				2	30			22.4
					24			21.9
				3	53			22.8
		SANDY SILT TILL: Sand layers, trace gravel, occasional shale fragments, grey, moist, very dense	194.5	4	100/250 mm			22.7
		-Becoming wet		5				
				6	50/125 mm			
		-Becoming moist		7				
				8	50/125 mm			
		-Becoming wet, increased shale fragments, reddish brown		9	50/75 mm			
			188.7	10				

Continued Next Page

Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	4.42	8.08

Notes:
1. Borehole advanced to completion at ~12.2 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Log of Borehole BH110-12

Project No. BRM-00601567-C0 Drawing No. 11

Project: Supplementary Sheet No. 2 of 2

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 / Shear Strength kPa 100 200	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Sample	Natural Unit Weight kN/m³
		SHALE: Weathered, reddish brown, grey limestone layers (Queenston Formation)	188.56	10				
					60/50 mm			
				11				
				12	60/25 mm			
		END OF BOREHOLE	186.3					

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Notes:
1. Borehole advanced to completion at ~12.2 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	4.42	8.08

Log of Borehole BH111-12

Project No. BRM-00601567-C0 Drawing No. 12

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 11, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~350 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, occasional boulder fragments, sand seams, brown, reddish brown pockets, oxidized zones, moist, hard	197.74	0
		SANDY SILT TILL: Sand layers, trace gravel and boulder fragments, brown changing to grey, wet changing to moist, very dense	195.5	2
		SHALE: Weathered, reddish brown (Queenston Formation)	192.2	3
		END OF BOREHOLE	190.1	6

SPT (N Value): 20 40 60 80
Shear Strength kPa: 100 200
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

SPT values: 3, 24, 35, 81, 70, 50/125 mm, 50/25 mm, 50/25 mm

Sample	Natural Unit Weight kN/m³
	19.2
	22.3
	22.8
	23.4

Notes:
1. Borehole advanced to completion at ~7.6 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	2.92	2.92 - wet cave

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Log of Borehole BH112-12

Project No. BRM-00601567-C0 Drawing No. 13

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 11, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~280 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel and boulder fragments, sand seams, brown with reddish brown pockets, oxidized zones, moist, hard	197.82	0
				1
			196.0	2
		SANDY SILT TILL: Sand layers, trace gravel, occasional shale fragments, brown changing to reddish brown, moist, very dense		
			193.9	3
		SHALE: Weathered, reddish brown, limestone interbeds (Queenston Formation)		4
				5
			191.7	6
		END OF BOREHOLE		

SPT (N Value) 20 40 60 80
Shear Strength kPa 100 200
Combustible Vapour Reading (ppm) 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30

Sample | Natural Unit Weight kN/m³

6 16 53 100/250 mm 50/125 mm 50/25 mm 50/25 mm

19.9 22.0 21.5 22.7

Notes:
1. Borehole advanced to completion at ~6.1 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	3.05	5.18

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Log of Borehole BH113-12

Project No. BRM-00601567-C0 Drawing No. 14

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 12, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~250 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, sand seams, occasional boulder fragments, brown with reddish brown pockets, moist, hard	199.08	0	4			20.2
				1	23			21.7
				2	21			22.0
		SANDY SILT TILL: Sand layers, trace gravel, brown, moist, very dense	196.9		46			22.3
		-Becoming reddish brown, numerous limestone fragments		3	50/125 mm			
		SHALE: Weathered, limestone interbeds, reddish brown (Queenston Formation)	195.2	4				
		END OF BOREHOLE	194.5		50/100 mm			

Notes:
1. Borehole advanced to completion at ~4.6 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	4.11	4.57

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Log of Borehole BH114-12

Project No. BRM-00601567-C0 Drawing No. 15

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

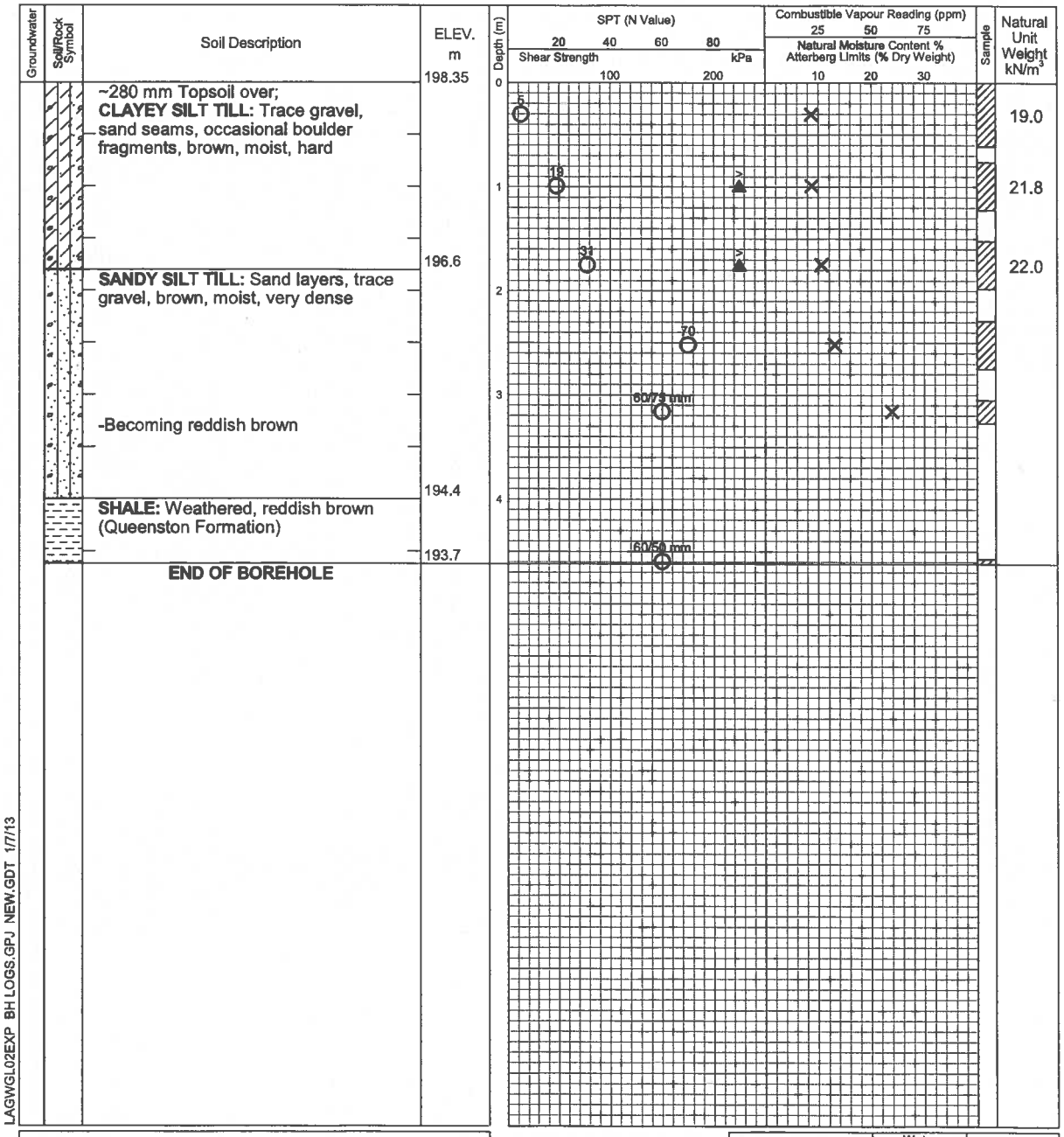
Date Drilled: December 13, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGL02EXP BH LOGS.GPJ NEW.GDT 1/7/13

Notes:
1. Borehole advanced to completion at ~4.6 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	3.81	4.42

Log of Borehole BH115-12

Project No. BRM-00601567-C0 Drawing No. 16

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 13, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 / Shear Strength kPa 100 200	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Sample	Natural Unit Weight kN/m³
		~280 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, sand seams, occasional shale fragments, brown, moist, hard	199.00	0	3			18.5
		-Becoming reddish brown		1	20			21.8
				2	60			22.7
			196.1		64			
		SANDY SILT TILL: Sand layers, trace gravel, brown, moist, very dense		3	34/200 mm			22.9
			195.0	4				
		SHALE: Weathered, limestone interbeds, reddish brown (Queenston Formation)	194.4		60/25 mm			
		END OF BOREHOLE						

Notes:
1. Borehole advanced to completion at ~4.6 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	4.27	4.50

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Log of Borehole BH116-12

Project No. BRM-00601567-C0 Drawing No. 17

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 12, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 / Shear Strength kPa 100 200	Combustible Vapour Reading (ppm) 25 50 75 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Sample	Natural Unit Weight kN/m³
		~250 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, numerous shale fragments, limestone layers, reddish brown to brown, moist, hard	198.59	0	3			18.5
				1	20			21.9
			196.4	2	64			
		SHALE: Highly weathered, limestone interbeds, reddish brown, olive green layers (Queenston Formation)			53			
			195.5	3	60/25 mm			
		END OF BOREHOLE						

LAGWGL02EXP BH LOGS.GPJ NEW.GDT 1/7/13

Notes:
1. Borehole advanced to completion at ~3.1 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	0.76	3.05

Log of Borehole BH117-12

Project No. BRM-00601567-C0 Drawing No. 18

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 13, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample ⊠
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube ■
Field Vane Test +S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢—○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~300 mm Topsoil over; **CLAYEY SILT TILL:** Reworked near surface, trace gravel, brown, wet, firm	198.97	0
		SANDY SILT TILL: Sand layers, trace gravel, reddish brown with olive green pockets, moist, compact to very dense	198.3	1
		-Limestone fragments	197.1	2
		SHALE: Weathered, reddish brown (Queenston Formation)	195.9	3
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength kPa: 100 200
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Sample | Natural Unit Weight kN/m³

5 — 19.8
14 — 22.0
82 — 21.8
60/75 mm
60/50 mm

Notes:
1. Borehole advanced to completion at ~3.1 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

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Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	No free water	2.74

LAGWGL02EXP BH LOGS.GPJ NEW.GDT 1/7/13

Log of Borehole BH118-12

Project No. BRM-00601567-C0 Drawing No. 19

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 13, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Sample	Natural Unit Weight kN/m³
		~300 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, sand seams, occasional boulder fragments, brown, moist, hard	199.48	0	3			19.0
				1	28			22.1
			198.1					
		SANDY SILT TILL: Trace gravel, sand layers, brown, moist, compact to dense		2	29			22.9
					38			22.5
			196.6	3	60/25 mm			
		SHALE: Weathered, limestone interbeds, reddish brown (Queenston Formation)		4	60/50 mm			
			194.9					
		END OF BOREHOLE						

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Notes:
1. Borehole advanced to completion at ~4.6 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

exp.
New identity of Trow Associates Inc.
Brampton

Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	3.81	4.27

LAGWGL02EXP BH LOGS.GPJ NEW.GDT 1/7/13

Log of Borehole BH119-12

Project No. BRM-00601567-C0 Drawing No. 20

Project: Supplementary Sheet No. 1 of 1

Location: Highway 407 and Derry Road (Alternative Site), Milton, ON

Date Drilled: December 13, 2012

Drill Type: CME 55

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)	Natural Unit Weight kN/m³
~350 mm Topsoil over; **CLAYEY SILT TILL:** Trace gravel, sand seams, occasional boulder fragments, brown, moist, hard	198.88	0	19.4
-Becoming reddish brown with shale fragments		1	22.1
	196.7	2	22.4
SHALE: Weathered, reddish brown (Queenston Formation)		3	
	194.3	4	
END OF BOREHOLE			

SPT (N Value) 20 40 60 80
Shear Strength 100 200 kPa
Combustible Vapour Reading (ppm) 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30
Sample

4
19
25
60/125 mm
60/50 mm
60/50 mm

Notes:
1. Borehole advanced to completion at ~4.6 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM-00601567-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Borehole backfilled to surface on completion.

exp.
New identity of Trow Associates Inc.
Brampton

Elapsed Time	Water Level (m)	Hole Open to (m)
On completion	0.99	4.57

LAGWGL02EXP BH LOGS.GPJ NEW.GDT 1/7/13

Monitoring Well: MW101-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	11-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	195.25 m AMSL
Number:	160311338	**Top of casing elevation:**	196.13 m AMSL
Field investigator:	AMD	**Easting:**	597639.77
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824037.58

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				196.13					
-2	-0.5								Above Ground Casing (Stickup = 0.88 m)
0	0.0		Ground Surface	195.25					
			TOPSOIL	0.00					Cement Seal
1			clayey silt, trace sand, some fibric organics, trace mesic organics, medium to dark brown, moderately dense, moist	195.00	1	SS	16	1-2-3-3 (5)	
	0.5		CLAYEY SILT	0.25					12/17/2012 1.34 m BTOC
2			trace fine grained sand, trace fine grained gravel, medium brown with grey/red iron oxidation mottling, moderately dense, moist, subangular to subrounded						
3	1.0		becoming grey with red iron ixode stain (mottled), dense		2	SS	18	5-7-11 (18)	152 mm Diameter Borehole
4									Bentonite Holeplug
5	1.5			193.67					
			becoming reddish brown	1.58					51 mm Diameter Schedule 40 PVC riser
6			RED SHALE with interbedded LIMESTONE SEAMS		3	SS	10" 56%	15-32-35 (67)	
7	2.0		red shale, dense, brittle in some areas, dry						Top of Sand (2.13 m BGS)
			limestone seams interbedded within shale, grey, very hard, dry, 0.9-1.2 cm thick						
8	2.5				4	SS	18" 100%	11-30-24 (54)	No. 3 Silica Sand
9			becoming slightly moist						
10	3.0								Top of Screen (3.05 m BGS)
11			becoming wet		5	SS	6" 33%	>50 (>0)	
12	3.5								
13									No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
14	4.0								
15	4.5				6	SS	1.5" 156%	>50/1.0" (50/1.0")	Bottom of Screen (4.57 m BGS)
16									
17	5.0								Bottom of Sand (4.57 m BGS)
18	5.5								
19									
20	6.0			189.13					
21			End of Borehole	6.12	7	SS	1" 104%	>50/1.0" (50/1.0")	
22	6.5								
23									
24	7.0								
25	7.5								
26									
27	8.0								
28	8.5								
29									
30	9.0								
31	9.5								

Screen Interval: 3.05 - 4.57 m BGS
Sand Pack Interval: 2.13 - 4.57 m BGS
Well Seal Interval: 0.46 - 2.13 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW102-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	10-Dec-2012 / 11-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.88 m AMSL
Number:	160311338	**Top of casing elevation:**	199.88 m AMSL
Field investigator:	AMD	**Easting:**	597751.16
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824208.54

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				199.88					
-3	-0.5								Above Ground Casing (Stickup = 1.00 m)
0	0.0		Ground Surface	198.88					
1			TOPSOIL clayey silt, trace sand, some fibric organics, medium brown, moderately dense, moist	0.00 198.53	1	SS	16	1-2-3-4 (5)	Cement Seal
2	0.5		CLAYEY SILT trace sand, trace fine grained gravel, medium brown with red/grey mottling, moderately dense, moist, angular to subangular	0.35					
3	1.0		greyish brown with red iron oxide mottling throughout, dense, slightly moist		2	SS	17	5-6-8 (14)	12/17/2012 1.71 m BTOC
4									
5	1.5		colour transitioning from greyish brown to dark brown with red iron oxide mottling throughout		3	SS	18	5-11-14 (25)	152 mm Diameter Borehole
6	2.0								Bentonite Holeplug
7									
8	2.5		medium brown with red iron oxide mottling throughout		4	SS	18	7-11-17 (28)	51 mm Diameter Schedule 40 PVC riser
9									
10	3.0		light greyish brown with red iron oxide mottling throughout, moist		5	SS	20	7-10-11 (21)	
11	3.5								
12									Top of Sand (3.66 m BGS)
13	4.0								
14									
15	4.5			194.31					
16			SILTY SAND silty fine grained sand, trace fine grained gravel, greyish brown, dense, moist to wet	4.57 193.97	6	SS	17	28-40->50 (>90)	Top of Screen (4.57 m BGS)
17	5.0		sand and gravel seam (2.5 cm thick), wet	4.88					No. 3 Silica Sand
18	5.5								No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
19									
20	6.0			192.79					
21	6.5		RED SHALE with interbedded LIMESTONE SEAMS red shale, dense, dry to moist limestone seams interbedded within shale, grey, very hard, dry, 0.9-1.2 cm thick	6.10	7	SS	11" 61%	20->50 (>50)	Bottom of Screen (6.10 m BGS)
22									Bottom of Sand (6.10 m BGS)
23	7.0								
24									
25	7.5			191.21					
26	8.0		End of Borehole	7.67	8	SS	2" 98%	>50/2.0" (50/2.0")	
27									
28	8.5								
29									
30	9.0								
31	9.5								

Screen Interval: 4.57 - 6.10 m BGS
Sand Pack Interval: 4.57 - 6.10 m BGS
Well Seal Interval: 0.71 - 3.66 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW103-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	10-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.20 m AMSL
Number:	160311338	**Top of casing elevation:**	199.16 m AMSL
Field investigator:	AMD	**Easting:**	597749.94
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824378.63

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				199.16					
-2	-0.5								Above Ground Casing (Stickup = 0.96 m)
-1			Ground Surface	198.20					
0	0.0		TOPSOIL silty clay, some fibric organics, dark brown with red iron oxide mottling, moist	0.00 197.85	1	SS	14	1-3-4-6 (7)	12/17/2012 0.95 m BTOC Cement Seal
1			CLAYEY SILT trace fine grained sand, trace fine to coarse grained gravel, dark brown with red iron oxide mottling throughout, dense, slightly moist, angular to subrounded	0.35					
2	0.5		grey with red iron oxide mottling throughout		2	SS	12	5-6-12 (18)	
3	1.0								Bentonite Holeplug
4									
5	1.5		very dark brown with trace red iron oxide staining		3	SS	13	7-13-25 (38)	152 mm Diameter Borehole
6									
7	2.0								Top of Sand (2.13 m BGS)
8	2.5		reddish brown		4	SS	18	13-13-35 (48)	
9									
10	3.0			195.15					
11	3.5		SILTY SAND silty fine grained sand, trace coarse grained sand, greyish brown with red iron oxide stain seams, moist brownish grey	3.05	5	SS	17	32-45-56 (101)	51 mm Diameter Schedule 40 PVC riser
12									
13	4.0								No. 3 Silica Sand and Slough (Hole Cave)
14									
15	4.5			193.62					
16			SAND medium grained sand, some silt, trace fine grained gravel, medium brown, loose, wet	4.57 193.55	6	SS	13	14-28-47 (75)	Top of Screen (4.57 m BGS)
17	5.0		SANDY SILT fine grained sandy silt, trace fine grained gravel, grey with trace red iron ixode mottling, dense, wet, angular	4.65					
18	5.5								No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
19									
20	6.0			192.10					
21	6.5		SILTY SAND silty fine grained sand, trace fine grained gravel, grey with trace red iron oxide mottling, dense, wet, angular	6.10	7	SS	5	>50 (>0)	Bottom of Screen (6.10 m BGS)
22									Bottom of Sand (6.10 m BGS)
23	7.0								
24									
25	7.5			190.58					
26	8.0		RED SHALE with interbedded LIMESTONE SEAMS red shale, dense, dry to moist limestone seams interbedded within shale, grey, very hard, dry, 0.9-1.2 cm thick	7.62	8	SS	8" 44%	28->50 (>50)	
27									
28	8.5								
29									
30	9.0			188.92	9	SS	8" 667%	28->50->50/-10.8" (50/-10.8")	
31	9.5		End of Borehole	9.27					

Screen Interval: 4.57 - 6.10 m BGS
Sand Pack Interval: n/a
Well Seal Interval: 0.15 - 2.13 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW104-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	11-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	196.92 m AMSL
Number:	160311338	**Top of casing elevation:**	197.82 m AMSL
Field investigator:	AMD	**Easting:**	597933.68
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824337.09

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram	Description
			197.82						
-2 -0.5									Above Ground Casing (Stickup = 0.90 m)
-1									12/17/2012
0 0.0		Ground Surface	196.92						0.64 m BTOC
1		TOPSOIL clayey silt, trace sand, some fibric organics, dark brown, moist	0.00 196.57						
		brownish grey with red iron oxide mottling, dense	0.18	1	SS	16	1-2-3-4 (5)		Cement Seal
2 0.5		CLAYEY SILT trace sand, dark brown, moist	0.35 196.03						Bentonite Holeplug
3		trace fine grained gravel, colour change to very dark brown with trace red iron oxide mottling, slightly moist, subangular		2	SS	17	4-8-12 (20)		Top of Sand (0.91 m BGS)
4 1.0									
5 1.5		brownish grey with red iron oxide mottling							152 mm Diameter Borehole
6				3	SS	14	6-12-28 (40)		
7 2.0		limestone cobble fragment (>51 mm diameter)	194.63						
8		SILTY SAND silty fine grained sand, trace fine grained gravel, reddish brown, moderately dense, moist, subangular	2.29	4	SS	12	38->50 (>50)		51 mm Diameter Schedule 40 PVC riser
9 2.5									
10 3.0		becoming wet at 3.05 m BGS							
11		brownish grey with trace red iron oxide mottling		5	SS	15	23-33-48 (81)		
12 3.5									No. 3 Silica Sand and Slough (Hole Cave)
13 4.0									
14									
15 4.5			192.35						
16		RED SHALE within SILTY SAND matrix red shale interspersed within silty fine grained sand, some grey limestone fragments, loose, wet	4.57	6	SS	2" 11%	>50 (>0)		Top of Screen (4.57 m BGS)
17 5.0									
18 5.5									No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
19									
20 6.0			190.82						
21		RED SHALE trace grey limestone fragments, brittle, dry to moist, hard drilling	6.10	7	SS	2" 11%	>50 (>0)		Bottom of Screen (6.10 m BGS)
22 6.5									Bottom of Sand (6.10 m BGS)
23 7.0									
24									
25 7.5			189.25						
26		End of Borehole	7.67	8	SS	4" 167%	>50/2.4" (50/2.4")		
27 8.0									
28 8.5									
29									
30 9.0									
31 9.5									

Screen Interval: 4.57 - 6.10 m BGS
Sand Pack Interval: n/a
Well Seal Interval: 0.15 - 0.91 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW105-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	11-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.04 m AMSL
Number:	160311338	**Top of casing elevation:**	198.94 m AMSL
Field investigator:	AMD	**Easting:**	597978.03
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824155.16

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				198.94					
-2	-0.5								Above Ground Casing (Stickup = 0.90 m)
0	0.0		Ground Surface	198.04					
			TOPSOIL	0.00					
1			clayey silt, trace sand, some fibric organics, dark brown, moderately dense, moist	197.76	1	SS	18	1-2-4-4 (6)	12/17/2012 0.95 m BTOC
	0.5		CLAYEY SILT	0.28					Cement Seal
2			trace to some fine to medium grained sand, trace fine grained gravel, greyish brown with red iron oxide mottling, moderately dense, moist, angular to subangular						Bentonite Holeplug
3	1.0		grey with red iron oxide mottling, dense, slightly moist		2	SS	16	5-8-11 (19)	Top of Sand (0.76 m BGS)
4				196.51					
5	1.5		RED SHALE and CLAYEY SILT	1.52					152 mm Diameter Borehole
6			red shale and clayey silt with some sand, red to grey, and interbedded grey limestone layers, dense but brittle, slightly moist	196.31	3	SS	4" 22%	>50 (>0)	
7	2.0		RED SHALE with interbedded LIMESTONE SEAMS	1.73					51 mm Diameter Schedule 40 PVC riser
8			red shale, brittle, dense and and dry to loose and wet						
	2.5		limestone seams interbedded within shale, grey, 0.9-1.2 cm thick		4	SS	3" 17%	>50 (>0)	Top of Screen (1.56 m BGS)
9									
10	3.0			194.95					No. 3 Silica Sand
11			End of Borehole	3.09	5	SS	1" 83%	>50/1.2" (50/1.2")	No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
	3.5								
12									Bottom of Screen (3.08 m BGS)
13	4.0								
14									Bottom of Sand (3.08 m BGS)
15	4.5								
16									
	5.0								
17									
18	5.5								
19									
20	6.0								
21									
22	6.5								
23									
24	7.0								
25									
26	7.5								
27									
28	8.0								
29									
30	8.5								
31									
	9.0								
	9.5								

Screen Interval: 1.52 - 3.05 m BGS
Sand Pack Interval: 1.52 - 3.05 m BGS
Well Seal Interval: 0.15 - 0.76 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW106-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	12-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.17 m AMSL
Number:	160311338	**Top of casing elevation:**	199.08 m AMSL
Field investigator:	AMD	**Easting:**	597980.75
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4823957.05

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				199.08					
-2	-0.5								Above Ground Casing (Stickup = 0.91 m)
0	0.0		Ground Surface	198.17					
			TOPSOIL	0.00					Cement Seal
1			clayey silt, trace sand, trace fibric organics, dark brown, moderately dense, moist	197.92	1	SS	18	0-2-3-3 (5)	
2	0.5		CLAYEY SILT trace sand, trace fine grained gravel, dark brown with trace red iron oxide mottling, becoming dense with depth, slightly moist to moist, subangular	0.25					12/17/2012 1.26 m BTOC
3	1.0			197.07	2	SS	6" 33%	6-9-11 (20)	Bentonite Holeplug
4			RED SHALE with interbedded LIMESTONE SEAMS red shale, dense, brittle, dry to slightly moist	1.09					152 mm Diameter Borehole
5	1.5		limestone seams interbedded within shale, grey, 0.9-1.2 cm thick						Top of Sand (1.22 m BGS)
6					3	SS	18" 100%	13-18-20 (38)	
7	2.0								51 mm Diameter Schedule 40 PVC riser
8			wet sections where broken/brittle layers exist, up to 0.15 m thick		4	SS	16" 89%	18-22-28 (50)	
9	2.5								Top of Screen (2.13 m BGS)
10	3.0								No. 3 Silica Sand
11			brittle, loose, wet		5	SS	9" 38%	23->50 (>50)	
12	3.5			194.51					No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
13			End of Borehole	3.66					Bottom of Screen (3.66 m BGS)
14	4.0								Bottom of Sand (3.66 m BGS)
15	4.5								
16									
17	5.0								
18	5.5								
19									
20	6.0								
21	6.5								
22									
23	7.0								
24									
25	7.5								
26									
27	8.0								
28	8.5								
29									
30	9.0								
31	9.5								

Screen Interval: 2.13 - 3.66 m BGS
Sand Pack Interval: 2.13 - 3.66 m BGS
Well Seal Interval: 0.35 - 1.22 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW107-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	12-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	197.78 m AMSL
Number:	160311338	**Top of casing elevation:**	198.65 m AMSL
Field investigator:	AMD	**Easting:**	598066.17
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4823873.18

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				198.65					
-2	-0.5								Above Ground Casing (Stickup = 0.87 m)
0	0.0		Ground Surface	197.78					
			TOPSOIL	0.00					Cement Seal
1			clayey silt, trace sand, trace fibric organics, dark brown, moderately dense, moist	197.53	1	SS	16	1-2-3-4 (5)	Bentonite Holeplug
2	0.5		CLAYEY SILT trace sand, trace fine grained gravel, dark brown, moderately dense, moist, angular trace red and grey mottling	0.25					12/17/2012 1.41 m BTOC
3	1.0		trace to some sand, medium to dark brown with trace red and grey mottling, dense, slightly moist		2	SS	15	5-8-12 (20)	Top of Sand (1.07 m BGS)
4									
5	1.5		some sand, medium to dark brown	196.16					152 mm Diameter Borehole
6			SILTY SAND	1.62	3	SS	18	8-9-16 (25)	
7	2.0		silty fine grained sand, trace fine grained gravel, medium brown, moderately dense, slightly moist, angular	196.08 1.70					51 mm Diameter Schedule 40 PVC riser
8			CLAYEY SILT some sand, trace fine grained gravel, medium to dark brown, dense, slightly moist, angular	195.85 1.93					
9	2.5		SILTY SAND silty fine grained sand, trace fine grained gravel, reddish brown, moderately dense, moist, angular	195.32 2.46	4	SS	6" 33%	19->50 (>50)	Top of Screen (2.01 m BGS)
10	3.0		RED SHALE with interbedded LIMESTONE SEAMS red shale, dense, brittle, dry to slightly moist						No. 3 Silica Sand
11			limestone seams interbedded within shale, grey, 0.9-1.2 cm thick	194.25	5	SS	2" 10%	>50 (>0)	No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
12	3.5		End of Borehole	3.53					Bottom of Screen (3.53 m BGS)
13	4.0								Bottom of Sand (3.53 m BGS)
14									
15	4.5								
16									
17	5.0								
18	5.5								
19									
20	6.0								
21	6.5								
22									
23	7.0								
24									
25	7.5								
26									
27	8.0								
28	8.5								
29									
30	9.0								
31	9.5								

Screen Interval: 2.01 - 3.53 m BGS
Sand Pack Interval: 2.01 - 3.53 m BGS
Well Seal Interval: 0.54 - 1.07 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW108-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	12-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	199.33 m AMSL
Number:	160311338	**Top of casing elevation:**	200.21 m AMSL
Field investigator:	AMD	**Easting:**	598219.42
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824058.45

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				200.21					
-2	-0.5								Above Ground Casing (Stickup = 0.88 m)
0	0.0		Ground Surface	199.33					
			TOPSOIL	0.00					Cement Seal
1			clayey silt, trace sand, trace fibric organics, dark brown, moderately dense, moist	199.05	1	SS	13	1-2-3-4 (5)	
	0.5		CLAYEY SILT	0.28					152 mm Diameter Borehole
2			trace sand, trace fine to coarse grained gravel, dark brown, moderately dense, moist, angular						
3				198.36					Bentonite Holeplug
	1.0		SILTY SAND	0.97	2	SS	16	3-7-7 (14)	
4			silty fine grained sand, some clay, trace fine grained gravel, medium brown, loose to slightly dense, slightly moist, angular						Top of Sand (0.91 m BGS)
5	1.5		trace medium to coarse grained sand, some fine grained gravel, trace clay, angular to subangular						12/17/2012 1.81 m BTOC
6					3	SS	15	7-12-15 (27)	
7	2.0								51 mm Diameter Schedule 40 PVC riser
8	2.5			196.81					
			RED SHALE with interbedded LIMESTONE SEAMS	2.51	4	SS	3" 17%	14->50 (>50)	Top of Screen (1.52 m BGS)
9			red shale, dense, brittle, dry to wet						
10	3.0		limestone seams interbedded within shale, grey, 0.9-1.2 cm thick	196.18					No. 3 Silica Sand
11			End of Borehole	3.15	5	SS	10" 833%	30->50/-4.8" (50/-4.8")	
	3.5								No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
12									
13	4.0								Bottom of Screen (3.05 m BGS)
14									
15	4.5								Bottom of Sand (3.05 m BGS)
16									
17	5.0								
18									
19	5.5								
20									
21	6.0								
22									
23	6.5								
24									
25	7.0								
26									
27	7.5								
28									
29	8.0								
30									
31	8.5								
	9.0								
	9.5								

Screen Interval: 1.52 - 3.05 m BGS
Sand Pack Interval: 1.52 - 3.05 m BGS
Well Seal Interval: 0.15 - 0.91 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Monitoring Well: MW109-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	10-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	195.89 m AMSL
Number:	160311338	**Top of casing elevation:**	196.91 m AMSL
Field investigator:	AMD	**Easting:**	597539.37
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824134.95

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value	Diagram / Description
				196.91					
-3 to -2	-0.5								Above Ground Casing (Stickup = 1.02 m)
-1									12/17/2012 0.70 m BTOC
0	0.0		Ground Surface	195.89					
1	0.5		TOPSOIL clayey silt, trace sand, trace fibric organics, dark brown, moderately dense, moist	0.00 195.51	1	SS	18	0-2-2-6 (4)	Cement Seal
2			SILTY CLAY trace sand, trace fine grained gravel, dark brown with some red and grey mottling, moist, subangular	0.38 195.13					152 mm Diameter Borehole
3	1.0		CLAYEY SILT trace sand, some fine to coarse grained gravel, light brown with some red and grey mottling, dense, dry, subangular	0.76	2	SS	16	2-15-13 (28)	Bentonite Holeplug
4									
5	1.5		trace gravel, medium brown	194.21	3	SS	15	11-19-19 (38)	51 mm Diameter Schedule 40 PVC riser
6	2.0		SILT some sand, some gravel, heavy iron staining (red and grey), dense, dry to moist	1.68 193.60					
7			SAND fine grained sand, trace to some silt, greyish brown, wet	2.29	4	SS	16	13-26-28 (54)	Top of Sand (2.29 m BGS)
8	2.5								
9									
10	3.0		trace red iron oxide mottling, increasing with depth		5	SS	18	10-20-25 (45)	Top of Screen (3.20 m BGS)
11									No. 3 Silica Sand
12	3.5								
13									No. 10 Slot Schedule 40 PVC screen 51 mm Diameter
14	4.0								
15	4.5			191.32					Bottom of Screen (4.72 m BGS)
16			CLAYEY SILT some fine grained sand, trace to some fine to coarse grained gravel, dense, moist, subangular to subrounded	4.57	6	SS	13	48->50 (>50)	
17	5.0			190.55					Bottom of Sand (4.72 m BGS)
18	5.5		RED SHALE with interbedded LIMESTONE SEAMS red shale, dense, brittle, dry to slightly moist limestone seams interbedded within shale, grey, 0.9-1.2 cm thick	5.33					
19									
20	6.0				7	SS	4" 22%	>50 (>0)	
21	6.5								
22									
23	7.0								
24									
25	7.5			188.27	8	SS	6" 100%	>50 (>0)	
26			End of Borehole	7.62					
27	8.0								
28									
29	8.5								
30									
31	9.0								
	9.5								

Screen Interval: 3.20 - 4.72 m BGS
Sand Pack Interval: 3.20 - 4.72 m BGS
Well Seal Interval: 0.15 - 2.29 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH110-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	10-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.56 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	AMD	**Easting:**	597665.04
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824292.06

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
		Ground Surface	198.56				
1		TOPSOIL clayey silt, trace sand, trace fibric organics, dark brown, moderately dense, moist	0.00 198.21	1	SS	17	0-0-3-3 (3)
2 — 0.5		CLAYEY SILT dark brown with red iron oxide mottling, moderately dense, moist	0.35				
3 — 1.0		dense, dry		2	SS	18	7-10-17 (27)
4							
5 — 1.5		trace sand, medium brown with red iron oxide mottling, dry to slightly moist					
6		grey with red iron oxide mottling		3	SS	18	10-13-17 (30)
7 — 2.0		medium brown with red iron oxide mottling					
8 — 2.5				4	SS	18	8-11-13 (24)
9		trace coarse gravel, angular, heavy red iron oxide staining					
10 — 3.0							
11 — 3.5		grey with red iron oxide mottling		5	SS	19	8-23-30 (53)
12							
13 — 4.0							
14							
15 — 4.5			193.98				
16 — 5.0		SILTY SAND silty fine grained sand, some gravel, reddish grey, dense, moist, subangular to subrounded	4.57 193.53	6	SS	18	25-49->50 (>99)
17		SAND AND GRAVEL silty coarse grained sand and fine grained gravel, reddish grey, wet	5.03				
18 — 5.5							
19							
20 — 6.0			192.46				
21 — 6.5		SILTY SAND silty fine grained sand, greyish brown, dense, wet	6.10	7	SS	6	>50 (>0)
22							
23 — 7.0							
24							
25 — 7.5			190.94				
26 — 8.0		SANDY SILT fine grained sandy silt, grey, dense, dry to moist	7.62 190.78	8	SS	6	>50 (>0)
27		RED SHALE brittle, dry to slightly moist	7.77				
28 — 8.5							
29							
30 — 9.0			189.32				
31 — 9.5		End of Borehole	9.23	9	SS	4" 115%	>50/3.5" (50/3.5")
32							
33 — 10.0							
34 — 10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH111-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	11-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	197.74 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	AMD	**Easting:**	597834.23
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824294.2

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	197.74				
			TOPSOIL clayey silt, trace sand, trace fibric organics, medium to dark brown, moderately dense, moist	0.00 197.39	1	SS	17	0-2-3-5 (5)
			grey with red iron oxide mottling, dense	0.35				
			CLAYEY SILT trace fine grained sand, trace fine grained gravel, medium to dark brown, moderately dense, moist, angular					
			brownish grey with red iron oxide mottling, slightly moist some fine grained sand, trace coarse grained gravel		2	SS	19	6-10-14 (24)
			dark brown with trace iron oxide mottling		3	SS	16	8-15-20 (35)
				195.46				
			GRAVELLY SAND fine to medium grained sand, less fine grained gravel, slightly reddish light to medium brown, moderately dense, wet	2.29	4	SS	16	18-40-41 (81)
				194.69				
			SILTY SAND silty fine grained sand, some fine grained gravel, medium brown with trace red iron oxide mottling, dense, moist to wet, angular	3.05 194.59	5	SS	16	17-34-36 (70)
			SANDY SILT some fine grained gravel, light to medium brown, dense, moist to wet, angular to subangular	3.15				
				193.17				
			SILTY SAND silty fine grained sand, some fine to coarse grained gravel, medium brown, becoming more dense with depth, moist to wet, angular to subangular	4.57 192.87	6	SS	2" 11%	24->50 (>50)
				4.88				
			RED SHALE brittle, dry					
			wet		7	SS	2" 11%	>50 (>0)
				190.11				
			dry, hard drilling End of Borehole	7.63	8	SS	2" 417%	>50/0.5" (50/0.5")

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH112-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	11-Dec-2012 / 12-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	197.82 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	AMD	**Easting:**	597946.48
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824193.29

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	197.82				
			TOPSOIL clayey silt, trace sand, trace fibric organics, dark brown, loose, moist	0.00 197.54	1	SS	12	0-2-4-4 (6)
2	0.5		CLAYEY SILT trace fine grained gravel, dark brown with red iron oxide mottling, dense, moist, angular	0.28				
3	1.0		trace sand, brownish grey with red iron oxide mottling, slightly moist grey with red iron oxide mottling		2	SS	16	5-8-8 (16)
5	1.5		reddish brown		3	SS	15	11-20-33 (53)
7	2.0			195.53				
8	2.5		SANDY SILT fine grained sandy silt, some fine grained gravel, trace clay, medium brown, slightly dense, moist, angular to subangular	2.29	4	SS	16	27-43->50 (>93)
10	3.0		some shale fragments, becoming more dense		5	SS	5	>50 (>0)
15	4.5			193.25				
16	5.0		RED SHALE and LIMESTONE red shale with interbedded limestone, hard to brittle, dry, hard drilling	4.57 192.64	6	SS	1" 6%	>50 (>0)
17			End of Borehole	5.18	7	SS	1.5" 96%	>50/1.6" (50/1.6")
18	5.5							
20	6.0							
21	6.5							
23	7.0							
24	7.5							
26	8.0							
27	8.5							
29	9.0							
30	9.5							
32	10.0							
33	10.5							
34								

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH113-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	12-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	199.08 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	AMD	**Easting:**	597894.38
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824041.16

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	199.08				
			TOPSOIL	0.00				
1			clayey silt, trace sand, trace fibric organics, medium to dark brown, loose, moist	198.83	1	SS	20	0-2-2-4 (4)
2	0.5		trace iron oxide mottling, slightly dense	0.25				
			CLAYEY SILT	198.32				
3			trace fine to coarse grained sand, medium to dark brown, loose, moist, angular	0.76				
	1.0		SANDY CLAYEY SILT		2	SS	16	8-9-14 (23)
4			some fine grained gravel, grey with red iron oxide mottling, dense, dry to slightly moist, angular to subrounded					
			greyish brown with red iron oxide mottling					
5	1.5							
			colour variations beginning, transitioning between grey, greyish brown, medium brown, and dark brown, trace red iron oxide mottling throughout		3	SS	16	8-9-12 (21)
6								
7	2.0							
			medium brown to dark brown, some red iron oxide mottling		4	SS	1" 6%	9-18-28 (46)
8	2.5			196.34				
9			RED SHALE with interbedded LIMESTONE SEAMS	2.74				
10	3.0		red shale, dense, brittle, dry to slightly moist					
			limestone seams interbedded within shale, grey, 0.9-1.2 cm thick		5	SS	5" 28%	>50 (>0)
11	3.5							
12								
13	4.0							
14								
15	4.5			194.41				
			End of Borehole	4.67	6	SS	3" 76%	>50/4.0" (50/4.0")
16								
17	5.0							
18								
19	5.5							
20								
21	6.0							
22								
23	6.5							
24								
25	7.0							
26								
27	7.5							
28								
29	8.0							
30								
31	8.5							
32								
33	9.0							
34								
	9.5							
	10.0							
	10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH114-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	13-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.35 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	MW	**Easting:**	598027.46
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824191.37

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	198.35				
			TOPSOIL clayey silt, trace sand, trace fibric organics, brown, moderately dense, moist	0.00 198.07	1	SS	19	5
2	0.5		CLAYEY SILT trace sand seams, trace gravel, occasional boulder fragments, brown, dense, moist	0.28				
3	1.0				2	SS	21.8	19
5	1.5			196.60				
6	2.0		SANDY CLAYEY SILT sand layers, trace gravel, brown, dense, moist	1.75	3	SS	22	31
8	2.5				4	SS	n/a	>50
10	3.0		becoming reddish brown		5	SS	3	>50
13	4.0			194.40				
14			RED SHALE weathered, reddish brown	3.95				
15	4.5			193.72				
			End of Borehole	4.62	6	SS	2	>50
16	5.0							
18	5.5							
20	6.0							
21	6.5							
23	7.0							
24	7.5							
26	8.0							
27	8.5							
28	9.0							
30	9.5							
31	10.0							
33	10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

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Sheet 1 of 1

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH115-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	13-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	199.00 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	MW	**Easting:**	598077.13
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824198.38

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	199.00				
			TOPSOIL	0.00				
1			clayey silt, trace sand, trace fibric organics, brown, moderately dense, moist	198.72	1	SS	18.5	3
2	0.5		CLAYEY SILT sand seams, trace gravel, occasional shale fragments, brown, dense, moist	0.28				
3	1.0				2	SS	21.8	20
4								
5	1.5				3	SS	22.7	>50
6								
7	2.0							
8	2.5		becoming reddish brown		4	SS	n/a	>50
9				196.10				
10	3.0		SANDY CLAYEY SILT sand layers, trace gravel, brown, dense, moist	2.90	5	SS	22.9	>50
11	3.5							
12								
13	4.0			195.00				
14			RED SHALE with interbedded LIMESTONE SEAMS weathered, reddish brown	4.00				
15	4.5			194.40				
16			End of Borehole	4.60	6	SS	1	>50
17	5.0							
18	5.5							
19								
20	6.0							
21	6.5							
22								
23	7.0							
24	7.5							
25								
26	8.0							
27								
28	8.5							
29	9.0							
30								
31	9.5							
32								
33	10.0							
34	10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH116-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	12-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.59 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	AMD	**Easting:**	598049.35
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824084.85

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	198.59				
			TOPSOIL clayey silt, trace sand, trace fibric organics, dark brown, loose to slightly dense, moist	0.00 198.34	1	SS	16	0-1-2-3 (3)
2	0.5		CLAYEY SILT trace sand, medium brown with trace iron oxide mottling, loose to slightly dense, moist	0.25 197.83				
3	1.0		SANDY CLAYEY SILT trace fine grained gravel, greyish browh, dense, slightly moist, subangular to subrounded	0.76 197.73	2	SS	11" 61%	7-10-10 (20)
4			RED SHALE AND SANDY CLAYEY SILT red shale with brown to grey soil interspersed	0.86 197.63				
5	1.5		RED SHALE with interbedded LIMESTONE SEAMS red shale, dense, brittle, dry to slightly moist	0.97				
6			limestone seams interbedded within shale, grey, 0.9-1.2 cm thick		3	SS	19" 106%	23-30-34 (64)
7	2.0							
8	2.5		wet		4	SS	16" 89%	30-15-38 (53)
9								
10	3.0			195.52				
11			hard drilling End of Borehole	3.07	5	SS	1" 104%	>50/1.0" (50/1.0")
12	3.5							
13	4.0							
14								
15	4.5							
16								
17	5.0							
18	5.5							
19								
20	6.0							
21	6.5							
22								
23	7.0							
24	7.5							
25								
26	8.0							
27								
28	8.5							
29	9.0							
30								
31	9.5							
32								
33	10.0							
34	10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH117-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	13-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.97 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	MW	**Easting:**	598106.21
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824114.26

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	198.97				
			TOPSOIL	0.00				
1			clayey silt, trace sand, trace fibric organics, brown, slightly dense, moist	198.67	1	SS	19.8	5
	0.5		CLAYEY SILT	0.30				
2			trace gravel, occasional shale fragments, brown, firm, wet	198.30				
			SANDY CLAYEY SILT	0.67				
3	1.0		sand layers, trace gravel, reddish brown with olive green pockets, compact to very dense, moist		2	SS	22	14
4								
5	1.5							
6				197.10	3	SS	21.8	>50
	2.0		limestone fragments	1.87				
7			RED SHALE					
			weathered, reddish brown					
8	2.5				4	SS	3	>50
9								
10	3.0			195.87				
			End of Borehole	3.10	5	SS	2	>50
11	3.5							
12								
13	4.0							
14								
15	4.5							
16								
17	5.0							
18	5.5							
19								
20	6.0							
21	6.5							
22								
23	7.0							
24	7.5							
25								
26	8.0							
27								
28	8.5							
29	9.0							
30								
31	9.5							
32								
33	10.0							
34	10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH118-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	13-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	199.48 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	MW	**Easting:**	598148.26
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824128.12

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
			Ground Surface	199.48				
			TOPSOIL clayey silt, trace sand, trace fibric organics, brown, moderately dense, moist	0.00 199.18	1	SS	19	3
			CLAYEY SILT sand seams, trace gravel, occasional boulder fragments, brown, dense, moist	0.30				
					2	SS	22.1	23
				198.10				
			SANDY CLAYEY SILT sand layers, trace gravel, brown, compact to dense, moist	1.38				
					3	SS	22.9	29
					4	SS	22.5	38
				196.60				
			RED SHALE with interbedded LIMESTONE SEAMS weathered, reddish brown	2.88	5	SS	1	>50
				194.86				
			End of Borehole	4.62	6	SS	2	>50

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

Borehole: BH119-12

Project:	Parkway West Compressor Station Hydrogeological Assessment	**Drilling method:**	Track Mount CME55 152 mm HSA
Client:	Union Gas	**Date started/completed:**	13-Dec-2012
Location:	Milton, Ontario	**Ground surface elevation:**	198.88 m AMSL
Number:	160311338	**Top of casing elevation:**	n/a
Field investigator:	MW	**Easting:**	598121.63
Contractor:	Malone's Soil Samples Co. Ltd.	**Northing:**	4824015.15

SUBSURFACE PROFILE				SAMPLE DETAILS			
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Recovery	N Value
		Ground Surface	198.88				
1		TOPSOIL clayey silt, trace sand, trace fibric organics, brown, moderately dense, moist	0.00 198.53	1	SS	19.4	4
2 — 0.5		CLAYEY SILT sand seams, trace gravel, occasional boulder fragments, brown, dense, moist	0.35				
3 — 1.0				2	SS	22.1	19
4							
5 — 1.5		becoming reddish brown with shale fragments		3	SS	22.4	25
6 — 2.0							
7			196.70				
8 — 2.5		RED SHALE weathered, reddish brown	2.18	4	SS	5	>50
9							
10 — 3.0				5	SS	2	>50
11 — 3.5							
12							
13 — 4.0							
14							
15 — 4.5			194.26				
16 — 5.0		End of Borehole	4.62	6	SS	2	>50
17							
18 — 5.5							
19							
20 — 6.0							
21 — 6.5							
22							
23 — 7.0							
24 — 7.5							
25							
26 — 8.0							
27							
28 — 8.5							
29 — 9.0							
30							
31 — 9.5							
32							
33 — 10.0							
34 — 10.5							

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
SS - split-spoon sample
n/a - not available

Drawn By/Checked By:

Stantec

STANTEC BOREHOLE AND WELL V2 160311338_BHLOGS.GPJ STANTEC - DATA TEMPLATE.GDT 1/17/13 ADUCHARME

MOE WATER WELL RECORDS - WELL USE

Well ID	Easting	Northing	Well Depth (m BGS)	Ground Surface Elevation (m AMSL)	Base Elevation (m AMSL)	Well Type	Well Use	Date Constructed
2802661	596945	4824065	12.80	198.07	185.27	Water Supply	Domestic	07-Dec-59
2802687	598423	4822997	9.75	192.67	182.92	Water Supply	Domestic	03-Feb-60
2802688	596679	4824698	12.19	202.40	190.21	Water Supply	Domestic	15-Apr-61
2802689	597883	4825281	10.36	201.15	190.79	Water Supply	Domestic	19-Aug-61
2802690	597099	4824361	12.19	199.58	187.39	Water Supply	Domestic	19-Dec-63
2802691	597846	4825218	12.19	200.94	188.75	Observation Wells	Not Used	18-May-66
2802711	598649	4824637	6.10	194.10	188.01	Water Supply	Domestic	30-Jul-64
2802771	598445	4824593	7.62	198.14	190.52	Water Supply	Domestic	27-Sep-68
2804114	596264	4823436	15.54	194.57	179.03	Water Supply	Domestic	29-Nov-72
2804135	598515	4824683	13.11	196.47	183.36	Water Supply	Domestic	04-Aug-72
2804439	598095	4823202	9.45	191.59	182.14	Water Supply	Domestic	06-Jul-73
2804455	596342	4823360	10.97	194.05	183.07	Water Supply	Domestic	07-Aug-73
2805664	598455	4824703	9.14	197.32	188.18	Water Supply	Domestic	10-Nov-80
2806982	598155	4824767	18.29	198.22	179.93	Water Supply	Commerical	16-Jun-88
2806983	598172	4824755	14.02	198.43	184.41	Water Supply	Commerical	03-Aug-88
2806984	598140	4824785	24.38	199.03	174.65	Abandoned-Supply	Commerical	02-Aug-88
2807698	598335	4824826	9.14	198.37	189.23	Water Supply	Commerical	20-Nov-90
2807701	598202	4824128	30.48	200.03	169.55	Water Supply	Domestic	27-Nov-90
2808101	598084	4825093	8.84	200.81	191.97	Abandoned-Other	Domestic	23-Dec-92
2808814	598403	4824634	9.14	198.77	189.62	Abandoned-Supply	Domestic	30-Mar-98
2808815	598432	4824632	10.67	198.21	187.54	Water Supply	Domestic	19-Mar-98
2808911	596918	4823493	12.19	196.00	183.80	Water Supply	Domestic	05-Oct-98
2808912	596918	4823493	19.81	196.00	176.18	Abandoned-Supply	Not Used	07-May-98
2808913	596918	4823493	30.48	196.00	165.52	Abandoned-Supply	Not Used	03-Jun-98
2808916	596918	4823493	20.12	196.00	175.88	Abandoned-Supply	Not Used	19-Aug-98
2808917	596918	4823493	9.45	196.00	186.55	Abandoned-Other	Not Used	14-Aug-98
2808918	596469	4823927	14.33	196.72	182.40	Water Supply	Domestic	25-Jun-98
2808920	596469	4823927	10.36	196.72	186.36	Abandoned-Other	Not Used	08-Jul-98
2808921	596918	4823493	10.67	196.00	185.33	Abandoned-Other	Not Used	08-Jul-98
2809010	597312	4825001	22.86	202.74	179.88	Water Supply	Domestic	01-Jul-99
4905332	597415	4823883	7.32	195.75	188.43	Water Supply	Domestic	08-Jun-77
4905604	598355	4825003	13.11	197.83	184.73	Water Supply	Domestic	06-Jul-79
4905605	598345	4824983	9.45	198.03	188.58	Water Supply	Domestic	06-Jul-79
7106332	599320	4823881	6.00	190.90	184.90	Test Hole	Test Hole	27-May-08
7107987	596348	4823210	6.10	192.55	186.45	Observation Wells	Monitoring	28-May-08
7144763	598338	4824993	4.57	198.01	193.44	Observation Wells	Monitoring	19-Mar-10

MOE WATER WELL RECORDS - STATIC WATER LEVELS

Well ID	Easting	Northing	Static Water Level	
			(m BGS)	(m AMSL)
2802661	596945	4824065	5.49	192.59
2802687	598423	4822997	3.96	188.71
2802688	596679	4824698	10.67	191.73
2802689	597883	4825281	6.10	195.05
2802691	597846	4825218	2.44	198.50
2802711	598649	4824637	3.05	191.06
2804114	596264	4823436	0.91	193.66
2804135	598515	4824683	3.35	193.11
2804439	598095	4823202	3.66	187.94
2804455	596342	4823360	4.88	189.17
2805664	598455	4824703	3.05	194.27
2806982	598155	4824767	3.66	194.56
2806983	598172	4824755	5.18	193.25
2806984	598140	4824785	3.66	195.37
2807698	598335	4824826	3.66	194.71
2807701	598202	4824128	1.22	198.81
2808815	598432	4824632	2.44	195.77
2808911	596918	4823493	8.84	187.16
2808918	596469	4823927	9.45	187.27
4905332	597415	4823883	0.91	194.83
4905604	598355	4825003	1.83	196.00
4905605	598345	4824983	2.74	195.29

MOE WATER WELL RECORDS - STRATIGRAPHY

Well ID	Easting	Northing	Ground Surface Elevation (m AMSL)	Top of Formation (m BGS)	Bottom of Formation (m BGS)	Top of Formation (m AMSL)	Bottom of Formation (m AMSL)	Primary Material	Secondary Material	Tertiary Material	Material Colour
2802661	596945	4824065	198.07	0.00	4.57	198.07	193.50	TOPSOIL	CLAY		BROWN
2802661	596945	4824065	198.07	4.57	12.19	193.50	185.88	CLAY	STONES		GREY
2802661	596945	4824065	198.07	12.19	12.80	185.88	185.27	MEDIUM SAND			
2802687	598423	4822997	192.67	0.00	4.88	192.67	187.79	CLAY	MEDIUM SAND	BOULDERS	BROWN
2802687	598423	4822997	192.67	4.88	9.75	187.79	182.92	CLAY			RED
2802688	596679	4824698	202.40	0.00	3.96	202.40	198.44	TOPSOIL	CLAY		BROWN
2802688	596679	4824698	202.40	3.96	11.58	198.44	190.82	CLAY	STONES		GREY
2802688	596679	4824698	202.40	11.58	12.19	190.82	190.21	COARSE SAND			
2802689	597883	4825281	201.15	0.00	6.10	201.15	195.05	TOPSOIL			BROWN
2802689	597883	4825281	201.15	6.10	10.06	195.05	191.09	CLAY			RED
2802689	597883	4825281	201.15	10.06	10.36	191.09	190.79	GRAVEL			
2802690	597099	4824361	199.58	0.00	3.66	199.58	195.92	TOPSOIL	CLAY		BROWN
2802690	597099	4824361	199.58	3.66	11.58	195.92	188.00	CLAY			GREY
2802690	597099	4824361	199.58	11.58	12.19	188.00	187.39	MEDIUM SAND			
2802691	597846	4825218	200.94	0.00	12.19	200.94	188.75	SILT	CLAY	STONES	GREY
2802711	598649	4824637	194.10	0.00	3.05	194.10	191.06	TOPSOIL	CLAY		BROWN
2802711	598649	4824637	194.10	3.05	6.10	191.06	188.01	SHALE			RED
2802771	598445	4824593	198.14	0.00	3.66	198.14	194.48	CLAY	MEDIUM SAND		BROWN
2802771	598445	4824593	198.14	3.66	7.62	194.48	190.52	COARSE SAND			
2804114	596264	4823436	194.57	0.00	0.30	194.57	194.27	TOPSOIL			BROWN
2804114	596264	4823436	194.57	0.30	4.27	194.27	190.30	CLAY			BROWN
2804114	596264	4823436	194.57	4.27	5.49	190.30	189.09	CLAY			GREY
2804114	596264	4823436	194.57	5.49	15.54	189.09	179.03	CLAY	STONES	SILT	GREY
2804135	598515	4824683	196.47	0.00	0.30	196.47	196.16	TOPSOIL			BROWN
2804135	598515	4824683	196.47	0.30	9.75	196.16	186.71	CLAY	PACKED		BROWN
2804135	598515	4824683	196.47	9.75	13.11	186.71	183.36	SHALE			RED
2804439	598095	4823202	191.59	0.00	0.30	191.59	191.29	TOPSOIL			BROWN
2804439	598095	4823202	191.59	0.30	3.96	191.29	187.63	CLAY	STONES		BROWN
2804439	598095	4823202	191.59	3.96	5.18	187.63	186.41	CLAY	BOULDERS		GREY
2804439	598095	4823202	191.59	5.18	6.71	186.41	184.89	CLAY	SAND	STONES	GREY
2804439	598095	4823202	191.59	6.71	8.53	184.89	183.06	SAND	STONES		GREY
2804439	598095	4823202	191.59	8.53	9.45	183.06	182.14	CLAY	SAND		RED
2804455	596342	4823360	194.05	0.00	0.30	194.05	193.74	TOPSOIL			BROWN
2804455	596342	4823360	194.05	0.30	4.57	193.74	189.47	CLAY			BROWN
2804455	596342	4823360	194.05	4.57	9.75	189.47	184.29	CLAY	STONES	SAND	GREY
2804455	596342	4823360	194.05	9.75	10.97	184.29	183.07	COARSE SAND	MEDIUM SAND	GRAVEL	GREY
2805664	598455	4824703	197.32	0.00	0.30	197.32	197.02	TOPSOIL			BROWN
2805664	598455	4824703	197.32	0.30	3.05	197.02	194.27	CLAY	STONES	HARD	BROWN
2805664	598455	4824703	197.32	3.05	3.66	194.27	193.66	MEDIUM SAND			BROWN
2805664	598455	4824703	197.32	3.66	5.49	193.66	191.83	SAND	CLAY	STONES	RED
2805664	598455	4824703	197.32	5.49	9.14	191.83	188.18	SHALE	HARD		RED
2806982	598155	4824767	198.22	0.00	1.83	198.22	196.39	CLAY	SANDY	LOOSE	BROWN
2806982	598155	4824767	198.22	1.83	3.96	196.39	194.25	CLAY	SANDY	LOOSE	BROWN
2806982	598155	4824767	198.22	3.96	7.32	194.25	190.90	SAND	LOOSE		BROWN
2806982	598155	4824767	198.22	7.32	8.84	190.90	189.38	FINE SAND	LOOSE		GREY
2806982	598155	4824767	198.22	8.84	11.58	189.38	186.63	GRAVEL	FINE SAND	LOOSE	BROWN
2806982	598155	4824767	198.22	11.58	12.19	186.63	186.02	CLAY	SANDY	LOOSE	RED
2806982	598155	4824767	198.22	12.19	13.11	186.02	185.11	COARSE SAND	FINE GRAVEL	LOOSE	BROWN
2806982	598155	4824767	198.22	13.11	18.29	185.11	179.93	SHALE	HARD		RED
2806983	598172	4824755	198.43	0.00	3.05	198.43	195.39	CLAY	SANDY	LOOSE	BROWN
2806983	598172	4824755	198.43	3.05	3.96	195.39	194.47	SAND	LOOSE		BROWN

MOE WATER WELL RECORDS - STRATIGRAPHY

Well ID	Easting	Northing	Ground Surface Elevation (m AMSL)	Top of Formation (m BGS)	Bottom of Formation (m BGS)	Top of Formation (m AMSL)	Bottom of Formation (m AMSL)	Primary Material	Secondary Material	Tertiary Material	Material Colour
2806983	598172	4824755	198.43	3.96	7.32	194.47	191.12	CLAY	SANDY	LOOSE	BROWN
2806983	598172	4824755	198.43	7.32	11.28	191.12	187.16	CLAY	SAND	LOOSE	BROWN
2806983	598172	4824755	198.43	11.28	12.19	187.16	186.24	CLAY	SAND	LOOSE	RED
2806983	598172	4824755	198.43	12.19	12.80	186.24	185.63	FINE GRAVEL	LOOSE		BROWN
2806983	598172	4824755	198.43	12.80	13.41	185.63	185.02	CLAY	SAND	LOOSE	GREY
2806983	598172	4824755	198.43	13.41	14.02	185.02	184.41	SHALE	HARD		RED
2806984	598140	4824785	199.03	0.00	2.13	199.03	196.90	CLAY	SANDY	LOOSE	BROWN
2806984	598140	4824785	199.03	2.13	3.96	196.90	195.07	CLAY	GRAVEL	LOOSE	BROWN
2806984	598140	4824785	199.03	3.96	7.92	195.07	191.11	SAND	LOOSE		BROWN
2806984	598140	4824785	199.03	7.92	10.97	191.11	188.06	FINE SAND	LOOSE		GREY
2806984	598140	4824785	199.03	10.97	11.28	188.06	187.75	SAND	GRAVEL	LOOSE	BROWN
2806984	598140	4824785	199.03	11.28	12.80	187.75	186.23	CLAY	SAND	LOOSE	RED
2806984	598140	4824785	199.03	12.80	24.38	186.23	174.65	SHALE	HARD		RED
2807698	598335	4824826	198.37	0.00	0.61	198.37	197.76	TOPSOIL	FINE SAND		BROWN
2807698	598335	4824826	198.37	0.61	2.13	197.76	196.24	CLAY	HARD		BROWN
2807698	598335	4824826	198.37	2.13	3.35	196.24	195.02	CLAY	STONEY	HARD	GREY
2807698	598335	4824826	198.37	3.35	4.88	195.02	193.49	SAND			BROWN
2807698	598335	4824826	198.37	4.88	9.14	193.49	189.23	SAND	SOFT		BROWN
2807701	598202	4824128	200.03	0.00	3.66	200.03	196.37	CLAY	SOFT		GREEN
2807701	598202	4824128	200.03	3.66	15.24	196.37	184.79	SHALE	SOFT		RED
2807701	598202	4824128	200.03	15.24	30.48	184.79	169.55	SHALE	SOFT		RED
2808101	598084	4825093	200.81	0.00	1.22	200.81	199.59	CLAY			
2808101	598084	4825093	200.81	1.22	3.05	199.59	197.77	CLAY	CEMENTED		
2808101	598084	4825093	200.81	3.05	8.84	197.77	191.97	STONES			
2808814	598403	4824634	198.77	0.00	9.14	198.77	189.62	UNKNOWN TYPE			
2808815	598432	4824632	198.21	0.00	0.61	198.21	197.60	TOPSOIL	SOFT		BROWN
2808815	598432	4824632	198.21	0.61	2.44	197.60	195.77	CLAY	STONES	HARD	BROWN
2808815	598432	4824632	198.21	2.44	5.18	195.77	193.03	SAND			BROWN
2808815	598432	4824632	198.21	5.18	5.49	193.03	192.73	GRAVEL	LOOSE		BROWN
2808815	598432	4824632	198.21	5.49	10.67	192.73	187.54	SHALE	LIMESTONE	HARD	RED
2808911	596918	4823493	196.00	0.00	0.30	196.00	195.69	TOPSOIL			
2808911	596918	4823493	196.00	0.30	5.18	195.69	190.82	CLAY			BROWN
2808911	596918	4823493	196.00	5.18	7.92	190.82	188.07	CLAY	SAND		GREY
2808911	596918	4823493	196.00	7.92	12.19	188.07	183.80	SAND	SILTY	CLAY	GREY
2808912	596918	4823493	196.00	0.00	0.30	196.00	195.69	TOPSOIL			BLACK
2808912	596918	4823493	196.00	0.30	7.62	195.69	188.38	CLAY			BROWN
2808912	596918	4823493	196.00	7.62	12.19	188.38	183.80	CLAY	SAND		GREY
2808912	596918	4823493	196.00	12.19	14.02	183.80	181.98	SAND			GREY
2808912	596918	4823493	196.00	14.02	14.63	181.98	181.37	CLAY			RED
2808912	596918	4823493	196.00	14.63	19.81	181.37	176.18	SHALE			RED
2808913	596918	4823493	196.00	0.00	0.30	196.00	195.69	TOPSOIL			BLACK
2808913	596918	4823493	196.00	0.30	7.92	195.69	188.07	CLAY			BROWN
2808913	596918	4823493	196.00	7.92	12.80	188.07	183.20	CLAY	SAND		GREY
2808913	596918	4823493	196.00	12.80	14.33	183.20	181.67	SAND			GREY
2808913	596918	4823493	196.00	14.33	14.94	181.67	181.06	CLAY			RED
2808913	596918	4823493	196.00	14.94	30.48	181.06	165.52	SHALE			RED
2808916	596918	4823493	196.00	0.00	0.30	196.00	195.69	TOPSOIL			BLACK
2808916	596918	4823493	196.00	0.30	7.01	195.69	188.99	CLAY			BROWN
2808916	596918	4823493	196.00	7.01	11.89	188.99	184.11	CLAY	SAND		GREY
2808916	596918	4823493	196.00	11.89	14.02	184.11	181.98	FINE SAND			GREY
2808916	596918	4823493	196.00	14.02	14.94	181.98	181.06	CLAY			RED

MOE WATER WELL RECORDS - STRATIGRAPHY

Well ID	Easting	Northing	Ground Surface Elevation (m AMSL)	Top of Formation (m BGS)	Bottom of Formation (m BGS)	Top of Formation (m AMSL)	Bottom of Formation (m AMSL)	Primary Material	Secondary Material	Tertiary Material	Material Colour
2808916	596918	4823493	196.00	14.94	20.12	181.06	175.88	SHALE			RED
2808917	596918	4823493	196.00	0.00	1.52	196.00	194.47	CLAY	SAND	FILL	
2808917	596918	4823493	196.00	1.52	3.66	194.47	192.34	SAND	CLEAN		
2808917	596918	4823493	196.00	3.66	3.96	192.34	192.03	UNKNOWN TYPE			
2808917	596918	4823493	196.00	3.96	7.32	192.03	188.68	SAND	CLEAN		
2808917	596918	4823493	196.00	7.32	7.62	188.68	188.38	UNKNOWN TYPE			
2808917	596918	4823493	196.00	7.62	9.45	188.38	186.55	GRAVEL	CLEAN		
2808918	596469	4823927	196.72	0.00	0.30	196.72	196.42	TOPSOIL			BLACK
2808918	596469	4823927	196.72	0.30	7.92	196.42	188.80	CLAY			BROWN
2808918	596469	4823927	196.72	7.92	14.02	188.80	182.70	CLAY	SAND	STONES	GREY
2808918	596469	4823927	196.72	14.02	14.33	182.70	182.40	MEDIUM GRAVEL			GREY
2808920	596469	4823927	196.72	0.00	1.52	196.72	195.20	CLAY	CLEAN	SAND	
2808920	596469	4823927	196.72	1.52	2.74	195.20	193.98	SAND	CLEAN		
2808920	596469	4823927	196.72	2.74	6.71	193.98	190.02	SAND	CLEAN		
2808920	596469	4823927	196.72	6.71	7.32	190.02	189.41	UNKNOWN TYPE			
2808920	596469	4823927	196.72	7.32	10.36	189.41	186.36	GRAVEL	CLEAN		
2808921	596918	4823493	196.00	0.00	1.52	196.00	194.47	CLAY	CLEAN	SAND	
2808921	596918	4823493	196.00	1.52	3.66	194.47	192.34	SAND	CLEAN		
2808921	596918	4823493	196.00	3.66	4.27	192.34	191.73	UNKNOWN TYPE			
2808921	596918	4823493	196.00	4.27	7.62	191.73	188.38	SAND	CLEAN		
2808921	596918	4823493	196.00	7.62	7.92	188.38	188.07	UNKNOWN TYPE			
2808921	596918	4823493	196.00	7.92	10.67	188.07	185.33	GRAVEL	CLEAN		
2809010	597312	4825001	202.74	0.00	3.66	202.74	199.09	CLAY			BROWN
2809010	597312	4825001	202.74	3.66	6.10	199.09	196.65	CLAY	SANDY	GRAVEL	BROWN
2809010	597312	4825001	202.74	6.10	16.46	196.65	186.28	CLAY	GRAVEL		BROWN
2809010	597312	4825001	202.74	16.46	17.37	186.28	185.37	SHALE	LOOSE		RED
2809010	597312	4825001	202.74	17.37	22.86	185.37	179.88	SHALE			RED
4905332	597415	4823883	195.75	0.00	4.88	195.75	190.87	CLAY	SANDY		BROWN
4905332	597415	4823883	195.75	4.88	6.10	190.87	189.65	CLAY	STONES	SANDY	RED
4905332	597415	4823883	195.75	6.10	7.32	189.65	188.43	SHALE			RED
4905604	598355	4825003	197.83	0.00	3.35	197.83	194.48	CLAY			
4905604	598355	4825003	197.83	3.35	13.11	194.48	184.73	SHALE			RED
4905605	598345	4824983	198.03	0.00	3.66	198.03	194.37	CLAY			
4905605	598345	4824983	198.03	3.66	9.45	194.37	188.58	SHALE			RED
7106332	599320	4823881	190.90	0.00	0.60	190.90	190.30	SILT	SAND	WATER-BEARING	BROWN
7106332	599320	4823881	190.90	0.60	1.80	190.30	189.10	SILT	CLAY	LOOSE	BROWN
7106332	599320	4823881	190.90	1.80	3.90	189.10	187.00	SILT	SAND	CLAY	BROWN
7106332	599320	4823881	190.90	3.90	4.70	187.00	186.20	SILT	GRAVEL	DENSE	GREY
7106332	599320	4823881	190.90	4.70	4.90	186.20	186.00	SAND	SILT	WATER-BEARING	GREY
7106332	599320	4823881	190.90	4.90	6.00	186.00	184.90	SILT	SAND	WATER-BEARING	GREY
7107987	596348	4823210	192.55		6.10		186.45	SILT	SAND	DENSE	BROWN
7107987	596348	4823210	192.55	0.00	0.60	192.55	191.95	TOPSOIL		LOOSE	BROWN
7107987	596348	4823210	192.55	0.60	5.10	191.95	187.45	CLAY	SAND	DENSE	BROWN
7107987	596348	4823210	192.55	5.10		187.45			GRAVEL		
7107987	596348	4823210	192.55	6.10		186.45			GRAVEL		
7144763	598338	4824993	198.01	0.00	4.57	198.01	193.44	SILT	SAND	SILT	BROWN

MOE WATER WELL RECORDS - THEORETICAL YIELDS

Well ID	Well Type	Well Depth (m BGS)	Depth to Bedrock (m BGS)	Static Water Level (m BGS)	Water Level after Pumping (m BGS)	Pump Test Drawdown (m)	Pumping Rate (IGPM)	Pumping Rate (L/min)	Pumping Rate (L/s)	Pumping Duration (hours)	Available Dd SWL (m)	Available Dd after Pump Test (m)	Specific Capacity $m^3/d/m$	Specific Capacity L/min/m	Specific Capacity L/s/m	Total Volume Pumped (L)	Available Drawdown (m)	**Theoretical Yield (L/s)**
BEDROCK WELLS																		
2804135	Bedrock	13.11	9.75	3.35	13.11					2	9.75	0.00						
2805664	Bedrock	9.14	5.49	3.05			14	63.6	1.1	1	6.10	9.14						
2806982	Bedrock	18.29	13.11	3.66	17.68	14.02	2	9.1	0.2	1	14.63	0.61	0.93	0.65	0.01	3,819	12.63	**0.14**
2806983	Bedrock	14.02	13.41	5.18	12.19	7.01	9	40.9	0.7	1	8.84	1.83	8.40	5.84	0.10	546	6.84	**0.67**
2806984	Bedrock	24.38	12.80	3.66	24.08	20.42	1	4.5	0.1	1	20.73	0.30	0.32	0.22	0.00	2,455	18.73	**0.07**
2807701	Bedrock	30.48	3.66	1.22	7.01	5.79	9	40.9	0.7	1	29.26	23.47	10.17	7.06	0.12	273	27.26	**3.21**
2808815	Bedrock	10.67	5.49	2.44	3.96	1.52	5	22.7	0.4	2	8.23	6.71	21.48	14.91	0.25	2,455	6.23	**1.55**
4905332	Bedrock	7.32	6.10	0.91	0.91	0.00	1	4.5	0.1	1	6.40	6.40						
4905604	Bedrock	13.11	3.35	1.83	12.19	10.36	1	4.5	0.1	1	11.28	0.91	0.63	0.44	0.01	273	9.28	**0.07**
4905605	Bedrock	9.45	3.66	2.74	5.79	3.05	7	31.8	0.5	1	6.71	3.66	15.03	10.44	0.17	273	4.71	**0.82**
OVERBURDEN WELLS																		
2802687	Overburden	9.75		3.96						8	5.79	9.75						
2804439	Overburden	9.45		3.66	7.32	3.66	7	31.8	0.5	1	5.79	2.13	12.53	8.70	0.15			
2804455	Overburden	10.97		4.88	10.36	5.49	14	63.6	1.1	1	6.10	0.61	16.70	11.60	0.19	1,909	4.10	**0.79**
2807698	Overburden	9.14		3.66	7.62	3.96	10	45.5	0.8	1	5.49	1.52	16.52	11.47	0.19	3,819	3.49	**0.67**
2808911	Overburden	12.19		8.84	10.06	1.22	4	18.2	0.3	25	3.35	2.13	21.48	14.91	0.25	2,728	1.35	**0.34**
2808918	Overburden	14.33		9.45	12.19	2.74	5	22.7	0.4	3	4.88	2.13	11.93	8.29	0.14	27,276	2.88	**0.40**

Bedrock	MAX =	3.21
	MIN =	0.07
	AVG =	0.93
Overburden	MAX =	0.79
	MIN =	0.34
	AVG =	0.55

Stantec

APPENDIX D

LABORATORY CERTIFICATE OF ANALYSIS

Maxxam

Success Through Science®

Your P.O. #: 16300R-40
Your Project #: 160311338
Your C.O.C. #: 38465001, 384650-01-01

Attention: Angela Ducharme
Stantec Consulting Ltd
49 Frederick St
Kitchener, ON
CANADA N2H 6M7

Report Date: 2012/12/28

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2K1199
Received: 2012/12/20, 15:40

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Alkalinity	9	N/A	2012/12/24	CAM SOP-00448	SM 2320B
Carbonate, Bicarbonate and Hydroxide	9	N/A	2012/12/27	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	9	N/A	2012/12/24	CAM SOP-00463	EPA 325.2
Conductivity	9	N/A	2012/12/24	CAM SOP-00448	SM 2510
Dissolved Organic Carbon (DOC)	9	N/A	2012/12/25	CAM SOP-00446	SM 5310 B
Hardness (calculated as CaCO3)	9	N/A	2012/12/28	CAM SOP 00102	SM 2340 B
Dissolved Metals by ICPMS	9	N/A	2012/12/28	CAM SOP-00447	EPA 6020
Ion Balance (% Difference)	9	N/A	2012/12/28		
Anion and Cation Sum	9	N/A	2012/12/28		
Total Ammonia-N	9	N/A	2012/12/28	CAM SOP-00441	US GS I-2522-90
Nitrate (NO3) and Nitrite (NO2) in Water (1)	9	N/A	2012/12/24	CAM SOP-00440	SM 4500 NO3I/NO2B
pH	9	N/A	2012/12/24	CAM SOP-00448	SM 4500H+ B
Orthophosphate	9	N/A	2012/12/24	CAM SOP-00461	EPA 365.1
Sat. pH and Langelier Index (@ 20C)	9	N/A	2012/12/28		
Sat. pH and Langelier Index (@ 4C)	9	N/A	2012/12/28		
Sulphate by Automated Colourimetry	9	N/A	2012/12/24	CAM SOP-00464	EPA 375.4
Total Dissolved Solids (TDS calc)	9	N/A	2012/12/28		
Turbidity	9	N/A	2012/12/24	CAM SOP-00417	APHA 2130B

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

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

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

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

../2

Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

* Results relate only to the items tested.

(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Renata Spena
31 Dec 2012 09:20:50 -05:00

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

Renata Spena, Project Manager
Email: RSpena@maxxam.ca
Phone# (905) 817-5700 Ext:5818

==========

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

Total cover pages: 2

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

RESULTS OF ANALYSES OF WATER

Maxxam ID		QB2909	QB2910	QB2911		
Sampling Date		2012/12/20 11:00	2012/12/20 12:00	2012/12/20 14:00		
	Units	**WG-160311338-20121220-AMD-001**	**WG-160311338-20121220-AMD-002**	**WG-160311338-20121220-AMD-003**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	12.4	9.66	9.89	N/A	3076944
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	420	410	400	1.0	3076349
Calculated TDS	mg/L	683	511	521	1.0	3076948
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.2	4.1	5.1	1.0	3076349
Cation Sum	me/L	13.2	10.5	10.3	N/A	3076944
Hardness (CaCO3)	mg/L	490	430	420	1.0	3076142
Ion Balance (% Difference)	%	3.00	4.08	2.07	N/A	3076943
Langelier Index (@ 20C)	N/A	0.860	0.987	0.912		3076945
Langelier Index (@ 4C)	N/A	0.613	0.740	0.665		3076946
Saturation pH (@ 20C)	N/A	7.05	7.04	7.22		3076945
Saturation pH (@ 4C)	N/A	7.30	7.28	7.47		3076946
Inorganics						
Total Ammonia-N	mg/L	0.18	0.35	0.40	0.050	3081087
Conductivity	umho/cm	1100	850	880	1.0	3078983
Dissolved Organic Carbon	mg/L	1.0	0.72	0.60	0.20	3079209
Orthophosphate (P)	mg/L	<0.010	<0.010	<0.010	0.010	3079382
pH	pH	7.91	8.02	8.14		3078984
Dissolved Sulphate (SO4)	mg/L	130	43	48	1	3079381
Turbidity	NTU	1800	2100	930	4	3078960
Alkalinity (Total as CaCO3)	mg/L	420	420	410	1.0	3078979
Dissolved Chloride (Cl)	mg/L	31	16	27	1	3079380
Nitrite (N)	mg/L	<0.010	<0.010	<0.010	0.010	3079083
Nitrate (N)	mg/L	5.9	<0.10	<0.10	0.10	3079083
Nitrate + Nitrite	mg/L	5.9	<0.10	<0.10	0.10	3079083

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

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

RESULTS OF ANALYSES OF WATER

Maxxam ID		QB2912		QB2913	QB2914		
Sampling Date		2012/12/20 13:30		2012/12/20 13:00	2012/12/19 13:45		
	Units	WG-160311338-20121220-AMD-004	RDL	WG-160311338-20121220-AMD-005	WG-160311338-20121219-AMD-006	RDL	QC Batch
Calculated Parameters							
Anion Sum	me/L	15.1	N/A	7.56	6.53	N/A	3076944
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	320	1.0	270	230	1.0	3076349
Calculated TDS	mg/L	873	1.0	430	399	1.0	3076948
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.0	1.0	1.7	<1.0	1.0	3076349
Cation Sum	me/L	17.0	N/A	8.21	7.86	N/A	3076944
Hardness (CaCO3)	mg/L	540	1.0	380	370	1.0	3076142
Ion Balance (% Difference)	%	5.97	N/A	4.12	9.29	N/A	3076943
Langelier Index (@ 20C)	N/A	0.923		0.771	0.543		3076945
Langelier Index (@ 4C)	N/A	0.677		0.522	0.294		3076946
Saturation pH (@ 20C)	N/A	7.08		7.07	7.03		3076945
Saturation pH (@ 4C)	N/A	7.32		7.31	7.28		3076946
Inorganics							
Total Ammonia-N	mg/L	0.39	0.050	0.18	0.061	0.050	3081087
Conductivity	umho/cm	1600	1.0	700	1500	1.0	3078983
Dissolved Organic Carbon	mg/L	0.58	0.20	0.84	0.98	0.20	3079209
Orthophosphate (P)	mg/L	<0.010	0.010	<0.010	<0.010	0.010	3079382
pH	pH	8.00		7.84	7.57		3078984
Dissolved Sulphate (SO4)	mg/L	130	1	43	39	1	3079381
Turbidity	NTU	440	4	1900	500	4	3078960
Alkalinity (Total as CaCO3)	mg/L	320	1.0	270	230	1.0	3078979
Dissolved Chloride (Cl)	mg/L	210	3	11	7	1	3079380
Nitrite (N)	mg/L	<0.010	0.010	0.038	<0.010	0.010	3079083
Nitrate (N)	mg/L	<0.10	0.10	14	14	1.0	3079083
Nitrate + Nitrite	mg/L	<0.10	0.10	14	14	1.0	3079083

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

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Maxxam Job #: B2K1199
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Your P.O. #: 16300R-40
Sampler Initials: AD

RESULTS OF ANALYSES OF WATER

Maxxam ID		QB2915		QB2916	QB2917		
Sampling Date		2012/12/19 15:15		2012/12/19 16:00	2012/12/20 14:30		
	Units	WG-160311338-20121219-AMD-007	RDL	WG-160311338-20121219-AMD-008	WG-160311338-20121220-AMD-009	RDL	QC Batch
Calculated Parameters							
Anion Sum	me/L	7.25	N/A	7.13	10.4	N/A	3076944
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	250	1.0	280	430	1.0	3076349
Calculated TDS	mg/L	429	1.0	401	532	1.0	3076948
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.3	1.0	1.8	6.8	1.0	3076349
Cation Sum	me/L	8.04	N/A	7.64	10.8	N/A	3076944
Hardness (CaCO3)	mg/L	380	1.0	360	420	1.0	3076142
Ion Balance (% Difference)	%	5.15	N/A	3.48	1.99	N/A	3076943
Langelier Index (@ 20C)	N/A	0.713		0.936	0.934		3076945
Langelier Index (@ 4C)	N/A	0.465		0.688	0.686		3076946
Saturation pH (@ 20C)	N/A	7.01		6.91	7.29		3076945
Saturation pH (@ 4C)	N/A	7.26		7.16	7.53		3076946
Inorganics							
Total Ammonia-N	mg/L	0.14	0.050	0.12	0.49	0.050	3081087
Conductivity	umho/cm	690	1.0	650	900	1.0	3078983
Dissolved Organic Carbon	mg/L	0.85	0.20	1.3	0.98	0.20	3079209
Orthophosphate (P)	mg/L	<0.010	0.010	<0.010	<0.010	0.010	3079382
pH	pH	7.72		7.85	8.22		3078984
Dissolved Sulphate (SO4)	mg/L	39	1	54	55	1	3079381
Turbidity	NTU	3700	4	1800	1300	4	3078960
Alkalinity (Total as CaCO3)	mg/L	250	1.0	280	440	1.0	3078979
Dissolved Chloride (Cl)	mg/L	9	1	4	13	1	3079380
Nitrite (N)	mg/L	<0.010	0.010	<0.010	<0.010	0.010	3079083
Nitrate (N)	mg/L	16	1.0	4.1	<0.10	0.10	3079083
Nitrate + Nitrite	mg/L	16	1.0	4.1	<0.10	0.10	3079083

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

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		QB2909		QB2910		
Sampling Date		2012/12/20 11:00		2012/12/20 12:00		
	Units	WG-160311338-20121220-AMD-001	RDL	WG-160311338-20121220-AMD-002	RDL	QC Batch
Metals						
Dissolved Aluminum (Al)	mg/L	0.0058	0.0050	0.014	0.0050	3081613
Dissolved Antimony (Sb)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Arsenic (As)	mg/L	<0.0010	0.0010	0.011	0.0010	3081613
Dissolved Barium (Ba)	mg/L	0.034	0.0020	0.12	0.0020	3081613
Dissolved Beryllium (Be)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Boron (B)	mg/L	0.58	0.010	0.079	0.010	3081613
Dissolved Cadmium (Cd)	mg/L	<0.00010	0.00010	<0.00010	0.00010	3081613
Dissolved Calcium (Ca)	mg/L	67	0.40	66	0.20	3081613
Dissolved Chromium (Cr)	mg/L	<0.0050	0.0050	<0.0050	0.0050	3081613
Dissolved Cobalt (Co)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Copper (Cu)	mg/L	<0.0010	0.0010	<0.0010	0.0010	3081613
Dissolved Iron (Fe)	mg/L	<0.10	0.10	<0.10	0.10	3081613
Dissolved Lead (Pb)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Magnesium (Mg)	mg/L	77	0.050	66	0.050	3081613
Dissolved Manganese (Mn)	mg/L	0.040	0.0020	0.043	0.0020	3081613
Dissolved Molybdenum (Mo)	mg/L	0.0073	0.00050	0.0041	0.00050	3081613
Dissolved Nickel (Ni)	mg/L	0.0022	0.0010	<0.0010	0.0010	3081613
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	<0.10	0.10	3081613
Dissolved Potassium (K)	mg/L	13	0.20	5.6	0.20	3081613
Dissolved Selenium (Se)	mg/L	<0.0020	0.0020	<0.0020	0.0020	3081613
Dissolved Silicon (Si)	mg/L	5.9	0.10	13	0.10	3081613
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	<0.00010	0.00010	3081613
Dissolved Sodium (Na)	mg/L	73	0.10	38	0.10	3081613
Dissolved Strontium (Sr)	mg/L	7.7	0.0010	1.7	0.0010	3081613
Dissolved Thallium (Tl)	mg/L	<0.000050	0.000050	<0.000050	0.000050	3081613
Dissolved Titanium (Ti)	mg/L	<0.0050	0.0050	0.0067	0.0050	3081613
Dissolved Uranium (U)	mg/L	0.0067	0.00010	0.0016	0.00010	3081613
Dissolved Vanadium (V)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Zinc (Zn)	mg/L	0.0078	0.0050	<0.0050	0.0050	3081613

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		QB2911		QB2912		
Sampling Date		2012/12/20 14:00		2012/12/20 13:30		
	Units	WG-160311338-20121220-AMD-003	RDL	WG-160311338-20121220-AMD-004	RDL	QC Batch
Metals						
Dissolved Aluminum (Al)	mg/L	<0.0050	0.0050	0.0052	0.0050	3081613
Dissolved Antimony (Sb)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Arsenic (As)	mg/L	0.0020	0.0010	<0.0010	0.0010	3081613
Dissolved Barium (Ba)	mg/L	0.072	0.0020	0.077	0.0020	3081613
Dissolved Beryllium (Be)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Boron (B)	mg/L	0.21	0.010	0.75	0.010	3081613
Dissolved Cadmium (Cd)	mg/L	<0.00010	0.00010	<0.00010	0.00010	3081613
Dissolved Calcium (Ca)	mg/L	44	0.20	88	1.0	3081613
Dissolved Chromium (Cr)	mg/L	<0.0050	0.0050	<0.0050	0.0050	3081613
Dissolved Cobalt (Co)	mg/L	<0.00050	0.00050	0.0012	0.00050	3081613
Dissolved Copper (Cu)	mg/L	<0.0010	0.0010	<0.0010	0.0010	3081613
Dissolved Iron (Fe)	mg/L	<0.10	0.10	<0.10	0.10	3081613
Dissolved Lead (Pb)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Magnesium (Mg)	mg/L	75	0.050	79	0.050	3081613
Dissolved Manganese (Mn)	mg/L	0.029	0.0020	0.16	0.0020	3081613
Dissolved Molybdenum (Mo)	mg/L	0.0036	0.00050	0.0099	0.00050	3081613
Dissolved Nickel (Ni)	mg/L	<0.0010	0.0010	0.0028	0.0010	3081613
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	<0.10	0.10	3081613
Dissolved Potassium (K)	mg/L	12	0.20	17	0.20	3081613
Dissolved Selenium (Se)	mg/L	<0.0020	0.0020	<0.0020	0.0020	3081613
Dissolved Silicon (Si)	mg/L	16	0.050	11	0.050	3081613
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	<0.00010	0.00010	3081613
Dissolved Sodium (Na)	mg/L	37	0.10	130	0.10	3081613
Dissolved Strontium (Sr)	mg/L	3.2	0.0010	10	0.0010	3081613
Dissolved Thallium (Tl)	mg/L	<0.000050	0.000050	<0.000050	0.000050	3081613
Dissolved Titanium (Ti)	mg/L	0.0092	0.0050	0.0051	0.0050	3081613
Dissolved Uranium (U)	mg/L	0.00015	0.00010	0.0011	0.00010	3081613
Dissolved Vanadium (V)	mg/L	<0.00050	0.00050	<0.00050	0.00050	3081613
Dissolved Zinc (Zn)	mg/L	<0.0050	0.0050	<0.0050	0.0050	3081613

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		QB2913	QB2914	QB2915		
Sampling Date		2012/12/20 13:00	2012/12/19 13:45	2012/12/19 15:15		
	Units	WG-160311338-20121220-AMD-005	WG-160311338-20121219-AMD-006	WG-160311338-20121219-AMD-007	RDL	QC Batch
Metals						
Dissolved Aluminum (Al)	mg/L	0.0081	0.050	0.031	0.0050	3081613
Dissolved Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	3081613
Dissolved Arsenic (As)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	3081613
Dissolved Barium (Ba)	mg/L	0.067	0.12	0.12	0.0020	3081613
Dissolved Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	3081613
Dissolved Boron (B)	mg/L	0.064	0.025	0.042	0.010	3081613
Dissolved Cadmium (Cd)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	3081613
Dissolved Calcium (Ca)	mg/L	91	110	110	0.20	3081613
Dissolved Chromium (Cr)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	3081613
Dissolved Cobalt (Co)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	3081613
Dissolved Copper (Cu)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	3081613
Dissolved Iron (Fe)	mg/L	<0.10	<0.10	<0.10	0.10	3081613
Dissolved Lead (Pb)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	3081613
Dissolved Magnesium (Mg)	mg/L	38	21	25	0.050	3081613
Dissolved Manganese (Mn)	mg/L	0.020	0.016	0.019	0.0020	3081613
Dissolved Molybdenum (Mo)	mg/L	0.0025	0.0010	0.00099	0.00050	3081613
Dissolved Nickel (Ni)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	3081613
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	3081613
Dissolved Potassium (K)	mg/L	4.3	3.2	5.0	0.20	3081613
Dissolved Selenium (Se)	mg/L	<0.0020	<0.0020	<0.0020	0.0020	3081613
Dissolved Silicon (Si)	mg/L	4.7	4.3	5.1	0.050	3081613
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	3081613
Dissolved Sodium (Na)	mg/L	9.5	7.7	8.8	0.10	3081613
Dissolved Strontium (Sr)	mg/L	1.4	0.57	0.87	0.0010	3081613
Dissolved Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.000050	0.000050	3081613
Dissolved Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	3081613
Dissolved Uranium (U)	mg/L	0.0037	0.0016	0.0023	0.00010	3081613
Dissolved Vanadium (V)	mg/L	0.00055	0.00053	0.00050	0.00050	3081613
Dissolved Zinc (Zn)	mg/L	<0.0050	<0.0050	<0.0050	0.0050	3081613

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		QB2916	QB2917		
Sampling Date		2012/12/19 16:00	2012/12/20 14:30		
	Units	WG-160311338-20121219-AMD-008	WG-160311338-20121220-AMD-009	RDL	QC Batch
Metals					
Dissolved Aluminum (Al)	mg/L	0.0059	<0.0050	0.0050	3081613
Dissolved Antimony (Sb)	mg/L	<0.00050	<0.00050	0.00050	3081613
Dissolved Arsenic (As)	mg/L	<0.0010	<0.0010	0.0010	3081613
Dissolved Barium (Ba)	mg/L	0.036	0.24	0.0020	3081613
Dissolved Beryllium (Be)	mg/L	<0.00050	<0.00050	0.00050	3081613
Dissolved Boron (B)	mg/L	0.019	0.33	0.010	3081613
Dissolved Cadmium (Cd)	mg/L	<0.00010	<0.00010	0.00010	3081613
Dissolved Calcium (Ca)	mg/L	120	35	0.20	3081613
Dissolved Chromium (Cr)	mg/L	<0.0050	<0.0050	0.0050	3081613
Dissolved Cobalt (Co)	mg/L	<0.00050	<0.00050	0.00050	3081613
Dissolved Copper (Cu)	mg/L	0.0012	<0.0010	0.0010	3081613
Dissolved Iron (Fe)	mg/L	<0.10	<0.10	0.10	3081613
Dissolved Lead (Pb)	mg/L	<0.00050	<0.00050	0.00050	3081613
Dissolved Magnesium (Mg)	mg/L	13	80	0.050	3081613
Dissolved Manganese (Mn)	mg/L	0.052	0.071	0.0020	3081613
Dissolved Molybdenum (Mo)	mg/L	0.0016	0.0031	0.00050	3081613
Dissolved Nickel (Ni)	mg/L	0.0012	<0.0010	0.0010	3081613
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	0.10	3081613
Dissolved Potassium (K)	mg/L	1.4	9.0	0.20	3081613
Dissolved Selenium (Se)	mg/L	<0.0020	<0.0020	0.0020	3081613
Dissolved Silicon (Si)	mg/L	4.8	11	0.050	3081613
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	3081613
Dissolved Sodium (Na)	mg/L	9.4	51	0.10	3081613
Dissolved Strontium (Sr)	mg/L	0.21	4.9	0.0010	3081613
Dissolved Thallium (Tl)	mg/L	<0.000050	<0.000050	0.000050	3081613
Dissolved Titanium (Ti)	mg/L	<0.0050	0.0057	0.0050	3081613
Dissolved Uranium (U)	mg/L	0.00077	0.00057	0.00010	3081613
Dissolved Vanadium (V)	mg/L	<0.00050	<0.00050	0.00050	3081613
Dissolved Zinc (Zn)	mg/L	0.038	<0.0050	0.0050	3081613

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

Test Summary

Maxxam ID QB2909
Sample ID WG-160311338-20121220-AMD-001
Matrix Water

Collected 2012/12/20
Shipped
Received 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk
Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

Maxxam ID QB2910
Sample ID WG-160311338-20121220-AMD-002
Matrix Water

Collected 2012/12/20
Shipped
Received 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

Test Summary

Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

Maxxam ID QB2911
Sample ID WG-160311338-20121220-AMD-003
Matrix Water

Collected 2012/12/20
Shipped
Received 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk
Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

Test Summary

Maxxam ID QB2912 **Collected** 2012/12/20
Sample ID WG-160311338-20121220-AMD-004 **Shipped**
Matrix Water **Received** 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk
Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

Maxxam ID QB2913 **Collected** 2012/12/20
Sample ID WG-160311338-20121220-AMD-005 **Shipped**
Matrix Water **Received** 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

Test Summary

Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

Maxxam ID QB2914
Sample ID WG-160311338-20121219-AMD-006
Matrix Water

Collected 2012/12/19
Shipped
Received 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk
Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

Test Summary

Maxxam ID QB2915 **Collected** 2012/12/19
Sample ID WG-160311338-20121219-AMD-007 **Shipped**
Matrix Water **Received** 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk
Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

Maxxam ID QB2916 **Collected** 2012/12/19
Sample ID WG-160311338-20121219-AMD-008 **Shipped**
Matrix Water **Received** 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

Test Summary

Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

Maxxam ID QB2917
Sample ID WG-160311338-20121220-AMD-009
Matrix Water

Collected 2012/12/20
Shipped
Received 2012/12/20

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Alkalinity	PH	3078979	N/A	2012/12/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	3076349	N/A	2012/12/27	Automated Statchk
Chloride by Automated Colourimetry	AC	3079380	N/A	2012/12/24	Deonarine Ramnarine
Conductivity	COND	3078983	N/A	2012/12/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	3079209	N/A	2012/12/25	Bernard Antwi
Hardness (calculated as CaCO3)		3076142	N/A	2012/12/28	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	3081613	N/A	2012/12/28	Hua Ren
Ion Balance (% Difference)	CALC	3076943	N/A	2012/12/28	Automated Statchk
Anion and Cation Sum	CALC	3076944	N/A	2012/12/28	Automated Statchk
Total Ammonia-N	LACH/NH4	3081087	N/A	2012/12/28	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	3079083	N/A	2012/12/24	Chris Li
pH	PH	3078984	N/A	2012/12/24	Surinder Rai
Orthophosphate	AC	3079382	N/A	2012/12/24	Birenkumar Patel
Sat. pH and Langelier Index (@ 20C)	CALC	3076945	N/A	2012/12/28	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	3076946	N/A	2012/12/28	Automated Statchk
Sulphate by Automated Colourimetry	AC	3079381	N/A	2012/12/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	3076948	N/A	2012/12/28	Automated Statchk
Turbidity	TURB	3078960	N/A	2012/12/24	Yogesh Patel

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
3078960	Turbidity	2012/12/24					0.2, RDL=0.2	NTU	NC	20	97	85 - 115
3078979	Alkalinity (Total as CaCO3)	2012/12/24					<1.0	mg/L	0.4	25	96	85 - 115
3078983	Conductivity	2012/12/24					<1.0	umho/cm	0.3	25	101	85 - 115
3079083	Nitrite (N)	2012/12/24	NC	80 - 120	100	85 - 115	<0.010	mg/L				
3079083	Nitrate (N)	2012/12/24	NC	80 - 120	99	85 - 115	<0.10	mg/L	0.5	25		
3079209	Dissolved Organic Carbon	2012/12/25	103	80 - 120	103	80 - 120	<0.20	mg/L	2.6	20		
3079380	Dissolved Chloride (Cl)	2012/12/24	102	80 - 120	103	80 - 120	<1	mg/L	0.3	20		
3079381	Dissolved Sulphate (SO4)	2012/12/24	NC	75 - 125	103	80 - 120	<1	mg/L	2.5	20		
3079382	Orthophosphate (P)	2012/12/24	110	75 - 125	101	80 - 120	<0.010	mg/L	NC	25		
3081087	Total Ammonia-N	2012/12/28	98	80 - 120	103	85 - 115	<0.050	mg/L	NC	20		
3081613	Dissolved Aluminum (Al)	2012/12/28	104	80 - 120	97	80 - 120	<0.0050	mg/L				
3081613	Dissolved Antimony (Sb)	2012/12/28	111	80 - 120	102	80 - 120	<0.00050	mg/L	NC	20		
3081613	Dissolved Arsenic (As)	2012/12/28	107	80 - 120	101	80 - 120	<0.0010	mg/L	NC	20		
3081613	Dissolved Barium (Ba)	2012/12/28	101	80 - 120	97	80 - 120	<0.0020	mg/L	NC	20		
3081613	Dissolved Beryllium (Be)	2012/12/28	102	80 - 120	99	80 - 120	<0.00050	mg/L	NC	20		
3081613	Dissolved Boron (B)	2012/12/28	NC	80 - 120	101	80 - 120	<0.010	mg/L	0.2	20		
3081613	Dissolved Cadmium (Cd)	2012/12/28	105	80 - 120	100	80 - 120	<0.00010	mg/L	NC	20		
3081613	Dissolved Calcium (Ca)	2012/12/28	NC	80 - 120	101	80 - 120	<0.20	mg/L				
3081613	Dissolved Chromium (Cr)	2012/12/28	NC	80 - 120	97	80 - 120	<0.0050	mg/L	1.1	20		
3081613	Dissolved Cobalt (Co)	2012/12/28	103	80 - 120	96	80 - 120	<0.00050	mg/L	NC	20		
3081613	Dissolved Copper (Cu)	2012/12/28	101	80 - 120	94	80 - 120	<0.0010	mg/L	NC	20		
3081613	Dissolved Iron (Fe)	2012/12/28	109	80 - 120	103	80 - 120	<0.10	mg/L				
3081613	Dissolved Lead (Pb)	2012/12/28	101	80 - 120	96	80 - 120	<0.00050	mg/L	NC	20		
3081613	Dissolved Magnesium (Mg)	2012/12/28	NC	80 - 120	102	80 - 120	<0.050	mg/L				
3081613	Dissolved Manganese (Mn)	2012/12/28	102	80 - 120	99	80 - 120	<0.0020	mg/L				
3081613	Dissolved Molybdenum (Mo)	2012/12/28	106	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20		
3081613	Dissolved Nickel (Ni)	2012/12/28	102	80 - 120	96	80 - 120	<0.0010	mg/L	NC	20		
3081613	Dissolved Phosphorus (P)	2012/12/28	103	80 - 120	99	80 - 120	<0.10	mg/L				
3081613	Dissolved Potassium (K)	2012/12/28	NC	80 - 120	103	80 - 120	<0.20	mg/L				
3081613	Dissolved Selenium (Se)	2012/12/28	109	80 - 120	100	80 - 120	<0.0020	mg/L	NC	20		
3081613	Dissolved Silicon (Si)	2012/12/28	104	80 - 120	101	80 - 120	<0.050	mg/L				
3081613	Dissolved Silver (Ag)	2012/12/28	96	80 - 120	96	80 - 120	<0.00010	mg/L	NC	20		
3081613	Dissolved Sodium (Na)	2012/12/28	NC	80 - 120	105	80 - 120	<0.10	mg/L	1.4	20		
3081613	Dissolved Strontium (Sr)	2012/12/28	NC	80 - 120	97	80 - 120	<0.0010	mg/L				
3081613	Dissolved Thallium (Tl)	2012/12/28	103	80 - 120	99	80 - 120	<0.000050	mg/L	NC	20		
3081613	Dissolved Titanium (Ti)	2012/12/28	113	80 - 120	102	80 - 120	<0.0050	mg/L				
3081613	Dissolved Uranium (U)	2012/12/28	103	80 - 120	100	80 - 120	<0.00010	mg/L	NC	20		

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Maxxam Job #: B2K1199
Report Date: 2012/12/28

Stantec Consulting Ltd
Client Project #: 160311338

Your P.O. #: 16300R-40
Sampler Initials: AD

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
3081613	Dissolved Vanadium (V)	2012/12/28	103	80 - 120	97	80 - 120	<0.00050	mg/L	NC	20		
3081613	Dissolved Zinc (Zn)	2012/12/28	102	80 - 120	98	80 - 120	<0.0050	mg/L	NC	20		

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

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Validation Signature Page

Maxxam Job #: B2K1199

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

Cristina Carriere

Cristina Carriere, Scientific Services

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

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Maxxam IMMEDIATE TEST

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STANTEC CHAIN O

20-Dec-12 15:40
Renata Spena

Page 1 of 1

B2K1199

ABH ENV-648

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:	
Company Name:	#23998 Stantec Consulting Ltd	Company Name:		Quotation #:	B21968
Contact Name:	Accounts Payable	Contact Name:	Angela Ducharme, Grant Whitehead	Task #:	609
Address:	49 Frederick St	Address:		Project #:	160311338
	Kitchener ON N2H 6M7			Profit Centre:	1603
Phone:	(519)579-4410 Fax: (519)579-6733	Phone:	Fax:	Site #:	—
Email:	Stantec.Accounts.Payable.Invoices@Stantec.com	Email:	Angela.Ducharme@stantec.com, Grant.Whitehead@Stantec.com	Sampled By:	A. Ducharme

BOTTLE ORDER #: 384650

C#384650-01-01

PROJECT MANAGER: Renata Spena

Regulation 153 (2011): ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ___ ☐ Res/Park ☐ Ind/Comm ☐ Agri/Other ☐ Medium/Fine ☐ Coarse ☐ For RSC

Other Regulations: ☐ CCME ☐ Reg. 558 ☐ MISA ☒ PWQO ☐ Other ___ ☐ Sanitary Sewer Bylaw ☐ Storm Sewer Bylaw ☐ Municipality ___

SPECIAL INSTRUCTIONS

Include Criteria on Certificate of Analysis (Y/N)? N

Note: For MOE regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water? (Y/N)	Metals Field Filtered? (Y/N)	RCAp - Comprehensive	Turbidity	# of Bottles	Comments
1	WG-160311338-20121220-AMD-001		20/12/12	11:00	GW	N	Y	X	X	4	Sediment present in bottles (all samples except filtered metals)
2	WG-160311338-20121220-AMD-002		20/12/12	12:00	GW	N	Y	X	X	4	
3	WG-160311338-20121220-AMD-003		20/12/12	14:00	GW	N	Y	X	X	4	
4	WG-160311338-20121220-AMD-004		20/12/12	13:30	GW	N	Y	X	X	4	
5	WG-160311338-20121220-AMD-005		20/12/12	13:00	GW	N	Y	X	X	4	
6	WG-160311338-20121219-AMD-006		19/12/12	13:45	GW	N	Y	X	X	4	
7	WG-160311338-20121219-AMD-007		19/12/12	15:15	GW	N	Y	X	X	4	
8	WG-160311338-20121219-AMD-008		19/12/12	16:00	GW	N	Y	X	X	4	
9	WG-160311338-20121220-AMD-009		20/12/12	14:30	GW	N	Y	X	X	4	
10					GW						

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted
Angela Ducharme AD	2012/12/20	15:36	ASHLEIGH SUTCLIFFE	2012/12/20	15:40	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
	5/3/4°C	Present		
		Intact		✓

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

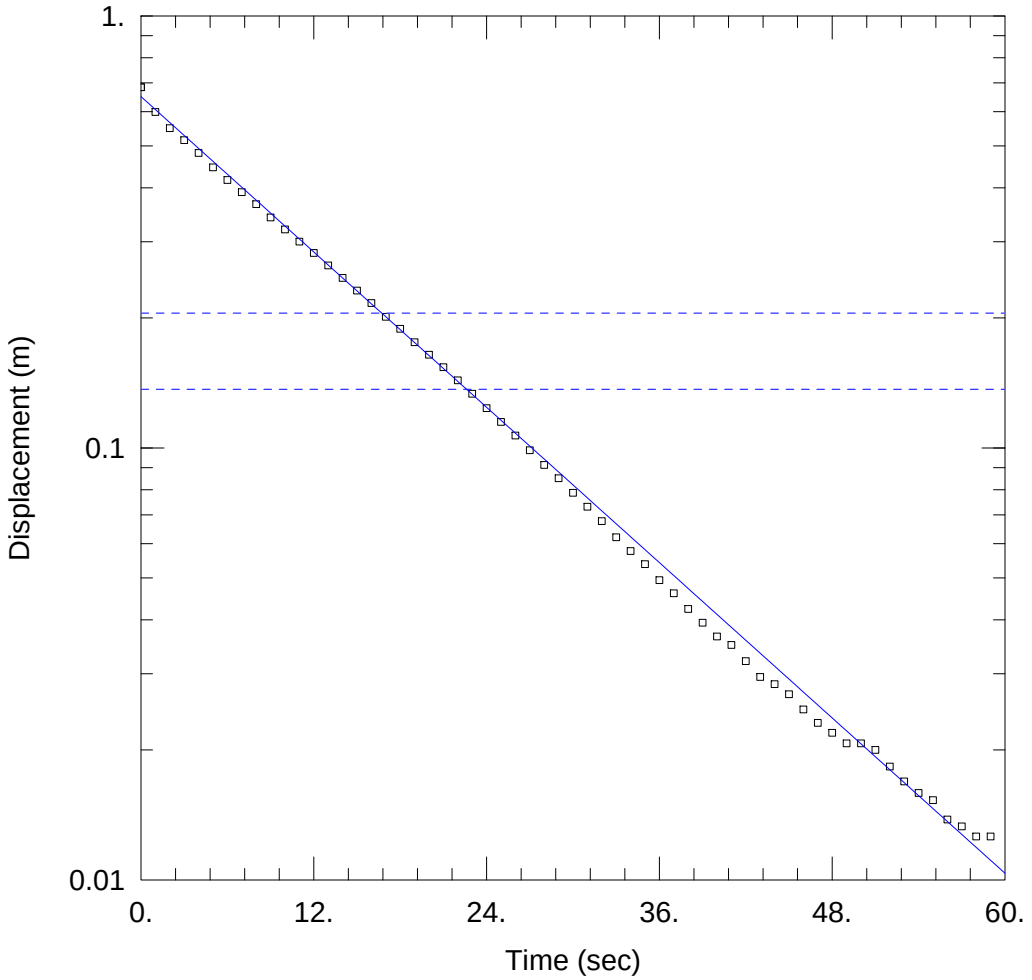
Maxxam Analytics International Corporation o/a Maxxam Analytics

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APPENDIX E

HYDRAULIC CONDUCTIVITY TESTING

ANALYTICAL SOLUTIONS



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW101-12.aqt
Date: 01/17/13 Time: 12:24:09

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW101-12
Test Date: 2012-Dec-20

AQUIFER DATA

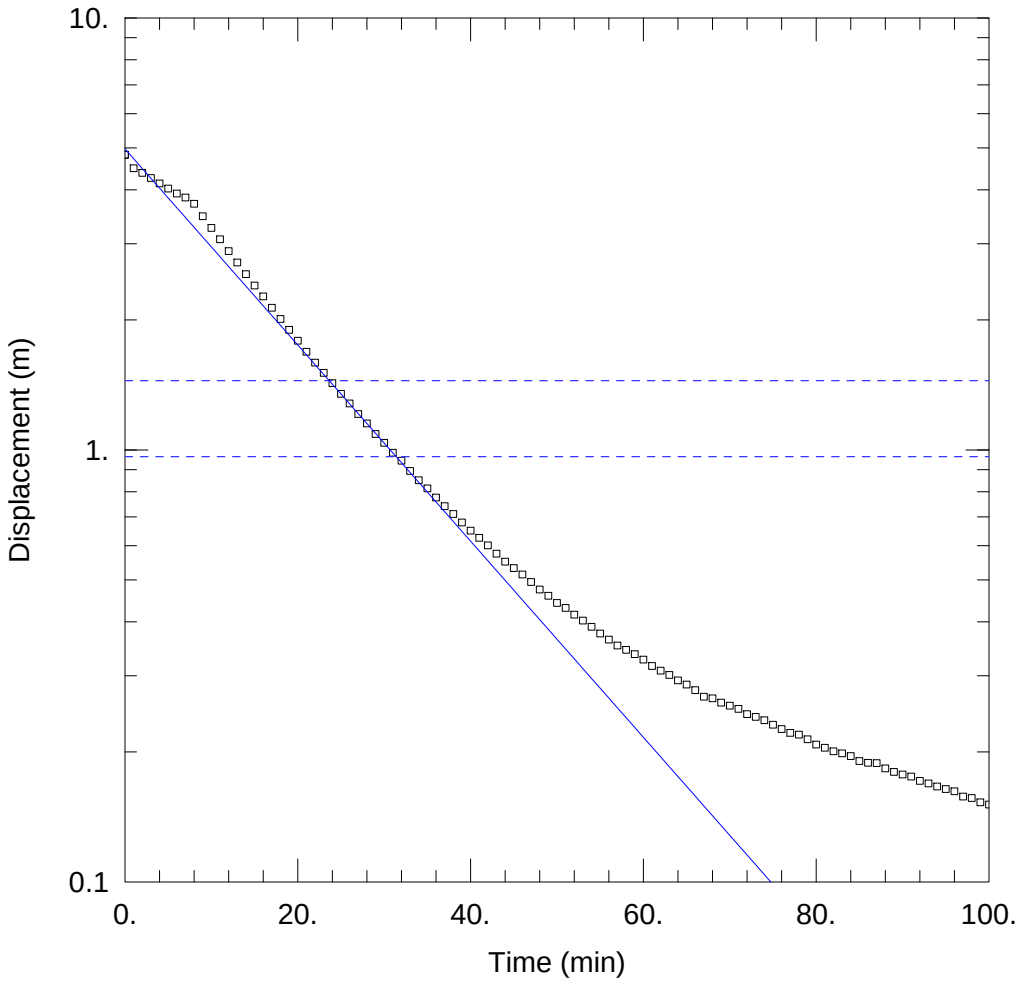
Saturated Thickness: 4.54 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW101-12)

Initial Displacement: 0.6837 m
Total Well Penetration Depth: 3.194 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.91 m
Screen Length: 1.524 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.243E-5 m/sec
y0 = 0.6504 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW102-12.aqt
Date: 01/17/13 Time: 12:25:51

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW102-12
Test Date: 2012-Dec-20

AQUIFER DATA

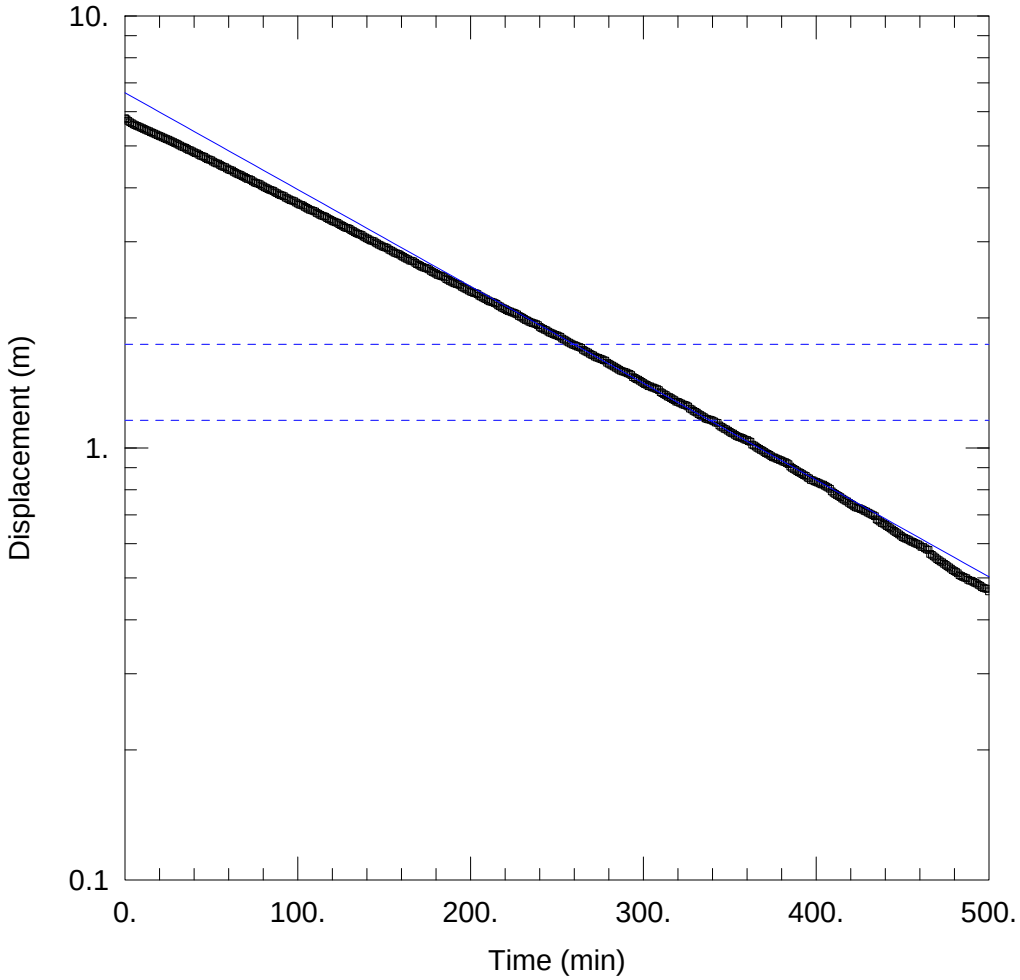
Saturated Thickness: 2.1 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW102-12)

Initial Displacement: 4.82 m
Total Well Penetration Depth: 5.313 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.1 m
Screen Length: 1.52 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 5.401E-7 m/sec
y0 = 4.975 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW103-12.aqt
Date: 01/17/13 Time: 12:27:42

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW103-12
Test Date: 2012-Dec-20

AQUIFER DATA

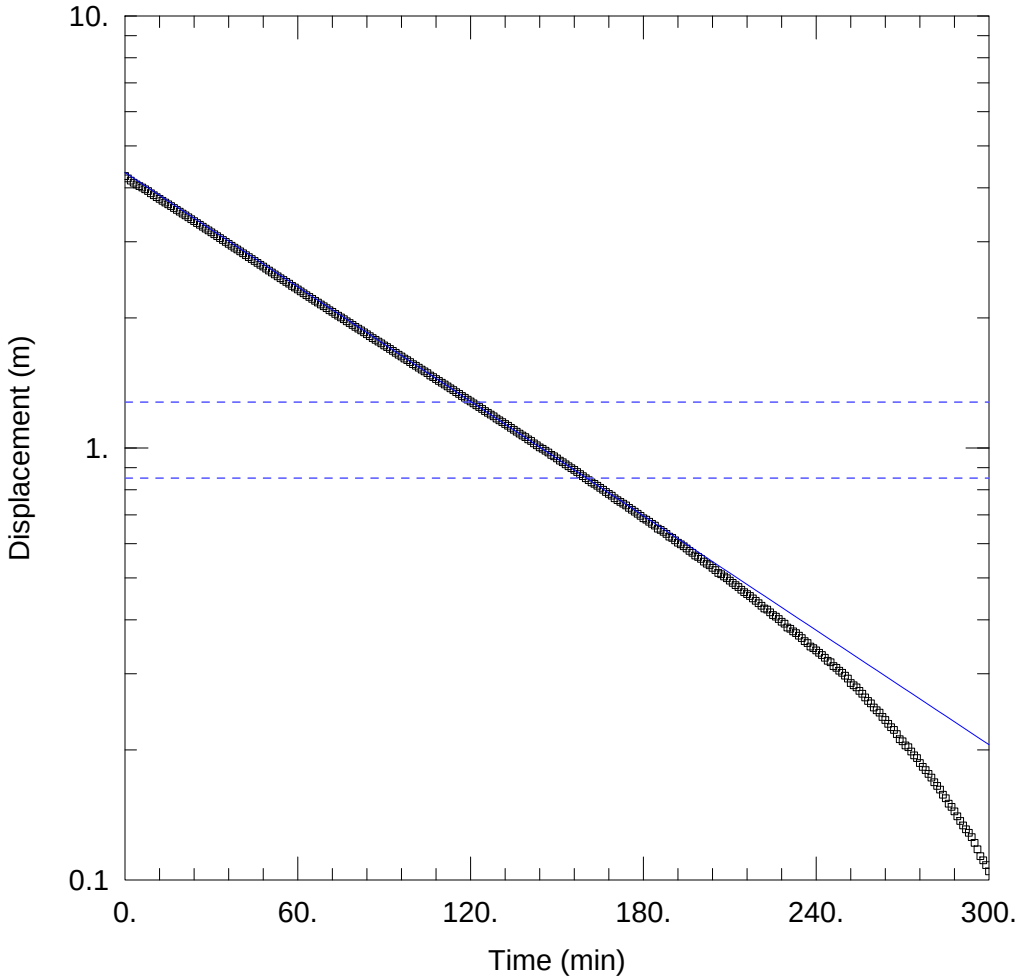
Saturated Thickness: 6.22 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW103-12)

Initial Displacement: 5.792 m
Total Well Penetration Depth: 6.077 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.077 m
Screen Length: 1.52 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 4.94E-8 m/sec
y0 = 6.641 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW104-12.aqt
Date: 01/17/13 Time: 12:29:40

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW104-12
Test Date: 2012-Dec-20

AQUIFER DATA

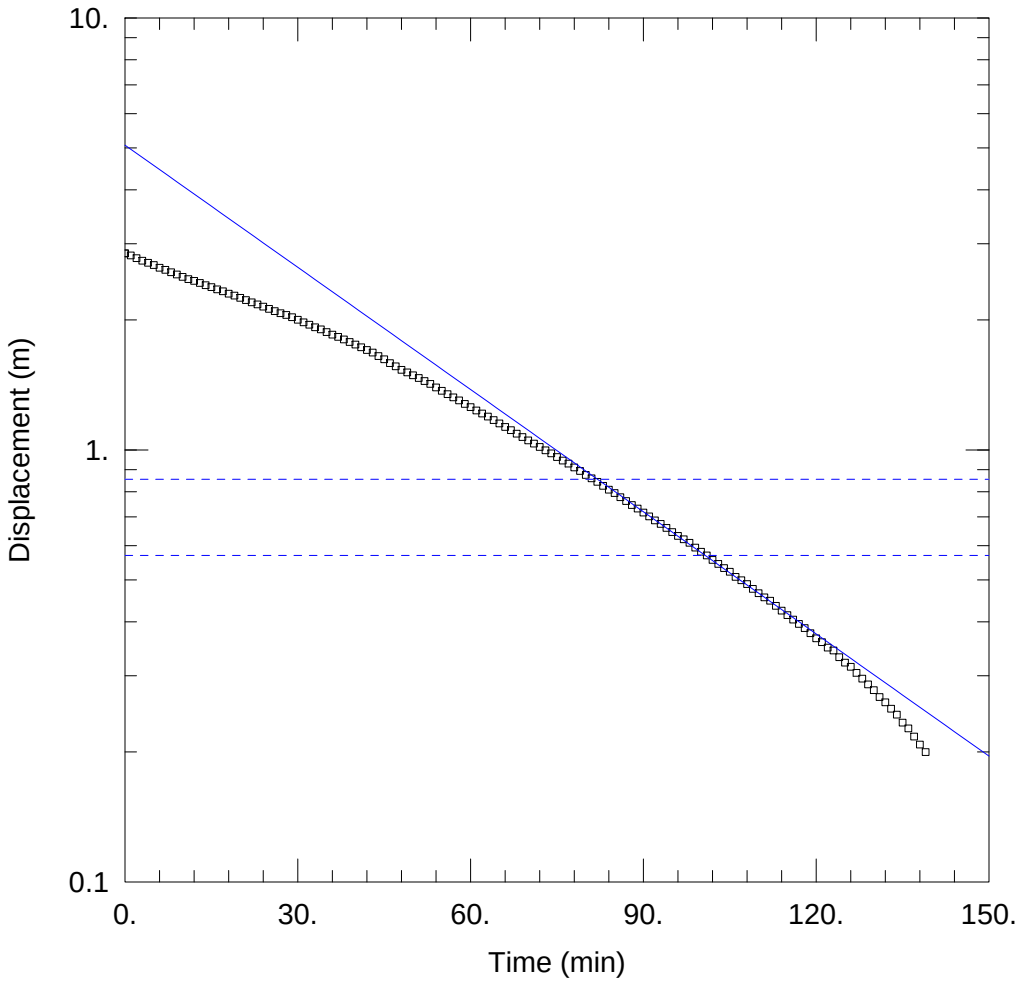
Saturated Thickness: 5.38 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW104-12)

Initial Displacement: 4.256 m
Total Well Penetration Depth: 4.623 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.623 m
Screen Length: 1.52 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 8.677E-8 m/sec
y0 = 4.341 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW105-12.aqt
Date: 01/17/13 Time: 12:31:06

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW105-12
Test Date: 2012-Dec-20

AQUIFER DATA

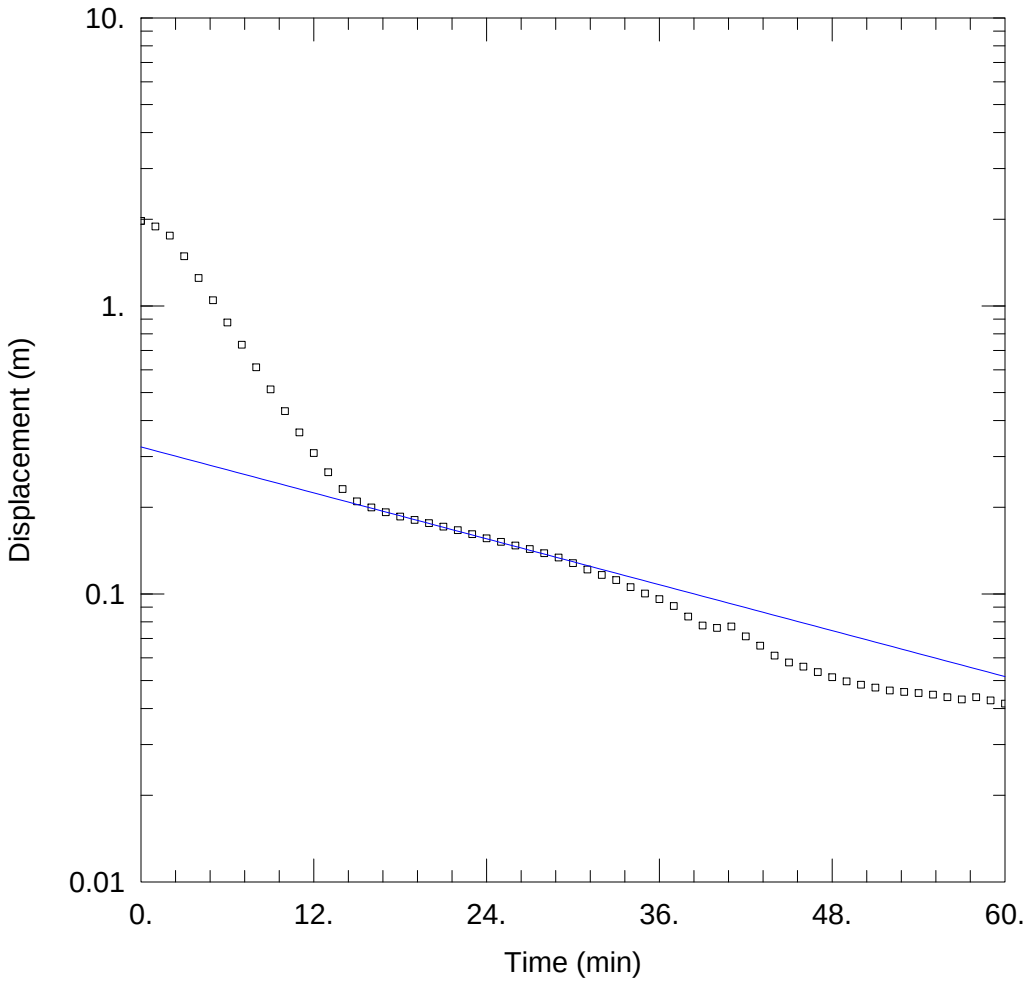
Saturated Thickness: 1.57 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW105-12)

Initial Displacement: 2.85 m
Static Water Column Height: 3.03 m
Total Well Penetration Depth: 3.03 m
Screen Length: 1.52 m
Casing Radius: 0.0254 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.011E-7 m/sec
y0 = 5.076 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW106-12.aqt
Date: 01/17/13 Time: 12:31:53

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW106-12
Test Date: 2012-Dec-19

AQUIFER DATA

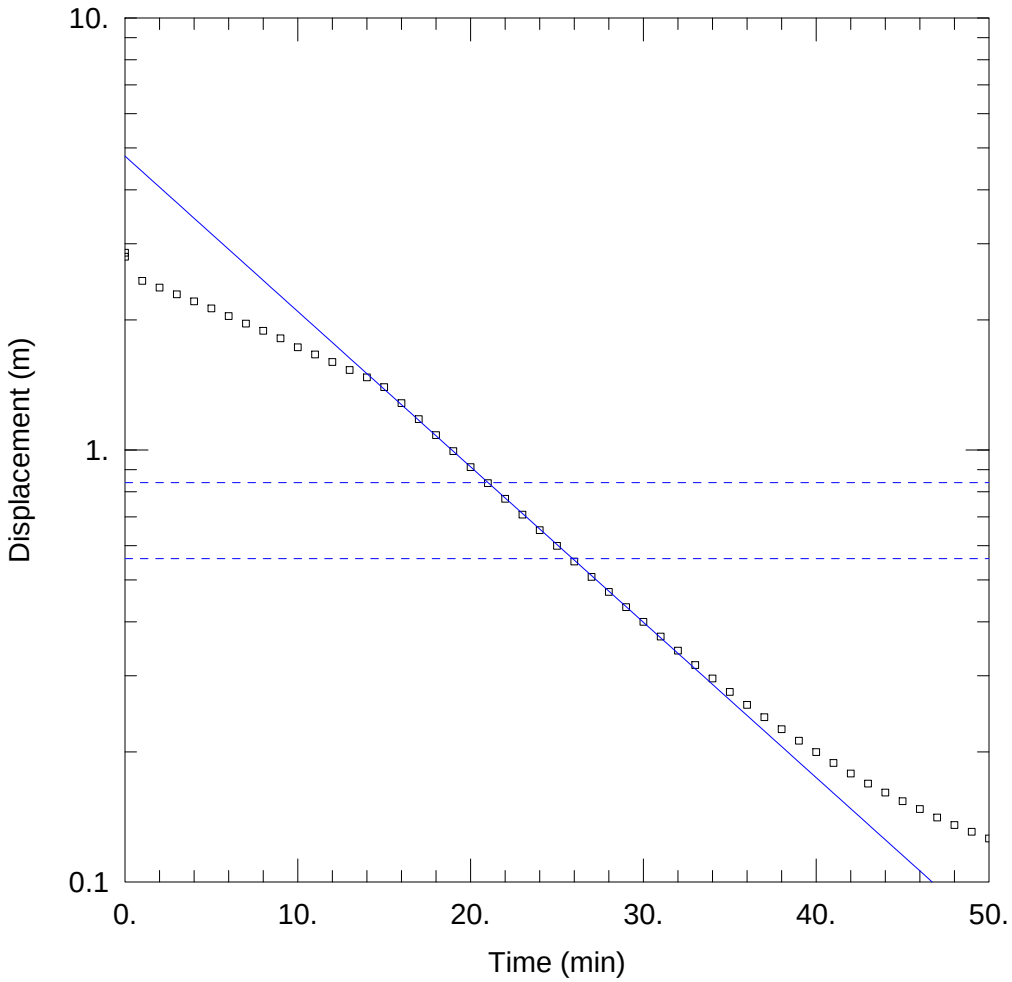
Saturated Thickness: 2.57 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW106-12)

Initial Displacement: 1.975 m
Total Well Penetration Depth: 3.22 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.21 m
Screen Length: 1.53 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.855E-7 m/sec
y0 = 0.3239 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW107-12.aqt
Date: 01/17/13 Time: 12:34:02

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW107-12
Test Date: 2012-Dec-19

AQUIFER DATA

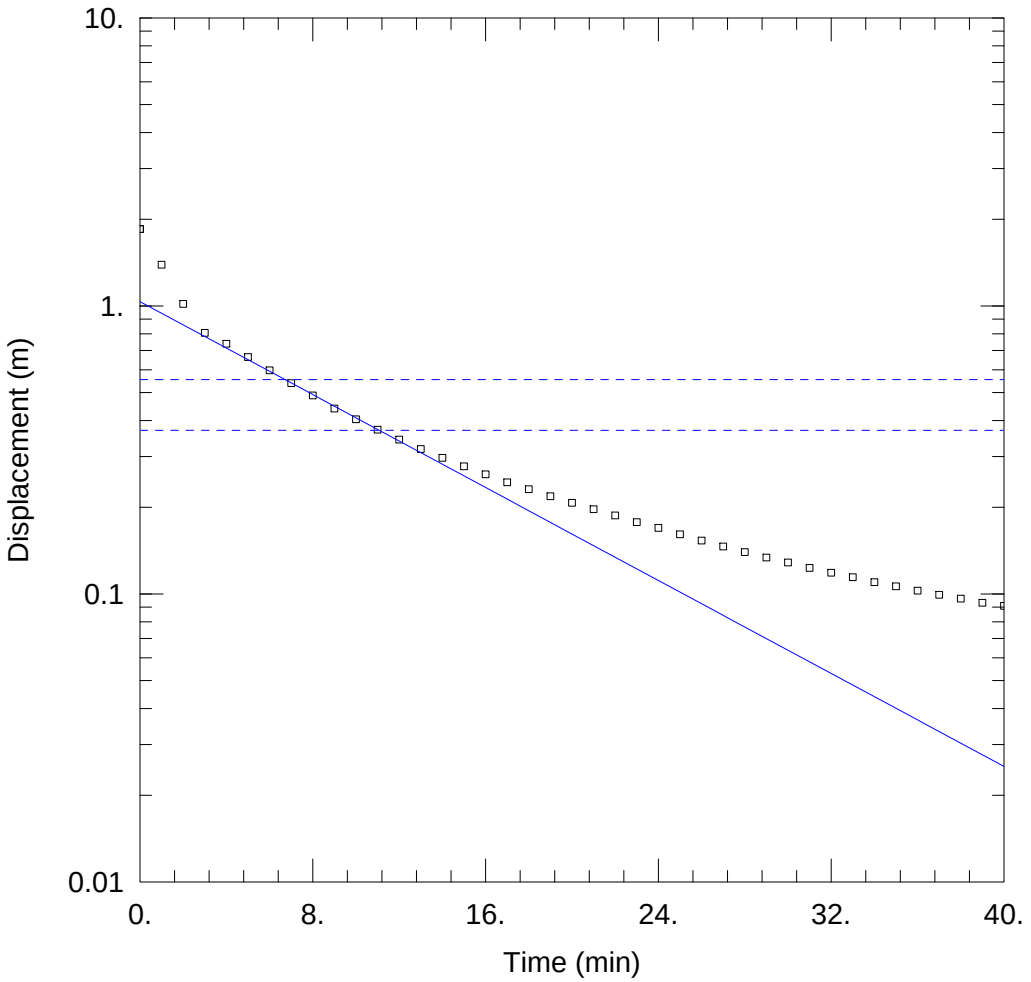
Saturated Thickness: 1.6 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW107-12)

Initial Displacement: 2.8 m
Total Well Penetration Depth: 2.855 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.855 m
Screen Length: 1.52 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.574E-7 m/sec
y0 = 4.788 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW108-12.aqt
Date: 01/17/13 Time: 12:35:46

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW108-12
Test Date: 2012-Dec-19

AQUIFER DATA

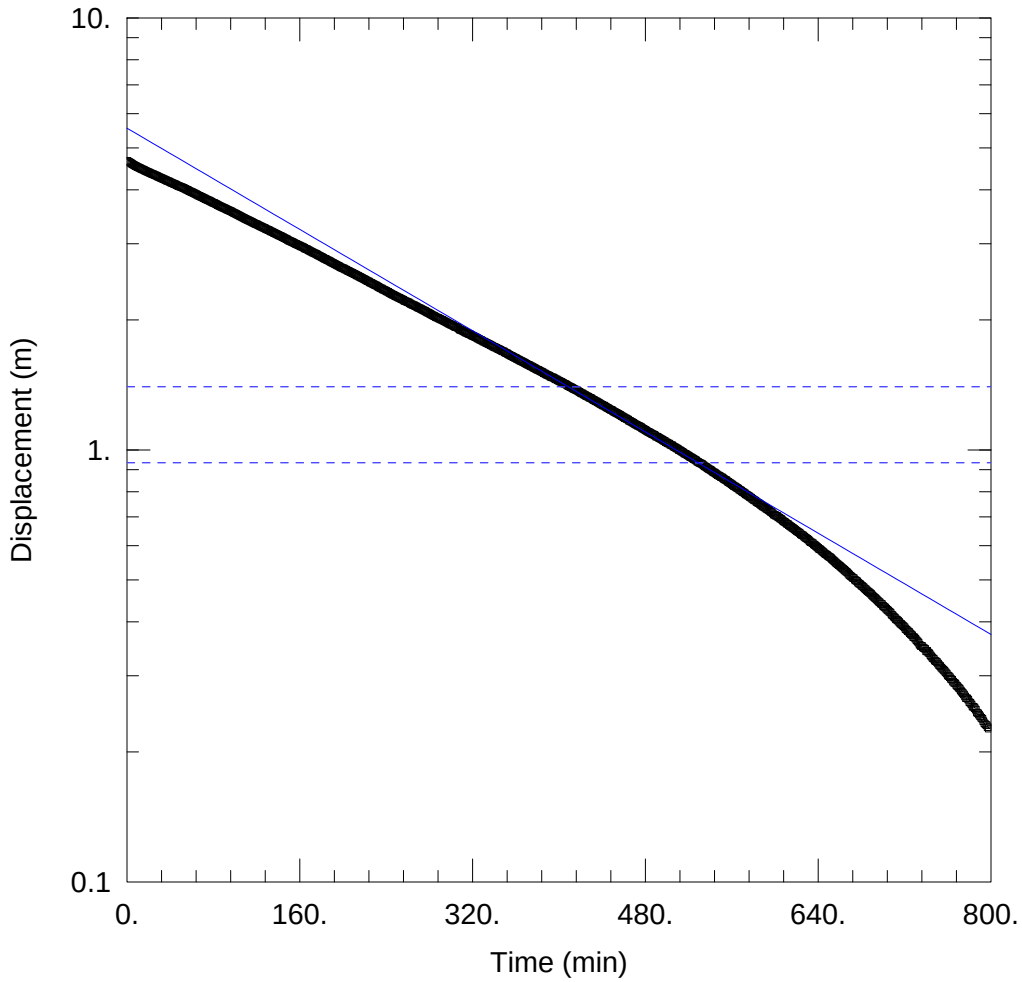
Saturated Thickness: 2.18 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW108-12)

Initial Displacement: 1.849 m
Total Well Penetration Depth: 1.899 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.899 m
Screen Length: 1.52 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 6.963E-7 m/sec
y0 = 1.035 m



RISING HEAD RECOVERY TEST

Data Set: W:\01609\active\160311338_Union Gas_Milton\planning\analysis\AQTESOLV\MW109-12.aqt
Date: 01/17/13 Time: 12:37:49

PROJECT INFORMATION

Company: Stantec Consulting Ltd
Client: Union Gas
Project: 160311338
Location: Milton, Ontario
Test Well: MW109-12
Test Date: 2012-Dec-20

AQUIFER DATA

Saturated Thickness: 2.28 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW109-12)

Initial Displacement: 4.668 m
Static Water Column Height: 4.928 m
Total Well Penetration Depth: 4.928 m
Screen Length: 1.52 m
Casing Radius: 0.0254 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.438E-8 m/sec
y0 = 5.556 m

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APPENDIX F

CLIMATE STATION NORMALS

TORONTO LESTER B. PEARSON INT'L A *

Latitude: 43°40'38.000" N Longitude: 79°37'50.000" W Elevation: 173.40 m

Climate ID: 6158733 WMO ID: 71624 TC ID: YYZ

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Average (°C)	-6.3	-5.4	-0.4	6.3	12.9	17.8	20.8	19.9	15.3	8.9	3.2	-2.9	7.5
Standard Deviation	3	2.7	2.3	1.7	2	1.5	1.3	1.3	1.2	1.6	1.5	2.7	0.9
Daily Maximum (°C)	-2.1	-1.1	4.1	11.5	18.8	23.7	26.8	25.6	21	13.9	7	0.9	12.5
Daily Minimum (°C)	-10.5	-9.7	-5	1	6.9	11.9	14.8	14	9.6	3.9	-0.7	-6.7	2.5
Extreme Maximum (°C)	16.7	14.9	25.6	31.1	34.4	36.7	37.6	**38.3**	36.7	30.6	25	20	
Date (yyyy/dd)	1950/25	1984/23	1945/28	1990/25	1962/16	1952/25	1988/07	**1948/25**	1953/02	1951/05	1950/01	1982/03	
Extreme Minimum (°C)	**-31.3**	-31.1	-28.9	-17.2	-5.6	0.6	3.9	1.1	-3.9	-8.3	-18.3	-31.1	
Date (yyyy/dd)	**1981/04**	1943/15	1950/04	1972/07	1966/07	1949/08	1968/30	1965/30	1965/27	1969/23	1949/26	1942/20	
Precipitation													
Rainfall (mm)	24.9	22.3	36.7	62.4	72.4	74.2	74.4	79.6	77.5	63.4	62	34.7	684.6
Snowfall (cm)	31.1	22.1	19.2	5.7	0.1	0	0	0	0	0.5	7.6	29.2	115.4
Precipitation (mm)	52.2	42.6	57.1	68.4	72.5	74.2	74.4	79.6	77.5	64.1	69.3	60.9	792.7
Average Snow Depth (cm)	7	6	3	0	0	0	0	0	0	0	0	3	2
Median Snow Depth (cm)	6	6	2	0	0	0	0	0	0	0	0	2	1
Snow Depth at Month-end (cm)	7	5	0	0	0	0	0	0	0	0	1	4	1
Extreme Daily Rainfall (mm)	58.7	31.8	41.7	55.8	92.7	53.8	118.5	80.8	108	**121.4**	86.1	40.9	
Date (yyyy/dd)	1946/09	1975/24	1942/16	1992/11	1944/31	2000/13	1980/28	1970/30	1948/18	**1954/15**	1962/10	1962/06	
Extreme Daily Snowfall (cm)	36.8	**39.9**	32.3	26.7	2.3	0	0	0	0	7.4	33.5	28.2	
Date (yyyy/dd)	1966/23	**1965/25**	1964/10	1939/10	1976/07	1938/01	1938/01	1938/01	1938/01	1962/25	1940/30	1944/11	
Extreme Daily Precipitation (mm)	58.7	55.9	41.7	55.8	92.7	53.8	118.5	80.8	108	**121.4**	86.1	40.9	
Date (yyyy/dd)	1946/09	1965/25	1942/16	1992/11	1944/31	2000/13	1980/28	1970/30	1948/18	**1954/15**	1962/10	1962/06	
Extreme Snow Depth (cm)	**67**	43	28	13	0	0	0	0	0	13	16	33	
Date (yyyy/dd)	**1999/15**	1982/06	1968/13	1975/04	1955/01	1955/01	1955/01	1955/01	1955/01	1969/22	1991/29	1977/09	
Days with Maximum Temperature:													
<= 0 °C	18.7	15.7	7.9	0.6	0	0	0	0	0	0	2.1	12.2	57.2
> 0 °C	12.3	12.6	23.1	29.4	31	30	31	31	30	31	27.9	18.8	308
> 10 °C	0.57	0.53	5.1	16.9	29.7	30	31	31	29.9	23.3	7.9	1.7	207.5
> 20 °C	0	0	0.6	2.5	11.8	23.6	30.1	28.8	16.7	3.5	0.27	0	118
> 30 °C	0	0	0	0.13	0.43	2.3	5.7	3.2	0.8	0	0	0	12.6
> 35 °C	0	0	0	0	0	0.1	0.37	0.07	0	0	0	0	0.54
Days with Minimum Temperature:													
> 0 °C	1.8	1.9	5.7	16.8	29.6	30	31	31	29.6	25.4	12.3	4.1	219.1
<= 2 °C	30.5	27.9	28.4	18.5	4.5	0.13	0	0.03	1.3	11.7	22.8	29.8	175.6
<= 0 °C	29.2	26.3	25.3	13.2	1.4	0	0	0	0.43	5.6	17.7	26.9	146.2
< -2 °C	26.9	23.5	20.4	7.1	0.2	0	0	0	0.03	2.2	11.3	22.7	114.3
< -10 °C	16	14	5.8	0.17	0	0	0	0	0	0	0.57	8.9	45.4
< -20 °C	2.8	1.6	0.23	0	0	0	0	0	0	0	0	0.63	5.2
< - 30 °C	0.1	0	0	0	0	0	0	0	0	0	0	0	0.1
Days with Rainfall:													
>= 0.2 mm	5.1	4.6	8	10.7	11.9	11	10.1	10.8	10.7	11.5	10.6	6.7	111.8
>= 5 mm	1.5	1.5	2.2	4.1	4.6	5.2	3.9	4.3	4.3	4	3.8	2.6	42.1
>= 10 mm	0.77	0.7	1.3	2.2	2.4	2.6	2.4	2.4	2.5	2.1	2	1	22.4
>= 25 mm	0.1	0.1	0.13	0.23	0.27	0.43	0.77	0.83	0.6	0.27	0.4	0.17	4.3
Days with Snowfall:													
>= 0.2 cm	12.6	9.4	7.1	2.6	0.07	0	0	0	0	0.4	4	10.3	46.5
>= 5 cm	2	1.4	1.3	0.33	0	0	0	0	0	0	0.37	1.8	7.2
>= 10 cm	0.47	0.27	0.33	0.1	0	0	0	0	0	0	0.2	0.67	2
>= 25 cm	0	0	0	0	0	0	0	0	0	0	0	0	0
Days with Precipitation:													
>= 0.2 mm	14.9	11.6	13.1	12.1	11.9	11	10.1	10.8	10.7	11.5	13.2	14.6	145.5
>= 5 mm	3.5	2.7	3.5	4.5	4.6	5.2	3.9	4.3	4.3	4	4.3	4.3	49.2
>= 10 mm	1.2	0.97	1.8	2.4	2.4	2.6	2.4	2.4	2.5	2.1	2.2	1.7	24.8
>= 25 mm	0.13	0.17	0.23	0.27	0.27	0.43	0.77	0.83	0.6	0.27	0.4	0.23	4.6
Days with Snow Depth:													
>= 1 cm	22	20.3	11.8	1.6	0	0	0	0	0	0.03	2.8	15.8	74.3
>= 5 cm	15.7	13.5	7.3	0.7	0	0	0	0	0	0	0.93	8.2	46.3
>= 10 cm	8.3	7.3	4.3	0.43	0	0	0	0	0	0	0.3	3.3	24
>= 20 cm	2.1	1.6	0.47	0	0	0	0	0	0	0	0	0.83	5

Appendix C4

Stormwater Management Report

Union Gas Compressor Station
Stormwater Management Report
Milton, Ontario

Prepared for:

Union Gas

Prepared by:

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410
Fax: (519) 579-6733

Project Number: 1603-11376
Date: February 2013

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APPENDIX B **HYDROLOGIC MODEL**

1.0 Introduction

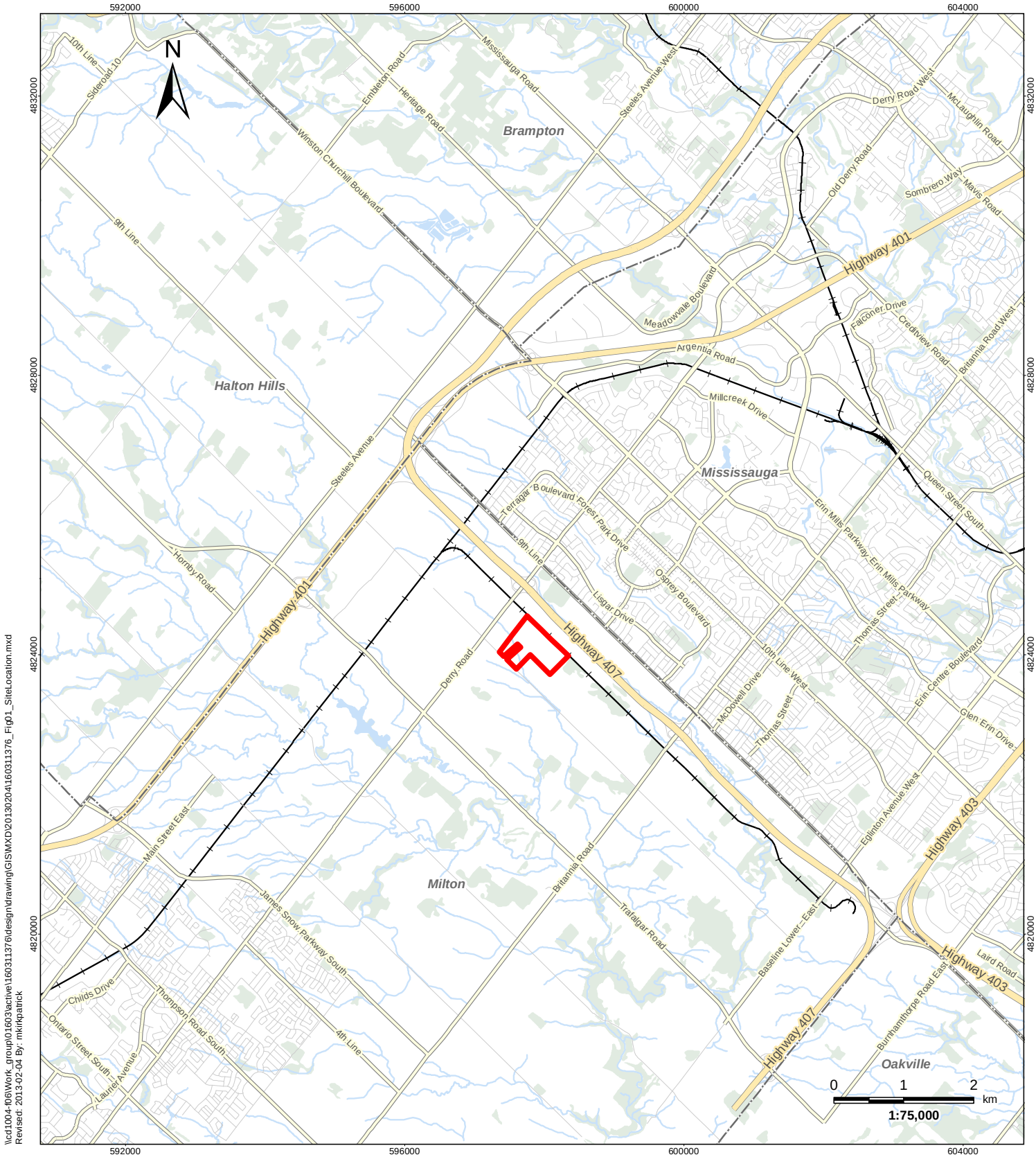
Stantec Consulting Ltd. (Stantec) has been retained to complete a drainage assessment and conceptual design of stormwater management (SWM) works associated with a proposed Union Gas Compressor Station in Milton, Ontario. The subject property is approximately 38 ha in size and is located on the east side of Eighth Line, south of Derry Road, and adjacent to the Canadian National Railway (CNR) tracks, as shown on Figure 1.0. The ultimate objective for the property is to undertake the construction of a new Union Gas Compressor Station.

This report documents the conceptual SWM strategy and design to mitigate against potential offsite water quality and quantity impacts associated with the development of the subject facility.

The SWM design involved the following study components:

- Complete a hydrologic study to determine the existing site conditions with respect to topography, soils information and existing land uses
- Prepare hydrologic models for the existing and proposed development conditions to determine runoff volumes and peak flow rates to downstream areas
- Complete the conceptual design of appropriate SWM facilities that will control the site runoff in a manner consistent with current requirements (water quality and water quantity)
- Summarize the study by identifying conclusions and recommendations

The primary guidance document referenced in the completion of the proposed SWM design is the *Stormwater Management Planning and Design (SWMPD) Manual*, Ministry of the Environment, 2003.



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Revised: 2013-02-04 By: mkirkpatrick

February 2013
160311376

Stantec

Legend

- Site Location
- Municipal Boundary
- Railroad
- Highway
- Major Road
- Local Road
- Watercourse
- Waterbody
- Wooded Area

Notes

1. Coordinate System: UTM NAD 83 - Zone 17 (N).
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2011.

Client/Project
Union Gas
Phase I Environmental Site Assessment
Compressor Station Site No. 2

Figure No.
1

Title
Site Location

2.0 Stormwater Management Design Criteria

Stormwater management criteria were established based on discussions with the Town of Milton, Conservation Halton, and the characteristics of the receiving systems. The SWM criteria applied to the site are as follows:

- Water Quality – Provide sufficient permanent pool and extended detention volume to meet MOE Enhanced (Level 1) criteria as identified in Table 3.2 of the SWMPD Manual
- Water Quantity - Control proposed flows to peak existing flow rates for all storm events up to and including the 100-year event
- Erosion and Sediment Control - Provide appropriate erosion and sediment control during construction to protect neighboring properties and the downstream receivers from potential siltation

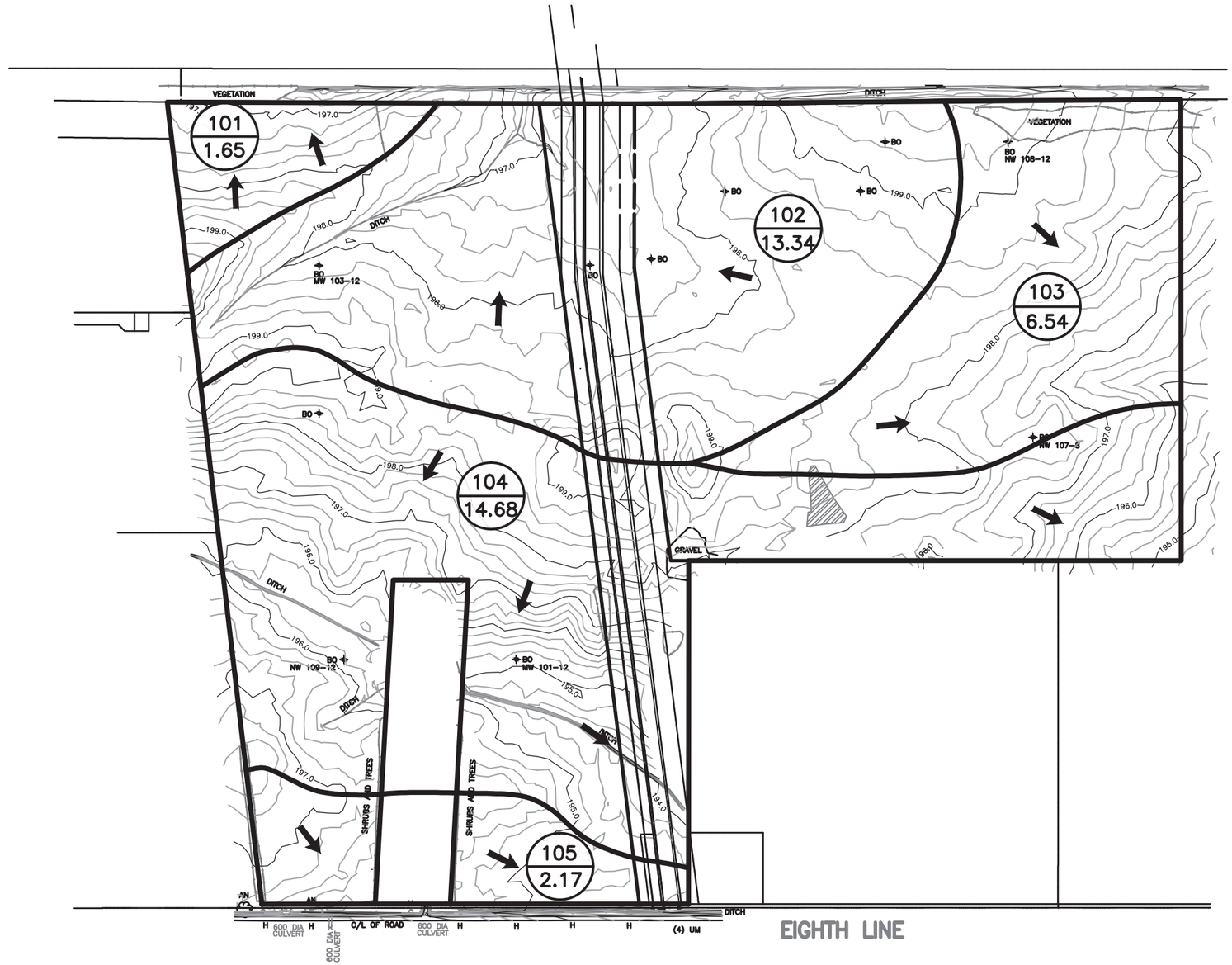
3.0 Existing Conditions

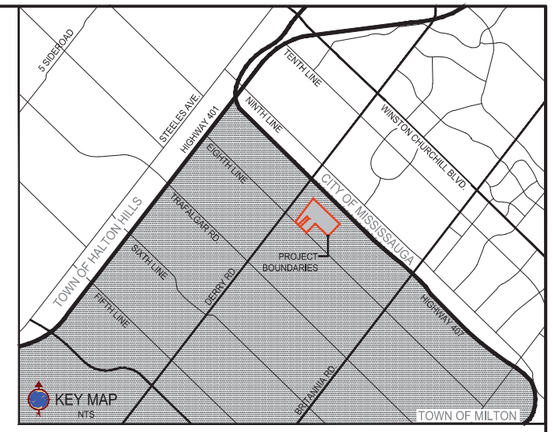
3.1 TOPOGRAPHY AND SURFACE DRAINAGE

As delineated on Figure 2.0, a ridge exists through the middle of the site, with the majority of the site draining either east or southwest from the site. Under existing conditions, the site is comprised primarily of agricultural land use. The existing topography of the catchment is relatively flat, with slopes in the range of 0.6-1.7%. Drainage from the east portion of the site drains to an existing draw that discharges off site at the east property limit and under the CNR line. This ditch is part of the East Branch of 16 Mile Creek and it eventually turns south and drains parallel to Highway 407 towards Britannia Road. The southwest portion of the site drains to an existing, regulated watercourse which discharges off-site to a ditch along Eighth Line. The southwestern drainage system is also part of the East Branch of 16 Mile Creek and joins up with the eastern drainage system south of Britannia Road. Existing drainage from external lands enters the site along the north property limit and is conveyed south through the site to the east and southwest drainage outlets.

3.2 GEOTECHNICAL INFORMATION

The surficial soils are comprised of a Chinguacousy clay loam, as identified on Ontario Ministry of Natural Resources mapping. Runoff curve numbers (CNs), as defined by the US Soil Conservation Service (SCS) and other hydrologic parameters were calculated for each existing catchment based on land use and soil type.





Legend

- OVERLAND FLOW
- DRAINAGE BOUNDARY LIMIT
- 101 / 1.65 — DRAINAGE AREA I.D. No. / DRAINAGE AREA (HECTARES)

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JANUARY 2013
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Client/Project
UNION GAS LTD.
UNION GAS SITE #2
MILTION, ON

Figure No. 2.0

Title
STORM DRAINAGE PLAN
EXISTING CONDITIONS

4.0 Stormwater Management Design

4.1 HYDROLOGIC MODELLING

A hydrologic model was prepared to simulate drainage conditions for the subject development. SWMHYMO (Stormwater Management Hydrologic Model) was employed to predict flows for the existing and proposed development conditions and design stormwater management systems to ensure the criteria are achieved. To address the criteria, existing and post-development conditions were modelled for the 2, 5, 10, 25, and 100-year 3-hour Chicago Storms derived using the Town of Milton Intensity Duration Frequency parameters as provided in Table 1.

Table 1 Rainfall Events – 3-hour Chicago Storm Even Depths
Town of Milton IDF Parameters

Return Period	IDF Parameters			
	A	B	C	Depth (mm)
2-year, 3 hr.	779	6	0.8206	32.1
5-year, 3 hr.	959	5.7	0.8024	43.5
10-year, 3 hr.	1089	5.7	0.7955	51.2
25-year, 3 hr.	1234	5.5	0.7863	60.9
100-year, 3 hr.	1435	5.2	0.7751	75.2

4.1.1 Existing Conditions Hydrologic Model

An existing conditions hydrologic model was prepared to simulate drainage using SWMHYMO. A table of catchment parameters is provided in Appendix A and all input and output files are provided in Appendix B. Under existing conditions the site is primarily agricultural and ultimately drains into 16 Mile Creek to the south. Soil Conservation Service (SCS) Curve Numbers were calculated for each catchment based on land use and soil type and are provided in Appendix A. Delineation of existing drainage catchments are provided on Figure 2.0 and summarized as follows:

- Catchment 101: 1.7 ha of agricultural drainage draining to the northeast corner of the site
- Catchment 102: 13.3 ha of agricultural land draining to an existing draw which discharges off-site to the east
- Catchment 103: 6.5 ha of agricultural land draining to the southeast and ultimately Eighth Line
- Catchment 104: 14.7 ha of agricultural land. An existing, regulated watercourse drains through the catchment, draining to the south and ultimately Eighth Line
- Catchment 105: 2.2 ha of agricultural land draining to Eighth Line

4.1.2 Proposed Conditions Hydrologic Model

The proposed development incorporates industrial land use with a SWM facility. Soil Conservation Service Curve Numbers were calculated for each catchment based on land use and soil type and are provided in Appendix A. A table of catchment parameters and all input and output files are provided in Appendix B. A proposed grading plan is not available at this time. As such, two SWM scenarios have been analyzed and are presented below. Scenario 1 assumes all site runoff is directed towards a single SWM facility while Scenario 2 assumes two catchments with two separate SWM facilities. The scenarios are summarized below. A conceptual General Arrangement Plan has been included in Appendix A and from this drawing the total site imperviousness was assumed to be 70%.

4.2 SWM FACILITY DESIGN

Conceptual wet pond SWM facilities have been designed assuming a total depth of 3.5 m with 1.5 m of permanent pool and 2.0 m of active storage. Two orifices and an overflow weir will provide flow controls for low- and high-flow rain events.

The proposed design of the SWM facilities will adhere to the guidelines as presented in the SWMPD Manual (2003). Planting strategies utilizing plant species indigenous to the area will be prepared and submitted during the final design and site plan approval process. Careful selection of plant species and their location in and around the basin will stabilize banks, mitigate temperature increases, deter waterfowl from nesting within the area, improve performance, and provide aesthetic and safety benefits.

4.2.1 Scenario 1 – One SWM Facility

For this Scenario, it has been assumed that all runoff from the 38 ha site will drain to a single SWM facility located at either the south or west limits of the site. These two locations have the lowest elevations on the site and locating a SWM facility there will help to reduce the grading requirements for the site. The SWM block has been sized using the existing peak flows to the south, but the SWM block size will be approximately the same if the SWM facility is ultimately located at the west limits of the site. In order to provide a conceptual SWM block size, a stage-storage chart was estimated in addition to a proposed conditions hydrologic model (refer to Appendix A).

All site runoff is proposed to be directed to an end of pipe facility, which would be located at either the south or west limits of the property. The proposed conditions target flow rate would be equivalent to the existing discharge from the property.

Pond design characteristics are summarized in Table 2, with detailed design calculations provided in Appendix A. Peak flow rates from the portion of the site draining to the facility are summarized in Table 3 with detailed modelling files included in Appendix B.

Based on this analysis, approximately 38,000 m^3 of total storage (13,000 m^3 of permanent pool storage and 25,000 m^3 of active storage) and a SWM block size of approximately 2.1 ha are required to provide SWM controls for the site in one pond.

Table 2: Scenario 1 SWM Facility Design Characteristics

Parameter	Basin Characteristics
Total Contributing Area	38.4 ha
Total Contributing Area req. Quality Control	38.4 ha
Total Percent Impervious	70%
Quality Control (Enhanced)	
Unit Area Storage Requirement	225 m^3/ha
Total Volume Required	8,640 m^3
Permanent Pool Volume Required (185 m^3/ha)	7,104 m^3
Permanent Pool Volume Provided in Wet Pond	12,944 m^3
Permanent Pool Depth in Wet Pond	1.5 m
Extended Detention Volume Required (40 m^3/ha)	1,536 m^3
Extended Detention Volume Provided in Pond	3,199 m^3

Table 3: Scenario 1 SWM Facility Operating Characteristics

Storm Event	Existing Peak Flow to South (m^3/s)	Proposed Peak Flow from SWM Facility (m^3/s)	Maximum Storage Volume (m^3)	Maximum Ponding Depth (m)
2-year	0.10	0.10	9,225	0.37
5-year	0.17	0.12	12,980	0.70
10-year	0.22	0.14	15,600	0.92
25-year	0.30	0.18	18,910	1.18
100-year	0.42	0.31	23,450	1.53

4.2.2 Scenario 2 – Two SWM Facilities

This scenario assumes that site runoff is split similar to the existing topography and is directed to the south (12 ha) and west (27 ha) sides of the property where the ground elevations are lower. In order to provide a conceptual SWM block size, a stage-storage chart was estimated in addition to a proposed conditions hydrologic model (refer to Appendix A).

The proposed conditions target flow rate for the south SWM facility would be equivalent to the discharge from the existing catchment located in the south of the property (Catchment 103) while the target flow rate for the west SWM facility would be equivalent to the discharge from the existing catchment located at the west side of the property (Catchment 104).

Pond design characteristics are summarized in Tables 4 and 6, with detailed design calculations provided in Appendix A. Peak flow rates from the portion of the site draining to the facility are summarized in Tables 5 and 7 with detailed modeling files included in Appendix B.

Based on this analysis, approximately 13,000 m^3 of storage (4,000 m^3 of permanent pool storage and 9,000 m^3 of active storage) and a SWM block size of approximately 1.0 ha are required to provide SWM controls for the south catchment (11.8 ha) and approximately 22,000 m^3 of storage (7,000 m^3 of permanent pool storage and 15,000 m^3 of active storage) and a SWM block size of approximately 1.4 ha are required to provide SWM controls for the west catchment (26.6 ha).

Scenario 2 generally requires approximately the same overall storage volume as Scenario 1 but would require a larger total SWM block area due to inefficiencies in using multiple ponds, which include additional grading around the exterior of the ponds to match proposed grades. Scenario 2 would allow for the proposed site grading to more closely match the existing topography compared to Scenario 1, which would reduce the overall grading requirements for the site.

Table 4: Scenario 2 South SWMF Facility Design Characteristics

Parameter	Basin Characteristics
Total Contributing Area	11.8 ha
Total Contributing Area req. Quality Control	11.8 ha
Total Percent Impervious	70%
Quality Control (Enhanced)	
Unit Area Storage Requirement	225 m^3/ha
Total Volume Required	2,655 m^3
Permanent Pool Volume Required (185 m^3/ha)	2,183 m^3
Permanent Pool Volume Provided in Wet Pond	3,831 m^3
Permanent Pool Depth in Wet Pond	1.5 m
Extended Detention Volume Required (40 m^3/ha)	472 m^3
Extended Detention Volume Provided in Pond	1,106 m^3

Table 5: Scenario 2 South SWM Facility Operating Characteristics

Storm Event	Existing Peak Flow to South (m^3/s)	Proposed Peak Flow from SWM Facility (m^3/s)	Maximum Storage Volume (m^3)	Maximum Ponding Depth (m)
2-year	0.10	0.03	2,750	0.25
5-year	0.17	0.05	3,890	0.55
10-year	0.22	0.05	4,680	0.73
25-year	0.30	0.06	5,700	0.96
100-year	0.42	0.25	6,710	1.17

Table 6: Scenario 2 West SWMF Facility Design Characteristics

Parameter	Basin Characteristics
Total Contributing Area	26.6 ha
Total Contributing Area req. Quality Control	26.6 ha
Total Percent Impervious	70%
Quality Control (Enhanced)	
Unit Area Storage Requirement	225 m^3/ha
Total Volume Required	5,985 m^3
Permanent Pool Volume Required (185 m^3/ha)	4,921m^3
Permanent Pool Volume Provided in Wet Pond	6,981 m^3
Permanent Pool Depth in Wet Pond	1.5 m
Extended Detention Volume Required (40 m^3/ha)	1,080 m^3
Extended Detention Volume Provided in Pond	1,856 m^3

Table 7: Scenario 2 West SWM Facility Operating Characteristics

Storm Event	Existing Peak Flow to South (m^3/s)	Proposed Peak Flow from SWM Facility (m^3/s)	Maximum Storage Volume (m^3)	Maximum Ponding Depth (m)
2-year	0.20	0.08	6,190	0.50
5-year	0.34	0.10	8,750	0.86
10-year	0.45	0.11	10,540	1.11
25-year	0.60	0.22	12,510	1.35
100-year	0.85	0.41	15,160	1.67

4.3 DRAINAGE CONSIDERATIONS

4.3.1 Pond Outlets

Ponds located along the west boundary of the site, along Eighth Line, have a sufficient outlet for flows from a proposed SWM facility. This area drains to a municipal road ditch and a regulated watercourse. Ponds located along the south boundary of the site do not drain directly to a sufficient outlet or watercourse and an easement may be required to drain flows to Eighth Line.

4.3.2 External Flows

External flows drain into the site from the north. These flows generally drain through the site, west towards Eighth Line or east towards the CNR line. Preliminary plans are to divert this water around the site to the downstream receivers, bypassing the proposed SWM facilities.

5.0 Conclusions

Based on the preceding report, the following conclusions can be drawn for the site:

- Enhanced (previously Level 1) water quality control can be provided by wet pond SWM facilities. Adequate permanent pool and extended detention volumes will be provided to meet the MOE water quality requirements associated with wet ponds
- The proposed SWM facilities will control post-development peak flows to existing rates
- A SWM block of approximately 2.1 ha is required to provide the required SWM controls for the entire site in one SWM block
- A total SWM block size of 2.4 ha is required to provide the required SWM controls for the entire site in two separate SWM blocks

All of which is respectfully submitted.

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APPENDIX A

Design Calculations

Union Gas - Milton - 1603-11376
NRCS (SCS) Curve Number Determination

Existing Conditions

Soil Type	**Hydrologic Soil Group**
Clay loam	**C**

TABLE OF CURVE NUMBERS (CN's)									Source
Land Use		Hydrologic Soil Type							
		A	AB	B	BC	C	CD	D	
Meadow	"Good"	30	44	58	64.5	71	74.5	78	MTO
Woodlot	"Fair"	36	48	60	66.5	73	76	79	MTO
Lawns	"Good"	39	50	61	67.5	74	77	80	USDA
Pasture/Range		58	61.5	65	70.5	76	78.5	81	MTO
Crop		66	70	74	78	82	84	86	MTO
Gravel		76	80.5	85	87	89	90	91	Chin
Bare Soil (Fallow)		77	81.5	86	88.5	91	92.5	94	MTO
Impervious		98	98	98	98	98	98	98	MTO

MTO - Ministry of Transportation Ontario Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
USDA - United States Department of Agriculture (2004), National Engineering Handbook, Part 630 Hydrology,
Chapter 9 Hydrologic Soil Cover Compexes
Chin - Water-Resources Engineering (2000), David A. Chin, Table 6.13 Curve Numbers for Various Urban Land Uses

HYDROLOGIC SOIL TYPE (%) - Existing Conditions								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
101					100			100
102					100			100
103					100			100
104					100			100
105					100			100

LAND USE (%) - Existing Conditions									
Catchment	Meadow	Woodlot	Lawns	Pasture Range	Crop	Gravel	Bare Soil	Impervious	Total
101	100								100.0
102	100								100.0
103	100								100.0
104	100								100.0
105	100								100.0

CURVE NUMBER (CN) - Existing Conditions										
Catchment	Meadow	Woodlot	Lawns	Pasture Range	Crop	Gravel	Bare Soil	Impervious	Weighted CN w/ imp area	Weighted CN w/o imp area
101	71.0								71	71
102	71.0								71	71
103	71.0								71	71
104	71.0								71	71
105	71.0								71	71

Notes:

AMC II assumed

Hydrological Soil Groups taken from MTO Drainage Manual

[*1] Catchments with impervious greater than 20% - only pervious portions used for CN calculation

Union Gas - Milton - 1603-11376
NRCS (SCS) Curve Number Determination

Proposed Conditions

Soil Type	**Hydrologic Soil Group**
Clay loam	**C**

TABLE OF CURVE NUMBERS (CN's)									Source
Land Use		Hydrologic Soil Type							
		A	AB	B	BC	C	CD	D	
Meadow	"Good"	30	44	58	64.5	71	74.5	78	MTO
Woodlot	"Fair"	36	48	60	66.5	73	76	79	MTO
Lawns	"Good"	39	50	61	67.5	74	77	80	USDA
Pasture/Range		58	61.5	65	70.5	76	78.5	81	MTO
Crop		66	70	74	78	82	84	86	MTO
Gravel		76	80.5	85	87	89	90	91	Chin
Bare Soil (Fallow)		77	81.5	86	88.5	91	92.5	94	MTO
Impervious		98	98	98	98	98	98	98	MTO

MTO - Ministry of Transportation Ontario Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
USDA - United States Department of Agriculture (2004), National Engineering Handbook, Part 630 Hydrology,
Chapter 9 Hydrologic Soil Cover Compexes
Chin - Water-Resources Engineering (2000), David A. Chin, Table 6.13 Curve Numbers for Various Urban Land Uses

HYDROLOGIC SOIL TYPE (%) - Existing Conditions								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
Scenario 1								
201					100			100
Scenario 2								
301					100			100
302					100			100

LAND USE (%) - Existing Conditions									
Catchment	Meadow	Woodlot	Lawns	Pasture Range	Crop	Gravel	Bare Soil	Impervious	Total
Scenario 1									
201	10					20		70.0	100.0
Scenario 2									
301	10					20		70.0	100.0
302	10					20		70.0	100.0

CURVE NUMBER (CN) - Existing Conditions										
Catchment	Meadow	Woodlot	Lawns	Pasture Range	Crop	Gravel	Bare Soil	Impervious	Weighted CN w/ imp area	Weighted CN w/o imp area
Scenario 1										
201	7.1					17.8		68.6	94	83
Scenario 2										
301	7.1					17.8		68.6	94	83
302	7.1					17.8		68.6	94	83

Notes:

AMC II assumed

Hydrological Soil Groups taken from MTO Drainage Manual

*1 Catchments with impervious greater than 20% - only pervious portions used for CN calculation

Union Gas - Milton - 1603-11376
SWMHYMO Parameters

Existing Conditions

Catchment Number	SWMHYMO Command	Area (ha)	CN	TIMP	XIMP	Rise (m)	Length (m)	Slope (%)	Tc (hrs)	Tp (hrs)
101	DESIGN NASHYD	1.7	71			2.4	106	2.3	0.38	0.23
102	DESIGN NASHYD	12.8	71			1.8	293	0.6	0.98	0.59
103	DESIGN NASHYD	7.0	71			1.9	216	0.9	0.75	0.45
104	DESIGN NASHYD	14.7	71			3.0	313	1.0	0.88	0.53
105	DESIGN NASHYD	2.6	71			1.1	132	0.8	0.60	0.36

Notes:

TIMP — Total percent impervious

XIMP — Percent impervious directly connected

Time of Concentration calculated using the SCS Lag Equation
(For areas greater than 100 ha)

$Tc = [259L^{0.8}[(1000 / CN) - 9]^{0.7}] / [1900S^{0.5}]$

Where: L = Length of Overland Flow (m)
CN = SCS Curve Number
S = Slope (%)

Length = $[(A / 1.5)^{0.5}]$

Where: A = area of catchment in sq. m

Time of Concentration calculated using the Airport Method
(For areas less than 100 ha)

$Tc = [3.26 (1.1-C) L^{0.5}] / S^{0.33}$

Where: C = Runoff Coefficient = 0.2 for undeveloped areas
L = Length of Overland Flow (m)
S = Slope (%)

Tp = 0.6Tc

Time to Peak

CN calculated for pervious areas only for CALIB STANDHYD. CN is a weighed average for CALIB NASHYD

Union Gas - Milton - 1603-11376
SWMHYMO Parameters

Proposed Conditions

Catchment Number	SWMHYMO Command	Area (ha)	CN	TIMP	XIMP	Rise (m)	Length (m)	Slope (%)	Tc (hrs)	Tp (hrs)
Scenario 1										
201	DESIGN STANDHYD	38.4	83	70	70		510	2.0	0.88	0.53
Scenario 2										
301	DESIGN STANDHYD	11.8	83	70	70		280	2.0	0.65	0.39
302	DESIGN STANDHYD	26.6	83	70	70		420	2.0	0.80	0.48

Notes:

TIMP — Total percent impervious

XIMP — Percent impervious directly connected

Time of Concentration calculated using the SCS Lag Equation
(For areas greater than 100 ha)

$Tc = [259L^{0.8}\,[(1000 / CN) - 9]^{0.7}] / [1900S^{0.5}]$

Where: L = Length of Overland Flow (m)
CN = SCS Curve Number
S = Slope (%)

Length = $[(A / 1.5)^{0.5}]$

Where: A = area of catchment in sq. m

Time of Concentration calculated using the Airport Method
(For areas less than 100 ha)

$Tc = [3.26 (1.1-C) L^{0.5}] / S^{0.33}$

Where: C = Runoff Coefficient = 0.2 for undeveloped areas
L = Length of Overland Flow (m)
S = Slope (%)

Time to Peak

$Tp = 0.6Tc$

CN calculated for pervious areas only for CALIB STANDHYD. CN is a weighed average for CALIB NASHYD

Union Gas - Milton - 1603-11376

Scenario 1 - SWM Basin Stage-Storage-Discharge Calculations

	Rating Curve				
	Elevation (m)	Discharge (m^3/s)	Active Storage (m^3)	Drawdown (hrs) Increment	Drawdown (hrs) Total
	98.50				
	99.00				
	99.50				
Permanent Pool	100.00	0	0	0.0	0.0
	100.50	0.061	5,331	48.5	48.5
	101.00	0.116	11,213	18.5	67.0
	101.50	0.151	17,669	13.4	80.4
	102.00	0.354	24,725	7.8	88.2

Volume Estimation				
Elevation (m)	Area (m^2)	Active Vol (m^3)	PP Vol (m^3)	Total Vol (m^3)
98.50	7200			
99.00	8125		3831	3831
99.50	9100		8138	8138
100.00	10125		12944	12944
100.50	11200	5331		18275
101.00	12325	11213		24156
101.50	13500	17669		30613
102.00	14725	24725		37669

Outlet Structure Controls				
Elevation (m)	Orifice 1 (m^3/s)	Orifice 2 (m^3/s)	Weir (m^3/s)	Total Flow (m^3/s)
98.50				
99.00				
99.50				
100.00	0.000	0.000	0.000	0.000
100.50	0.035	0.026	0.000	0.061
101.00	0.051	0.065	0.000	0.116
101.50	0.064	0.088	0.000	0.151
102.00	0.074	0.106	0.175	0.354

Parameters	
Orifice 1	
Orifice Invert Elev. (m)	Orifice Coeff.
100.00	0.60
Orifice Mid-point Elev. (m)	Perimeter (m)
100.08	0.50
Orifice Diam.(mm)	Area (m^2)
160	0.020
Weir Coeff. (semi-circular)	Orientation
1.62	Vertical
Orifice 2	
Orifice Invert Elev. (m)	Orifice Coeff.
100.30	0.60
Orifice Mid-point Elev. (m)	Perimeter (m)
100.40	0.63
Orifice Diam.(mm)	Area (m^2)
200	0.031
Weir Coeff. (semi-circular)	Orientation
1.62	Vertical
Emergency Overflow Weir	
Weir Invert (m)	Weir Length m)
101.90	3.0
Weir Coeff. (rect.)	Side Slopes
1.70	(H:V) (?:1)
Weir Coeff. (tri.)	3.0
0.60	

Approximate Pond Dimensions at Bottom of Pond
Length 120 m
Width 60 m

Approximate Pond Dimensions at Top of Pond
Length 155 m
Width 95 m

Approximate Dimensions of Pond Block including a 10 m buffer
Length 175 m
Width 115 m
Area 20125 m^2

Orifice Equation Used: Orifice flow equation

$Q = C \cdot A \cdot (2 \cdot g \cdot h)^{0.5}$

where
C = orifice coefficient
A = area of orifice
g = acceleration due to gravity
h = head above centre line of orifice

Note: Sharp crested weir equation with equivalent linear length used for calculating orifice flow rates when head is below centre line

Sharp crested semi-circular weir equation

$Q = C^* D^{2.5} * (H/D)^{1.88}$

where
C = sharp crested semi-circular weir coefficient
D = diameter of orifice
H = head above orifice invert

Note: used when water elevation is below mid-point of orifice

Broad Crested Weir Equation: $Q = (C_{rectangle} \cdot L \cdot H^{3/2}) + ((C_{triangle} \cdot (8/15 \cdot (2*g)^{1/2} \cdot \tan \Theta/2) \cdot H^{5/2})$

where
L = bottom width of weir
H = head above weir invert
S = side slopes (ratio of H:V)
$C_{triangle}$ = triangular weir coefficient
$C_{rectangle}$ = broad-crested rectangular weir coefficient
g = 9.81 m/s^2
$\Theta/2$ = angle formed by trapezoidal weir side slopes

Union Gas - Milton - 1603-11376

Scenario 2 - West SWM Basin Stage-Storage-Discharge Calculations

	Rating Curve				
	Elevation (m)	Discharge (m^3/s)	Active Storage (m^3)	Drawdown (hrs) Increment	Drawdown (hrs) Total
	98.50				
	99.00				
	99.50				
Permanent Pool	100.00	0	0	0.0	0.0
	100.50	0.040	3,094	42.5	42.5
	101.00	0.085	6,613	15.6	58.1
	101.50	0.113	10,581	11.2	69.3
	102.00	0.363	15,025	5.2	74.5

Volume Estimation				
Elevation (m)	Area (m^2)	Active Vol (m^3)	Total PP Vol (m^3)	Total Vol (m^3)
98.50	3600			
99.00	4275		1969	1969
99.50	5000		4288	4288
100.00	5775		6981	6981
100.50	6600	3094		10075
101.00	7475	6613		13594
101.50	8400	10581		17563
102.00	9375	15025		22006

Outlet Structure Controls					
Elevation (m)	Orifice 1 (m^3/s)	Orifice 2 (m^3/s)	Weir (m^3/s)	Total Flow (m^3/s)	Parameters
98.50					Orifice 1
99.00					Orifice Invert Elev. (m) 100.00 / Orifice Coeff. 0.60
99.50					Orifice Mid-point Elev. (m) 100.05 / Perimeter (m) 0.31
100.00	0.000	0.000	0.000	0.000	Orifice Diam.(mm) 100 / Area (m^2) 0.008
100.50	0.014	0.026	0.000	0.040	Weir Coeff. (semi-circular) 1.62 / Orientation Vertical
101.00	0.020	0.065	0.000	0.085	Orifice 2
101.50	0.025	0.088	0.000	0.113	Orifice Invert Elev. (m) 100.30 / Orifice Coeff. 0.60
102.00	0.029	0.106	0.228	0.363	Orifice Mid-point Elev. (m) 100.40 / Perimeter (m) 0.63
					Orifice Diam.(mm) 200 / Area (m^2) 0.031
					Weir Coeff. (semi-circular) 1.62 / Orientation Vertical
					Emergency Overflow Weir
					Weir Invert (m) 101.90 / Weir Length m) 4.0
					Weir Coeff. (rect.) 1.70 / Side Slopes (H:V) (?:1)
					Weir Coeff. (tri.) 0.60 / 3.0

Approximate Pond Dimensions at Bottom of Pond
Length 90 m
Width 40 m

Approximate Pond Dimensions at Top of Pond
Length 125 m
Width 75 m

Approximate Dimensions of Pond Block including a 10 m buffer
Length 145 m
Width 95 m
Area 13775 m^2

Orifice Equation Used: Orifice flow equation

$Q = C \cdot A \cdot (2 \cdot g \cdot h)^{0.5}$

where
C = orifice coefficient
A = area of orifice
g = acceleration due to gravity
h = head above centre line of orifice

Note: Sharp crested weir equation with equivalent linear length used for calculating orifice flow rates when head is below centre line

Sharp crested semi-circular weir equation

$Q = C * D^{2.5} * (H/D)^{1.88}$

where
C = sharp crested semi-circular weir coefficient
D = diameter of orifice
H = head above orifice invert

Note: used when water elevation is below mid-point of orifice

Broad Crested Weir Equation: $Q = (C_{rectangle} \cdot L \cdot H^{3/2}) + ((C_{triangle} \cdot (8/15 \cdot (2*g)^{1/2} \cdot \tan \Theta/2) \cdot H^{5/2})$

where
L = bottom width of weir
H = head above weir invert
S = side slopes (ratio of H:V)
$C_{triangle}$ = triangular weir coefficient
$C_{rectangle}$ = broad-crested rectangular weir coefficient
g = 9.81 m/s^2
$\Theta/2$ = angle formed by trapezoidal weir side slopes

Union Gas - Milton - 1603-11376

Scenario 2 - South SWM Basin Stage-Storage-Discharge Calculations

	Rating Curve				
	Elevation (m)	Discharge (m^3/s)	Active Storage (m^3)	Drawdown (hrs) Increment	Drawdown (hrs) Total
	98.50				
	99.00				
	99.50				
Permanent Pool	100.00	0	0	0.0	0.0
	100.50	0.026	1,844	39.3	39.3
	101.00	0.046	4,013	16.6	55.9
	101.50	0.060	6,531	13.2	69.0
	102.00	3.227	9,425	0.5	69.5

Volume Estimation				
Elevation (m)	Area (m^2)	Active Vol (m^3)	Total PP Vol (m^3)	Total Vol (m^3)
98.50	1800			
99.00	2275		1019	1019
99.50	2800		2288	2288
100.00	3375		3831	3831
100.50	4000	1844		5675
101.00	4675	4013		7844
101.50	5400	6531		10363
102.00	6175	9425		13256

Outlet Structure Controls					
Elevation (m)	Orifice 1 (m^3/s)	Orifice 2 (m^3/s)	Weir (m^3/s)	Total Flow (m^3/s)	Parameters
98.50					Orifice 1
99.00					Orifice Invert Elev. (m) 100.00 / Orifice Coeff. 0.60
99.50					Orifice Mid-point Elev. (m) 100.05 / Perimeter (m) 0.31
100.00	0.000	0.000	0.000	0.000	Orifice Diam.(mm) 100 / Area (m^2) 0.008
100.50	0.014	0.012	0.000	0.026	Weir Coeff. (semi-circular) 1.62 / Orientation Vertical
101.00	0.020	0.026	0.000	0.046	Orifice 2
101.50	0.025	0.035	0.000	0.060	Orifice Invert Elev. (m) 100.30 / Orifice Coeff. 0.60
102.00	0.029	0.042	3.156	3.227	Orifice Mid-point Elev. (m) 100.36 / Perimeter (m) 0.39
					Orifice Diam.(mm) 125 / Area (m^2) 0.012
					Weir Coeff. (semi-circular) 1.62 / Orientation Vertical
					Emergency Overflow Weir
					Weir Invert (m) 101.50 / Weir Length m) 4.0
					Weir Coeff. (rect.) 1.70 / Side Slopes (H:V) (?:1)
					Weir Coeff. (tri.) 0.60 / 3.0

Approximate Pond Dimensions at Bottom of Pond
Length 60 m
Width 30 m

Approximate Pond Dimensions at Top of Pond
Length 95 m
Width 65 m

Approximate Dimensions of Pond Block including a 10 m buffer
Length 115 m
Width 85 m
Area 9775 m^2

Orifice Equation Used: Orifice flow equation

$Q = C \cdot A \cdot (2 \cdot g \cdot h)^{0.5}$

where
C = orifice coefficient
A = area of orifice
g = acceleration due to gravity
h = head above centre line of orifice

Note: Sharp crested weir equation with equivalent linear length used for calculating orifice flow rates when head is below centre line

Sharp crested semi-circular weir equation

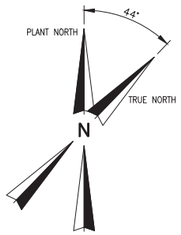
$Q = C^* D^{2.5} * (H/D)^{1.88}$

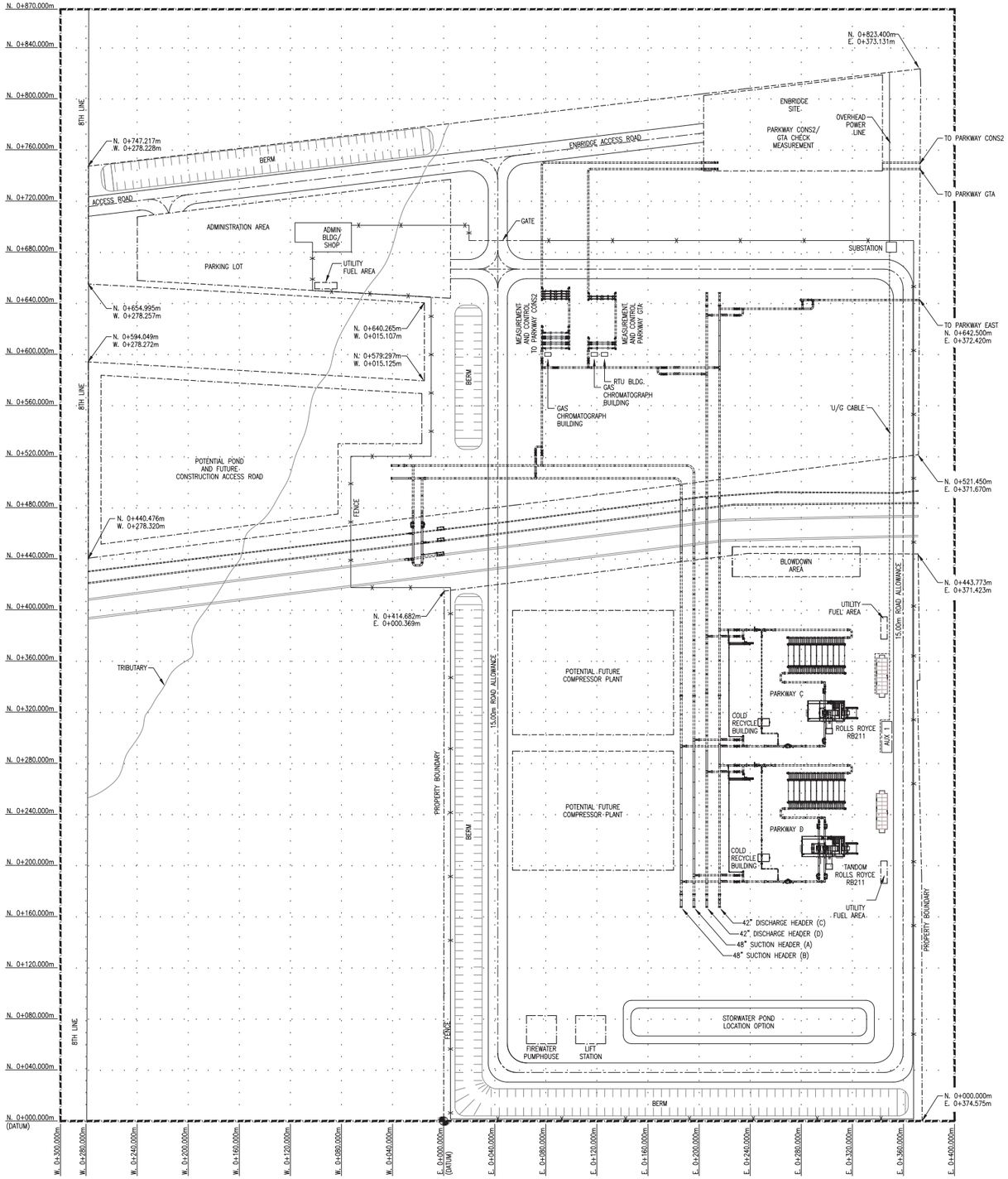
where
C = sharp crested semi-circular weir coefficient
D = diameter of orifice
H = head above orifice invert

Note: used when water elevation is below mid-point of orifice

Broad Crested Weir Equation: $Q = (C_{rectangle} \cdot L \cdot H^{3/2}) + ((C_{triangle} \cdot (8/15 \cdot (2*g)^{1/2} \cdot \tan \Theta/2) \cdot H^{5/2})$

where
L = bottom width of weir
H = head above weir invert
S = side slopes (ratio of H:V)
$C_{triangle}$ = triangular weir coefficient
$C_{rectangle}$ = broad-crested rectangular weir coefficient
g = 9.81 m/s^2
$\Theta/2$ = angle formed by trapezoidal weir side slopes







PARKWAY WEST NEW PROPOSED SITE – AERIAL VIEW

SCALE: NTS

BUILDING/EQUIPMENT OFFSETS (MINIMUMS)

- 100m BETWEEN ADJACENT COMP BUILDINGS – CENTER TO CENTER
- 50m FROM COMP VALVE NEST TO NEAREST ABOVE GROUND EQUIPMENT
- 50m FROM COMP BUILDING CENTERLINE TO COMP CONTROL BUILDING
- 50m FROM COMP BUILDING CENTERLINE TO COMP AUXILIARY BUILDING
- 150m FROM COMP BUILDING CENTERLINE TO NEAREST PROPERTY LINE (EXCLUDING EAST BOUNDARY)
- 50m FROM BLOWDOWN AREA TO ABOVE GRADE EQUIPMENT
- 10m BETWEEN PARALLEL SUCTION AND DISCHARGE HEADERS

DPH FOCUS

PROJECT ENGINEER:

No.	DATE	BY	APP'D	REMARKS
A	13.01.15	JGA		ISSUED FOR DISCUSSION – DPH FOCUS JOB #12661

REVISIONS

unionGas
A Spectra Energy Company

PARKWAY WEST COMPRESSOR STATION
PARKWAY WEST COMPRESSORS ADDITION
ORLANDO PROPERTY
OVERALL PLAN

DRAWN BY JGA	DATE 2013.01.02	PLOT SPEC:	1:1500
CHECKED BY	DATE	CAD CODE:	AA241-00-STUDY6
PROJECT COORDINATOR	DATE	FILE REVISION DATE	2013.01.15
GRID No. N/A	SYSTEM 00	DRAWING No.	AA241-00-STUDY6

APPENDIX B

Hydrologic Model

```
00001> 2     Metric units
00002> *#*************************************************************************
00003> *#  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00004> *#  Date         : January 23, 2013
00005> *#  Modeller     : [T. Fraser/J. Innes]
00006> *#  Company      : Stantec Consulting Ltd. (Kitchener)
00007> *#  License #    :  4730904
00008> *#
00009> *#  This hydrologic analysis was prepared to determine the existing flows from
00010> *#  from the site.  Rainfall data from the Milton Town Standards.
00011> *#*************************************************************************
00012> START                TZERO=[0.0]hrs or date,  METOUT=[2],  NSTORM=[1],  NRUN=[1]
00013> *                    ["3h_2yr.STM"] <--storm filename, one per line for NSTORM ti
00014> *%-----------------|-------------------------------------------------------|
00015> READ STORM           STORM_FILENAME=["STORM.001"]
00016> *%-----------------|-------------------------------------------------------|
00017> *#  Existing Conditions
00018> *%-----------------|-------------------------------------------------------|
00019> *#  Catchment 101 - Northeast corner of site, draining off-site.
00020> *%-----------------|-------------------------------------------------------|
00021> DESIGN NASHYD        ID=[1], NHYD=["101"], DT=[1]min, AREA=[1.7](ha),
00022>                      DWF=[0](cms), CN/C=[71], TP=[0.23]hrs,
00023>                      RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
00024> *%-----------------|-------------------------------------------------------|
00025> *#  Catchment 102 - East/central catchment draining to existing draw discharging
00026> *#                  to the east.
00027> *%-----------------|-------------------------------------------------------|
00028> DESIGN NASHYD        ID=[2], NHYD=["102"], DT=[1]min, AREA=[13.3](ha),
00029>                      DWF=[0](cms), CN/C=[71], TP=[0.59]hrs,
00030>                      RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
00031> *%-----------------|-------------------------------------------------------|
00032> *#  Catchment 103 - Southeast portion of site draining to the south.
00033> *%-----------------|-------------------------------------------------------|
00034> DESIGN NASHYD        ID=[3], NHYD=["103"], DT=[1]min, AREA=[6.5](ha),
00035>                      DWF=[0](cms), CN/C=[71], TP=[0.45]hrs,
00036>                      RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
00037> *%-----------------|-------------------------------------------------------|
00038> *#  Catchment 104 - Central catchment draining to existing, regulated watercours
00039> *#                  and draining off-site to neighbouring property to south.
00040> *%-----------------|-------------------------------------------------------|
00041> DESIGN NASHYD        ID=[4], NHYD=["104"], DT=[1]min, AREA=[14.7](ha),
00042>                      DWF=[0](cms), CN/C=[71], TP=[0.53]hrs,
00043>                      RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
00044> *%-----------------|-------------------------------------------------------|
00045> *#  Catchment 105 - Northwest corner catchment draining to northwest.
00046> *%-----------------|-------------------------------------------------------|
00047> DESIGN NASHYD        ID=[5], NHYD=["105"], DT=[1]min, AREA=[2.2](ha),
00048>                      DWF=[0](cms), CN/C=[71], TP=[0.36]hrs,
00049>                      RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
00050> *%-----------------|-------------------------------------------------------|
00051> DEFAULT VALUES       ICASEdef=[3],  print current values
00052> *%-----------------|-------------------------------------------------------|
00053> START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
00054> *%                   ["3h_5yr.STM"] <--storm filename, one per line for NSTORM t
00055> *%-----------------|-------------------------------------------------------|
00056> START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
00057> *%                   ["3h_10yr.STM"] <--storm filename, one per line for NSTORM
00058> *%-----------------|-------------------------------------------------------|
00059> START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
00060> *%                   ["3h_25yr.STM"] <--storm filename, one per line for NSTORM
00061> *%-----------------|-------------------------------------------------------|
00062> START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[5]
00063> *%                   ["3h_100yr.STM"] <--storm filename, one per line for NSTORM
00064> *%-----------------|-------------------------------------------------------|
00065> START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[6]
00066> *%                   ["hurhaz48.STM"] <--storm filename, one per line for NSTORM
00067> *%-----------------|-------------------------------------------------------|
00068> FINISH
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```
00001> ================================================================================
00002>
00003>  SSSSS  W    W  M    M  H    H  Y    Y  M    M   OOO         999    999  =========
00004>  S      W W W  MM MM  H    H   Y Y     MM MM  O   O       9   9  9   9
00005>  SSSSS  W W W  M M M  HHHHH    Y      M M M  O   O  ##   9   9  9   9  Ver. 4.02
00006>      S   W W   M    M  H    H    Y     M    M  O   O        9999   9999 July 1999
00007>  SSSSS   W W   M    M  H    H    Y     M    M   OOO           9      9  =========
00008>                                                           9   9  9   9  # 4730904
00009>       StormWater Management HYdrologic Model              999    999  =========
00010>
00011>  ********************************************************************************
00012>  ************************** SWMHYMO-99 Ver/4.02 ************************************
00013>  *******  A single event and continuous hydrologic simulation model  *******
00014>  *******     based on the principles of HYMO and its successors      *******
00015>  *******                  OTTHYMO-83 and OTTHYMO-89.                  *******
00016>  ********************************************************************************
00017>  ******* Distributed by:  J.F. Sabourin and Associates Inc.          *******
00018>  *******                  Ottawa,  Ontario: (613) 727-5199           *******
00019>  *******                  Gatineau, Quebec: (819) 243-6858           *******
00020>  *******                  E-Mail: swmhymo@jfsa.Com                   *******
00021>  ********************************************************************************
00022>
00023>  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00024>  +++++++ Licensed user: Stantec Consulting Ltd. (Kitchener)          +++++++
00025>  +++++++                Kitchener            SERIAL#:4730904        +++++++
00026>  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00027>
00028>  ********************************************************************************
00029>  *******           ++++++ PROGRAM ARRAY DIMENSIONS ++++++                *******
00030>  *******           Maximum value for ID numbers  :     10               *******
00031>  *******           Max. number of rainfall points:  15000               *******
00032>  *******           Max. number of flow points    :  15000               *******
00033>  ********************************************************************************
00034>
00035>  *** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) ***
00036>  ***------------------------------------------------------------------------***
00037>  ***    ID:  Hydrograph IDentification numbers, (1-10).                   ***
00038>  ***  NHYD:  Hydrograph reference numbers, (6 digits or characters).      ***
00039>  ***  AREA:  Drainage area associated with hydrograph, (ac.) or (ha.).    ***
00040>  *** QPEAK:  Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s).      ***
00041>  *** TpeakDate_hh:mm is the date and time of the peak flow.               ***
00042>  ***  R.V.:  Runoff Volume of simulated hydrograph, (in) or (mm).         ***
00043>  ***  R.C.:  Runoff Coefficient of simulated hydrograph, (ratio).         ***
00044>  ***     *:  see WARNING or NOTE message printed at end of run.           ***
00045>  ***    **:  see  ERROR  message printed at end of run.                   ***
00046>  ********************************************************************************
00047>  ********************************************************************************
00048>
00049> ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
00050>
00051>  ********************************************************************************
00052>
00053>  *********************   S U M M A R Y   O U T P U T   *********************
00054>  ********************************************************************************
00055>  *       DATE: 2013-01-23     TIME: 16:32:28     RUN COUNTER: 000833       *
00056>  ********************************************************************************
00057>  * Input   filename: C:\TREVOR-1\160311~3\SWMHYMO\UGex.dat                    *
00058>  * Output  filename: C:\TREVOR-1\160311~3\SWMHYMO\UGex.out                    *
00059>  * Summary filename: C:\TREVOR-1\160311~3\SWMHYMO\UGex.sum                    *
00060>  * User comments:                                                            *
00061>  * 1:_____________________________________________________________________*
00062>  * 2:_____________________________________________________________________*
00063>  * 3:_____________________________________________________________________*
00064>  ********************************************************************************
00065>
00066>
00067> #*******************************************************************************
00068> #  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00069> #  Date        : January 23, 2013
00070> #  Modeller    : [T. Fraser/J. Innes]
00071> #  Company     : Stantec Consulting Ltd. (Kitchener)
00072> #  License #   :  4730904
00073> #
00074> #  This hydrologic analysis was prepared to determine the existing flows from
00075> #  from the site.  Rainfall data from the Milton Town Standards.
00076> #*******************************************************************************
00077>  RUN:COMMAND#
00078>  001:0001--------------------------------------------------------------------------
00079>      START
00080>       [TZERO =    .00 hrs on        0]
00081>       [METOUT=   2    (1=imperial, 2=metric output)]
00082>       [NSTORM=   1 ]
00083>       [NRUN  =   1 ]
00084>  001:0002--------------------------------------------------------------------------
00085>      READ STORM
00086>       Filename = STORM.001
00087>       Comment  = CHICAGO STORM
00088>       [SDT= 5.00:SDUR=   3.00:PTOT=  32.07]
00089> #  Existing Conditions
00090> #  Catchment 101 - Northeast corner of site, draining off-site.
00091>  001:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00092>      DESIGN NASHYD      01:101        1.70     .040 No_date    1:27    6.96 .217
00093>       [CN= 71.0: N= 3.00]
00094>       [Tp=  .23:DT= 1.00]
00095> #  Catchment 102 - East/central catchment draining to existing draw discharging
00096> #                  to the east.
00097>  001:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00098>      DESIGN NASHYD      02:102       13.30     .164 No_date    1:55    6.96 .217
00099>       [CN= 71.0: N= 3.00]
00100>       [Tp=  .59:DT= 1.00]
00101> #  Catchment 103 - Southeast portion of site draining to the south.
00102>  001:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00103>      DESIGN NASHYD      03:103        6.50     .097 No_date    1:44    6.96 .217
00104>       [CN= 71.0: N= 3.00]
00105>       [Tp=  .45:DT= 1.00]
00106> #  Catchment 104 - Central catchment draining to existing, regulated watercours
00107> #                  and draining off-site to neighbouring property to south.
00108>  001:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00109>      DESIGN NASHYD      04:104       14.70     .196 No_date    1:50    6.96 .217
00110>       [CN= 71.0: N= 3.00]
00111>       [Tp=  .53:DT= 1.00]
00112> #  Catchment 105 - Northwest corner catchment draining to northwest.
00113>  001:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00114>      DESIGN NASHYD      05:105        2.20     .038 No_date    1:37    6.96 .217
00115>       [CN= 71.0: N= 3.00]
00116>       [Tp=  .36:DT= 1.00]
00117>  001:0008--------------------------------------------------------------------------
00118>      DEFAULT VALUES
00119>       Filename = *** internal values ***
00120>       ICASEdv  = 3 (print current values)
00121>       FileTitle= Internal values are based on various model calibration
00122>                  exercises conducted mainly in Ontario.
00123>       Horton's infiltration equation parameters:
00124>       [Fo= 50.00 mm/hr] [Fc= 7.50 mm/hr] [DCAY= 2.00 /hr] [F=  .00 mm]
00125>       Parameters for PERVIOUS surfaces in STANDHYD:
00126>       [IAper=   1.50 mm] [LGP=40.00 m] [MNP= .250]
00127>       Parameters for IMPERVIOUS surfaces in STANDHYD:
00128>       [IAimp=    .80 mm] [CLI= 1.50]   [MNI= .013]
00129>       Parameters used in NASHYD:
00130>       [Ia=   1.50 mm] [N= 3.00]
00131>   ** END OF RUN :   1
00132>
00133> ********************************************************************************
00134>
00135>

00136>
00137>
00138>
00139>  RUN:COMMAND#
00140>  002:0001--------------------------------------------------------------------------
00141>      START
00142>       [TZERO =    .00 hrs on        0]
00143>       [METOUT=   2    (1=imperial, 2=metric output)]
00144>       [NSTORM=   1 ]
00145>       [NRUN  =   2 ]
00146> #*******************************************************************************
00147> #  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00148> #  Date        : January 23, 2013
00149> #  Modeller    : [T. Fraser/J. Innes]
00150> #  Company     : Stantec Consulting Ltd. (Kitchener)
00151> #  License #   :  4730904
00152> #
00153> #  This hydrologic analysis was prepared to determine the existing flows from
00154> #  from the site.  Rainfall data from the Milton Town Standards.
00155> #*******************************************************************************
00156>  002:0002--------------------------------------------------------------------------
00157>      READ STORM
00158>       Filename = STORM.001
00159>       Comment  = CHICAGO STORM
00160>       [SDT= 5.00:SDUR=   3.00:PTOT=  43.48]
00161> #  Existing Conditions
00162> #  Catchment 101 - Northeast corner of site, draining off-site.
00163>  002:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00164>      DESIGN NASHYD      01:101        1.70     .068 No_date    1:26   12.09 .278
00165>       [CN= 71.0: N= 3.00]
00166>       [Tp=  .23:DT= 1.00]
00167> #  Catchment 102 - East/central catchment draining to existing draw discharging
00168> #                  to the east.
00169>  002:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00170>      DESIGN NASHYD      02:102       13.30     .283 No_date    1:55   12.09 .278
00171>       [CN= 71.0: N= 3.00]
00172>       [Tp=  .59:DT= 1.00]
00173> #  Catchment 103 - Southeast portion of site draining to the south.
00174>  002:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00175>      DESIGN NASHYD      03:103        6.50     .167 No_date    1:44   12.09 .278
00176>       [CN= 71.0: N= 3.00]
00177>       [Tp=  .45:DT= 1.00]
00178> #  Catchment 104 - Central catchment draining to existing, regulated watercours
00179> #                  and draining off-site to neighbouring property to south.
00180>  002:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00181>      DESIGN NASHYD      04:104       14.70     .337 No_date    1:50   12.09 .278
00182>       [CN= 71.0: N= 3.00]
00183>       [Tp=  .53:DT= 1.00]
00184> #  Catchment 105 - Northwest corner catchment draining to northwest.
00185>  002:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00186>      DESIGN NASHYD      05:105        2.20     .066 No_date    1:37   12.09 .278
00187>       [CN= 71.0: N= 3.00]
00188>       [Tp=  .36:DT= 1.00]
00189>  002:0008--------------------------------------------------------------------------
00190>      DEFAULT VALUES
00191>       Filename = *** internal values ***
00192>       ICASEdv  = 3 (print current values)
00193>       FileTitle= Internal values are based on various model calibration
00194>                  exercises conducted mainly in Ontario.
00195>       Horton's infiltration equation parameters:
00196>       [Fo= 50.00 mm/hr] [Fc= 7.50 mm/hr] [DCAY= 2.00 /hr] [F=  .00 mm]
00197>       Parameters for PERVIOUS surfaces in STANDHYD:
00198>       [IAper=   1.50 mm] [LGP=40.00 m] [MNP= .250]
00199>       Parameters for IMPERVIOUS surfaces in STANDHYD:
00200>       [IAimp=    .80 mm] [CLI= 1.50]   [MNI= .013]
00201>       Parameters used in NASHYD:
00202>       [Ia=   1.50 mm] [N= 3.00]
00203>   ** END OF RUN :   2
00204>
00205> ********************************************************************************
00206>
00207>
00208>
00209>
00210>
00211>  RUN:COMMAND#
00212>  003:0001--------------------------------------------------------------------------
00213>      START
00214>       [TZERO =    .00 hrs on        0]
00215>       [METOUT=   2    (1=imperial, 2=metric output)]
00216>       [NSTORM=   1 ]
00217>       [NRUN  =   3 ]
00218> #*******************************************************************************
00219> #  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00220> #  Date        : January 23, 2013
00221> #  Modeller    : [T. Fraser/J. Innes]
00222> #  Company     : Stantec Consulting Ltd. (Kitchener)
00223> #  License #   :  4730904
00224> #
00225> #  This hydrologic analysis was prepared to determine the existing flows from
00226> #  from the site.  Rainfall data from the Milton Town Standards.
00227> #*******************************************************************************
00228>  003:0002--------------------------------------------------------------------------
00229>      READ STORM
00230>       Filename = STORM.001
00231>       Comment  = CHICAGO STORM
00232>       [SDT= 5.00:SDUR=   3.00:PTOT=  51.19]
00233> #  Existing Conditions
00234> #  Catchment 101 - Northeast corner of site, draining off-site.
00235>  003:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00236>      DESIGN NASHYD      01:101        1.70     .090 No_date    1:26   16.09 .314
00237>       [CN= 71.0: N= 3.00]
00238>       [Tp=  .23:DT= 1.00]
00239> #  Catchment 102 - East/central catchment draining to existing draw discharging
00240> #                  to the east.
00241>  003:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00242>      DESIGN NASHYD      02:102       13.30     .375 No_date    1:54   16.09 .314
00243>       [CN= 71.0: N= 3.00]
00244>       [Tp=  .59:DT= 1.00]
00245> #  Catchment 103 - Southeast portion of site draining to the south.
00246>  003:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00247>      DESIGN NASHYD      03:103        6.50     .222 No_date    1:43   16.09 .314
00248>       [CN= 71.0: N= 3.00]
00249>       [Tp=  .45:DT= 1.00]
00250> #  Catchment 104 - Central catchment draining to existing, regulated watercours
00251> #                  and draining off-site to neighbouring property to south.
00252>  003:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00253>      DESIGN NASHYD      04:104       14.70     .447 No_date    1:50   16.09 .314
00254>       [CN= 71.0: N= 3.00]
00255>       [Tp=  .53:DT= 1.00]
00256> #  Catchment 105 - Northwest corner catchment draining to northwest.
00257>  003:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00258>      DESIGN NASHYD      05:105        2.20     .087 No_date    1:36   16.09 .314
00259>       [CN= 71.0: N= 3.00]
00260>       [Tp=  .36:DT= 1.00]
00261>  003:0008--------------------------------------------------------------------------
00262>      DEFAULT VALUES
00263>       Filename = *** internal values ***
00264>       ICASEdv  = 3 (print current values)
00265>       FileTitle= Internal values are based on various model calibration
00266>                  exercises conducted mainly in Ontario.
00267>       Horton's infiltration equation parameters:
00268>       [Fo= 50.00 mm/hr] [Fc= 7.50 mm/hr] [DCAY= 2.00 /hr] [F=  .00 mm]
00269>       Parameters for PERVIOUS surfaces in STANDHYD:
00270>       [IAper=   1.50 mm] [LGP=40.00 m] [MNP= .250]
```

```
00271>       Parameters for IMPERVIOUS surfaces in STANDHYD:
00272>       [IAimp=    .80 mm] [CLI= 1.50]   [MNI= .013]
00273>       Parameters used in NASHYD:
00274>       [Ia=   1.50 mm] [N= 3.00]
00275>   ** END OF RUN :   3
00276>
00277> ****************************************************************************
00278>
00279>
00280>
00281>
00282>
00283>  RUN:COMMAND#
00284>  004:0001------------------------------------------------------------------
00285>      START
00286>       [TZERO =    .00 hrs on        0]
00287>       [METOUT=   2    (1=imperial, 2=metric output)]
00288>       [NSTORM=   1 ]
00289>       [NRUN  =   4 ]
00290> #*****************************************************************************
00291> #  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00292> #  Date        : January 23, 2013
00293> #  Modeller    : [T. Fraser/J. Innes]
00294> #  Company     : Stantec Consulting Ltd. (Kitchener)
00295> #  License #   :  4730904
00296> #
00297> #  This hydrologic analysis was prepared to determine the existing flows from
00298> #  from the site.  Rainfall data from the Milton Town Standards.
00299> #*****************************************************************************
00300>  004:0002------------------------------------------------------------------
00301>      READ STORM
00302>       Filename = STORM.001
00303>       Comment  = CHICAGO STORM
00304>       [SDT= 5.00:SDUR=   3.00:PTOT=  60.91]
00305> #  Existing Conditions
00306> #  Catchment 101 - Northeast corner of site, draining off-site.
00307>  004:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00308>      DESIGN NASHYD      01:101        1.70     .121 No_date    1:26   21.63 .355
00309>       [CN= 71.0: N= 3.00]
00310>       [Tp=  .23:DT= 1.00]
00311> #  Catchment 102 - East/central catchment draining to existing draw discharging
00312> #                  to the east.
00313>  004:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00314>      DESIGN NASHYD      02:102       13.30     .503 No_date    1:54   21.63 .355
00315>       [CN= 71.0: N= 3.00]
00316>       [Tp=  .59:DT= 1.00]
00317> #  Catchment 103 - Southeast portion of site draining to the south.
00318>  004:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00319>      DESIGN NASHYD      03:103        6.50     .297 No_date    1:43   21.63 .355
00320>       [CN= 71.0: N= 3.00]
00321>       [Tp=  .45:DT= 1.00]
00322> #  Catchment 104 - Central catchment draining to existing, regulated watercours
00323> #                  and draining off-site to neighbouring property to south.
00324>  004:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00325>      DESIGN NASHYD      04:104       14.70     .600 No_date    1:49   21.63 .355
00326>       [CN= 71.0: N= 3.00]
00327>       [Tp=  .53:DT= 1.00]
00328> #  Catchment 105 - Northwest corner catchment draining to northwest.
00329>  004:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00330>      DESIGN NASHYD      05:105        2.20     .117 No_date    1:36   21.63 .355
00331>       [CN= 71.0: N= 3.00]
00332>       [Tp=  .36:DT= 1.00]
00333>  004:0008------------------------------------------------------------------
00334>      DEFAULT VALUES
00335>       Filename = *** internal values ***
00336>       ICASEdv  = 3 (print current values)
00337>       FileTitle= Internal values are based on various model calibration
00338>                  exercises conducted mainly in Ontario.
00339>       Horton's infiltration equation parameters:
00340>       [Fo= 50.00 mm/hr] [Fc= 7.50 mm/hr] [DCAY= 2.00 /hr] [F=  .00 mm]
00341>       Parameters for PERVIOUS surfaces in STANDHYD:
00342>       [IAper=   1.50 mm] [LGP=40.00 m] [MNP= .250]
00343>       Parameters for IMPERVIOUS surfaces in STANDHYD:
00344>       [IAimp=    .80 mm] [CLI= 1.50]   [MNI= .013]
00345>       Parameters used in NASHYD:
00346>       [Ia=   1.50 mm] [N= 3.00]
00347>   ** END OF RUN :   4
00348>
00349> ****************************************************************************
00350>
00351>
00352>
00353>
00354>
00355>  RUN:COMMAND#
00356>  005:0001------------------------------------------------------------------
00357>      START
00358>       [TZERO =    .00 hrs on        0]
00359>       [METOUT=   2    (1=imperial, 2=metric output)]
00360>       [NSTORM=   1 ]
00361>       [NRUN  =   5 ]
00362> #*****************************************************************************
00363> #  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00364> #  Date        : January 23, 2013
00365> #  Modeller    : [T. Fraser/J. Innes]
00366> #  Company     : Stantec Consulting Ltd. (Kitchener)
00367> #  License #   :  4730904
00368> #
00369> #  This hydrologic analysis was prepared to determine the existing flows from
00370> #  from the site.  Rainfall data from the Milton Town Standards.
00371> #*****************************************************************************
00372>  005:0002------------------------------------------------------------------
00373>      READ STORM
00374>       Filename = STORM.001
00375>       Comment  = CHICAGO STORM
00376>       [SDT= 5.00:SDUR=   3.00:PTOT=  75.19]
00377> #  Existing Conditions
00378> #  Catchment 101 - Northeast corner of site, draining off-site.
00379>  005:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00380>      DESIGN NASHYD      01:101        1.70     .171 No_date    1:26   30.61 .407
00381>       [CN= 71.0: N= 3.00]
00382>       [Tp=  .23:DT= 1.00]
00383> #  Catchment 102 - East/central catchment draining to existing draw discharging
00384> #                  to the east.
00385>  005:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00386>      DESIGN NASHYD      02:102       13.30     .710 No_date    1:54   30.61 .407
00387>       [CN= 71.0: N= 3.00]
00388>       [Tp=  .59:DT= 1.00]
00389> #  Catchment 103 - Southeast portion of site draining to the south.
00390>  005:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00391>      DESIGN NASHYD      03:103        6.50     .419 No_date    1:43   30.61 .407
00392>       [CN= 71.0: N= 3.00]
00393>       [Tp=  .45:DT= 1.00]
00394> #  Catchment 104 - Central catchment draining to existing, regulated watercours
00395> #                  and draining off-site to neighbouring property to south.
00396>  005:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00397>      DESIGN NASHYD      04:104       14.70     .846 No_date    1:49   30.61 .407
00398>       [CN= 71.0: N= 3.00]
00399>       [Tp=  .53:DT= 1.00]
00400> #  Catchment 105 - Northwest corner catchment draining to northwest.
00401>  005:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00402>      DESIGN NASHYD      05:105        2.20     .165 No_date    1:36   30.61 .407
00403>       [CN= 71.0: N= 3.00]
00404>       [Tp=  .36:DT= 1.00]
00405>  005:0008------------------------------------------------------------------
00406>      DEFAULT VALUES
00407>       Filename = *** internal values ***
00408>       ICASEdv  = 3 (print current values)
00409>       FileTitle= Internal values are based on various model calibration
00410>                  exercises conducted mainly in Ontario.
00411>       Horton's infiltration equation parameters:
00412>       [Fo= 50.00 mm/hr] [Fc= 7.50 mm/hr] [DCAY= 2.00 /hr] [F=  .00 mm]
00413>       Parameters for PERVIOUS surfaces in STANDHYD:
00414>       [IAper=   1.50 mm] [LGP=40.00 m] [MNP= .250]
00415>       Parameters for IMPERVIOUS surfaces in STANDHYD:
00416>       [IAimp=    .80 mm] [CLI= 1.50]   [MNI= .013]
00417>       Parameters used in NASHYD:
00418>       [Ia=   1.50 mm] [N= 3.00]
00419>   ** END OF RUN :   5
00420>
00421> ****************************************************************************
00422>
00423>
00424>
00425>
00426>
00427>  RUN:COMMAND#
00428>  006:0001------------------------------------------------------------------
00429>      START
00430>       [TZERO =    .00 hrs on        0]
00431>       [METOUT=   2    (1=imperial, 2=metric output)]
00432>       [NSTORM=   1 ]
00433>       [NRUN  =   6 ]
00434> #*****************************************************************************
00435> #  Project Name: [Union Gas Milton] Project Number: [1603-11376]
00436> #  Date        : January 23, 2013
00437> #  Modeller    : [T. Fraser/J. Innes]
00438> #  Company     : Stantec Consulting Ltd. (Kitchener)
00439> #  License #   :  4730904
00440> #
00441> #  This hydrologic analysis was prepared to determine the existing flows from
00442> #  from the site.  Rainfall data from the Milton Town Standards.
00443> #*****************************************************************************
00444>  006:0002------------------------------------------------------------------
00445>      READ STORM
00446>       Filename = STORM.001
00447>       Comment  = REGIONAL STORM
00448>       [SDT=15.00:SDUR=  48.00:PTOT= 285.00]
00449> #  Existing Conditions
00450> #  Catchment 101 - Northeast corner of site, draining off-site.
00451>  006:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00452>      DESIGN NASHYD      01:101        1.70     .223 No_date   46:01  207.55 .728
00453>       [CN= 71.0: N= 3.00]
00454>       [Tp=  .23:DT= 1.00]
00455> #  Catchment 102 - East/central catchment draining to existing draw discharging
00456> #                  to the east.
00457>  006:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00458>      DESIGN NASHYD      02:102       13.30    1.477 No_date   46:27  207.55 .728
00459>       [CN= 71.0: N= 3.00]
00460>       [Tp=  .59:DT= 1.00]
00461> #  Catchment 103 - Southeast portion of site draining to the south.
00462>  006:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00463>      DESIGN NASHYD      03:103        6.50     .775 No_date   46:13  207.55 .728
00464>       [CN= 71.0: N= 3.00]
00465>       [Tp=  .45:DT= 1.00]
00466> #  Catchment 104 - Central catchment draining to existing, regulated watercours
00467> #                  and draining off-site to neighbouring property to south.
00468>  006:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00469>      DESIGN NASHYD      04:104       14.70    1.681 No_date   46:21  207.55 .728
00470>       [CN= 71.0: N= 3.00]
00471>       [Tp=  .53:DT= 1.00]
00472> #  Catchment 105 - Northwest corner catchment draining to northwest.
00473>  006:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00474>      DESIGN NASHYD      05:105        2.20     .275 No_date   46:07  207.55 .728
00475>       [CN= 71.0: N= 3.00]
00476>       [Tp=  .36:DT= 1.00]
00477>  006:0008------------------------------------------------------------------
00478>      DEFAULT VALUES
00479>       Filename = *** internal values ***
00480>       ICASEdv  = 3 (print current values)
00481>       FileTitle= Internal values are based on various model calibration
00482>                  exercises conducted mainly in Ontario.
00483>       Horton's infiltration equation parameters:
00484>       [Fo= 50.00 mm/hr] [Fc= 7.50 mm/hr] [DCAY= 2.00 /hr] [F=  .00 mm]
00485>       Parameters for PERVIOUS surfaces in STANDHYD:
00486>       [IAper=   1.50 mm] [LGP=40.00 m] [MNP= .250]
00487>       Parameters for IMPERVIOUS surfaces in STANDHYD:
00488>       [IAimp=    .80 mm] [CLI= 1.50]   [MNI= .013]
00489>       Parameters used in NASHYD:
00490>       [Ia=   1.50 mm] [N= 3.00]
00491>  006:0002------------------------------------------------------------------
00492>      FINISH
00493> ----------------------------------------------------------------------------
00494> ****************************************************************************
00495>      WARNINGS / ERRORS / NOTES
00496>      -------------------------
00497>    Simulation ended on 2013-01-23     at 16:32:30
00498> ============================================================================
00499>
```

```
2     Metric units
*#*************************************************************************
*#  Project Name: [Union Gas Milton] Project Number: [1603-11338]
*#  Date        : January 2013
*#  Modeller    : [T. Fraser/J. Innes]
*#  Company     : Stantec Consulting Ltd. (Kitchener)
*#  License #   :  4730904
*#
*#  This hydrologic analysis was prepared to determine the proposed flows from
*#  from the site.
*#*************************************************************************
START               TZERO=[0.0]hrs or date,  METOUT=[2],  NSTORM=[1],  NRUN=[1]
*                    ["3h_2yr.STM"] <--storm filename, one per line for NSTORM ti
*%-----------------|-------------------------------------------------------------|
READ STORM          STORM_FILENAME=["STORM.001"]
*%-----------------|-------------------------------------------------------------|
*#  Scenario 1 - Proposed Conditions
*%-----------------|-------------------------------------------------------------|
*#  Catchment 201 - All drainage to a single SWMF
*%-----------------|-------------------------------------------------------------|
DESIGN STANDHYD     ID=[1], NHYD=["201"], DT=[2]min, AREA=[38.4](ha),
                    XIMP=[0.70], TIMP=[0.70], DWF=[0](cms), LOSS=[2], CN=[83],
                    SLOPE=[2.0](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------------|
ROUTE RESERVOIR     IDout=[2],   NHYD=["Spnd1"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                [   0.000 ,  0.0 ]
                                [   0.000 ,  0.3831 ]
                                [   0.061 ,  0.5331 ]
                                [   0.116 ,  1.1213 ]
                                [   0.151 ,  1.7669 ]
                                [   0.354 ,  2.4725 ]
                                [   4.000 ,  3.0000 ]
                                [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[3], NHYDovf=["SOV1"]

*%-----------------|-------------------------------------------------------------|
*#  Scenario 2 - Proposed Conditions
*%-----------------|-------------------------------------------------------------|
*#  Catchment 301 - Drainage to South SWMF
*%-----------------|-------------------------------------------------------------|
DESIGN STANDHYD     ID=[4], NHYD=["301"], DT=[2]min, AREA=[11.8](ha),
                    XIMP=[0.70], TIMP=[0.70], DWF=[0](cms), LOSS=[2], CN=[83],
                    SLOPE=[2.0](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------------|
ROUTE RESERVOIR     IDout=[5],   NHYD=["Spnd2"],  IDin=[4],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                [   0.000 ,  0.0 ]
                                [   0.000 ,  0.1019 ]
                                [   0.026 ,  0.1844 ]
                                [   0.046 ,  0.4013 ]
                                [   0.060 ,  0.6531 ]
                                [   3.227 ,  0.9425 ]
                                [   4.000 ,  3.0000 ]
                                [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[6], NHYDovf=["SOV2"]
*%-----------------|-------------------------------------------------------------|
*#  Catchment 302 - Drainage to West SWMF
*%-----------------|-------------------------------------------------------------|
DESIGN STANDHYD     ID=[7], NHYD=["302"], DT=[2]min, AREA=[26.6](ha),
                    XIMP=[0.70], TIMP=[0.70], DWF=[0](cms), LOSS=[2], CN=[83],
                    SLOPE=[2.0](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-------------------------------------------------------------|
ROUTE RESERVOIR     IDout=[8],   NHYD=["Wpond"],  IDin=[7],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                [   0.000 ,  0.0 ]
                                [   0.000 ,  0.1506 ]
                                [   0.040 ,  0.3094 ]
                                [   0.085 ,  0.6613 ]
                                [   0.113 ,  1.0581 ]
                                [   0.363 ,  1.5025 ]
                                [   5.000 ,  3.0000 ]
                                [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[9], NHYDovf=["WOVF"]
*%-----------------|-------------------------------------------------------------|
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
*%                   ["3h_5yr.STM"] <--storm filename, one per line for NSTORM t
*%-----------------|-------------------------------------------------------------|
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
*%                   ["3h_10yr.STM"] <--storm filename, one per line for NSTORM
*%-----------------|-------------------------------------------------------------|
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
*%                   ["3h_25yr.STM"] <--storm filename, one per line for NSTORM
*%-----------------|-------------------------------------------------------------|
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[5]
*%                   ["3h_100yr.STM"] <--storm filename, one per line for NSTORM
*%-----------------|-------------------------------------------------------------|
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[6]
*%                   ["hurhaz48.STM"] <--storm filename, one per line for NSTORM
*%-----------------|-------------------------------------------------------------|
FINISH
```

```
00001> ================================================================================
00002>
00003>  SSSSS  W    W  M    M  H    H  Y    Y  M    M   OOO        999    999  =========
00004>  S      W W W  MM MM  H    H   Y Y     MM MM  O   O      9   9  9   9
00005>  SSSSS  W W W  M M M  HHHHH    Y      M M M  O   O  ##  9   9  9   9  Ver. 4.02
00006>      S   W W   M    M  H    H    Y     M    M  O   O       9999   9999 July 1999
00007>  SSSSS   W W   M    M  H    H    Y     M    M   OOO            9      9 =========
00008>                                                              9   9  9   9 # 4730904
00009>       StormWater Management HYdrologic Model                  999    999  =========
00010>
00011>  ********************************************************************************
00012>  ************************** SWMHYMO-99 Ver/4.02 ********************************
00013>  *******  A single event and continuous hydrologic simulation model  *******
00014>  *******     based on the principles of HYMO and its successors       *******
00015>  *******                  OTTHYMO-83 and OTTHYMO-89.                  *******
00016>  ********************************************************************************
00017>  ******* Distributed by:  J.F. Sabourin and Associates Inc.           *******
00018>  *******                  Ottawa,  Ontario: (613) 727-5199            *******
00019>  *******                  Gatineau, Quebec: (819) 243-6858            *******
00020>  *******                  E-Mail: swmhymo@jfsa.Com                    *******
00021>  ********************************************************************************
00022>
00023>  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00024>  +++++++ Licensed user: Stantec Consulting Ltd. (Kitchener)          +++++++
00025>  +++++++                Kitchener              SERIAL#:4730904       +++++++
00026>  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00027>
00028>  ********************************************************************************
00029>  *******          ++++++ PROGRAM ARRAY DIMENSIONS ++++++                 *******
00030>  *******          Maximum value for ID numbers  :     10                 *******
00031>  *******          Max. number of rainfall points:  15000                 *******
00032>  *******          Max. number of flow points    :  15000                 *******
00033>  ********************************************************************************
00034>
00035>  *** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) ***
00036>  ***------------------------------------------------------------------------***
00037>  ***    ID:  Hydrograph IDentification numbers, (1-10).                   ***
00038>  ***  NHYD:  Hydrograph reference numbers, (6 digits or characters).      ***
00039>  ***  AREA:  Drainage area associated with hydrograph, (ac.) or (ha.).    ***
00040>  *** QPEAK:  Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s).      ***
00041>  *** TpeakDate_hh:mm is the date and time of the peak flow.                ***
00042>  ***  R.V.:  Runoff Volume of simulated hydrograph, (in) or (mm).         ***
00043>  ***  R.C.:  Runoff Coefficient of simulated hydrograph, (ratio).         ***
00044>  ***    *:  see WARNING or NOTE message printed at end of run.            ***
00045>  ***   **:  see  ERROR  message printed at end of run.                    ***
00046>  ********************************************************************************
00047>  ********************************************************************************
00048>
00049>  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
00050>
00051>  ********************************************************************************
00052>
00053>  *********************   S U M M A R Y   O U T P U T   *********************
00054>  ********************************************************************************
00055>  *       DATE: 2013-01-23     TIME: 15:43:28     RUN COUNTER: 000832       *
00056>  ********************************************************************************
00057>  * Input   filename: C:\TREVOR-1\160311~3\SWMHYMO\UGpr.dat                    *
00058>  * Output  filename: C:\TREVOR-1\160311~3\SWMHYMO\UGpr.out                    *
00059>  * Summary filename: C:\TREVOR-1\160311~3\SWMHYMO\UGpr.sum                    *
00060>  * User comments:                                                            *
00061>  * 1:_____________________________________________________________________*
00062>  * 2:_____________________________________________________________________*
00063>  * 3:_____________________________________________________________________*
00064>  ********************************************************************************
00065>
00066>
00067> #*******************************************************************************
00068> #  Project Name: [Union Gas Milton] Project Number: [1603-11338]
00069> #  Date         : January 2013
00070> #  Modeller     : [T. Fraser/J. Innes]
00071> #  Company      : Stantec Consulting Ltd. (Kitchener)
00072> #  License #    :  4730904
00073> #
00074> #  This hydrologic analysis was prepared to determine the proposed flows from
00075> #  from the site.
00076> #*******************************************************************************
00077>  RUN:COMMAND#
00078>  001:0001--------------------------------------------------------------------
00079>      START
00080>       [TZERO =    .00 hrs on        0]
00081>       [METOUT=   2    (1=imperial, 2=metric output)]
00082>       [NSTORM=   1 ]
00083>       [NRUN  =   1 ]
00084>  001:0002--------------------------------------------------------------------
00085>      READ STORM
00086>       Filename = STORM.001
00087>       Comment  = CHICAGO STORM
00088>       [SDT= 5.00:SDUR=   3.00:PTOT=  32.07]
00089> #  Scenario 1 - Proposed Conditions
00090> #  Catchment 201 - All drainage to a single SWMF
00091>  001:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00092>      DESIGN STANDHYD    01:201       38.40    5.514 No_date    1:13   25.29 .788
00093>       [XIMP=.70:TIMP=.70]
00094>       [SLP=2.00:DT= 2.50]
00095>       [LOSS= 2 :CN= 83.0]
00096>  001:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00097>      ROUTE RESERVOIR -> 01:201       38.40    5.514 No_date    1:13   25.29  n/a
00098>   *  [RDT=  .83] out<- 02:Spnd1      38.40     .096 No_date    3:08   15.31  n/a
00099>             overflow <= 03:SOV1         .00     .000 No_date    0:00     .00  n/a
00100>      {MxStoUsed=.9056E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00101> #  Scenario 2 - Proposed Conditions
00102> #  Catchment 301 - Drainage to South SWMF
00103>  001:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00104>      DESIGN STANDHYD    04:301       11.80    2.066 No_date    1:10   25.29 .788
00105>       [XIMP=.70:TIMP=.70]
00106>       [SLP=2.00:DT= 2.50]
00107>       [LOSS= 2 :CN= 83.0]
00108>  001:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00109>      ROUTE RESERVOIR -> 04:301       11.80    2.066 No_date    1:10   25.29  n/a
00110>   *  [RDT=  .83] out<- 05:Spnd2      11.80     .034 No_date    3:04   16.65  n/a
00111>             overflow <= 06:SOV2         .00     .000 No_date    0:00     .00  n/a
00112>      {MxStoUsed=.2752E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00113> #  Catchment 302 - Drainage to West SWMF
00114>  001:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00115>      DESIGN STANDHYD    07:302       26.60    3.972 No_date    1:13   25.29 .788
00116>       [XIMP=.70:TIMP=.70]
00117>       [SLP=2.00:DT= 2.50]
00118>       [LOSS= 2 :CN= 83.0]
00119>  001:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00120>      ROUTE RESERVOIR -> 07:302       26.60    3.972 No_date    1:13   25.29  n/a
00121>   *  [RDT=  .83] out<- 08:Wpond      26.60     .080 No_date    3:06   19.63  n/a
00122>             overflow <= 09:WOVF         .00     .000 No_date    0:00     .00  n/a
00123>      {MxStoUsed=.6194E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00124>   ** END OF RUN :   1
00125>
00126>  ********************************************************************************
00127>
00128>
00129>
00130>
00131>
00132>  RUN:COMMAND#
00133>  002:0001--------------------------------------------------------------------
00134>      START
00135>       [TZERO =    .00 hrs on        0]
00136>       [METOUT=   2    (1=imperial, 2=metric output)]
00137>       [NSTORM=   1 ]
00138>       [NRUN  =   2 ]
00139> #*******************************************************************************
00140> #  Project Name: [Union Gas Milton] Project Number: [1603-11338]
00141> #  Date         : January 2013
00142> #  Modeller     : [T. Fraser/J. Innes]
00143> #  Company      : Stantec Consulting Ltd. (Kitchener)
00144> #  License #    :  4730904
00145> #
00146> #  This hydrologic analysis was prepared to determine the proposed flows from
00147> #  from the site.
00148> #*******************************************************************************
00149>  002:0002--------------------------------------------------------------------
00150>      READ STORM
00151>       Filename = STORM.001
00152>       Comment  = CHICAGO STORM
00153>       [SDT= 5.00:SDUR=   3.00:PTOT=  43.48]
00154> #  Scenario 1 - Proposed Conditions
00155> #  Catchment 201 - All drainage to a single SWMF
00156>  002:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00157>      DESIGN STANDHYD    01:201       38.40    7.679 No_date    1:13   35.50 .816
00158>       [XIMP=.70:TIMP=.70]
00159>       [SLP=2.00:DT= 2.50]
00160>       [LOSS= 2 :CN= 83.0]
00161>  002:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00162>      ROUTE RESERVOIR -> 01:201       38.40    7.679 No_date    1:13   35.50  n/a
00163>   *  [RDT=  .83] out<- 02:Spnd1      38.40     .124 No_date    3:09   25.52  n/a
00164>             overflow <= 03:SOV1         .00     .000 No_date    0:00     .00  n/a
00165>      {MxStoUsed=.1277E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00166> #  Scenario 2 - Proposed Conditions
00167> #  Catchment 301 - Drainage to South SWMF
00168>  002:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00169>      DESIGN STANDHYD    04:301       11.80    2.857 No_date    1:10   35.50 .816
00170>       [XIMP=.70:TIMP=.70]
00171>       [SLP=2.00:DT= 2.50]
00172>       [LOSS= 2 :CN= 83.0]
00173>  002:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00174>      ROUTE RESERVOIR -> 04:301       11.80    2.857 No_date    1:10   35.50  n/a
00175>   *  [RDT=  .83] out<- 05:Spnd2      11.80     .045 No_date    3:04   26.87  n/a
00176>             overflow <= 06:SOV2         .00     .000 No_date    0:00     .00  n/a
00177>      {MxStoUsed=.3888E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00178> #  Catchment 302 - Drainage to West SWMF
00179>  002:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00180>      DESIGN STANDHYD    07:302       26.60    5.489 No_date    1:13   35.50 .816
00181>       [XIMP=.70:TIMP=.70]
00182>       [SLP=2.00:DT= 2.50]
00183>       [LOSS= 2 :CN= 83.0]
00184>  002:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00185>      ROUTE RESERVOIR -> 07:302       26.60    5.489 No_date    1:13   35.50  n/a
00186>   *  [RDT=  .83] out<- 08:Wpond      26.60     .100 No_date    3:07   29.84  n/a
00187>             overflow <= 09:WOVF         .00     .000 No_date    0:00     .00  n/a
00188>      {MxStoUsed=.8749E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00189>   ** END OF RUN :   2
00190>
00191>  ********************************************************************************
00192>
00193>
00194>
00195>
00196>
00197>  RUN:COMMAND#
00198>  003:0001--------------------------------------------------------------------
00199>      START
00200>       [TZERO =    .00 hrs on        0]
00201>       [METOUT=   2    (1=imperial, 2=metric output)]
00202>       [NSTORM=   1 ]
00203>       [NRUN  =   3 ]
00204> #*******************************************************************************
00205> #  Project Name: [Union Gas Milton] Project Number: [1603-11338]
00206> #  Date         : January 2013
00207> #  Modeller     : [T. Fraser/J. Innes]
00208> #  Company      : Stantec Consulting Ltd. (Kitchener)
00209> #  License #    :  4730904
00210> #
00211> #  This hydrologic analysis was prepared to determine the proposed flows from
00212> #  from the site.
00213> #*******************************************************************************
00214>  003:0002--------------------------------------------------------------------
00215>      READ STORM
00216>       Filename = STORM.001
00217>       Comment  = CHICAGO STORM
00218>       [SDT= 5.00:SDUR=   3.00:PTOT=  51.19]
00219> #  Scenario 1 - Proposed Conditions
00220> #  Catchment 201 - All drainage to a single SWMF
00221>  003:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00222>      DESIGN STANDHYD    01:201       38.40    9.107 No_date    1:13   42.55 .831
00223>       [XIMP=.70:TIMP=.70]
00224>       [SLP=2.00:DT= 2.50]
00225>       [LOSS= 2 :CN= 83.0]
00226>  003:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00227>      ROUTE RESERVOIR -> 01:201       38.40    9.107 No_date    1:13   42.55  n/a
00228>   *  [RDT=  .83] out<- 02:Spnd1      38.40     .138 No_date    3:09   32.58  n/a
00229>             overflow <= 03:SOV1         .00     .000 No_date    0:00     .00  n/a
00230>      {MxStoUsed=.1536E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00231> #  Scenario 2 - Proposed Conditions
00232> #  Catchment 301 - Drainage to South SWMF
00233>  003:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00234>      DESIGN STANDHYD    04:301       11.80    3.376 No_date    1:10   42.55 .831
00235>       [XIMP=.70:TIMP=.70]
00236>       [SLP=2.00:DT= 2.50]
00237>       [LOSS= 2 :CN= 83.0]
00238>  003:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00239>      ROUTE RESERVOIR -> 04:301       11.80    3.376 No_date    1:10   42.55  n/a
00240>   *  [RDT=  .83] out<- 05:Spnd2      11.80     .050 No_date    3:05   33.92  n/a
00241>             overflow <= 06:SOV2         .00     .000 No_date    0:00     .00  n/a
00242>      {MxStoUsed=.4678E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00243> #  Catchment 302 - Drainage to West SWMF
00244>  003:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00245>      DESIGN STANDHYD    07:302       26.60    6.567 No_date    1:13   42.55 .831
00246>       [XIMP=.70:TIMP=.70]
00247>       [SLP=2.00:DT= 2.50]
00248>       [LOSS= 2 :CN= 83.0]
00249>  003:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00250>      ROUTE RESERVOIR -> 07:302       26.60    6.567 No_date    1:13   42.55  n/a
00251>   *  [RDT=  .83] out<- 08:Wpond      26.60     .113 No_date    3:08   36.89  n/a
00252>             overflow <= 09:WOVF         .00     .000 No_date    0:00     .00  n/a
00253>      {MxStoUsed=.1054E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00254>   ** END OF RUN :   3
00255>
00256>  ********************************************************************************
00257>
00258>
00259>
00260>
00261>
00262>  RUN:COMMAND#
00263>  004:0001--------------------------------------------------------------------
00264>      START
00265>       [TZERO =    .00 hrs on        0]
00266>       [METOUT=   2    (1=imperial, 2=metric output)]
00267>       [NSTORM=   1 ]
00268>       [NRUN  =   4 ]
00269> #*******************************************************************************
00270> #  Project Name: [Union Gas Milton] Project Number: [1603-11338]
```

```
00271> #  Date        : January 2013
00272> #  Modeller    : [T. Fraser/J. Innes]
00273> #  Company     : Stantec Consulting Ltd. (Kitchener)
00274> #  License #   :  4730904
00275> #
00276> #  This hydrologic analysis was prepared to determine the proposed flows from
00277> #  from the site.
00278> #*****************************************************************************
00279>  004:0002----------------------------------------------------------------------
00280>      READ STORM
00281>       Filename = STORM.001
00282>       Comment  = CHICAGO STORM
00283>       [SDT= 5.00:SDUR=   3.00:PTOT=  60.91]
00284> #  Scenario 1 - Proposed Conditions
00285> #  Catchment 201 - All drainage to a single SWMF
00286>  004:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00287>      DESIGN STANDHYD    01:201       38.40   11.129 No_date    1:13   51.58 .847
00288>        [XIMP=.70:TIMP=.70]
00289>        [SLP=2.00:DT= 2.50]
00290>        [LOSS= 2 :CN= 83.0]
00291>  004:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00292>      ROUTE RESERVOIR -> 01:201       38.40   11.129 No_date    1:13   51.58  n/a
00293>   *   [RDT= .83] out<- 02:Spnd1      38.40     .180 No_date    3:08   41.60  n/a
00294>             overflow <= 03:SOV1        .00     .000 No_date    0:00     .00  n/a
00295>      {MxStoUsed=.1867E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00296> #  Scenario 2 - Proposed Conditions
00297> #  Catchment 301 - Drainage to South SWMF
00298>  004:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00299>      DESIGN STANDHYD    04:301       11.80    4.110 No_date    1:10   51.58 .847
00300>        [XIMP=.70:TIMP=.70]
00301>        [SLP=2.00:DT= 2.50]
00302>        [LOSS= 2 :CN= 83.0]
00303>  004:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00304>      ROUTE RESERVOIR -> 04:301       11.80    4.110 No_date    1:10   51.58  n/a
00305>   *   [RDT= .83] out<- 05:Spnd2      11.80     .055 No_date    3:05   42.94  n/a
00306>             overflow <= 06:SOV2        .00     .000 No_date    0:00     .00  n/a
00307>      {MxStoUsed=.5703E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00308> #  Catchment 302 - Drainage to West SWMF
00309>  004:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00310>      DESIGN STANDHYD    07:302       26.60    7.920 No_date    1:13   51.58 .847
00311>        [XIMP=.70:TIMP=.70]
00312>        [SLP=2.00:DT= 2.50]
00313>        [LOSS= 2 :CN= 83.0]
00314>  004:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00315>      ROUTE RESERVOIR -> 07:302       26.60    7.920 No_date    1:13   51.58  n/a
00316>   *   [RDT= .83] out<- 08:Wpond      26.60     .221 No_date    3:04   45.92  n/a
00317>             overflow <= 09:WOVF        .00     .000 No_date    0:00     .00  n/a
00318>      {MxStoUsed=.1251E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00319>    ** END OF RUN :   4
00320>
00321> *****************************************************************************
00322>
00323>
00324>
00325>
00326>
00327>  RUN:COMMAND#
00328>  005:0001----------------------------------------------------------------------
00329>      START
00330>       [TZERO =    .00 hrs on        0]
00331>       [METOUT=   2    (1=imperial, 2=metric output)]
00332>       [NSTORM=   1 ]
00333>       [NRUN  =   5 ]
00334> #*****************************************************************************
00335> #  Project Name: [Union Gas Milton] Project Number: [1603-11338]
00336> #  Date        : January 2013
00337> #  Modeller    : [T. Fraser/J. Innes]
00338> #  Company     : Stantec Consulting Ltd. (Kitchener)
00339> #  License #   :  4730904
00340> #
00341> #  This hydrologic analysis was prepared to determine the proposed flows from
00342> #  from the site.
00343> #*****************************************************************************
00344>  005:0002----------------------------------------------------------------------
00345>      READ STORM
00346>       Filename = STORM.001
00347>       Comment  = CHICAGO STORM
00348>       [SDT= 5.00:SDUR=   3.00:PTOT=  75.19]
00349> #  Scenario 1 - Proposed Conditions
00350> #  Catchment 201 - All drainage to a single SWMF
00351>  005:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00352>      DESIGN STANDHYD    01:201       38.40   14.310 No_date    1:13   65.03 .865
00353>        [XIMP=.70:TIMP=.70]
00354>        [SLP=2.00:DT= 2.50]
00355>        [LOSS= 2 :CN= 83.0]
00356>  005:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00357>      ROUTE RESERVOIR -> 01:201       38.40   14.310 No_date    1:13   65.03  n/a
00358>   *   [RDT= .83] out<- 02:Spnd1      38.40     .310 No_date    3:06   55.06  n/a
00359>             overflow <= 03:SOV1        .00     .000 No_date    0:00     .00  n/a
00360>      {MxStoUsed=.2319E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00361> #  Scenario 2 - Proposed Conditions
00362> #  Catchment 301 - Drainage to South SWMF
00363>  005:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00364>      DESIGN STANDHYD    04:301       11.80    5.171 No_date    1:10   65.03 .865
00365>        [XIMP=.70:TIMP=.70]
00366>        [SLP=2.00:DT= 2.50]
00367>        [LOSS= 2 :CN= 83.0]
00368>  005:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00369>      ROUTE RESERVOIR -> 04:301       11.80    5.171 No_date    1:10   65.03  n/a
00370>   *   [RDT= .83] out<- 05:Spnd2      11.80     .253 No_date    2:32   56.40  n/a
00371>             overflow <= 06:SOV2        .00     .000 No_date    0:00     .00  n/a
00372>      {MxStoUsed=.6707E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00373> #  Catchment 302 - Drainage to West SWMF
00374>  005:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00375>      DESIGN STANDHYD    07:302       26.60   10.930 No_date    1:10   65.03 .865
00376>        [XIMP=.70:TIMP=.70]
00377>        [SLP=2.00:DT= 2.50]
00378>        [LOSS= 2 :CN= 83.0]
00379>  005:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00380>      ROUTE RESERVOIR -> 07:302       26.60   10.930 No_date    1:10   65.03  n/a
00381>   *   [RDT= .83] out<- 08:Wpond      26.60     .405 No_date    3:01   59.37  n/a
00382>             overflow <= 09:WOVF        .00     .000 No_date    0:00     .00  n/a
00383>      {MxStoUsed=.1516E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00384>    ** END OF RUN :   5
00385>
00386> *****************************************************************************
00387>
00388>
00389>
00390>
00391>
00392>  RUN:COMMAND#
00393>  006:0001----------------------------------------------------------------------
00394>      START
00395>       [TZERO =    .00 hrs on        0]
00396>       [METOUT=   2    (1=imperial, 2=metric output)]
00397>       [NSTORM=   1 ]
00398>       [NRUN  =   6 ]
00399> #*****************************************************************************
00400> #  Project Name: [Union Gas Milton] Project Number: [1603-11338]
00401> #  Date        : January 2013
00402> #  Modeller    : [T. Fraser/J. Innes]
00403> #  Company     : Stantec Consulting Ltd. (Kitchener)
00404> #  License #   :  4730904
00405> #
00406> #  This hydrologic analysis was prepared to determine the proposed flows from
00407> #  from the site.
00408> #*****************************************************************************
00409>  006:0002----------------------------------------------------------------------
00410>      READ STORM
00411>       Filename = STORM.001
00412>       Comment  = REGIONAL STORM
00413>       [SDT=15.00:SDUR=  48.00:PTOT= 285.00]
00414> #  Scenario 1 - Proposed Conditions
00415> #  Catchment 201 - All drainage to a single SWMF
00416>  006:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00417>      DESIGN STANDHYD    01:201       38.40    5.532 No_date    46:00  270.80 .950
00418>        [XIMP=.70:TIMP=.70]
00419>        [SLP=2.00:DT= 2.14]
00420>        [LOSS= 2 :CN= 83.0]
00421>  006:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00422>      ROUTE RESERVOIR -> 01:201       38.40    5.532 No_date    46:00  270.80  n/a
00423>   *   [RDT= 1.07] out<- 02:Spnd1      37.25    4.000 No_date    45:40  260.52  n/a
00424>             overflow <= 03:SOV1        1.15    1.530 No_date    46:00  270.80  n/a
00425>      {MxStoUsed=.3000E+01, TotOvfVol=.3118E+00, N-Ovf=    3, TotDurOvf=    1.hrs
00426> #  Scenario 2 - Proposed Conditions
00427> #  Catchment 301 - Drainage to South SWMF
00428>  006:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00429>      DESIGN STANDHYD    04:301       11.80    1.708 No_date    46:00  270.80 .950
00430>        [XIMP=.70:TIMP=.70]
00431>        [SLP=2.00:DT= 2.14]
00432>        [LOSS= 2 :CN= 83.0]
00433>  006:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00434>      ROUTE RESERVOIR -> 04:301       11.80    1.708 No_date    46:00  270.80  n/a
00435>   *   [RDT= 1.07] out<- 05:Spnd2      11.80    1.643 No_date    46:02  262.16  n/a
00436>             overflow <= 06:SOV2        .00     .000 No_date     0:00     .00  n/a
00437>      {MxStoUsed=.7978E+00, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00438> #  Catchment 302 - Drainage to West SWMF
00439>  006:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00440>      DESIGN STANDHYD    07:302       26.60    3.841 No_date    46:00  270.80 .950
00441>        [XIMP=.70:TIMP=.70]
00442>        [SLP=2.00:DT= 2.14]
00443>        [LOSS= 2 :CN= 83.0]
00444>  006:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
00445>      ROUTE RESERVOIR -> 07:302       26.60    3.841 No_date    46:00  270.80  n/a
00446>   *   [RDT= 1.07] out<- 08:Wpond      26.60    2.859 No_date    46:31  265.14  n/a
00447>             overflow <= 09:WOVF        .00     .000 No_date     0:00     .00  n/a
00448>      {MxStoUsed=.2308E+01, TotOvfVol=.0000E+00, N-Ovf=    0, TotDurOvf=    0.hrs
00449>  006:0002----------------------------------------------------------------------
00450>      FINISH
00451> ----------------------------------------------------------------------------
00452> *****************************************************************************
00453>      WARNINGS / ERRORS / NOTES
00454>      -------------------------
00455>  001:0004 ROUTE RESERVOIR
00456>       *** WARNING: Outflow volume is less than inflow volume.
00457>  001:0006 ROUTE RESERVOIR
00458>       *** WARNING: Outflow volume is less than inflow volume.
00459>  001:0008 ROUTE RESERVOIR
00460>       *** WARNING: Outflow volume is less than inflow volume.
00461>  002:0004 ROUTE RESERVOIR
00462>       *** WARNING: Outflow volume is less than inflow volume.
00463>  002:0006 ROUTE RESERVOIR
00464>       *** WARNING: Outflow volume is less than inflow volume.
00465>  002:0008 ROUTE RESERVOIR
00466>       *** WARNING: Outflow volume is less than inflow volume.
00467>  003:0004 ROUTE RESERVOIR
00468>       *** WARNING: Outflow volume is less than inflow volume.
00469>  003:0006 ROUTE RESERVOIR
00470>       *** WARNING: Outflow volume is less than inflow volume.
00471>  003:0008 ROUTE RESERVOIR
00472>       *** WARNING: Outflow volume is less than inflow volume.
00473>  004:0004 ROUTE RESERVOIR
00474>       *** WARNING: Outflow volume is less than inflow volume.
00475>  004:0006 ROUTE RESERVOIR
00476>       *** WARNING: Outflow volume is less than inflow volume.
00477>  004:0008 ROUTE RESERVOIR
00478>       *** WARNING: Outflow volume is less than inflow volume.
00479>  005:0004 ROUTE RESERVOIR
00480>       *** WARNING: Outflow volume is less than inflow volume.
00481>  005:0006 ROUTE RESERVOIR
00482>       *** WARNING: Outflow volume is less than inflow volume.
00483>  005:0008 ROUTE RESERVOIR
00484>       *** WARNING: Outflow volume is less than inflow volume.
00485>  006:0004 ROUTE RESERVOIR
00486>       *** WARNING: Outflow volume is less than inflow volume.
00487>  006:0006 ROUTE RESERVOIR
00488>       *** WARNING: Outflow volume is less than inflow volume.
00489>  006:0008 ROUTE RESERVOIR
00490>       *** WARNING: Outflow volume is less than inflow volume.
00491>    Simulation ended on 2013-01-23     at 15:43:30
00492> ============================================================================
00493>
```

Appendix C5

Detailed Tree Inventory

Union Gas Compressor Station,
Parkway West – Site #2
Milton, Ontario

Detailed Tree Inventory

Prepared for:

Union Gas Ltd.

Prepared by:

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Project 1603-11376
January 2013

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1.0 Introduction

Stantec Consulting Ltd. (Stantec) has been retained by Union Gas Ltd. to complete a Detailed Tree Inventory to support a Zone Change Application for the proposed Compressor Station in Milton Ontario. This report identifies the existing trees and shrubs on the project property and provides the Town of Milton with a summary of the current vegetation site conditions. This report also provides the Client with recommendations for vegetation management.

The project site is located on east side of Eighth Line, south of Derry Road in Milton, Ontario. The project site is an agricultural field approximately 94 acres (38 hectares) in size. The project site is abutted by a hydro corridor, railway and Highway 407 to the east. The northern and southern boundaries of the project site are abutted by residential and agricultural properties. Residential properties, #6689, #6621, and #6603 Eighth line abut the study area property boundaries.

Hedgerows were comprised of trees and shrubs along the west and north property boundaries of the site. No vegetation was observed along the southern project boundary. There were isolated groupings of vegetation and small trees along the eastern perimeter of the site.

1.1 REPORT CONTENT AND PURPOSE

This report catalogues the existing trees and shrubs observed within the project site. The existing conditions will support the Zone Change Application and satisfy the Town of Milton's requirements for the application.

Outlined below is a summary of information contained within this report:

- Detailed inventory of isolated tree species, and general inventory for vegetation units included inventory data such as diameter at breast height (DBH), dripline radius, general health condition, and tolerance to construction impact
- Identification of any rare or endangered species, or species that may be of interest to retain and protect, and
- Recommendations for vegetation management.

2.0 Methodology

2.1 SITE INSPECTION AND REPORT

Ms. Daniella Giovanatto, BLA, Certified Arborist, completed an inventory and assessment of the trees located within the property boundaries and trees directly adjacent to the property line that may be impacted by future site development. This inventory was limited to lands currently owned by Union Gas and the proposed property acquisition as illustrated on Figure 1.0, Tree Inventory Plan. Trees that were located outside of study area were visually assessed. Only trees located approximately 5m onto private property were included in this inventory.

The detailed inventory includes trees that were 10cm diameter at breast height (DBH) and greater. The trees located on the development property were tagged with a numbered steel tree tag, and trees located on adjacent property were provided an alphabetical identification key. Tree species identification, general health condition, DBH, and dripline radius were recorded for each tree.

The general inventory includes general species composition, and average condition of existing trees and shrubs less than 10cm DBH. Tree condition has been assessed based on observed health indicators which include live crown, deadwood, structural defects and presence of disease.

Both the detailed and general inventory data has compiled into tables and is provided at the end of section 3.0. Table 1 includes the detailed inventory and Table 2 includes the general inventory. Inventoried trees and shrubs have been grouped into vegetation units, ‘A’ through ‘N’ and the approximate locations of these units have been identified on the Tree Inventory Plan, Figure 1.0, Appendix A.

2.2 TREE CONDITION RATING

Outlined below are the detailed guidelines utilized for the classification of condition rating:

Excellent: (Vigour Class 6: Healthy)
No major branch mortality: crown is reasonably normal with less than 10% branch or twig mortality; no signs of decay.

Good: (Vigour Class 5: Light Decline)
Branch mortality, twig dieback in 11-25% of the crown: broken branches or crown missing based on presence of old snags is less than 26%; minor evidence of decay.

Fair: (Vigour Class 4: Moderate Decline)
Branch mortality, twig dieback in 26-50% of the crown: broken branches or crown area missing based on presence of old snags is 50% or less; decay evident.

Poor: (Vigour Class 3: Severe Decline)
Branch mortality, twig dieback in more than 50% of the crown: broken branches or crown area missing based on presence of old snags in more than 50%; decay resulting in high hazard assessment.

Dead: (Vigour Class 2: Dead due to Natural Causes)
Tree is dead, either standing or down: phloem under bark has brown streaks: few epicormic shoots may be present.

Dead: (Vigour Class 1: Dead due to Human Causes)
Tree removed: tree has been sawed or girdled by human activity.

2.3 TOLERANCE TO IMPACT

There are a number of factors that influence how trees respond to impacts, including species, age, health, and structural development. Trees vary widely in their ability to tolerate injury and changes in their environment. Some trees are able to withstand removal of a maximum of 50% of their root system, while others will be fatally impacted by the removal of significantly less roots. The tolerance levels have been provided for each tree species to assist in determining which trees may be retained or removed. The tolerance to impact rating also guides site plan development, servicing, and grading by providing a clear indication of which trees can survive impacts through development.

2.4 PRESERVATION PRIORITY

Vegetation units were analyzed to identify a preservation priority of High, Medium, or Low. The priority level is based on existing trees' and shrubs' condition rating, the DBH, and whether the species is an aggressive invasive or nonnative invasive species. The following outlines the qualifications for each preservation priority:

High	- Tree with a condition rating of excellent or good. And/or greater than 15cm DBH - Trees located on private property, outside study area boundaries.
Medium	- Tree with a condition rating of fair. And/or Ash trees. And/or trees between 11cm DBH to 15cm DBH
Low	- Tree with a condition rating of poor and/or 10cm DBH or less. And/or a non-native/invasive species. And/or trees with evidence of Emerald Ash Borer (EAB) infestation
Dead	- Trees that were dead

Preservation priority has been assigned to units as a guide during design process only. Assigned priorities are reflective of the above criteria and meant to serve as a guide of future opportunities or constraints. Removal/retention recommendations must be made based upon existing conditions and are part of the site plan process.

3.0 Observations and Summary

This section is to be read in conjunction with Figure 1.0 attached in Appendix 'A' for location of vegetation units, and Table 1. Detailed Tree Inventory, and Table 2. General Vegetation Inventory located at the end of Section 3.0 for species and species data. For ease of discussion, observations have been separated into vegetation units. The vegetation units below identify species that were included in general or detailed inventory and a description of the unit.

There were no rare or endangered species observed within the project site.

3.1 UNIT A - Tree #901 to Tree #912

Observations:

Unit A is located along the north property line. This unit is comprised of a hedgerow with trees and shrubs. A dense understory of shrubs, and small trees and saplings were observed between isolated trees. Small trees present include *Acer negundo* (Manitoba Maple), *Fraxinus sp.* (Ash) and *Crataegus sp.* (Hawthorn). Shrubs present include *Lonicera sp. (*Honeysuckle), *Prunus virginiana* (Chokecherry), and *Rhamnus sp.* (Buckthorn sp.). Black Knot disease was observed in the Chokecherries' branches. Trees located within this unit were generally in fair to good condition.

Recommendations:

Unit A is categorized as a low preservation priority due to the species type and diameter, Retention of this unit in not imperative but would be beneficial to the future development as a vegetated screen and as a windbreak.

3.2 UNIT B - Tree #913 to Tree #914

Observations:

Unit B is located along the north property line. This unit was predominately comprised of isolated clumps of *Crataegus sp.* (Hawthorn Sp.) interspersed with *Prunus virginiana* (Chokecherry) shrubs. Black Knot disease was observed in the Chokecherries' branches. The vegetation was located at the edge of the property, growing adjacent to the fence line and were generally in fair to good condition.

Recommendations:

Unit B is categorized as a low preservation priority due to the species type and diameter, Retention of this unit in not imperative but would be beneficial to the future development as a vegetated screen to the adjacent property and as a windbreak.

3.3 UNIT C – No Trees

Observations:
Unit C is located at the east property boundary. This unit is comprised of isolated shrubs and isolated *Fraxinus sp. (*Ash) saplings growing adjacent to the fence line. This unit was predominately shrubs including both *Rhamnus sp.* (Buckthorn sp.) *and Rosa sp.* (Wild Rose). Vegetation observed was in fair to good condition.

Recommendations:
Unit C is classified as a low preservation priority due to species type (Buckthorn is considered a non-native invasive species), and diameter size.

3.4 UNIT D - Tree #915

Observations:
Unit D is located at the centre of the east property line of the study area. This unit is comprised of isolated trees, shrubs, and saplings growing adjacent to the fence line. Smaller vegetation noted included: *Lonicera sp.* (Honeysuckle), *Rhamnus sp.* (Buckthorn), and *Vitis sp.* (Wild Grape) and was generally in fair to good condition.

Recommendations:
Unit D is classified as a low preservation priority due to species type (Buckthorn is considered a non-native invasive species), and diameter size.

3.5 UNIT E – No Trees greater than 10cm DBH

Observations:
Unit E is located at the east boundary of the study area. This unit is comprised of an untilled area where grasses, saplings and small trees have become established in dense colonies. Species observed were *Lonicera sp.* (Honeysuckle), *Rhamnus sp.* (Buckthorn), *Rosa sp.,* (Wild Rose), *Rubus sp.* (Raspberry), and *Vitis sp.* (Wild Grape). The vegetation observed in Unit E was generally in fair to good condition.

Recommendations:
Unit E is classified as a low preservation priority due to species type (Buckthorn is considered a non-native invasive species), and diameter size.

3.6 UNIT F – No Trees

Observations:
Unit F is located within the Union Gas property and adjacent to existing residential property, 6603 Eighth Line. This unit is comprised of a dense stand of *Syringa vulgaris* (Common Lilac) shrubs in fair to good condition.

Recommendations:
Unit F is classified as a low preservation priority due to species type (Lilacs are considered a non-native invasive species) and diameter size.

3.7 UNIT G – Tree #918

Observations:
Unit G is located within the central area of the project site and within existing gas line property owned by Union Gas. This unit is comprised of dense clumps of shrubs and saplings. Tree #918 is a *Fraxinus pennsylvanica* (Green Ash) and was growing within the dense shrubs. Smaller vegetation noted includes: *Lonicera sp.* (Honeysuckle) and *Rhamnus sp.* (Buckthorn). Vegetation within Unit G was generally in poor to fair condition and Black Knot was observed on the *Prunus virginiana (*Chokecherry) shrubs.

Recommendations:
Unit G has a low preservation priority with the exception of Tree #918 which is a 17cm DBH *Fraxinus pennsylvanica* (Green Ash) which has a medium preservation priority. A low preservation priority for the remaining vegetation is due to species type and diameter size.

3.8 UNIT H - Trees A & B

Observations:
Unit H is located adjacent to the west property line of the project site and the within the property boundaries of existing residential property, 6621 Eighth Line. This unit is comprised of two large privately-owned trees, identified as Tree A which is an *Acer saccharinum (*Silver Maple) and Tree B which is a *Salix alba 'Tristis'* (Golden Weeping Willow). Both of these trees were in fair to good condition.

Recommendations:
Unit H is considered a high preservation priority as the trees are located on private property and should not be impacted by any future design or development.

3.9 UNIT I - Tree #916 & Tree #917, Tree #919 to Tree # 931

Observations:
Unit I is located along the western property boundary and adjacent to the right-of-way of Eighth Line. This unit is a dense hedgerow of trees and shrubs that have been pruned for overhead hydro clearance. A dense understory of saplings and shrubs is present. Smaller vegetation noted includes: *Lonicera sp.* (Honeysuckle), *Rhamnus sp.* (Buckthorn), and *Rosa sp.* (Wild Rose). Trees and shrubs located within Unit I were in poor to fair condition due to pruning.

Recommendations:
The majority of the vegetation in Unit I is considered low preservation priority due to the condition and diameter size. Trees #916, #917, and #919 through #931 are also classified as having a low preservation priority due to condition and species. The retention of this unit is not imperative due to the condition of the vegetation and species it contains. However, retained vegetation would provide screening as the trees topped for hydro line clearance still have approximately fifty per cent of their branches. As such, if a vegetation screen is desired, then the unit should be retained.

3.10 UNIT J - Trees C to KK

Observations:
Unit J is located at the southern limit of existing residential property, 6689 Eighth Line. This unit is a maintained landscape hedgerow with medium aged, privately owned trees. Saplings have established in open areas within the hedgerow.

Recommendations:
Unit J is considered a high preservation priority as the trees are located on private property and should not be impacted by any future design or development.

3.11 UNIT K – No Trees Greater than 10cm DBH

Observations:
Unit K is located at southern limit of existing residential property, 6689 Eighth Line. This unit is comprised of saplings and young trees growing in a natural area with long grassed areas interspersed. Some *Rhamnus sp.* (Buckthorn) was noted growing within this unit. The trees located within this unit were in fair to good condition.

Recommendations:
Unit K is considered a high preservation priority as the trees are located on private property and should not be impacted by any future design or development.

3.12 UNIT L - Trees LL to MM

Observations:
Unit L is located at the property limit of existing residential property, 6689 Eighth Line. This unit is comprised of isolated young trees and saplings growing in a natural area with long grassed areas interspersed.

Recommendations:
Unit L is considered a high preservation priority as the trees are located on private property and should not be impacted by any future design or development.

3.13 UNIT M - Trees NN to UUU

Observations:
Unit M is located at the property limit of existing residential property, 6689 Eighth Line. This unit is a maintained landscape hedgerow with medium aged, privately owned trees. There were areas of dense saplings that have become established and naturalized open areas within the hedgerow.

Recommendations:
Unit M is considered a high preservation priority as the trees are located on private property and should not be impacted by any future design or development.

3.14 UNIT N - Trees #932 to Tree #937

Observations:
Unit N is located along the western property boundary and adjacent to the right-of-way of Eighth Line. This unit is an open hedgerow of trees and saplings that have been pruned for overhead hydro clearance.

Recommendations:
This unit is categorized as low preservation priority due to species, condition, and diameter size. Retention of this unit is not imperative, but retention would provide vegetation screening from Eighth line into the site.

3.15 SUMMARY

The detailed tree information included in this report and tables is an inventory of the proposed property acquisition as outlined in Figure 1.0, Tree Inventory Plan, included in Appendix A. The study area is primarily devoid of trees with the exception of the outer property limits. The majority of these trees were located outside the study area limits.

TABLE #1 - Union Gas Compressor Station, Parkway West - Site #2, January 7, 2013

UNIT	Tag #	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Condition	Comments	Tolerance to Impact
A	901	*Fraxinus pennsylvanica*	Green Ash	11	1	G	Double leader.	Good
	902	*Fraxinus pennsylvanica*	Green Ash	10	1	F	Mechanical damage to trunk; Double leader.	Good
	903	*Fraxinus nigra*	Black Ash	19	1	G	Hawthorn growing at base.	Good
	904	*Ulmus americana*	White Elm	27	2.5	G	Located immediately adjacent to Tree #905.	Moderate
	905	*Ulmus americana*	White Elm	39	3	G	Located immediately adjacent to Tree #904.	Moderate
	906	*Fraxinus pennsylvanica*	Green Ash	10	1	G	Double leader.	Good
	907	*Quercus macrocarpa*	Bur Oak	15	1	G		Moderate to Good
	908	*Malus sp.*	Apple Sp.	15,17,10,20, (2)12,14	2	F	Dead wood present in canopy.	Good
	909	*Fraxinus pennsylvanica*	Green Ash	13	1	G		Good
	910	*Ulmus americana*	White Elm	13	2	F	Leans into field; 90 degree bend in trunk.	Moderate
	911	*Fraxinus pennsylvanica*	Green Ash	34	2	F	White lichen present on lower branches.	Good
	912	*Fraxinus pennsylvanica*	Green Ash	29	2	G		Good
B	913	*Fraxinus pennsylvanica*	Green Ash	13	1	F	Insect holes present in trunk.	Good
	914	*Fraxinus pennsylvanica*	Green Ash	21,25	2	F		Good
D	915	*Fraxinus pennsylvanica*	Green Ash	15	1	F		Good
I	916	*Fraxinus pennsylvanica*	Green Ash	26	1.5	P	Pruned for overhead Hydro lines, topped.	Good
	917	*Fraxinus pennsylvanica*	Green Ash	25	1.5	P	Pruned for overhead Hydro lines, topped.	Good
G	918	*Fraxinus pennsylvanica*	Green Ash	17	1.5	F	Wounds present on trunk, frost cracks; No signs of rot present.	Good
I	919	*Acer negundo*	Manitoba Maple	15,15	2	G		Good
	920	*Gleditsia triocanthos*	Honey Locust	21	1.5	P	Pruned for overhead Hydro lines, topped; Suckering	Good
	921	*Fraxinus pennsylvanica*	Green Ash	23	2	F	Pruned for overhead Hydro.	Good
	922	*Gleditsia triocanthos*	Honey Locust	13	1.5	P	Pruned for overhead Hydro lines, topped.	Good
	923	*Gleditsia triocanthos*	Honey Locust	19	1.5	P	Pruned for overhead Hydro lines, topped.	Good
	924	*Gleditsia triocanthos*	Honey Locust	20	2	F	Pruned for overhead Hydro lines; Rose growing through canopy.	Good
	925	*Gleditsia triocanthos*	Honey Locust	21	2	F	Pruned for overhead Hydro lines, topped.	Good
	926	*Gleditsia triocanthos*	Honey Locust	10,12,(2)15	2.5	P	Pruned for overhead Hydro lines; Rose growing through canopy.	Good
	927	*Gleditsia triocanthos*	Honey Locust	(2)13,16,10 (2)<10	2.5	P	Pruned for overhead Hydro lines, topped.	Good
	928	*Gleditsia triocanthos*	Honey Locust	24	3	F	Pruned for overhead Hydro.	Good
	929	*Gleditsia triocanthos*	Honey Locust	30, 24	3	F	Pruned for overhead Hydro.; 24 DBH stem topped.	Good
	930	*Fraxinus pennsylvanica*	Green Ash	10, 1<10	1.5	P	Pruned for overhead Hydro lines, topped.	Good
	931	*Fraxinus pennsylvanica*	Green Ash	12	1.5	P	Pruned for overhead Hydro lines, topped.	Good
N	932	*Malus sp.*	Apple Sp.	17, 15, (2)<10	4	F	Pruned for overhead Hydro.	Good
	933	*Malus sp.*	Apple Sp.	19, 37	3	P	Pruned for overhead Hydro; Three stems fused together to make 37 DBH.	Good
	934	*Malus sp.*	Apple Sp.	12, 10, 1<10	3	F	Pruned for overhead Hydro.	Good
	935	*Fraxinus pennsylvanica*	Green Ash	19	3	P	Pruned for overhead Hydro lines, topped.	Good
	936	*Fraxinus pennsylvanica*	Green Ash	12	2	P	Pruned for overhead Hydro lines, topped.	Good
	937	*Fraxinus pennsylvanica*	Green Ash	24,19,11, 24, 32	3	P	Pruned for overhead Hydro lines, topped.	Good
H	A	*Acer saccharinum*	Silver Maple	40 to 50	3	G		Poor to Moderate
	B	*Salix alba 'Tristis'*	Golden Weeping Willow	100+	4	F	Multi-stemmed; Wound at base of trunk.	Moderate to Good
J	C	*Fraxinus pennsylvanica*	Green Ash	10 to 20	1.5	F	Pruned for overhead Hydro lines.	Good
	D	*Picea abies*	Norway Spruce	10 to 20	1.5	P		Moderate
	E	*Fraxinus pennsylvanica*	Green Ash	(3) 10 to 2	1.5	F		Moderate
	F	*Picea abies*	Norway Spruce	10 to 20	2	P		Moderate
	G	*Picea glauca*	White Spruce	20 to 30	2	P		Moderate
	H	*Picea abies*	Norway Spruce	20 to 30	2	F		Moderate
	I	*Picea abies*	Norway Spruce	10 to 20	0	D		Moderate
	J	*Picea abies*	Norway Spruce	10 to 20	0.5	P		Moderate

UNIT	Tag #	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Condition	Comments	Tolerance to Impact
J	K	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2	G		Good
	L	*Thuja occidentalis*	Eastern White Cedar	<10	0.5	F		Good
	M	*Picea glauca*	White Spruce	20 to 30	1.5	F		Moderate
	N	*Picea glauca*	White Spruce	10 to 20	0	D		Moderate
	O	*Fraxinus pennsylvanica*	Green Ash	0 to 10	1	G		Good
	P	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2.5	F	Co-dominant stems.	Good
	Q	*Picea abies*	Norway Spruce	20 to 30	2	G		Moderate
	R	*Picea abies*	Norway Spruce	20 to 30	2	G		Moderate
	S	*Picea abies*	Norway Spruce	20 to 30	2	G		Moderate
	T	*Picea abies*	Norway Spruce	20 to 30	2	G		Moderate
	U	*Picea abies*	Norway Spruce	20 to 30	2	G		Moderate
	V	*Picea abies*	Norway Spruce	20 to 30	2	G		Moderate
	W	*Picea abies*	Norway Spruce	20 to 30	2	F		Moderate
	X	*Picea abies*	Norway Spruce	20 to 30	2	F		Moderate
	Y	*Picea abies*	Norway Spruce	10 to 20	2	F		Moderate
	Z	*Fraxinus pennsylvanica*	Green Ash	0 to 10	1	G		Good
	AA	*Fraxinus pennsylvanica*	Green Ash	20 to 30	3	F		Good
	BB	*Fraxinus pennsylvanica*	Green Ash	20 to 30	3	F		Good
	CC	*Fraxinus pennsylvanica*	Green Ash	10 to 20	2	F		Good
	DD	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2	F		Good
	EE	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2	F		Good
	FF	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2	F		Good
	GG	*Picea glauca*	White Spruce	10 to 20	2	F		Moderate
	HH	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2	F		Good
	II	*Fraxinus pennsylvanica*	Green Ash	(7) 0 to 10	3.5	F		Good
	JJ	*Populus sp.*	Poplar Sp.	10 to 20	0.5	F		Good
	KK	*Fraxinus pennsylvanica*	Green Ash	10 to 20	2	F	Co-dominant stems.	Good
L	LL	*Fraxinus pennsylvanica*	Green Ash	20 to 30	2	F		Good
	MM	*Fraxinus pennsylvanica*	Green Ash	10 to 20	2	G		Good
M	NN	*Picea glauca*	White Spruce	20 to 30	3	G		Moderate
	OO	*Picea abies*	Norway Spruce	10 to 20	0	D		Moderate
	PP	*Picea abies*	Norway Spruce	0 to 10	0	D		Moderate
	QQ	*Picea abies*	Norway Spruce	20 to 30	3	F		Moderate
	RR	*Picea abies*	Norway Spruce	10 to 20	3	F		Moderate
	SS	*Picea abies*	Norway Spruce	30 to 40	3	F		Moderate
	TT	*Picea abies*	Norway Spruce	20 to 30	3	G		Moderate
	UU	*Picea abies*	Norway Spruce	20 to 30	3	G		Moderate
	VV	*Picea abies*	Norway Spruce	30 to 40	3	G		Moderate
	WW	*Picea abies*	Norway Spruce	30 to 40	3	G		Moderate
	XX	*Picea abies*	Norway Spruce	10 to 20	2.5	G		Moderate
	YY	*Picea glauca*	White Spruce	10 to 20	2.5	F		Moderate
	ZZ	*Picea abies*	Norway Spruce	10 to 20	3	P		Moderate
	AAA	*Picea abies*	Norway Spruce	10 to 20	3	F		Moderate
	BBB	*Picea abies*	Norway Spruce	10 to 20	2	P		Moderate
	CCC	*Picea abies*	Norway Spruce	10 to 20	1.5	P		Moderate
	DDD	*Picea abies*	Norway Spruce	20 to 30	2	F		Moderate
	EEE	*Picea abies*	Norway Spruce	10 to 20	1.5	P		Moderate
	FFF	*Picea abies*	Norway Spruce	20 to 30	3	F		Moderate
	GGG	*Picea abies*	Norway Spruce	30 to 40	3	F		Moderate
	HHH	*Picea glauca*	White Spruce	20 to 30	3	F		Moderate
	III	*Picea glauca*	White Spruce	10 to 20	2	G		Moderate
	JJJ	*Picea glauca*	White Spruce	10 to 20	3	P	Growth suppressed by adjacent trees.	Moderate
	KKK	*Picea glauca*	White Spruce	30 to 40	3.5	G		Moderate

UNIT	Tag #	Botanical Name	Common Name	DBH (cm)	Dripline Radius (m)	Condition	Comments	Tolerance to Impact
M	LLL	*Fraxinus pennsylvanica*	Green Ash	0 to 10	1	F		Good
	MMM	*Picea glauca*	White Spruce	20 to 30	3	F		Moderate
	NNN	*Picea glauca*	White Spruce	30 to 40	3	F		Moderate
	OOO	*Picea glauca*	White Spruce	10 to 20	2	P		Moderate
	PPP	*Picea glauca*	White Spruce	30 to 40	2	P		Moderate
	QQQ	*Fraxinus pennsylvanica*	Green Ash	20 to 30	3	F		Good
	RRR	*Picea abies*	Norway Spruce	20 to 30	1	F		Moderate
	SSS	*Picea abies*	Norway Spruce	10 to 20	0.5	P		Moderate
	TTT	*Picea abies*	Norway Spruce	10 to 20	1	F		Moderate
	UUU	*Picea glauca*	White Spruce	10 to 20	1	P		Moderate

LEGEND:

G - Good

F - Fair

P - Poor

901 - Trees identified with steel, numbered tree tag, located within property limits and right-of-way

A - Trees located on private property or could not physically be tagged. DBH was estimated into diamter class.

TABLE #2 - Union Gas Compressor Station, Parkway West - Site #2. General Tree Inventory. January 7, 2013

Species Composition	*Botanical Name*	Common Name	Diameter Class (cm)	Average Condition	Comments	Tolerance to Impact
UNIT A						
1%	*Acer negundo*	Manitoba Maple	0 to 10	Fair - Good		Good
25%	*Crataegus sp.*	Hawthorn Sp.	0 to 10	Fair - Good	Dense clumps of multi-stem shrubs.	Good
23%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
50%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		
1%	*Ulmus americana*	American Elm	0 to 10	Fair - Good		Moderate
UNIT B						
100%	*Crataegus sp.*	Hawthorn Sp.	0 to 10	Fair - Good	Isolated clumps of multi-stem shrubs.	Good
UNIT C						
12%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
76%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		Good
UNIT D						
29%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
71%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		Good
UNIT E						
58%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
4%	*Populus sp.*	Poplar Sp.	0 to 10	Fair - Good		Good
34%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		Good
4%	*Ulmus americana*	American Elm	0 to 10	Fair - Good		Moderate
UNIT F						
100%	*Syringa sp.*	Lilac Sp.	0 to 10	Fair - Good		Good
UNIT G						
25%	*Crataegus sp.*	Hawthorn Sp.	0 to 10	Fair - Good		Good
64%	*Prunus virginiana*	Chokecherry	0 to 10	Poor - Fair	Black knot present in stems.	Good
11%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		Good
UNIT I						
<1%	*Acer negundo*	Manitoba Maple	0 to 10	Fair - Good		Good
65%	*Crataegus sp.*	Hawthorn Sp.	0 to 10	Fair - Good	Numerous small saplings present.	Good
32%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good	Numerous small saplings present.	Good
2%	*Gleditsia triocanthos*	Honey Locust	0 to 10	Fair - Good		Good
<1%	*Juglans nigra*	Black Walnut	0 to 10	Fair - Good		Poor to Moderate
<1%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		Good
UNIT J						
85%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
12%	*Populus sp.*	Poplar Sp.	0 to 10	Fair - Good		Good
3%	*Quercus macrocarpa*	Bur Oak	0 to 10	Fair - Good		Moderate to Good

TABLE #2 - Union Gas Compressor Station, Parkway West - Site #2. General Tree Inventory. January 7, 2013

Species Composition	*Botanical Name*	Common Name	Diameter Class (cm)	Average Condition	Comments	Tolerance to Impact
UNIT K						
14%	*Acer negundo*	Manitoba Maple	0 to 10	Fair - Good		Good
72%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
14%	*Rhamnus sp.*	Buckthorn Sp.	0 to 10	Fair - Good		Good
UNIT L						
100%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good	Isolated tree.	Good
UNIT M						
100%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good	Numerous small saplings present.	Good
UNIT N						
83%	*Fraxinus sp.*	Ash Sp.	0 to 10	Fair - Good		Good
17%	*Juglans nigra*	Black Walnut	0 to 10	Fair - Good		Poor to Moderate

4.0 Disclaimer

The assessment of the trees presented within this report has been prepared using accepted arboricultural techniques. These include a visual examination of the above-ground parts of each tree for structural defects, scars, external indications of decay, evidence of insect presence, discoloured foliage, the general condition if the trees and the surrounding site, as well as the proximity of property and people. None of the trees examined were dissected, cored, probed, or climbed, and detailed root crown examinations involving excavation were not undertaken.

Notwithstanding the recommendations and conclusions made in this report, it must be realized that trees are living organisms and their health and vigour is constantly changing. They are not immune to changes in site conditions or seasonal variations in the weather.

While reasonable efforts have been made to ensure the trees recommended for retention are healthy, no guarantees are offered or implied, that these trees or any part of them will remain standing. It is both professionally and practically impossible to predict with absolute certainty the behavior of any single tree or group of trees in all circumstances. Inevitably a standing tree will always pose some risk. Most trees have the potential for failure provided with the necessary combinations of stresses and elements. This risk can only be eliminated if the tree is removed.

Although every effort has been made to ensure that this assessment is reasonably accurate the trees should be re-assessed periodically. The assessment presented in this report is valid at the time of inspection.

All of which is respectfully submitted;

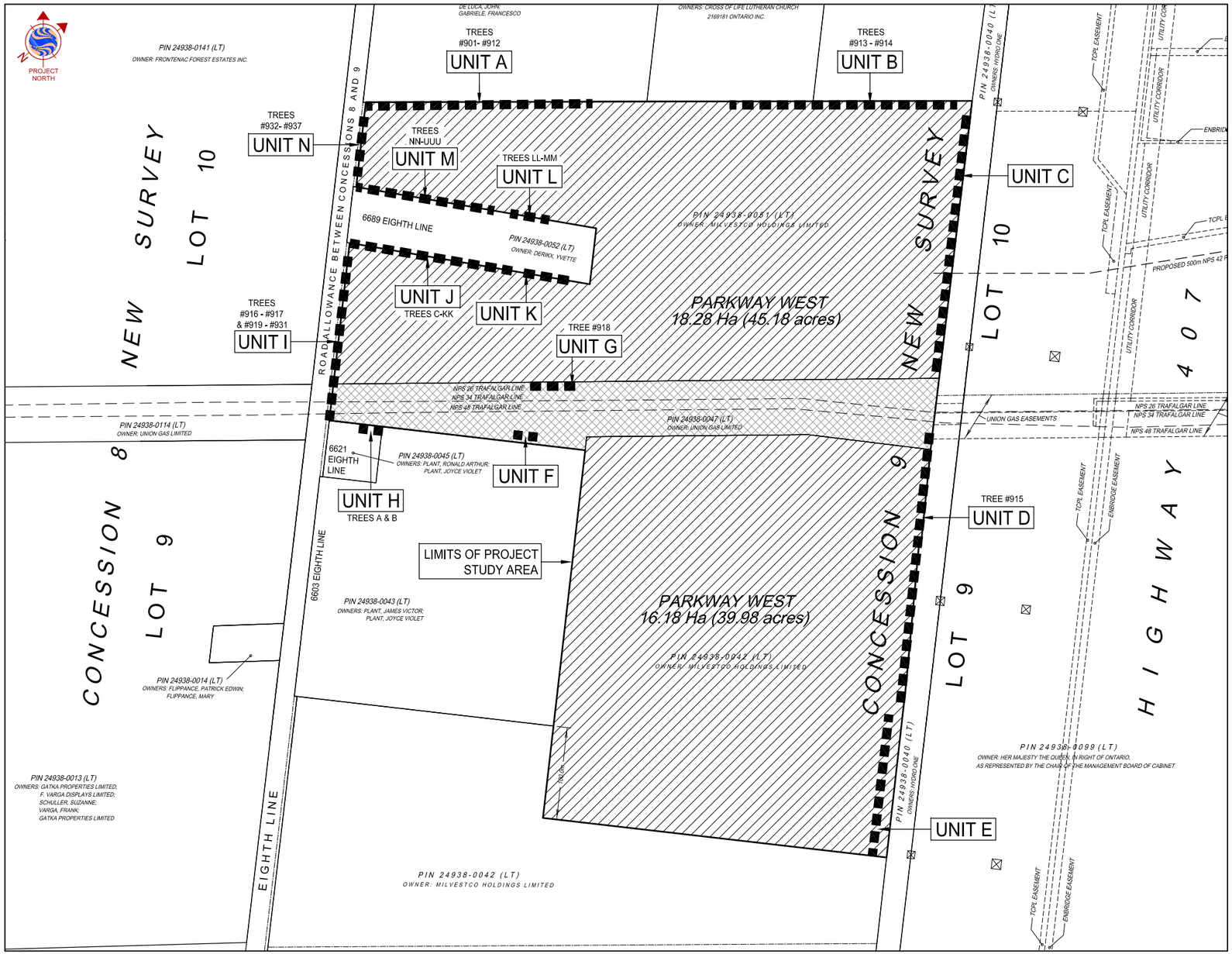
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APPENDIX A

Tree Inventory Plan, Figure 1.0





LEGEND:

- LIMITS OF PROJECT STUDY AREA
- APPROXIMATE LOCATION OF VEGETATION UNIT
- PROPERTY OWNED BY CLIENT
- PROPOSED PROPERTY ACQUISITION BY CLIENT

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Client/Project
Union Gas Ltd.
Parkway West Project

Figure No.
1.0

Title
Tree Inventory Plan

Appendix C6

Noise Impact Study

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Noise Impact Feasibility Study for the Proposed Union Gas Limited Parkway West Compressor Station Town of Milton, Ontario

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February 5, 2013

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3 CRITERIA 3

4 ANALYSIS METHODS & RESULTS 5

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APPENDIX B – SOURCE SOUND POWER LEVELS

1 INTRODUCTION AND SUMMARY

HGC Engineering was retained by Union Gas Limited ("Union Gas") to undertake a noise impact feasibility study of the proposed Parkway West Compressor Station in the Town of Milton, Ontario. A scaled location map of the surrounding area is included as Figure 1. This study uses predictive analysis to assess the potential impact of sound sources associated with the site with respect to the guidelines of the Ontario Ministry of the Environment ("MOE"), which are acceptable to the Town of Milton. The study is required to satisfy a condition of a rezoning pre-consultation between Union Gas and the Town of Milton.

Source sound levels of the primary pieces of noise producing equipment were based on measurements conducted by HGC Engineering of similar Union Gas installations at other compressor stations in Ontario. The predicted sound levels at the nearest sound sensitive points of reception were evaluated with respect to the guidelines of the MOE.

The analysis indicates that, with the noise control measures integral to the station design, sound emissions from the subject site will be within the applicable sound level limits of the MOE during all hours of operation. The reader is referred to the main body of the report for assumptions and results of the analysis.

2 DESCRIPTION OF SITE & SURROUNDING AREA

The Parkway West Compressor Station is proposed to be located on the south side of Derry Road, east of Eighth Line in the Town of Milton, as depicted in Figure 2, a satellite image of the site and surrounding area. The site is bordered on the east by a CP Rail spur, with Highway 407 approximately 225 metres further east. The lands surrounding the site are zoned by the Town of Milton for agricultural use, as is the designation for these lands in the Official Plan. Union Gas will be submitting an application to the Town of Milton to request a Zoning By-Law amendment on the subject lands. The current Official Plan and Zoning maps for the subject area are included as Appendix A.

HGC Engineering visited the site and surrounding area on November 10, 2011 and January 17, 2013 and observed the background sound in the vicinity of the subject site to be dominated by road traffic on Highway 407 and Derry Road. The area surrounding the site is best categorized as a Class 2 (semi-urban) acoustical environment, under MOE noise assessment guidelines. Sound sensitive points of reception proximate to the subject site include homes located northwest, west and south of the site. For the purposes of this study, seven unique locations have been selected to represent these homes, and are labeled as R1 through R7 in Figure 2.

The Parkway West Compressor Station site straddles a below-grade pipeline through which natural gas is imported for distribution throughout the Greater Toronto Area. The Parkway West Station will host two natural gas compressor plants, each utilizing a gas turbine engine powered compressor to boost the pressure of natural gas flowing through the station as required. The compressor plants, designated as “C Plant” and “D Plant”, will be located on the east side of the pipeline, as depicted in Figure 3. Also depicted in Figure 3 are the locations of three emergency generators: two associated with the compressor plants and one with the Administration Building on the west side of the site.

The compressor plants will operate up to 24 hours per day, seven days per week, particularly during winter months of peak natural gas consumption. The emergency generators will be tested on a regular basis, during daytime hours only, for maintenance purposes. Although the emergency operation of these units during a power outage is exempt from assessment under MOE guidelines, as a life safety event, the periodic operation for maintenance purposes must be considered, and is thus included herein. All three emergency generators were conservatively assumed to be tested simultaneously during a predictable worst case daytime hour, although this would be unlikely in practice, where each unit would be tested individually.

Considerable noise control measures will be integral to the design of each of the compressor plants, which are typical of Union Gas installations across Southwestern Ontario. Each plant will consist of an acoustically treated primary building that will house a Rolls Royce RB211 gas turbine engine (which itself will be located within an acoustical enclosure inside the building) and

compressor(s). The C Plant and D Plant will be equipped with one and two compressors, respectively. The gas turbine combustion air intake and exhaust, as well as the enclosure ventilation air intake and exhaust, will be fitted with acoustical silencers, as will the lube oil cooler intake and exhaust and all building ventilation openings, including rooftop exhausters. Doors leading into the buildings will be acoustically rated. While the majority of natural gas piping on the subject site will be buried below-grade, the above-grade portions will be equipped with high performance acoustical insulation. Natural gas discharged from the compressor plants will be routed through gas aftercoolers, air-cooled heat exchangers equipped with large diameter axial fans, located northwest of each of the plants.

Each of the emergency generators will be housed within outbuildings. The combustion air exhausts of each unit will be equipped with mufflers; cooling for the generator engines will be provided by outdoor coolers.

Additional proposed equipment, including boilers for hot water, natural gas heating units, an electrically-driven firewater pump located within a building and modest amounts of above grade piping and valves used for gas flow measurement and regulation will be acoustically insignificant in the context of the subject site. Similarly, a small 145 horsepower electric drive, reciprocating blowdown recovery compressor, which will operate only when the compressor plants are not in operation, will be acoustically insignificant. Blowdowns, which are events during which pressurized gas is released from the station lines, occur on an extremely infrequent basis under emergency conditions and are not considered a planned, predictable mode of operation. Blowdowns also occur during particular maintenance events, still on an infrequent basis, and these events occur in a controlled manner over a short term duration. Accordingly, blowdown events have not been considered as part of this assessment.

3 CRITERIA

In Ontario, the guidelines of the MOE form the basis of environmental noise assessment, specifically publication NPC-205, “Sound Level Limits For Stationary Sources in Class 1 & 2 Areas (Urban).” The MOE guidelines draw a distinction between “stationary sources” (industrial

or commercial sounds), and other types of sources such as traffic or construction activities, for example. The sound sources associated with the proposed Parkway West Compressor Station are classified as stationary sources. The guidelines for stationary sources are site specific and depend on the background sound in the vicinity which includes road traffic sound but excludes the source under assessment. The guidelines also stipulate that the assessment consider the potential noise impact during a "predictable worst case hour" of operation, which is defined as a situation when the normally busy activity of the source coincides with an hour of low background sound. In other words, the principle of assessment involves evaluating the subject source against the background sound, on an hourly basis. If the acoustic environment in the vicinity is such that the ambient sound level falls off significantly during quiet hours, there are exclusionary minimum sound level limits, which set the lower bound for the acceptability criteria. Specifically, NPC-205 states that the sound level limit for a stationary source that could operate during daytime and nighttime hours in a Class 2 environment is the greater of the minimum one-hour energy-equivalent ambient sound level (L_{EQ}) during any hour that the subject source may operate or 50 dBA during daytime hours (07:00 to 19:00), and 45 dBA during evening/nighttime hours (19:00 to 07:00).

Characteristic ambient sound levels can be determined through automatic sound level monitoring (typically for a period of at least 48 hours), or predicted from road traffic volumes in areas where traffic sound is dominant. Where it can be demonstrated that the hourly background sound levels remain greater than the exclusionary minimum limits listed above, the criterion becomes the lowest measured/predicted one-hour L_{EQ} sound level during each respective period. At locations where the ambient sound levels are low, the exclusionary minimum criteria of 50/45 dBA apply.

Observations made in the vicinity of locations R1 through R7 indicate that background sound levels are likely to fall below the exclusionary minimum levels set out by NPC-205 during the quietest hours of the day and night. Given that the subject facility will operate during both daytime and nighttime hours, the applicable limits are the exclusionary minimums of 50/45 dBA during daytime and evening/nighttime hours, respectively.

Some types of sound have a special quality which may tend to increase their audibility and potential for disturbance or annoyance. For tonal sound, MOE guideline NPC-104 stipulates that a penalty of 5 dBA is to be added to the measured source level. A tonal sound is defined as one which has a "pronounced audible tonal quality such as a whine, screech, buzz or hum". Although unmitigated sound emissions from gas turbine engines and gas compressors typically exhibit a tonal character (related to the blade pass frequency of the gas turbine engine and/or gas compressor), experience with recently constructed, well-silenced compressor plants such as those proposed for the subject site has found that their overall sound emissions are not necessarily tonal in nature. However, this study conservatively includes a 5 dBA penalty added to the overall sound level predicted at each point of reception.

4 ANALYSIS METHODS & RESULTS

As outlined in Section 2, the primary sources of sound associated with the Parkway West site will be the two natural gas compressor plants and the emergency generators. Sound emissions from each component of the compressor plants and emergency equipment, including the integral noise control features highlighted in Section 2, were based on measurements conducted by HGC Engineering at similar Union Gas compressor stations. The sound power level of each source is summarized in Table B1 of Appendix B. The location of each sound source on the site is depicted in Figures 3, 4A and 4B.

Considering the above outlined inputs, a computational acoustical model of the site was created using Cadna/A software. Cadna/A is a computer implementation of ISO standard 9613-2, "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General Method of Calculation" to predict sound levels at the nearest noise sensitive point of reception. The ISO method accounts for reduction in sound level with distance due to geometrical spreading, air absorption, ground attenuation and acoustical shielding by intervening structures such as buildings. The following table summarizes the predicted sound levels at the key point of reception:

Table 1: Predicted Equivalent Hourly Sound Levels, Day/Night, L_{EQ} [dBA]

Source Group	Point of Reception						
	R1	R2	R3	R4	R5	R6	R7
C Plant							
Turbine Combustion Air Intake/Exhaust	10	14	16	12	20	11	10
Turbine Encl. Vent. Air Intake/Exhaust	9	5	6	10	17	13	8
Lube Oil Cooler Intake/Exhaust	10	10	12	10	12	2	--
Bldg. Vent. Openings/Rooftop Exhausts	20	20	22	20	26	19	16
Bldg. Doors	19	19	21	21	25	19	14
Suction Piping	27	28	30	31	36	30	24
Discharge Piping	18	17	20	19	24	16	--
Gas Aftercooler	13	13	15	13	19	11	7
D Plant							
Turbine Combustion Air Intake/Exhaust	12	13	11	12	19	11	11
Turbine Encl. Vent. Air Intake/Exhaust	3	4	6	7	10	13	9
Lube Oil Cooler Intake/Exhaust	6	9	11	12	14	4	--
Bldg. Vent. Openings/Rooftop Exhausts	18	20	22	20	26	19	16
Bldg. Doors	17	19	21	21	26	21	16
Suction Piping	21	29	31	31	35	32	29
Discharge Piping	19	21	24	22	27	20	--
Gas Aftercooler	12	13	14	13	19	11	8
Emergency Generator #1	29/--	23/--	26/--	25/--	38/--	31/--	21/--
Emergency Generator #2	31/--	23/--	23/--	33/--	38/--	31/--	20/--
Admin Building Emergency Generator	25/--	37/--	44/--	30/--	28/--	25/--	15/--
Total*	40/36	44/38	50/40	43/40	49/45	43/40	37/36
Criteria	50/45	50/45	50/45	50/45	50/45	50/45	50/45
Within Limits?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* Point of reception sound levels include a 5 dBA penalty for tonal sound emissions, in accordance with MOE guideline NPC-104, as detailed in Section 3.

The prediction results detailed in Table 1 indicate that sound levels from the proposed Parkway West Compressor Station will be within the applicable limits at the selected points of reception during all hours of operation. Figures 5 and 6 show the predicted energy-equivalent (L_{EQ}) sound level contours resulting from the sound emissions of the subject site during daytime hours (which include testing of the emergency generators) and nighttime hours, respectively.

5 CONCLUSIONS

The above analysis indicates that, with the benefit of noise control measures integral to the facility design, the predicted L_{EQ} sound level impact of the proposed Union Gas Parkway West Compressor Station will be within MOE sound level limits during all hours of operation.

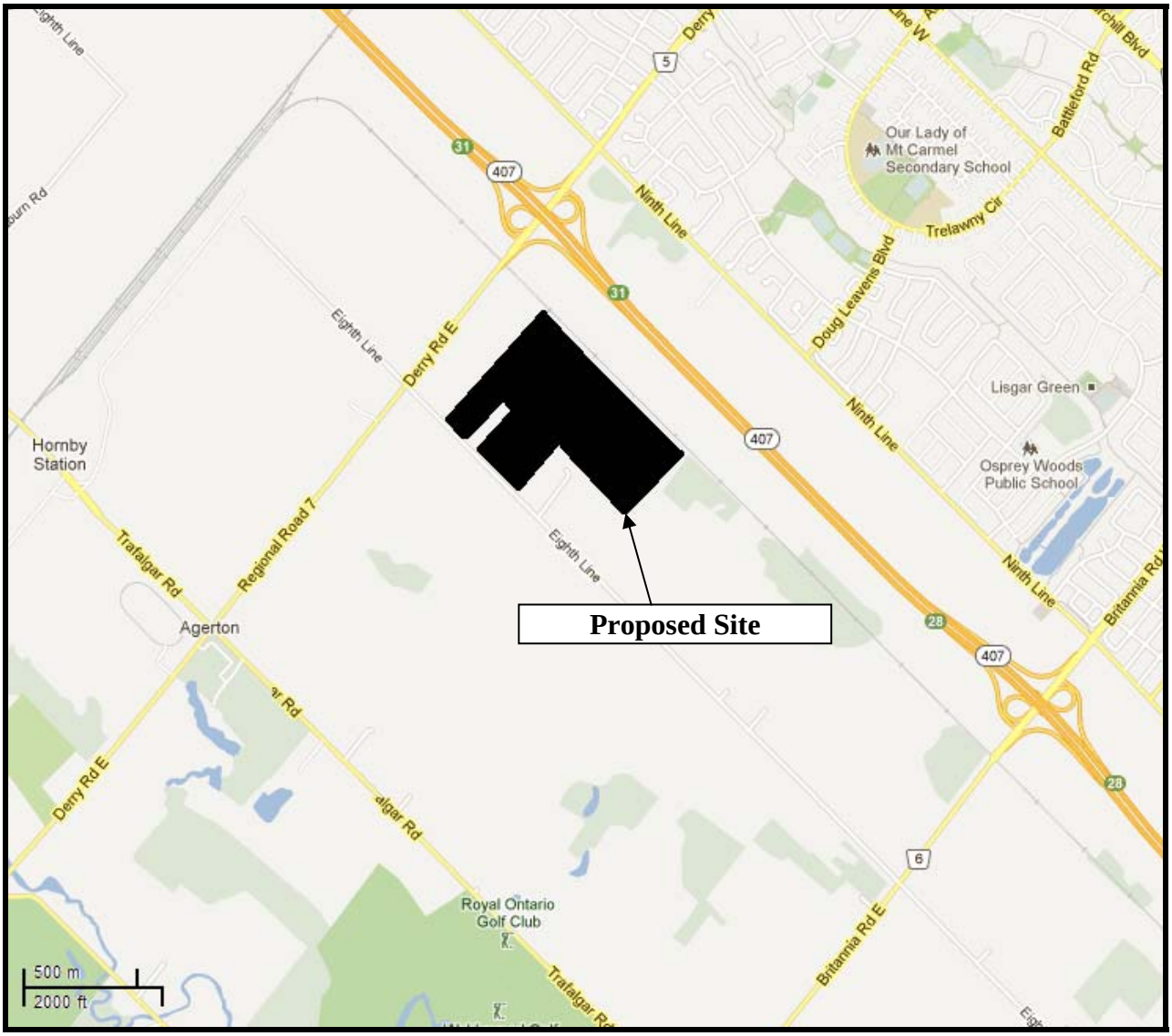


Figure 1: Location Map

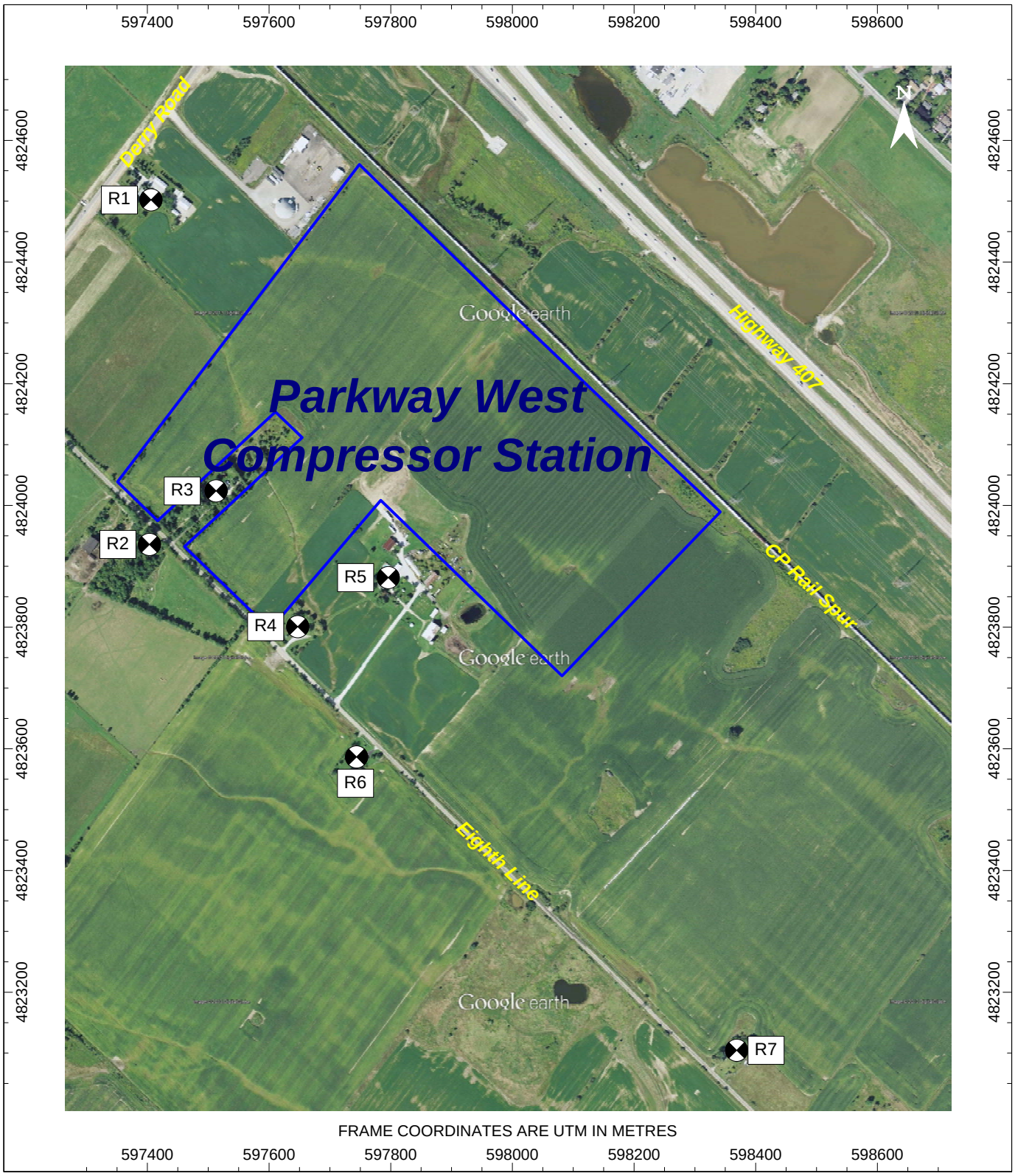


Figure 2: Satellite Image Showing Location of Proposed Parkway West Compressor Station and Nearest Sound Sensitive Points of Reception

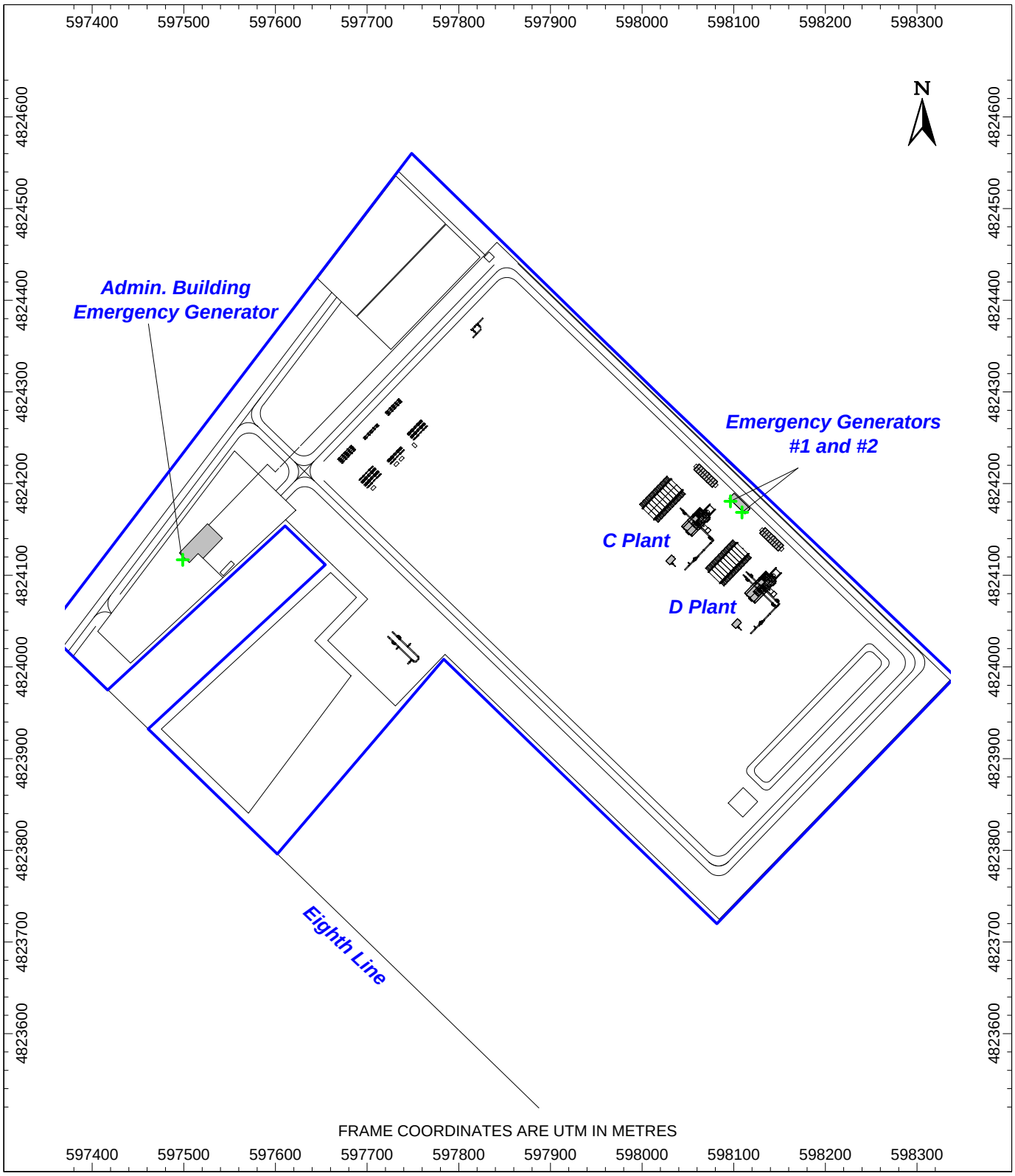


Figure 3: Parkway West Compressor Station Site Plan
Showing Locations of Compressor Plants and Emergency Generators

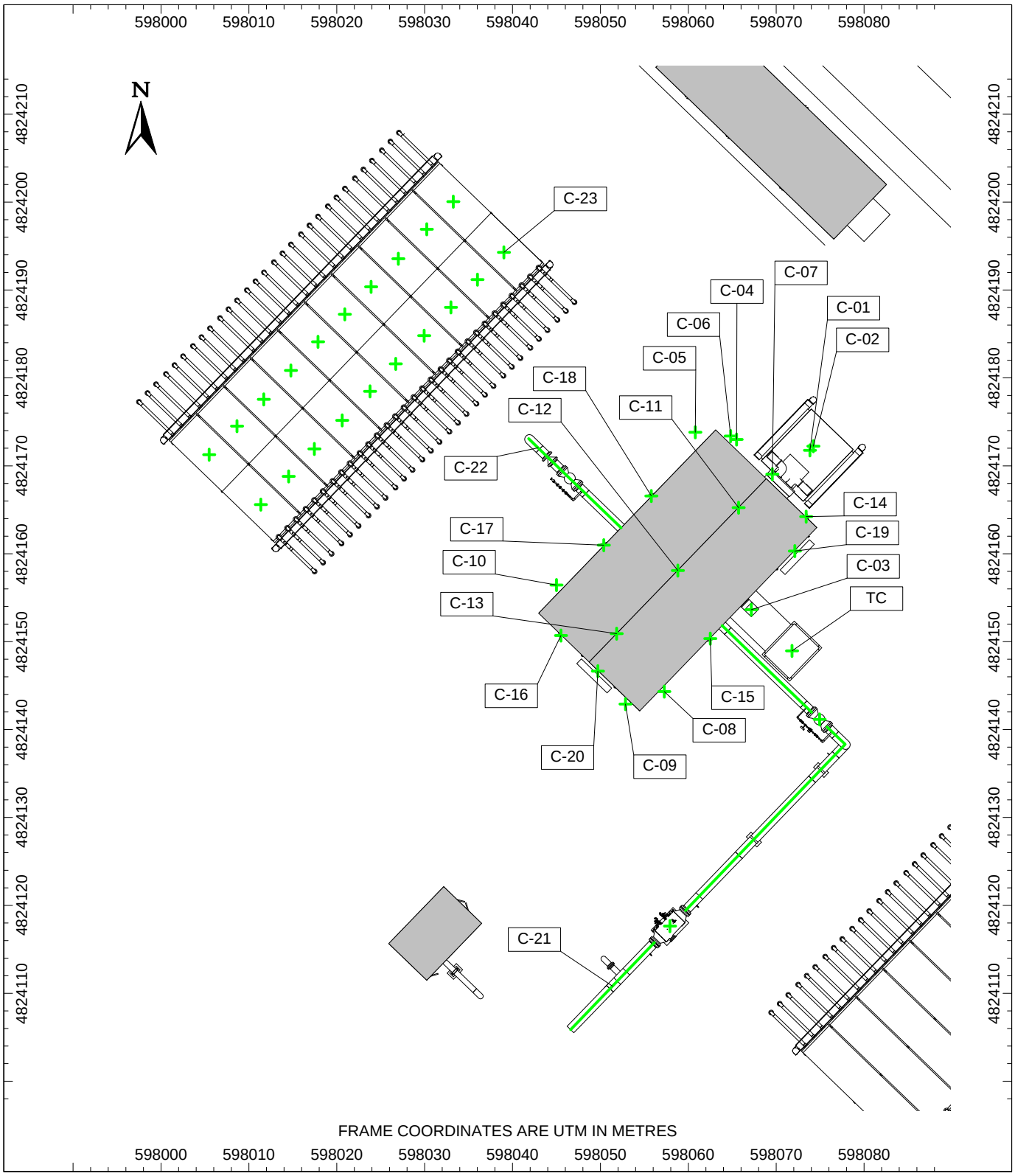


Figure 4A: Parkway West Compressor Station Site Plan
Showing Locations of C Plant Sound Sources

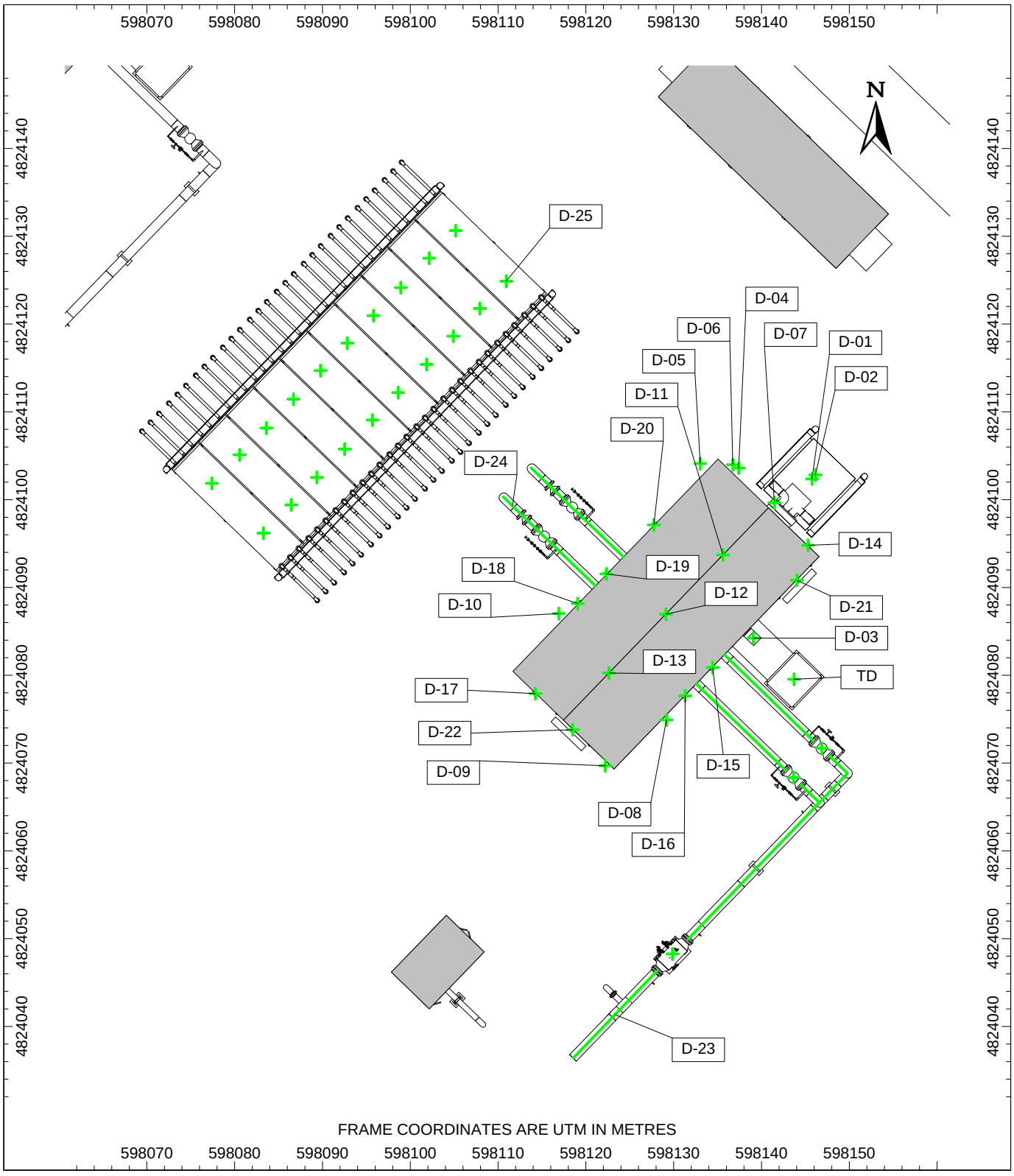


Figure 4B: Parkway West Compressor Station Site Plan
Showing Locations of D Plant Sound Sources

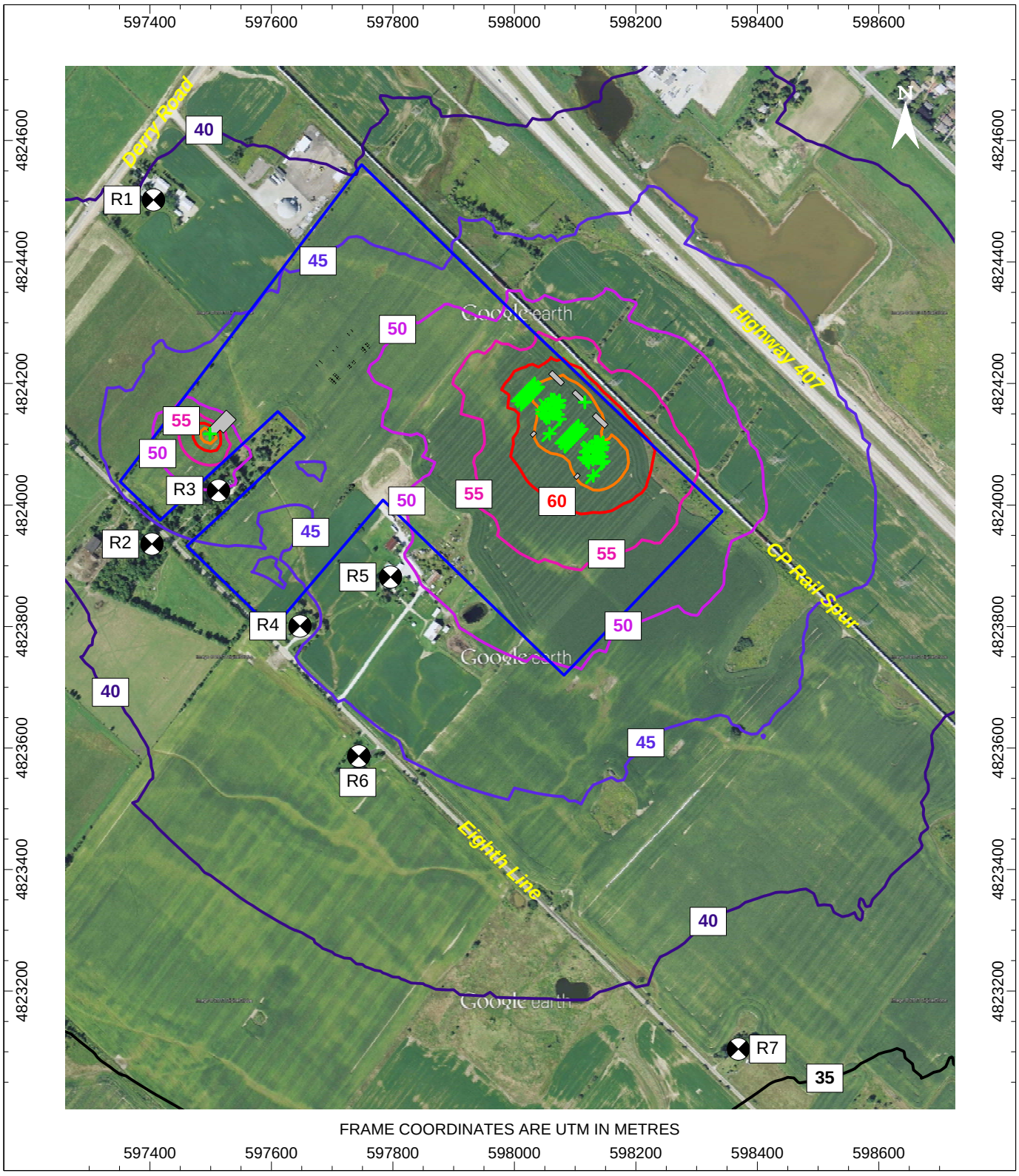


Figure 5: Satellite Image Showing Parkway West Compressor Station, Points of Reception and Predicted Daytime Sound Level Contours, Leq [dBA], Including 5 dBA Tonal Penalty Prediction Elevation = 4.5 metres Above Grade, Representative of Second Storey Windows

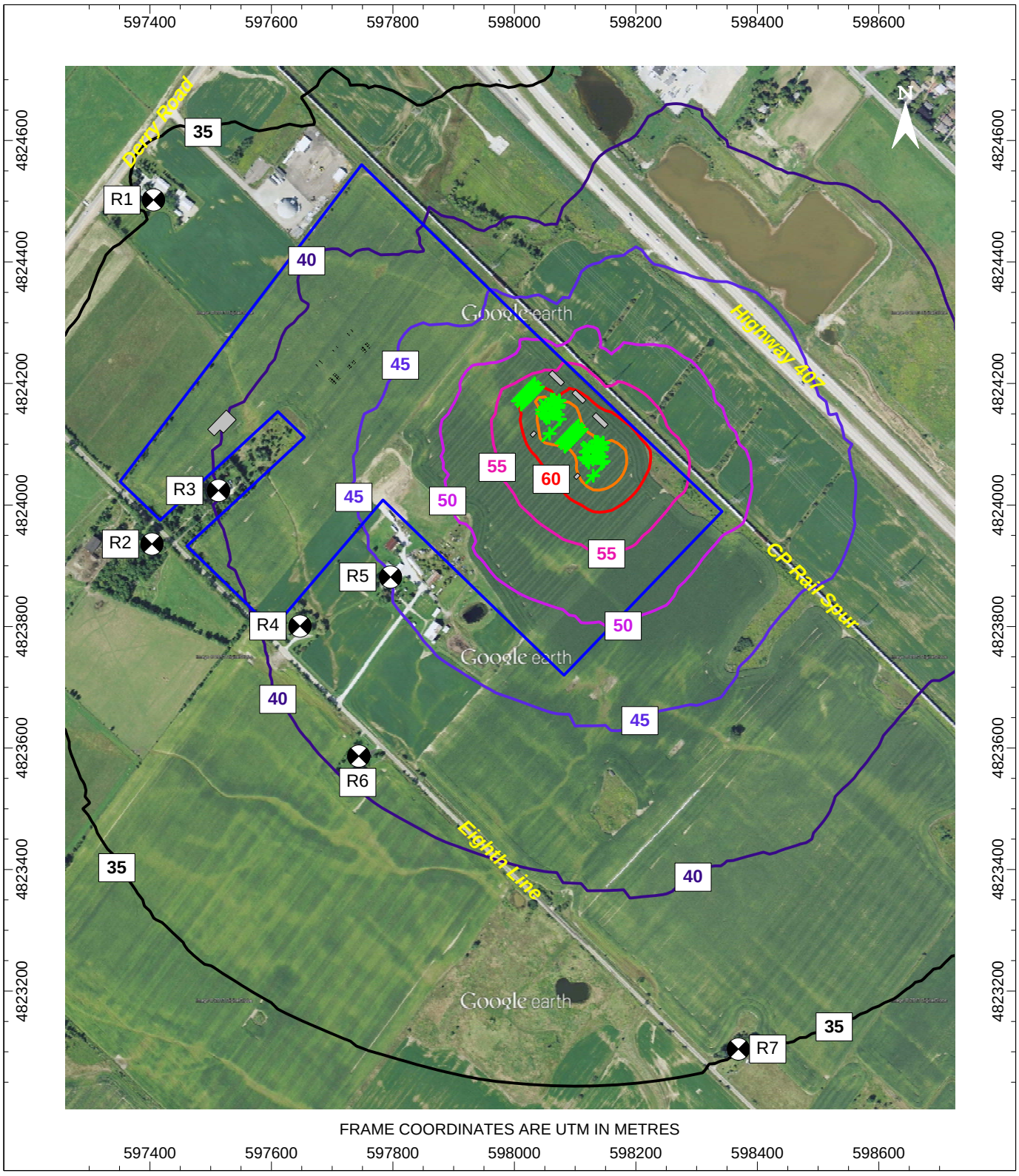
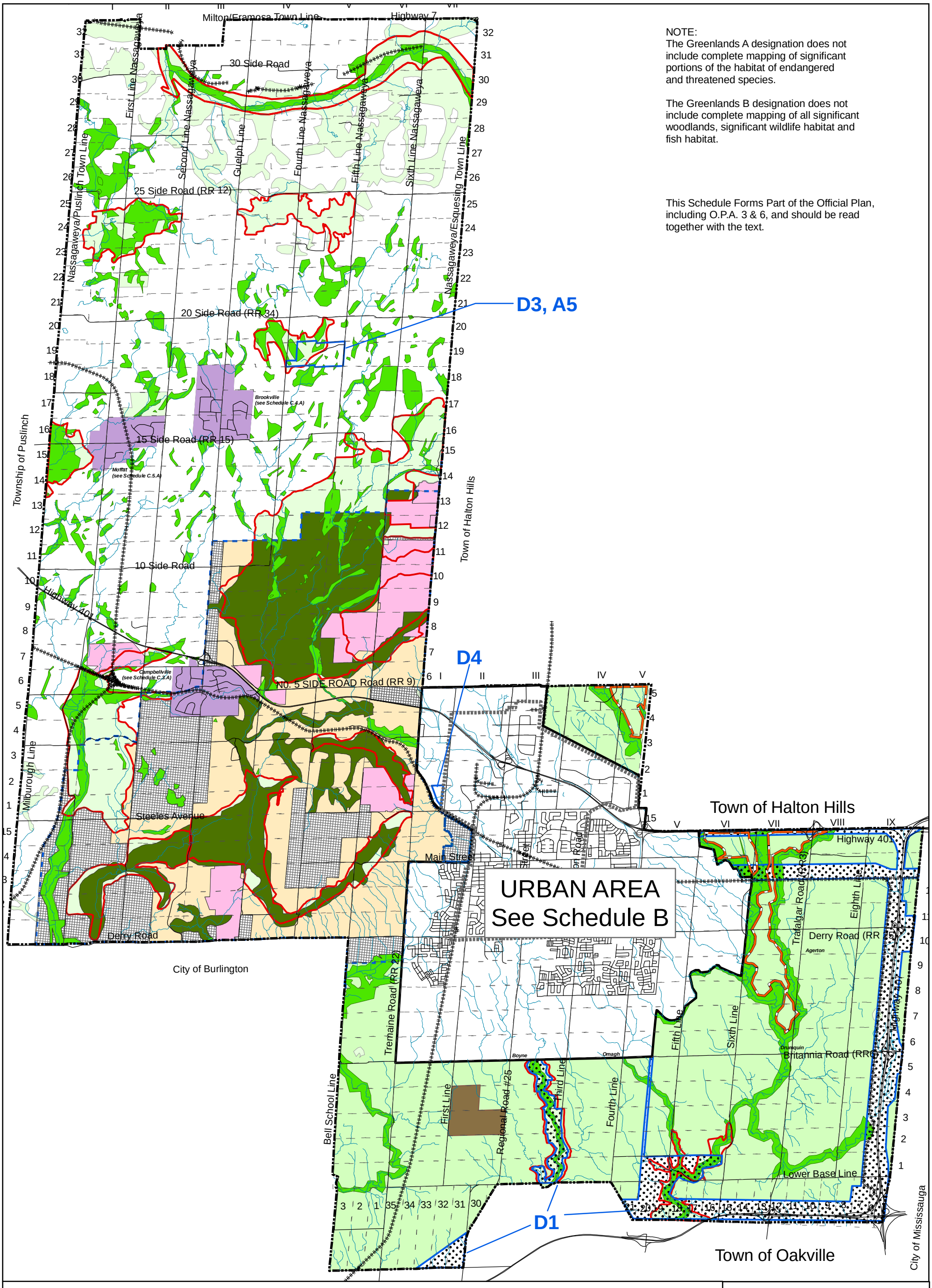


Figure 6: Satellite Image Showing Parkway West Compressor Station, Points of Reception and Predicted Nighttime Sound Level Contours, Leq [dBA], Including 5 dBA Tonal Penalty Prediction Elevation = 4.5 metres Above Grade, Representative of Second Storey Windows

APPENDIX A
OFFICIAL PLAN AND ZONING MAP



NOTE:
The Greenlands A designation does not include complete mapping of significant portions of the habitat of endangered and threatened species.

The Greenlands B designation does not include complete mapping of all significant woodlands, significant wildlife habitat and fish habitat.

This Schedule Forms Part of the Official Plan, including O.P.A. 3 & 6, and should be read together with the text.

- LOTS & CONCESSIONS
- MUNICIPAL BOUNDARY
- RAILWAY
- PERMANENT URBAN SEPERATOR
- SPECIFIC POLICY AREA 13
- URBAN EXPANSION AREA BOUNDARY
- AGRICULTURAL AREA
- DEFERRED AND APPEALED AREAS
- ENVIRONMENTALLY SENSITIVE AREA
- ERAMOSA RIVER - BLUE SPRINGS CREEK POLICY AREA
- ESCARPMENT NATURAL AREA
- ESCARPMENT PROTECTION AREA
- ESCARPMENT RURAL AREA
- GREENLANDS A AREA
- GREENLANDS B AREA
- HALTON WASTE MANAGEMENT SITE
- HAMLET AREA
- MINERAL RESOURCE EXTRACTION AREA
- NIAGARA ESCARPMENT PLAN BOUNDARY
- PARKWAY BELT WEST PLAN AREA
- RURAL AREA
- WATERCOURSE
- EXISTING URBAN AREA BOUNDARY

TOWN OF MILTON OFFICIAL PLAN

Schedule A

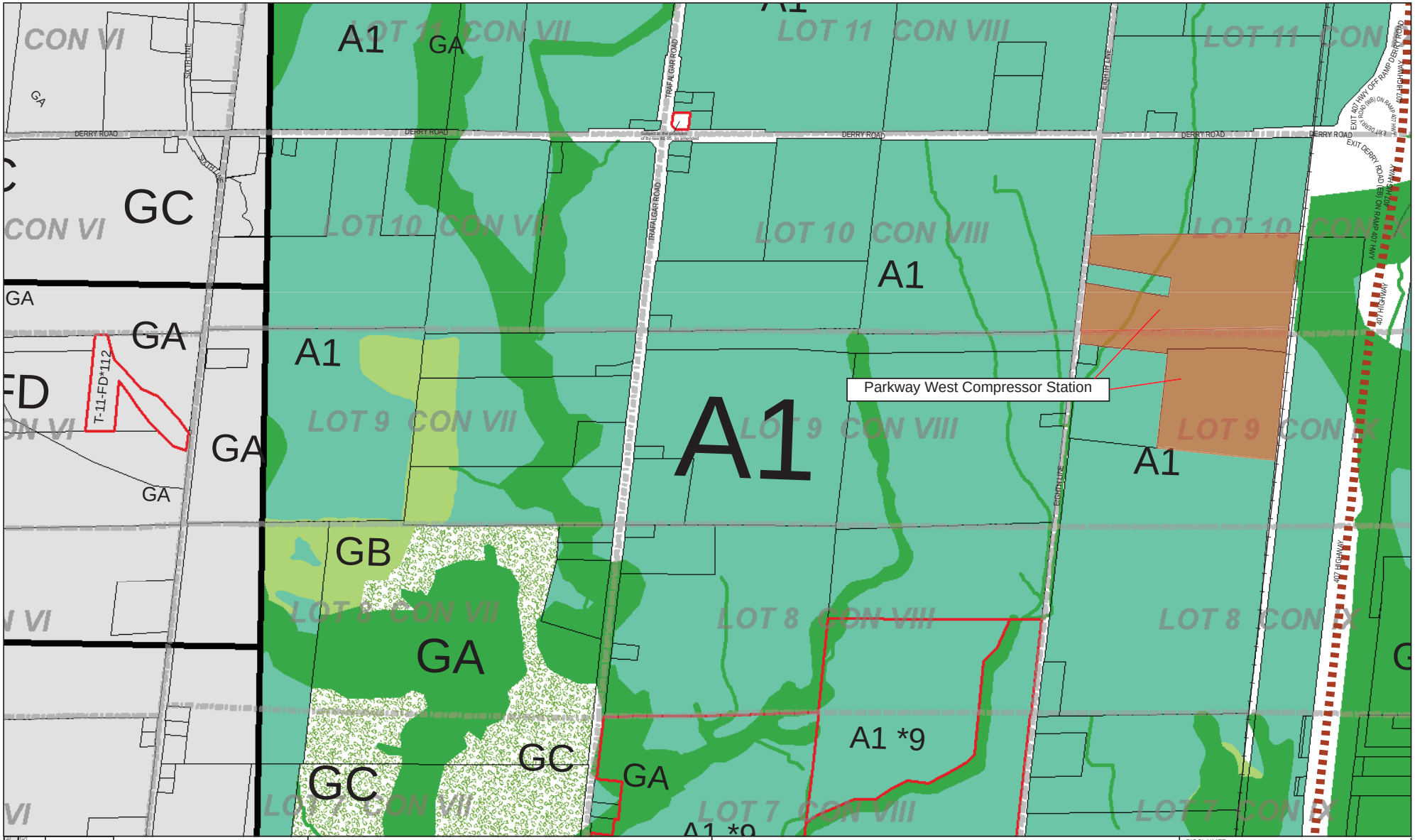
Land Use Plan

NAD 1983 - UTM Zone 17N

This Schedule Forms Part Of The Official Plan And Should Be Read Together With The Text.

(C) Copyright Teranet, Town of Milton 2008

Consolidated August 2008



Sheet J06

Town of Milton - Zoning By-Law 144-2003
RURAL AREA
Consolidated June 2009

Date of Last Revision: July 19, 2010

DISCLAIMER:

The following map sheets provide a representation of Schedule 'A' to By-law 144-2003 and have been produced for the convenience of the reader. While efforts are made to ensure that these map sheets are up to date, in order to ensure accuracy, official zoning information should always be confirmed with the Town's Zoning Officer.

Further, these maps should be read in conjunction with the document "The Town of Milton Comprehensive Zoning By-law 144-2003", as amended from time to time.

APPENDIX B
SOURCE SOUND POWER LEVELS

Table B1: Source Sound Power Levels [dB re 10^{-12} Watt]

Source ID	Source Description	Octave Band Centre Frequency [Hz]							
		63	125	250	500	1k	2k	4k	8k
Compressor Plants									
TC/TD	Turbine Combustion Air Exhaust	86	84	87	84	71	69	64	53
C/D-01	Turbine Combustion Air Intake	97	86	79	70	62	62	71	71
C/D-02	Turbine Enclosure Ventilation Air Intake	101	81	76	69	67	63	68	66
C/D-03	Turbine Enclosure Ventilation Air Exhaust	95	73	75	76	76	63	61	57
C/D-04	Lube Oil Cooler Intake	71	66	55	58	62	38	40	46
C/D-05	Lube Oil Cooler Exhaust	96	84	59	62	60	63	64	56
C/D-06 thru C/D-01	Compressor Building Ventilation Openings	72	51	61	64	66	58	46	41
C/D-11 thru C/D-34	Compressor Building Rooftop Exhausts	95	93	87	83	78	74	67	57
C-14 thru C-18 D-14 thru D-20	Compressor Building Man Doors (Closed)	67	48	63	67	75	59	46	39
C-19 & C-20 D-21 & D-22	Compressor Building Overhead Doors (Closed)	72	69	78	79	82	73	57	44
C-21	C Plant Suction Piping	114	97	88	93	96	89	85	69
C-22	C Plant Discharge Piping	77	73	69	76	82	85	72	59
D-23	D Plant Suction Piping	114	99	90	95	98	92	88	72
D-24	D Plant Discharge Piping	80	76	72	79	85	88	75	62
C-23 & D-25	Gas Aftercooler (each of 20 cells)	78	76	72	66	62	60	56	51
Emergency Generators									
EG1	Emergency Generator #1	104	107	99	97	95	91	85	78
EG2	Emergency Generator #2	104	107	99	97	95	91	85	78
EG3	Admin Building Emergency Generator	98	100	93	90	89	85	78	71

Appendix C7

Stage 1 and 2 Archaeological Assessments

Archaeological Research Associates Ltd.

154 Otonabee Drive, Kitchener, ON N2C 1L7
Tel: (519) 804-2291
Fax: (519) 286-0493
248 Ruby St., Midland, ON L4R 2L4
Tel: (705) 526-9518
Fax: (705) 526-4541

January 14, 2013

Doug Schmidt
Principal Environmental Planner
Union Gas Ltd.
P.O. Box 2001, Chatham, ON N7M 5M1
Tel: 1 (866) 949-1595 ext. 76954 | Cell: (519) 365-0723
DSchmidt@uniongas.com

RE: Stage 1 and 2 Archaeological Assessments at the Proposed Parkway West Station Lands (Orlando Property) – Progress Report (MTCS Licence #P007, PIF #P007-388-2012 and #P007-411-2012).

Archaeological Research Associates Ltd. (ARA) initiated Stage 1 and 2 archaeological assessments for the proposed Parkway West Station Lands in May 2012 under Ministry of Tourism, Culture and Sport (MTCS) licence #P007, PIF #P007-388-2012 (Stage 1) and #P007-411-2012 (Stage 2). To date, the northernmost Part 1 has been fully assessed (fieldwork was conducted on May 23, September 12, and December 20, 2012), whereas the southernmost Part 2 has only been subjected to a partial Stage 1 assessment (fieldwork was conducted on May 23, 2012). The areas of assessment and the results to date are shown in Map 1.

The Stage 2 assessment of Part 1 resulted in the discovery of three locations of archaeological materials (Findspots 9, 10 and 11). Findspot 9 consisted of a 1 x 3 m lithic scatter in the eastern part of the property, and comprised two secondary flakes of an undetermined Pre-Contact date. Findspot 10 consisted of a 28 x 40 m scatter of 213 Euro-Canadian artifacts in the central part of the property, 44 of which were collected for laboratory analysis. A total of 34 of these artifacts were diagnostic, including pearlwares (pre-1830), shell-edged whitewares (ca. 1830s) and cut nails (1830–1900). Findspot 11 comprised a single lithic flake of an undetermined Pre-Contact date in the western part of the property.

Of the three findspots, only Findspot 10 met the MTCS's criteria for sites requiring further work (with a minimum of 20 artifacts dating the period of use prior to 1900). Accordingly, ARA recommends that Findspot 10 be subjected to a Stage 3 site-specific assessment when conditions improve. An appropriate Stage 3 assessment strategy would involve a Controlled Surface Pickup of the remaining artifacts and the excavation of an array of 1 x 1 m test units along a 5 m grid across the 28 x 40 m scatter. Judging from historical depictions of the property, this site may have functioned as a midden (refuse deposit) in the vicinity of Moses McCurdy's historic homestead.

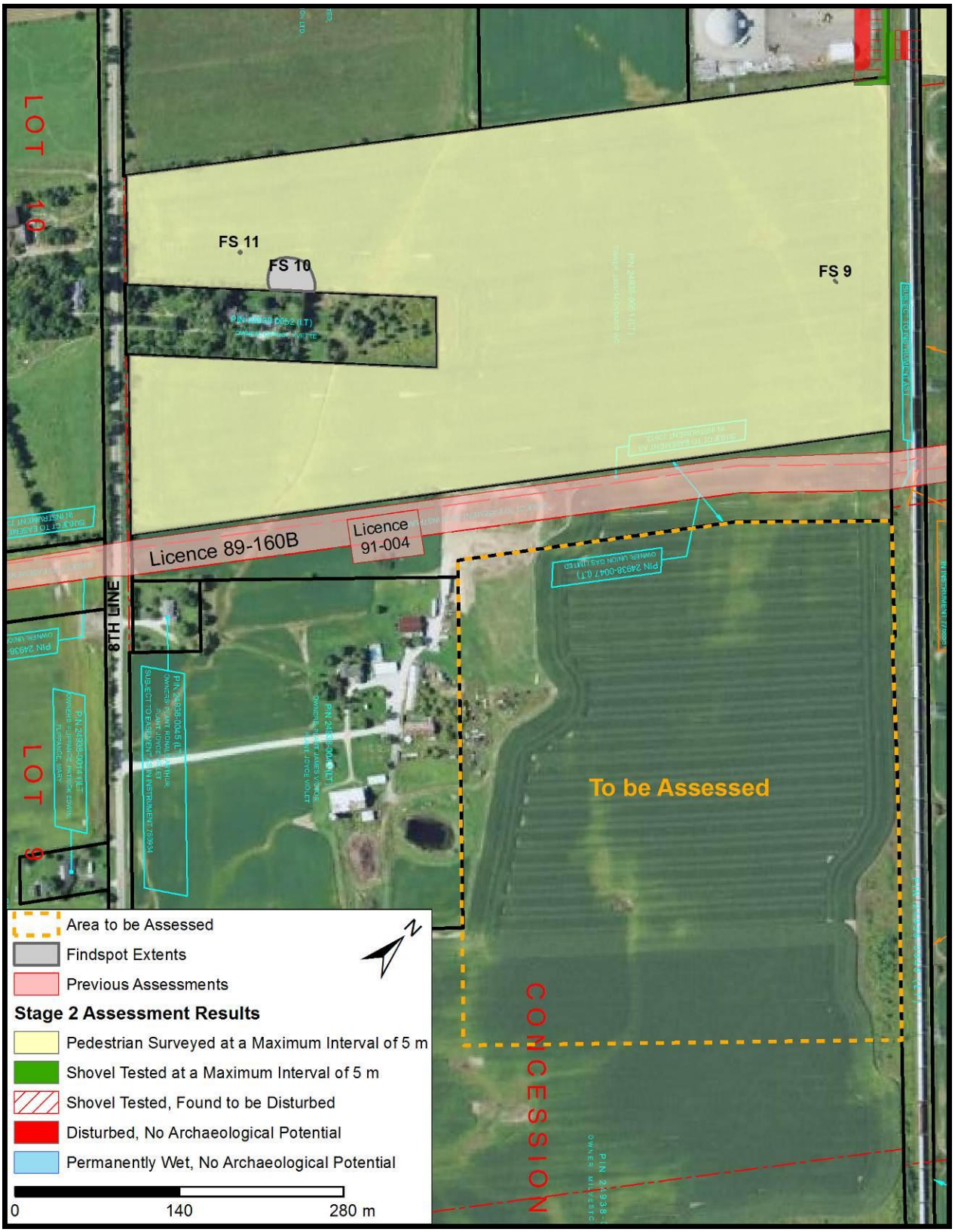
The remaining Stage 1 and 2 assessments on the southernmost Part 2 will be carried out when weather conditions improve, and all agricultural lands will be ploughed and subjected to pedestrian survey at a maximum internal of 5 m. In those parts of the property that cannot be ploughed, or where ploughing is not viable, the assessment will be conducted using the test pit survey method at a maximum interval of 5 m. Any previously-unassessed areas within the existing Union Gas Ltd. easement (PIN 24938-0047) with the potential to be impacted by the project will also be examined for archaeological materials.

Should you have any questions or concerns, please do not hesitate to contact me at your earliest convenience.

Sincerely,



Christopher J. Gohm, Ph.D. Candidate
Deliverables Manager
Archaeological Research Associates Ltd.
154 Otonabee Drive, Kitchener, ON N2C 1L7
Tel: (519) 804-2291 ext. 101 | Fax: (519) 286-0493
cjgohm@arch-research.com



Map 1: Stage 1 and 2 Assessments – Progress Report
(Google Earth 2013)

Appendix C8

Eight Line Pavement Evaluation

Final Report: Pavement Evaluation on Eighth Line, from Derry Road to Approximately 1.1 km South, Milton

Submitted to:
Ashleigh Barnwell, P.Eng.
Union Gas Ltd./A Spectra Energy Company

750 Richmond Street
Chatham ON N7M 5J5

Submitted by:
Stantec Consulting Ltd.
49 Frederick Street
Kitchener, ON N2H 6M7

February 1, 2013

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1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by Union Gas Ltd. to conduct a pavement investigation consisting of Ground Penetrating Radar (GPR) surveys, deflection testing using a Falling Weight Deflectometer (FWD), subsurface investigations and visual pavement condition assessments. The purpose of this project is to identify the existing pavement conditions on Eighth Line in Milton, Ontario from Derry Road southerly for approximately 1.1 km.

1.1 PROJECT SITE DESCRIPTION AND BACKGROUND

Presented below in Figure 1.1, are the limits of the project and extent of the pavement investigation on Eighth Line, from Derry Road southerly for an approximate length of 1,100 m.

Based on our understanding of the project, Union Gas is to undertake a rezoning (i.e. the process of a Zoning By-Law Amendment Application) of the subject property referred to as Lot 9 and 10 Concession 9, on Eighth Line, in Milton Ontario.

It is our understanding that Union Gas is in the preliminary stages of completing the Site Plan Process in order to permit the construction of a new Union Gas Compressor Station.

Union Gas has requested that Stantec undertake a comprehensive pavement evaluation to determine the existing conditions of the pavements including the in-situ structural capacity on Eighth Line, from Derry Road southerly for an approximate length of 1,100 m.

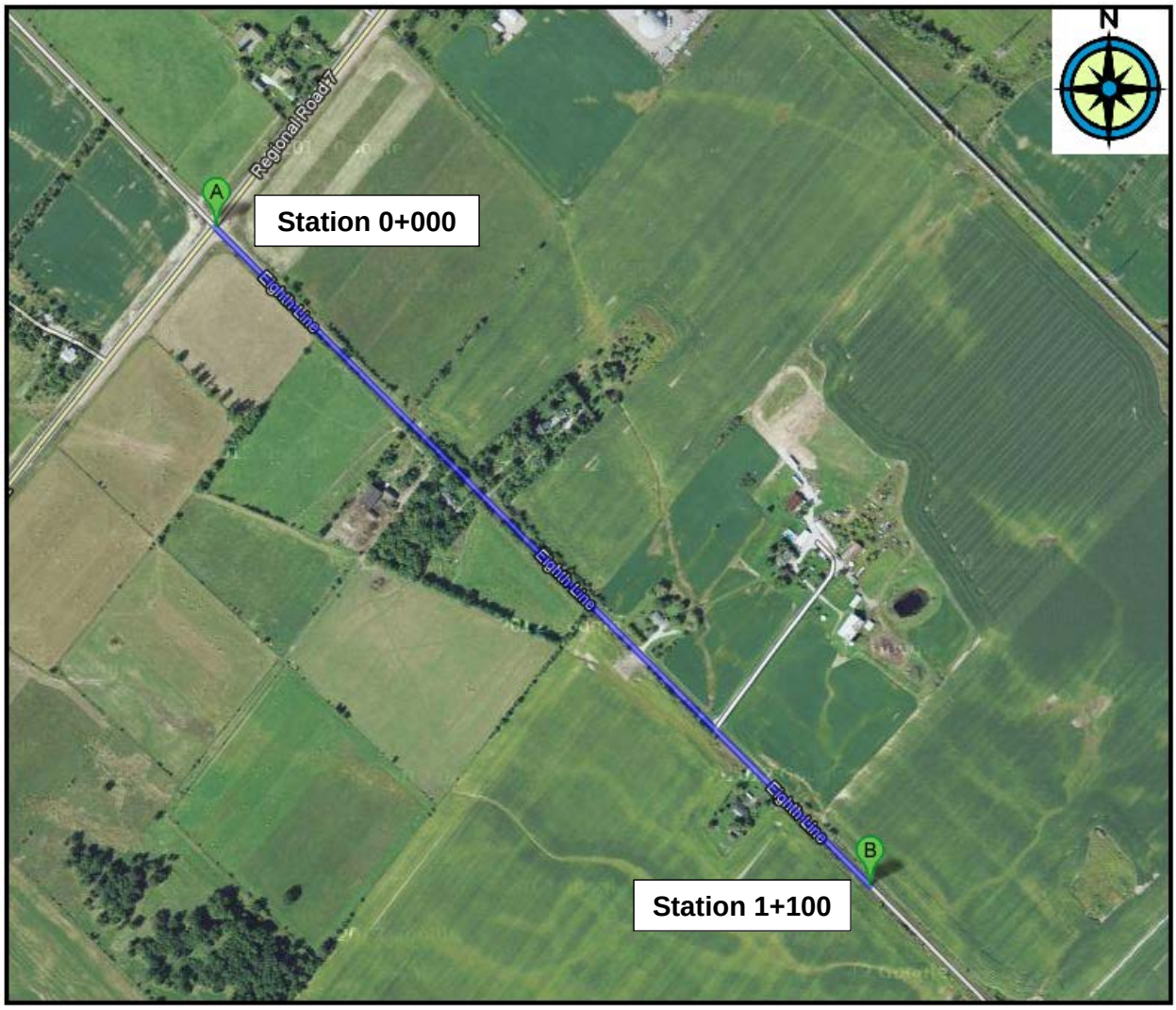


Figure 1.1: Eighth Line Project Limits

2.0 Pavement Data Collection

The following sections provide background information on the various pavement evaluation and data collection methods that were employed to assess the condition of the existing pavements on Eighth Line.

2.1 VISUAL DISTRESS SURVEY

A visual distress survey was completed by Stantec personnel to assess the severity and extent of the distresses observed on the pavements. In addition, a number of digital photographs were taken along the length of the project in both lanes to document the surface condition of the pavement.

The pavement distresses collected during the visual distress survey on site are presented below in Table 2.1.

Table 2.1: Collected Distresses

Distress Type	Severity Levels	Extent Levels
Fatigue Cracking	• Low • Moderate • High	• Very Slight • Slight • Moderate • Severe • Very Severe
Block Cracking		
Wheel path Longitudinal Cracking		
Non-wheel path Longitudinal Cracking		
Transverse Cracking		
Patch Deterioration		

2.2 SUBSURFACE INVESTIGATION – BORING

2.2.1 Boring

Fifteen boreholes were advanced directly on the Eighth Line through the asphalt and into the underlying materials. The drilling was completed using 100 mm continuous flight, solid-stem augers. Stantec personnel recorded the asphalt thickness and subsurface conditions observed in the auger probes at the time of investigation. Representative granular and subgrade soil samples were recovered by sampling directly from the augers. Material type and thickness of the granular layers were recorded. Once the borings were complete, the auger probes were backfilled with auger cuttings and compacted in lifts. Auger probes in paved areas were capped with compacted cold mix asphalt. All soil samples were placed in labeled moisture-proof bags and transported to the Kitchener laboratory for classification. Each borehole location was identified by the station and GPS coordinates. The borehole logs are presented in Appendix B.

2.3 LABORATORY REVIEW AND TESTING

All samples were returned to the laboratory for detailed visual classification. Four representative samples of the granular material were submitted for moisture content and grain size analysis testing. Two representative samples of the subgrade material were submitted for grain size analysis, and three samples was submitted for Atterberg Limits testing. The soil samples will be retained for a period of one month following issue of the final report.

2.4 GROUND PENETRATING RADAR (GPR) SURVEYS

GPR data was collected continuously in one pass on each lane and direction of Eighth Line within the project limits. GPR testing was completed using a GPR system manufactured by Geophysical Survey Systems Inc. (GSSI). It consists of a SIR-20 data acquisition system with a model 4105 2.5-GHz air coupled horn antenna and wheel-mounted distance measuring instrument (DMI). The operator logs distresses or objects, intersections, or pavement distresses that may be in the test path while testing. The GPR vehicle is equipped with a Trimble GPS system that will simultaneously collect GPS coordinates along the road sections. The quality of the GPS data depends on the satellite coverage within the area.

The transmission rate for the GPR data collection was set to 100 kHz in North America. Data was collected at a scan rate of 156 scans/sec and 4 scans/m. The GPR data was saved to the lap top, and backed up. The GPR antenna and DMI were calibrated each day.



During data collection, the operator “flagged” the start and end of all sections within the data file. It is important to note that several factors can influence signal penetration and the quality of collected data. Pavements or base/subbase materials with high moisture contents adversely affect GPR signal penetration. To limit or eliminate this problem, data was not collected during or immediately after a rain event.

2.5 FALLING WEIGHT DEFLECTOMETER (FWD) TESTING

The Falling Weight Deflectometer testing was completed on November 16, 2012. FWD testing was completed using a Stantec LTPP-SHRP calibrated Dynatest Heavy Weight Deflectometer (HWD) to determine the in-situ pavement structural capacity and subgrade soil conditions within the project limits.

Deflection testing was completed in the right wheel path (RWP) in both directions on Eighth Line. In addition, the FWD test points were staggered across the lanes to ensure maximum coverage. At each test location, a series of four load applications were applied to the pavement surface. The first load application is a “seating” drop of 50 kN to ensure that the load plate is firmly resting on the pavement surface. The first load application is followed by three consecutive loads applied at 40 kN, 50 kN and 70 kN +/- 5% at each test location. Pavement deflections under each load were measured by nine sensors (geophones) placed at fixed distances from the center of the approximately 300 mm diameter load plate (see Table 2.2). Pavement surface and air temperature readings were recorded at each FWD test point.

Table 2.2: FWD Sensor Configuration

Sensor Number	1	2	3	4	5	6	7	8	9
Radial Offset from Center of the Load Plate (mm)	0	200	300	450	600	900	1200	1500	1800

3.0 Pavement Data Analysis and Results

3.1 VISUAL DISTRESS SURVEY

A visual distress survey was completed in both directions of Eighth Line within the project limits. As part of the distress survey, a number of digital photographs were also taken along the length of each lane. For reporting purposes, Eighth Line has been segmented into two pavement sections starting from the north end at the intersection with Derry Road at Station 0+000 to Station 0+080, and from Station 0+080 southbound to Station 1+100. The road was segmented into two unique sections to account for the varying performance and conditions observed on site. This section presents the results of the visual distress survey.

3.1.1 Eighth Line – Station 0+000 to Station 0+080

Eighth Line, from the north end at the intersection of Derry Road at Station 0+000 southbound to Station 0+080, was recently resurfaced and assessed to be in good condition with no significant distresses observed.

Photographs of the typical pavement condition observed on this sub-section of Eighth Line are presented below in Figures 3.1 and 3.2.



Figure 3.1: Resurfaced Pavement



Figure 3.2: Pavement Transition

3.1.2 Eighth Line – Station 0+080 to Station 1+100

Eighth Line, from Station 0+080 northbound to Station 1+100, was generally assessed to be in fair condition with the following distresses:

- Slight to moderate raveling throughout;
- Frequent slight to moderate pavement edge cracking;
- Intermittent slight longitudinal cracking; and
- Intermittent slight rutting.

Photographs of the typical distresses observed on this sub-section of Eighth Line are shown in Figures 3.3 to 3.6.



Figure 3.3: Slight to Moderate Ravelling Throughout



Figure 3.4: Slight to Moderate Pavement Edge Cracking



Figure 3.5: Slight Mid-Lane Longitudinal Cracking



Figure 3.6: Slight Rutting

3.2 SUBSURFACE INVESTIGATION

3.2.1 Asphalt Concrete

A total of fifteen boreholes were advanced directly through the asphalt pavement on Eighth Line. The asphalt thicknesses in the boreholes were measured, which was used to calibrate the GPR data. The asphalt log documents the asphalt concrete thicknesses at each borehole location and is provided in Appendix A. The minimum, maximum and mean asphalt concrete thickness observed in the parking lots and laneways are provided below in the Table 3.1.

Table 3.1: Asphalt Concrete Pavement Thickness

Eighth Line	Asphalt Concrete Thickness (mm)			Number of Auger Probes
	Min	Max	Mean	
Northbound	80	160	110	6
Southbound	80	110	100	9

3.2.2 Silty Sand with Crushed Gravel

A silty sand with crushed gravel material was observed in fourteen auger probes underlying the asphalt concrete on Eighth Line. The silty sand with crushed gravel contained varying amounts of silt. The thickness of the silty sand with crushed gravel layer is summarized below in Table 3.2. Based on visual examination, the silty sand with crushed gravel was generally assessed to be dry to moist.

Table 3.2: Silty Sand with Crushed Gravel Thickness

Eighth Line	Sand some Crushed Gravel Thickness (mm)			Number of Auger Probes
	Min	Max	Mean	
Northbound	110	250	150	5
Southbound	100	510	150	9

Grain size analysis and moisture content testing was completed on two representative samples of the silty sand with crushed gravel material and the test results yielded:

12%	Gravel
56% to 60%	Sand
28% to 32%	Fines (passing the 75 μm sieve)
3% to 4%	Moisture Content

The results are presented graphically in Appendix D.

3.2.3 Silty Sand with Gravel

A brown silty sand with gravel was observed underlying the asphalt in one auger probe on the southbound lane of Eighth Line. The silty sand with gravel was also observed below the silty sand with crushed gravel layer in four and eight auger probes on the north and southbound lanes of Eighth Line respectively. The silty sand with gravel contained varying amounts of silt. The thickness of the silty sand with gravel layer is summarized below in Table 3.3. Based on visual examination, the material was generally assessed to be dry to moist.

Table 3.3: Silty Sand with Gravel Thickness

Eighth Line	Sand with Gravel Thickness (mm)			Number of Auger Probes
	Min	Max	Mean	
Northbound	180	260	210	5
Southbound	160	390	270	8

Grain size analysis and moisture content testing was completed on two representative samples of the brown silty sand with gravel material. The test results yielded:

19% to 20%	Gravel
55% to 57%	Sand
24% to 25%	Fines (passing the 75 μm sieve)
3%	Natural Moisture Content

The results are presented graphically in Appendix D.

3.2.4 Clayey Silt to Silty Clay

A brown clayey silt to silty clay with varying amounts of sand was observed below the silty sand with crushed gravel and silty sand with gravel layers in twelve auger probes on Eighth Line. The clayey silt to silty clay layer generally extended to the termination depth of the auger probe approximately 1.5 m below the ground surface. Based on the visual assessment, the subgrade material was generally assessed to be moist.

Grain size analysis and moisture content testing was completed on one representative sample of the brown clayey silt to silty clay material. The test results yielded:

2%	Gravel
22%	Sand
47%	Silt
29%	Clay
15%	Natural Moisture Content

Atterberg Limits testing was completed on three representative samples of the clayey silt to silty clay subgrade material. The test results yielded:

33 to 43	Liquid Limit
18 to 19	Plastic Limit
15 to 24	Plasticity Index
17% to 21%	Natural Moisture Content

The results are presented graphically in Appendix D.

3.2.5 Sandy Silt

A brown sandy silt with varying amounts of clay was observed below the silty sand with crushed gravel, silty sand with gravel, and clayey silt to silty clay layers in four auger probes on Eighth Line. The sandy silt layer generally extended to the termination depth of the auger probe approximately 1.5 m below the ground surface. Based on the visual assessment, the subgrade material was generally assessed to be moist.

Grain size analysis and moisture content testing was completed on one representative sample of the brown sandy silt material. The test results yielded:

3%	Gravel
33%	Sand
39%	Silt
25%	Clay
13%	Natural Moisture Content

The results are presented graphically in Appendix D.

3.2.6 Topsoil

Topsoil was not observed in any of the auger probes advanced on Eighth Line.

3.2.7 Groundwater

Groundwater was not observed in any of the auger probes advanced on Eighth Line.

3.3 GROUND PENETRATING RADAR (GPR) SURVEY

Pavement layer information was obtained from a continuous GPR survey, performed on Eighth Line within the project limits to determine the pavement layer profiles. Borehole data was used to calibrate the GPR layer profile data.

GPR data was checked for quality and processed using RADAN 6.6, an advanced GPR data reduction software developed by GSSI. GPR data processing involves identifying reflections caused by changes in the electrical properties (dielectric, electrical conductivity, etc.) of a layer. The operator digitizes the reflection and the software converts the digitized reflection into layer thicknesses. Once the layers have been identified with RADAN 6.6, the layer and thickness data was exported as an ASCI or Excel file. GPR layer statistics including the minimum, maximum, average, and standard deviation are reported. A sample of the detailed GPR results is included in Appendix C.

The GPR data was exported at an interval of 5 m. Each GPR thickness measurement represents the average layer thickness over the 5 m interval. A summary of the minimum, maximum, average, and standard deviation of the asphalt concrete and granular thicknesses obtained from the GPR surveys for both directions are provided in Tables 3.4 and 3.5.

Table 3.4: Summary of GPR Asphalt Concrete Layer Statistics

Street	Dir	Lane	GPR AC Layer Thickness (mm)			
			Min.	Max.	Avg.	Stdev
Eighth Line	N	1	65	203	121	30
	S	1	79	163	111	18

Table 3.5: Summary of GPR Granular Layer Statistics

Street	Dir	Lane	GPR Granular Base Thickness (mm)				GPR Granular Subbase Layer Thickness (mm)			
			Min.	Max.	Avg.	Stdev	Min.	Max.	Avg.	Stdev
Eighth Line	N	1	48	294	143	53	49	315	185	72
	S	1	56	411	142	42	89	334	232	56

A sample screen capture identifying the asphalt and granular base/subbase layers for the collected GPR data for the northbound lane is presented in Figure 3.

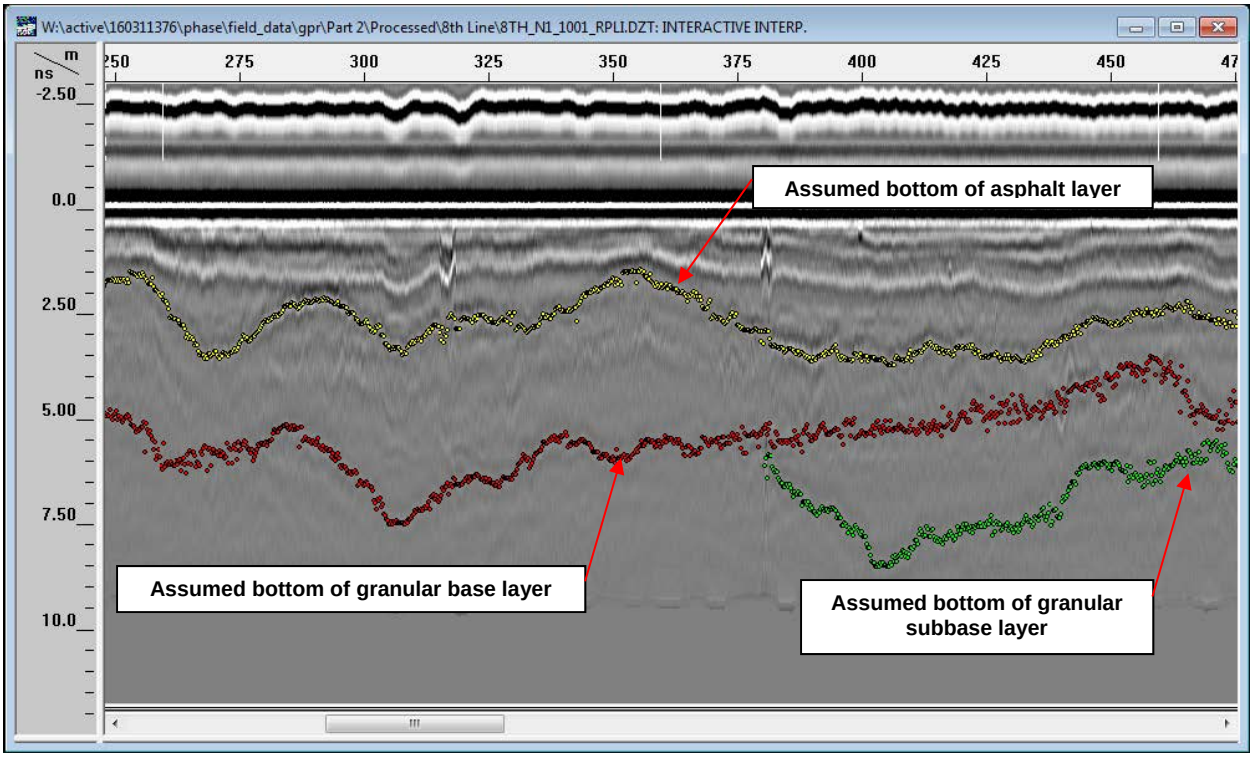


Figure 3.7: Eighth Line - Northbound Lane

The GPR layer profiles representing the total asphalt concrete (AC) and granular base/subbase thicknesses are presented below in Figures 3.8 and 3.9.

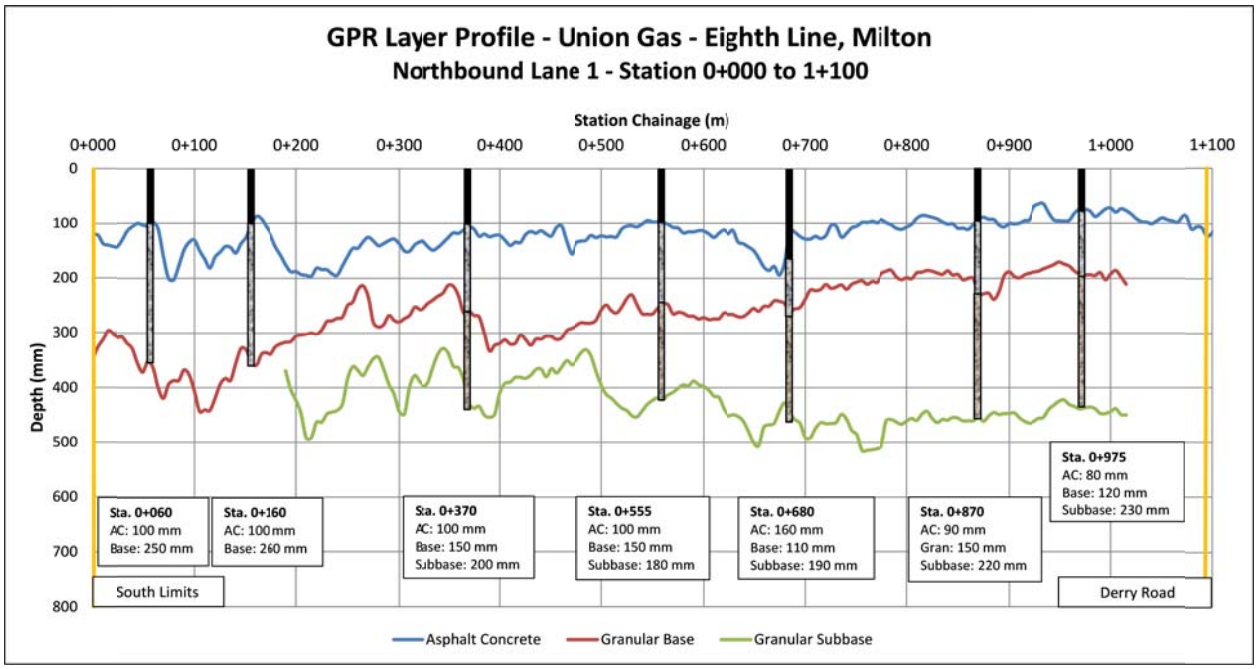


Figure 3.8: Eighth Line - Northbound Lane

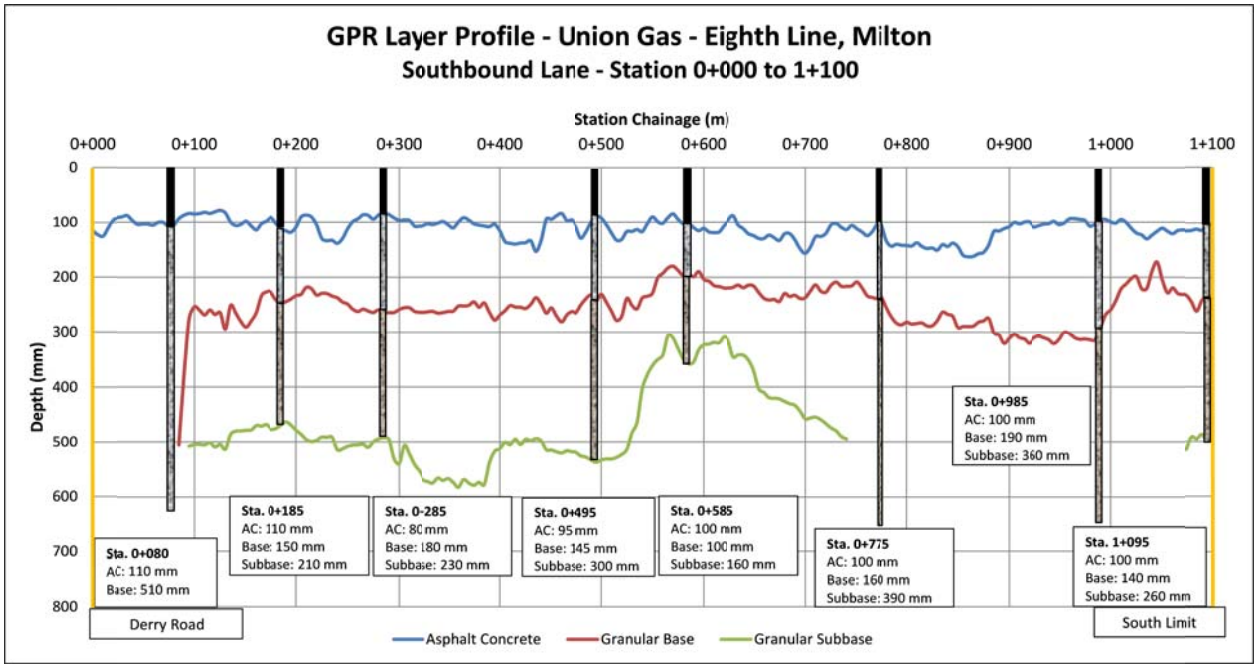


Figure 3.9: Eighth Line - Southbound Lane

4.0 FWD Analysis Methodology

Backcalculation analysis was completed using procedures outlined in the 1993 AASHTO Guide for the Design of Pavement Structures to determine the effective Structural Number (pavement structural capacity) and the in-situ subgrade soil Resilient Modulus (MR). The following subsections summarize the AASHTO analysis methodology.

4.1 AASHTO 1993 ANALYSIS METHODOLOGY

4.1.1 Maximum Normalized Deflection

The maximum normalized deflection (D_o), measured at the center of the load plate, is a good indicator of the overall pavement stiffness (strength). The deflection at this location is a function of the pavement layer stiffness, including the support capacity of the subgrade soil. The deflections recorded under the load plate is normalized to adjust for load variation during FWD testing between different test locations and to normalize the deflection values collected at different FWD load levels to a common standard load level of 40 kN, at a standard temperature of 20°C. The AASHTO 1993 temperature correction methodology was used to normalize to a standard temperature of 20°C.

4.1.2 Backcalculation and Evaluation of the In-situ Pavement Conditions

The FWD measured deflections were used to determine the effective Structural Number and the in-situ subgrade Resilient Modulus. The Structural Number is a representation of the pavement strength and the subgrade Resilient Modulus is a representation of the strength of the subgrade soil to resist permanent deformation under traffic.

Backcalculation analysis uses analytical pavement response models to predict deflections based on a set of given layer thickness values and moduli. With pavement thickness held constant, based on pavement layer thickness information, the response models identify the set of subgrade and pavement layer moduli that produce deflections similar to those measured during FWD testing. The backcalculated moduli are examined to draw conclusions about the degree of structural deterioration in the pavement layers and the expected remaining life of the pavement structure. Backcalculated moduli can also be used for design of structural overlays.

The outputs of the backcalculation and evaluation analysis are the modulus of elasticity of the pavement structure, known as the Effective Pavement Modulus (E_P), the Effective Structural Number (SN_{eff}) of the pavement layers and the Subgrade Soil Resilient Modulus (M_R).

5.0 Falling Weight Deflectometer Evaluation and Results

5.1 FWD ANALYSIS RESULTS

The results of the AASHTO 1993 backcalculation and pavement evaluation analysis are presented in the following sections. The results are presented in terms of the normalized pavement deflection (D_0) under the load plate, the in-situ M_R, the E_P, and the SN_{eff}, respectively.

5.1.1 Normalized FWD Deflections

The measured deflections were normalized to a standard load of 40 kN and corrected for a standard temperature of 20°C. Table 5.1 summarizes the minimum, maximum, average, and standard deviation for both directions; while, Figure 5.1 presents the variation of the normalized maximum deflection (D_0) data.

Table 5.1: Summary of Normalized Deflections

Direction	Pavement Type	From	To	Minimum Deflection (µm)	Maximum Deflection (µm)	Average Deflection (µm)	Standard Deviation (µm)
Northbound	Flexible	1.1 km South of Derry Rd	Derry Road	209	1,291	674	238
Southbound	Flexible	Derry Road	1.1 km South of Derry Road	208	922	569	190

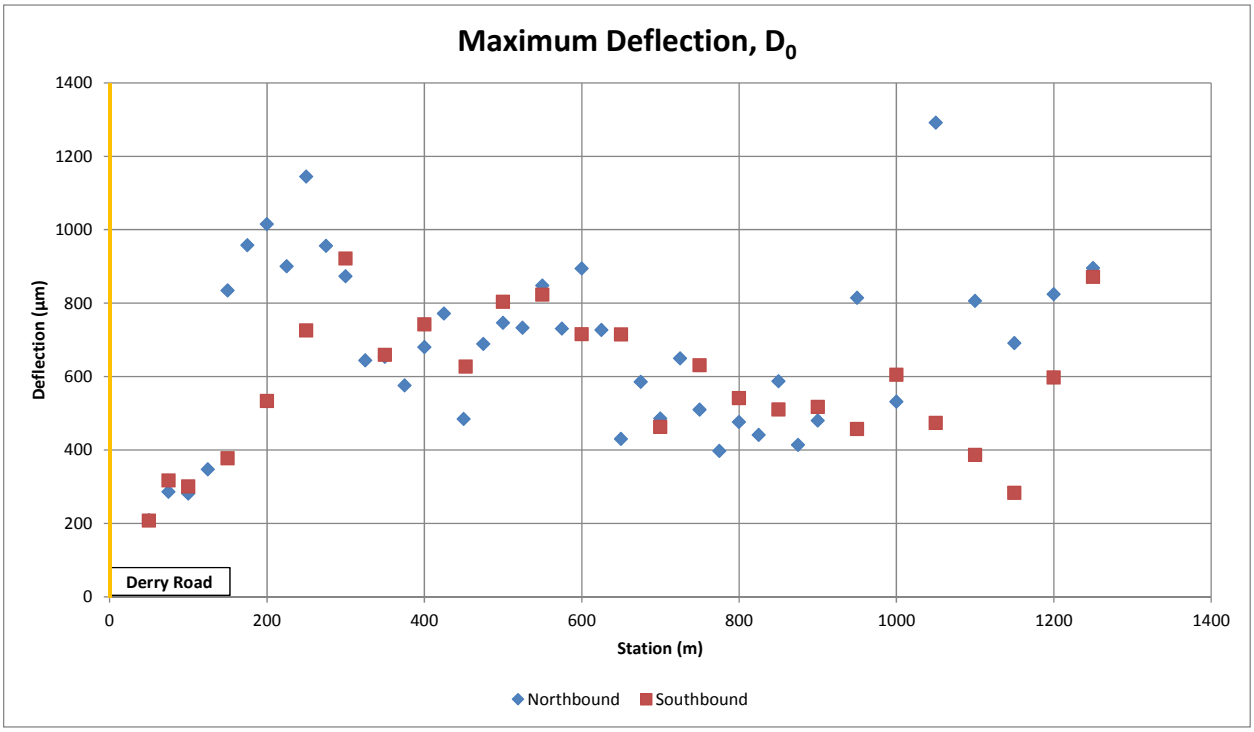


Figure 5.1: Maximum Normalized Deflection, NB and SB Direction

5.1.2 In-Situ Pavement Conditions

5.1.2.1 Subgrade Resilient Modulus (MR)

The calculated Subgrade Soil Resilient Modulus (M_R) for Eighth Line is graphically presented in Figure 5.2. Table 5.2 summarizes the minimum, maximum, average, and standard deviation for both directions. A high subgrade resilient modulus is desirable to provide adequate support for the pavement structure and resist the permanent deformation under repeated traffic loading. Low Subgrade Resilient Modulus values are usually associated with weak and/or soft subgrade soil conditions.

The average M_R value for the north and southbound lanes are 36 MPa and 37 MPa respectively. Based on the MTO document "Adaptation and Verification of AASHTO 1993 Pavement Design Guide for Ontario Conditions", these M_R values indicate good subgrade support for a clayey silt to silty clay subgrade.

Table 5.2: Summary of Subgrade Resilient Modulus

Direction	Pavement Type	From	To	Minimum (MPa)	Maximum (MPa)	Average (MPa)	Standard Deviation (MPa)
Northbound	Asphalt	1.1 km South of Derry Rd	Derry Road	23	52	36	8
Southbound	Asphalt	Derry Road	1.1 km South of Derry Road	23	56	37	8

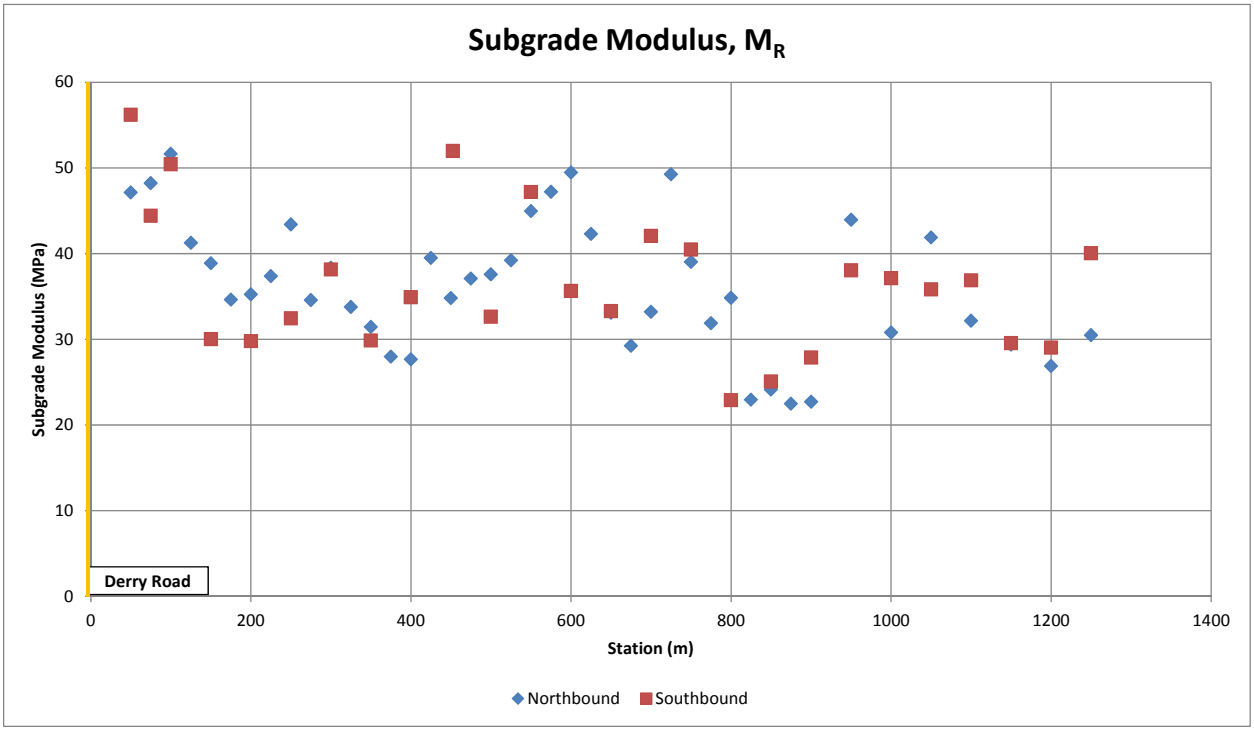


Figure 5.2: Subgrade Resilient Modulus, NB and SB Direction

5.1.2.2 Effective Pavement Modulus (E_P)

The backcalculation results for the Effective Pavement Modulus of Elasticity (E_P) are provided in Figures 5.5 and 5.6. Table 5.3 summarizes the minimum, maximum, average, and standard deviation for both directions. E_P is a representation of the overall pavement stiffness (the combined stiffnesses of all pavement layers above the subgrade) and is used to calculate the effective structural number. E_P values for new flexible pavements usually range between 1,000 to 1,700 MPa depending on the overall pavement thickness. High values of E_P indicate a stronger pavement structure.

The average E_P value for the north and southbound lanes are 260 MPa and 326 MPa respectively. E_P values are dependent on the overall pavement thickness and the integrity of the pavement layers.

Table 5.3: Summary of Effective Pavement Modulus

Direction	Pavement Type	From	To	Minimum (MPa)	Maximum (MPa)	Average (MPa)	Standard Deviation (MPa)
Northbound	Asphalt	1.1 km South of Derry Rd	Derry Road	64	1,232	260	221
Southbound	Asphalt	Derry Road	1.1 km South of Derry Road	108	1,179	327	260

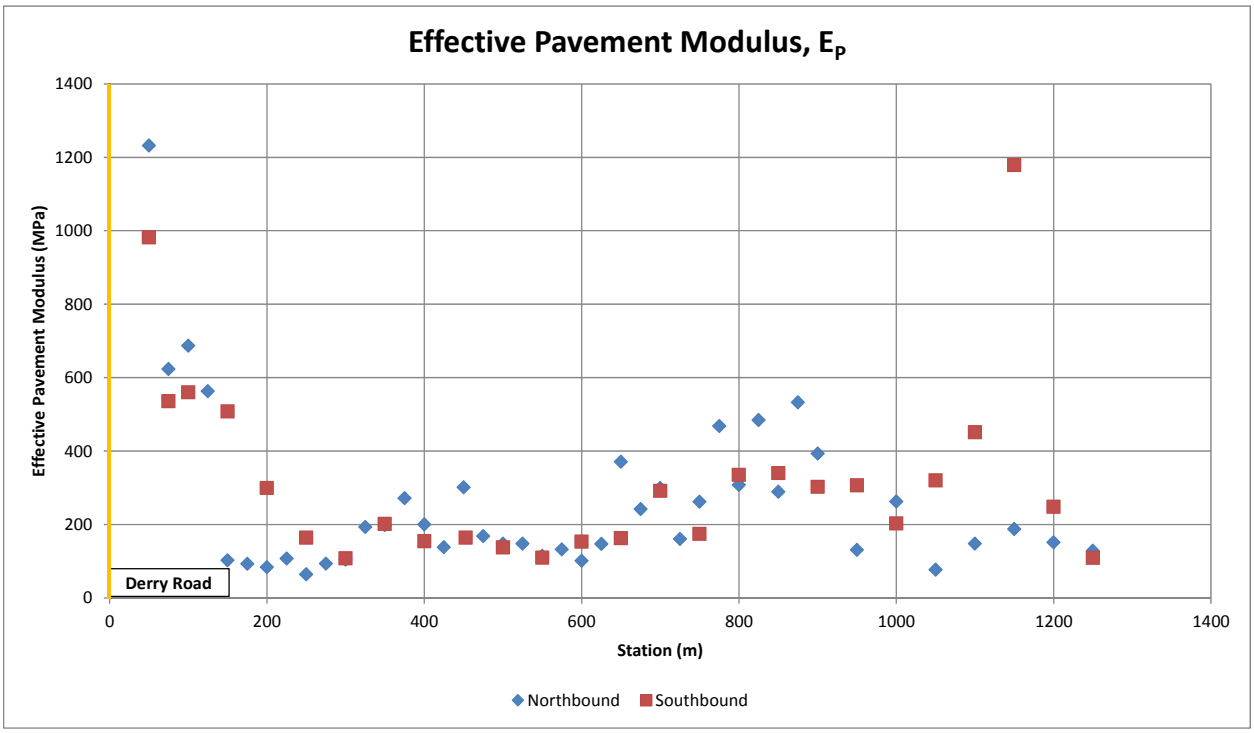


Figure 5.3: Effective Pavement Modulus, NB and SB Direction

5.1.2.3 Effective Structural Number (SN_{eff})

The backcalculation results for the Effective Structural Number are provided in Figure 5.4. Table 5.4 summarizes the minimum, maximum, average, and standard deviation for both directions. The effective strength or structural capacity of the existing pavement layers is traditionally represented by the Effective Structural Number. Low SN_{eff} values indicate low structural capacity of the pavement structure; while, high SN_{eff} values indicate high structural capacity of the pavement structure. Based on the layer thickness data, this pavement section would have been constructed at an approximate SN of 85 at the beginning of its service life. The average SN_{eff} value for the north and southbound lanes are 38 and 39 respectively.

Table 5.4: Summary of Effective Structural Number

Direction	Pavement Type	From	To	Minimum	Maximum	Average	Standard Deviation
Northbound	Asphalt	1.1 km South of Derry Rd	Derry Road	18	62	38	12
Southbound	Asphalt	Derry Road	1.1 km South of Derry Road	26	59	39	10

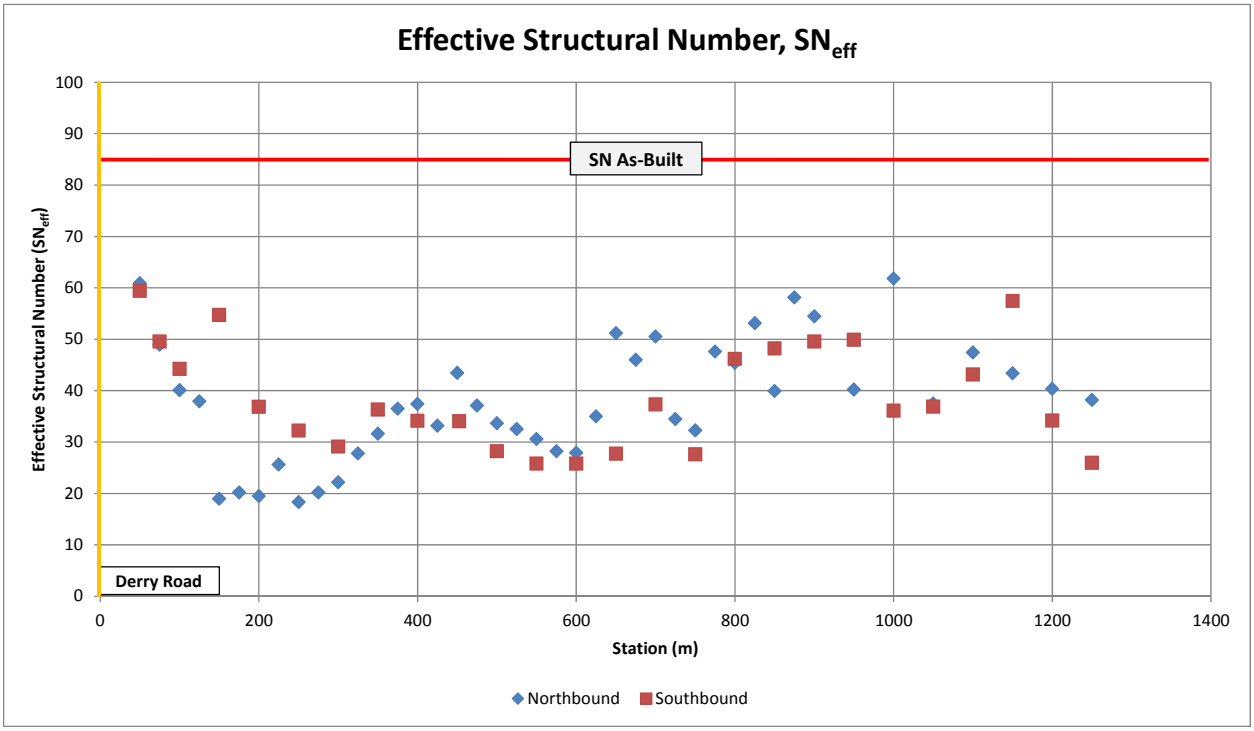


Figure 5.4: Effective Structural Number, NB and SB Direction

5.1.3 Elmod 6.0 Analysis – Layer Moduli

Elmod 6.0, from Dynatest, was also used to analyze the FWD data collected on Eighth Line. The Elmod software backcalculates modulus values for each individual layer in the pavement structure. The backcalculation results for each of the material layers are provided in Figures 5.5 and 5.6. Table 5.5 summarizes the minimum, maximum, average, and standard deviation factor for both directions.

Table 5.5: Summary of Layer Moduli

Direction	Material Type	Minimum (MPa)	Maximum (MPa)	Average (MPa)	Standard Deviation Factor (MPa)	84th Percentile (MPa)
Northbound	Asphalt	716	14,969	2,606	1.980	1,316
	Granular Base	19	1,796	116	3.251	36
	Subgrade	16	142	45	1.509	30
Southbound	Asphalt	1,038	9,612	3,205	1.742	1,840
	Granular Base	14	1,364	205	2.820	73
	Subgrade	21	126	47	1.447	33

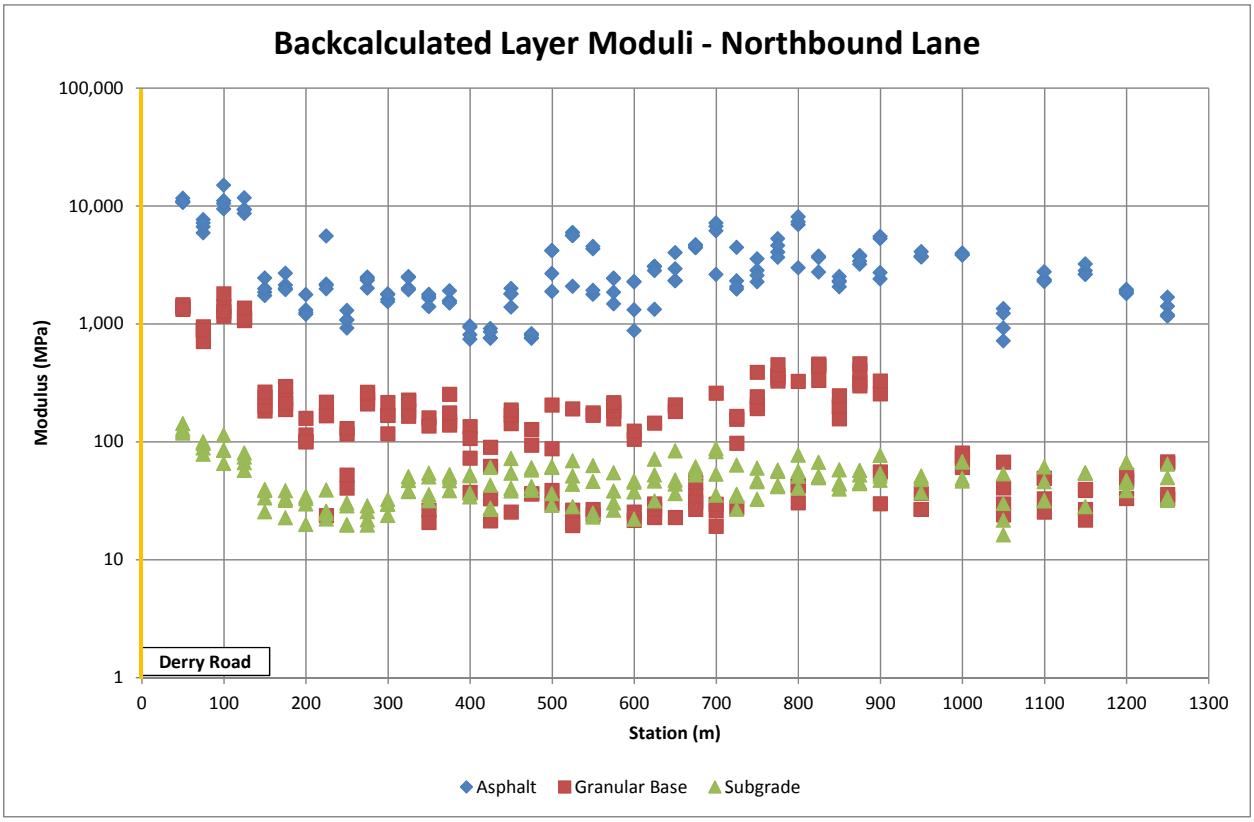


Figure 5.5: Backcalculated Layer Moduli, Northbound Lane

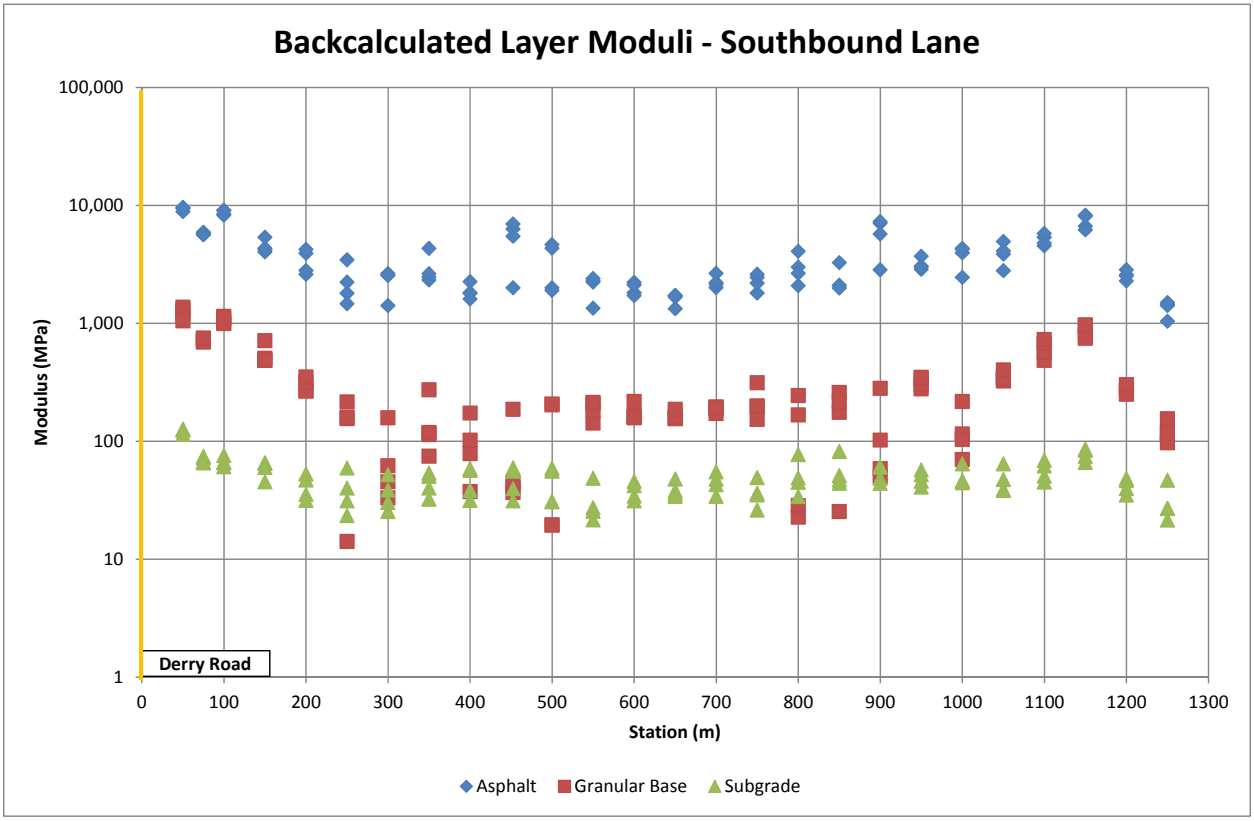


Figure 5.6: Backcalculated Layer Moduli, Southbound Lane

5.1.4 Summary of FWD Testing and Analysis

The average maximum normalized deflection (D_0) and the backcalculation results (M_R, E_P, and SN_{eff}) for the northbound and southbound lane on Eighth Line are summarized below in Table 5.6.

Table 5.6: Summary of FWD Testing and Analysis Results

Direction	Pavement Type	Maximum Normalized Deflection (µm)	Subgrade Resilient Modulus M_R (MPa)	Effective Pavement Modulus E_P (MPa)	Effective Structural Number (SN_{eff})
Northbound	Asphalt	674	36	260	38
Southbound	Asphalt	569	37	327	39

6.0 Pavement Analysis Parameters

The design parameters presented below in Table 6.1 were selected for use in determining the estimated remaining service life of Eighth Line based on the results of the field investigation and the laboratory test programs and the information presented in the MTO document *Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*, MI-183. These design parameters were used in the evaluation of the pavement using the 1993 American Association of State Highway Transportation (AASHTO) Pavement Design Guide. The traffic data presented in Table 6.1 was estimated from traffic counts performed as a part of this project. The calculations are summarized and presented in Appendix E.

Based on the parameters below, the calculated required SN for 1 year of projected traffic is 49 and 81 for a 20 year design life.

Table 6.1: Pavement Analysis Parameters – Eighth Line

Existing Traffic	**Eighth Line** 2012 AADT: 882 (5% Truck Traffic) 4% medium trucks 1% heavy trucks 2.0% Growth Rate (assumed) 14,000 ESAL's (1 yr) 335,000 MESAL's (20 yrs)	**SN Required** **49** **81**
Projected Traffic with Union Gas Compressor Station	**Eighth Line** 2012 AADT: 918 (5% Truck Traffic) 4% medium trucks 1% heavy trucks 2.0% Growth Rate (assumed) 14,350 ESAL's (1 yr) 348,800 ESAL's (20 yrs)	**SN Required** **49** **81**
Truck Factors	2 and 3 axle trucks – 0.5 4 axle trucks – 2.3 5 axle trucks – 1.6 6 and more axle trucks – 5.5 Buses – 2.0	
Reliability	85 %	
Serviceability	Initial 4.2 Terminal: 2.0	
Subgrade and Drainage	Clayey Silt to Silty Clay: M_r of 35 MPa	

7.0 Discussion and Recommendations

Union Gas has retained Stantec to identify the existing pavement condition on Eighth Line in Milton. A subsurface investigation and distress survey have been conducted along with GPR and FWD testing to identify the in-situ pavement condition. The pavement distress survey indicated that there are three distinct sections along the project length with varying performance.

Grain size analysis was completed on two representative samples of the granular base material recovered from below the asphalt pavements on the northbound and southbound lanes of Eighth Line. The granular samples tested did not meet the gradation requirements for a Granular A material due to an excess of fines in the samples. The granular samples collected from the other auger probes were visually reviewed and it was assessed that those materials would not meet the crushed particle count requirements for a Granular A. Based on these results, the existing granular base material was assessed to not be suitable for reuse as a granular base, however, it would be acceptable as a select subgrade material (SSM).

The typical modulus values for each material in a pavement structure are presented below in Table 7.1. From the backcalculation results, it was observed that the asphalt layer moduli were well below typical values. The mean 84th percentile of the asphalt layer modulus was approximately 1,600 MPa, while the typical modulus for new asphalt is at least 3,000 MPa. The backcalculated effective structural number (SN_{eff}) also indicated, on average, a reduction in structural strength of more than 50% as compared to the original strength at construction.

Table 7.1: Typical Modulus Values

Material	Modulus (MPa)	84th Percentile Modulus (MPa)	Within Range (Yes/No)
Asphalt at 20°C	3,000 to 7,000	1578	No
Granular Base	100 to 1,000	55	No
Subgrade	30 to 300	32	Yes

An AASHTO 1993 analysis was run using the parameters described in Section 6.0 using existing traffic on Eighth Line as well as the projected Union Gas site traffic. The analysis results are included in Appendix E. It was determined from FWD testing that the in-situ structural number for both directions of Eighth Line is 39. The AASHTO analysis using the given traffic data indicates that a Structural Number of 49 is required for both existing and projected traffic, for one year of service. A Structural Number of 81 is required for both existing and projected traffic, for 20 years of service. It is important to note that the additional traffic projected to be using Eighth Line is very minimal and had no effect on the required structural number.

The results of the pavement investigation indicate that the pavement is at the end of its service life and requires major rehabilitation or reconstruction. It is also worth noting that no signs of pavement preservation treatments such as crack sealing or patching were observed on site.

8.0 Closure

This report presents the results of the pavement investigation performed to date by Stantec for Union Gas.

A pavement investigation is a limited sampling of the site and the information presented is representative of the findings at the specific test location. This information can only be extrapolated to an undefined area around the location, and the extent of the limited area depends on the pavement, soil and groundwater conditions as well as the history of the site. The analyses submitted are based upon field exploration performed at the locations shown in this report. Fluctuations in the water table may occur due to rainfall, temperature, seasonal runoff or adjacent irrigation practices. Construction planning should be based on assumptions of possible variations.

This report was prepared by Stantec and the material in it reflects the best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust the information presented herein meets your present requirements. Should you have any questions or comments please call:

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Appendix A: Asphalt Logs

Appendix A: Asphalt Logs

Table A.1: Eighth Line – Asphalt Thicknesses and Borehole Locations

Borehole - ID	Layer Type	Total Thickness (mm)	Underlying Base Type	GPS Coordinates
BH-1	Asphalt	110	Silty Sand with Crushed Gravel	W079 47'48.01" N043 33'51.86"
BH-2	Asphalt	110	Silty Sand with Crushed Gravel	W079 47'44.99" N043 33'49.51"
BH-3	Asphalt	80	Silty Sand with Crushed Gravel	W079 47'41.91" N043 33'47.27"
BH-5	Asphalt	95	Silty Sand with Crushed Gravel	W079 47'35.47" N043 33'42.68"
BH-6	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'32.43" N043 33'40.24"
BH-8	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'26.04" N043 33'35.53"
BH-10	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'19.70" N043 33'30.74"
BH-11	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'16.54" N043 33'28.71"
BH-14	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'17.98" N043 33'29.82"
BH-15	Asphalt	100	Silty Sand with Gravel	W079 47'21.10" N043 33'32.22"
BH-17	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'27.73" N043 33'36.73"
BH-19	Asphalt	100	Silty Sand with Crushed Gravel	W079 47'33.93" N043 33'41.34"
BH-20	Asphalt	160	Silty Sand with Crushed Gravel	W079 47'37.33" N043 33'43.91"
BH-22	Asphalt	90	Silty Sand with Crushed Gravel	W079 47'43.70" N043 33'48.57"
BH-23	Asphalt	80	Silty Sand with Crushed Gravel	W079 47'47.19" N043 33'51.01"

Appendix B: Auger Probe Logs

Appendix B: Auger Probe Logs

Eighth Line - Union Gas

BH1, 100m S of Derry, SB, 1.8 Lt

0	-	110	Asphalt
110	-	620	Brown Silty Sand with Crushed Gravel
620	-	1500	Brown Clayey Silt, Firm, Moist

BH23, 150m S of Derry, NB, 1.6 Rt

0	-	80	Asphalt
80	-	200	Silty Sand with Crushed Gravel
200	-	430	Brown Silty Sand with Gravel
430	-	1500	Brown Clayey Silt, Firm, Moist

BH2, 200m S of Derry, SB, 1.6 Lt

0	-	110	Asphalt
110	-	260	Silty Sand with Crushed Gravel
260	-	470	Brown Silty Sand with Gravel
470	-	1500	Brown Clayey Silt, Firm, Moist

BH22, 250m S of Derry, SB, 1.8 Lt

0	-	90	Asphalt
90	-	240	Brown Silty Sand with Crushed Gravel
240	-	460	Brown Silty Sand some Gravel
460	-	800	Dark Brown Clayey Silt, Firm, Moist
800	-	1500	Brown Sandy Silt Trace Gravel, Moist

BH3, 300m S of Derry, SB, 1.8 Lt

0	-	80	Asphalt
80	-	260	Silty Sand with Crushed Gravel
260	-	490	Brown Silty Sand with Gravel
490	-	1500	Brown Clayey Silt, Firm, Moist

BH20, 450m S of Derry NB, 1.7 Rt

0	-	160	Asphalt
160	-	270	Brown Silty Sand with Crushed Gravel
160	-	460	Brown Silty Sand with Gravel
460	-	1500	Brown Clayey Silt, Firm, Moist

BH5, 500m S of Derry, SB, 1.7 Lt

0	-	95	Asphalt
95	-	240	Silty Sand with Crushed Gravel
240	-	540	Brown Silty Sand with Gravel
540	-	1500	Brown Clayey Silt, Firm, Moist

BH19, 550m S of Derry NB, 1.6 Rt

0	-	100	Asphalt
100	-	250	Silty Sand with Crushed Gravel
250	-	430	Brown Sand with Gravel some Silt
430	-	700	Brown Sandy Silt with Clay race Gravel, Moist
700	-	1500	Brown Sandy Silt Trace Gravel, Moist

BH6, 600m S of Derry SB, 1.6 Lt

0	-	100	Asphalt
100	-	200	Silty Sand with Crushed Gravel
200	-	360	Brown Sand with Gravel and Silt
360	-	950	Dark Brown Clayey Silt, Firm, Moist
950	-	1500	Brown Clayey Silt, Firm, Moist

BH17, 750m S of Derry NB, 1.6 Rt

0	-	100	Asphalt
100	-	250	Silty Sand with Crushed Gravel
250	-	450	Brown Sand with Gravel some Silt
450	-	700	Dark Brown Clayey Silt, Firm, Moist
700	-	1500	Brown Sandy Silt some Gravel, Moist

BH8, 800m S of Derry, SB, 1.8 Lt

0	-	100	Asphalt
100	-	260	Silty Sand with Crushed Gravel
260	-	650	Brown Sand with Gravel and Silt
650	-	1500	Dark Brown Clayey Silt, Firm, Moist

BH 15, 950m S of Derry NB, 1.6 Rt

0	-	100	Asphalt
100	-	360	Brown Sand with Silt and Gravel
360	-	1500	Dark Brown Silty Clay, Firm, Moist

Appendix B: Auger Probe Logs

BH10, 1000m S of Derry, SB, 1.8 Lt

0	-	100	Asphalt
100	-	290	Silty Sand with Crushed Gravel
290	-	650	Brown Sand with Gravel and Silt
650	-	1500	Dark Brown Clayey Silt, Firm, Moist

BH14, 1050m S of Derry NB, 1.6 Rt

0	-	100	Asphalt
100	-	350	Silty Sand with Crushed Gravel
350	-	1500	Brown Clayey Silt with Sand Trace Gravel, Moist

BH11, 1100m S of Derry, SB, 1.7 Lt

0	-	100	Asphalt
100	-	240	Silty Sand with Crushed Gravel
240	-	500	Brown Sand with Gravel some Silt
500	-	1500	Brown Sandy Silt some Gravel, Moist

Appendix C: GPR Layer Profile Graphs and Data

Appendix C: GPR Layer Profile Graphs and Data

Table C.1: Eighth Line - Northbound Lane

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	192	0+000	Asphalt	121	Core	Base	346	225	Core	Subbase			Core
Eighth Line - Northbound Lane	197	0+005	Asphalt	122	Core	Base	325	203	Core	Subbase			Core
Eighth Line - Northbound Lane	202	0+010	Asphalt	138	Core	Base	312	174	Core	Subbase			Core
Eighth Line - Northbound Lane	207	0+015	Asphalt	140	Core	Base	297	157	Core	Subbase			Core
Eighth Line - Northbound Lane	212	0+020	Asphalt	143	Core	Base	302	160	Core	Subbase			Core
Eighth Line - Northbound Lane	217	0+025	Asphalt	143	Core	Base	308	165	Core	Subbase			Core
Eighth Line - Northbound Lane	222	0+030	Asphalt	131	Core	Base	307	176	Core	Subbase			Core
Eighth Line - Northbound Lane	227	0+035	Asphalt	114	Core	Base	319	205	Core	Subbase			Core
Eighth Line - Northbound Lane	232	0+040	Asphalt	106	Core	Base	329	223	Core	Subbase			Core
Eighth Line - Northbound Lane	237	0+045	Asphalt	100	Core	Base	356	255	Core	Subbase			Core
Eighth Line - Northbound Lane	242	0+050	Asphalt	103	Core	Base	372	269	Core	Subbase			Core
Eighth Line - Northbound Lane	247	0+055	Asphalt	105	Core	Base	353	248	Core	Subbase			Core
Eighth Line - Northbound Lane	252	0+060	Asphalt	98	Core	Base	364	266	Core	Subbase			Core
Eighth Line - Northbound Lane	257	0+065	Asphalt	110	Core	Base	400	290	Core	Subbase			Core
Eighth Line - Northbound Lane	262	0+070	Asphalt	160	Core	Base	419	260	Core	Subbase			Core
Eighth Line - Northbound Lane	267	0+075	Asphalt	200	Core	Base	395	194	Core	Subbase			Core
Eighth Line - Northbound Lane	272	0+080	Asphalt	203	Core	Base	387	184	Core	Subbase			Core
Eighth Line - Northbound Lane	277	0+085	Asphalt	177	Core	Base	387	210	Core	Subbase			Core
Eighth Line - Northbound Lane	282	0+090	Asphalt	149	Core	Base	368	219	Core	Subbase			Core
Eighth Line - Northbound Lane	287	0+095	Asphalt	134	Core	Base	377	242	Core	Subbase			Core
Eighth Line - Northbound Lane	292	0+100	Asphalt	131	Core	Base	406	276	Core	Subbase			Core
Eighth Line - Northbound Lane	297	0+105	Asphalt	150	Core	Base	443	294	Core	Subbase			Core
Eighth Line - Northbound Lane	302	0+110	Asphalt	165	Core	Base	441	276	Core	Subbase			Core
Eighth Line - Northbound Lane	307	0+115	Asphalt	181	Core	Base	442	260	Core	Subbase			Core
Eighth Line - Northbound Lane	312	0+120	Asphalt	162	Core	Base	420	258	Core	Subbase			Core

Appendix C: GPR Layer Profile Graphs and Data

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	317	0+125	Asphalt	152	Core	Base	394	242	Core	Subbase			Core
Eighth Line - Northbound Lane	322	0+130	Asphalt	142	Core	Base	383	241	Core	Subbase			Core
Eighth Line - Northbound Lane	327	0+135	Asphalt	144	Core	Base	387	243	Core	Subbase			Core
Eighth Line - Northbound Lane	332	0+140	Asphalt	154	Core	Base	356	202	Core	Subbase			Core
Eighth Line - Northbound Lane	337	0+145	Asphalt	137	Core	Base	329	191	Core	Subbase			Core
Eighth Line - Northbound Lane	342	0+150	Asphalt	125	Core	Base	331	206	Core	Subbase			Core
Eighth Line - Northbound Lane	347	0+155	Asphalt	102	Core	Base	354	251	Core	Subbase			Core
Eighth Line - Northbound Lane	352	0+160	Asphalt	88	Core	Base	359	271	Core	Subbase			Core
Eighth Line - Northbound Lane	357	0+165	Asphalt	92	Core	Base	339	246	Core	Subbase			Core
Eighth Line - Northbound Lane	362	0+170	Asphalt	107	Core	Base	336	230	Core	Subbase			Core
Eighth Line - Northbound Lane	367	0+175	Asphalt	121	Core	Base	339	218	Core	Subbase			Core
Eighth Line - Northbound Lane	372	0+180	Asphalt	143	Core	Base	326	183	Core	Subbase			Core
Eighth Line - Northbound Lane	377	0+185	Asphalt	158	Core	Base	320	162	Core	Subbase			Core
Eighth Line - Northbound Lane	382	0+190	Asphalt	175	Core	Base	317	142	Core	Subbase	369	52	Core
Eighth Line - Northbound Lane	387	0+195	Asphalt	188	Core	Base	316	128	Core	Subbase	403	88	Core
Eighth Line - Northbound Lane	392	0+200	Asphalt	188	Core	Base	306	118	Core	Subbase	423	117	Core
Eighth Line - Northbound Lane	397	0+205	Asphalt	193	Core	Base	303	110	Core	Subbase	448	144	Core
Eighth Line - Northbound Lane	402	0+210	Asphalt	195	Core	Base	302	108	Core	Subbase	492	190	Core
Eighth Line - Northbound Lane	407	0+215	Asphalt	196	Core	Base	300	103	Core	Subbase	491	192	Core
Eighth Line - Northbound Lane	412	0+220	Asphalt	182	Core	Base	302	120	Core	Subbase	463	161	Core
Eighth Line - Northbound Lane	417	0+225	Asphalt	184	Core	Base	294	110	Core	Subbase	463	169	Core
Eighth Line - Northbound Lane	422	0+230	Asphalt	184	Core	Base	279	94	Core	Subbase	448	170	Core
Eighth Line - Northbound Lane	427	0+235	Asphalt	192	Core	Base	277	85	Core	Subbase	445	167	Core
Eighth Line - Northbound Lane	432	0+240	Asphalt	194	Core	Base	273	78	Core	Subbase	441	169	Core
Eighth Line - Northbound Lane	437	0+245	Asphalt	177	Core	Base	271	93	Core	Subbase	431	160	Core
Eighth Line - Northbound Lane	442	0+250	Asphalt	160	Core	Base	249	89	Core	Subbase	384	135	Core

Appendix C: GPR Layer Profile Graphs and Data

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	447	0+255	Asphalt	146	Core	Base	243	97	Core	Subbase	362	119	Core
Eighth Line - Northbound Lane	452	0+260	Asphalt	145	Core	Base	221	75	Core	Subbase	369	148	Core
Eighth Line - Northbound Lane	457	0+265	Asphalt	134	Core	Base	214	80	Core	Subbase	378	164	Core
Eighth Line - Northbound Lane	462	0+270	Asphalt	125	Core	Base	233	108	Core	Subbase	362	128	Core
Eighth Line - Northbound Lane	467	0+275	Asphalt	132	Core	Base	281	148	Core	Subbase	347	66	Core
Eighth Line - Northbound Lane	472	0+280	Asphalt	141	Core	Base	289	148	Core	Subbase	345	56	Core
Eighth Line - Northbound Lane	477	0+285	Asphalt	137	Core	Base	284	147	Core	Subbase	367	83	Core
Eighth Line - Northbound Lane	482	0+290	Asphalt	131	Core	Base	268	136	Core	Subbase	394	127	Core
Eighth Line - Northbound Lane	487	0+295	Asphalt	129	Core	Base	277	148	Core	Subbase	412	136	Core
Eighth Line - Northbound Lane	492	0+300	Asphalt	138	Core	Base	279	142	Core	Subbase	444	164	Core
Eighth Line - Northbound Lane	497	0+305	Asphalt	150	Core	Base	273	123	Core	Subbase	448	175	Core
Eighth Line - Northbound Lane	502	0+310	Asphalt	151	Core	Base	267	117	Core	Subbase	398	131	Core
Eighth Line - Northbound Lane	507	0+315	Asphalt	139	Core	Base	252	113	Core	Subbase	378	126	Core
Eighth Line - Northbound Lane	512	0+320	Asphalt	134	Core	Base	257	123	Core	Subbase	389	133	Core
Eighth Line - Northbound Lane	517	0+325	Asphalt	132	Core	Base	256	124	Core	Subbase	397	141	Core
Eighth Line - Northbound Lane	522	0+330	Asphalt	142	Core	Base	246	105	Core	Subbase	392	146	Core
Eighth Line - Northbound Lane	527	0+335	Asphalt	149	Core	Base	240	91	Core	Subbase	364	124	Core
Eighth Line - Northbound Lane	532	0+340	Asphalt	144	Core	Base	233	88	Core	Subbase	340	107	Core
Eighth Line - Northbound Lane	537	0+345	Asphalt	136	Core	Base	227	91	Core	Subbase	328	101	Core
Eighth Line - Northbound Lane	542	0+350	Asphalt	126	Core	Base	213	87	Core	Subbase	337	124	Core
Eighth Line - Northbound Lane	547	0+355	Asphalt	118	Core	Base	214	97	Core	Subbase	361	147	Core
Eighth Line - Northbound Lane	552	0+360	Asphalt	118	Core	Base	231	113	Core	Subbase	364	133	Core
Eighth Line - Northbound Lane	557	0+365	Asphalt	112	Core	Base	262	150	Core	Subbase	386	124	Core
Eighth Line - Northbound Lane	562	0+370	Asphalt	107	Core	Base	259	153	Core	Subbase	428	169	Core
Eighth Line - Northbound Lane	567	0+375	Asphalt	110	Core	Base	267	157	Core	Subbase	438	170	Core
Eighth Line - Northbound Lane	572	0+380	Asphalt	124	Core	Base	270	146	Core	Subbase	434	164	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	577	0+385	Asphalt	120	Core	Base	300	180	Core	Subbase	450	151	Core
Eighth Line - Northbound Lane	582	0+390	Asphalt	124	Core	Base	333	208	Core	Subbase	454	121	Core
Eighth Line - Northbound Lane	587	0+395	Asphalt	122	Core	Base	323	201	Core	Subbase	449	126	Core
Eighth Line - Northbound Lane	592	0+400	Asphalt	122	Core	Base	319	197	Core	Subbase	409	90	Core
Eighth Line - Northbound Lane	597	0+405	Asphalt	131	Core	Base	312	182	Core	Subbase	392	80	Core
Eighth Line - Northbound Lane	602	0+410	Asphalt	140	Core	Base	320	180	Core	Subbase	390	70	Core
Eighth Line - Northbound Lane	607	0+415	Asphalt	134	Core	Base	319	184	Core	Subbase	381	63	Core
Eighth Line - Northbound Lane	612	0+420	Asphalt	135	Core	Base	304	169	Core	Subbase	381	77	Core
Eighth Line - Northbound Lane	617	0+425	Asphalt	121	Core	Base	312	191	Core	Subbase	383	71	Core
Eighth Line - Northbound Lane	622	0+430	Asphalt	115	Core	Base	322	207	Core	Subbase	377	55	Core
Eighth Line - Northbound Lane	627	0+435	Asphalt	118	Core	Base	311	193	Core	Subbase	367	56	Core
Eighth Line - Northbound Lane	632	0+440	Asphalt	114	Core	Base	311	197	Core	Subbase	366	55	Core
Eighth Line - Northbound Lane	637	0+445	Asphalt	120	Core	Base	306	186	Core	Subbase	380	75	Core
Eighth Line - Northbound Lane	642	0+450	Asphalt	123	Core	Base	307	184	Core	Subbase	365	59	Core
Eighth Line - Northbound Lane	647	0+455	Asphalt	107	Core	Base	312	205	Core	Subbase	373	62	Core
Eighth Line - Northbound Lane	652	0+460	Asphalt	105	Core	Base	309	203	Core	Subbase	362	53	Core
Eighth Line - Northbound Lane	657	0+465	Asphalt	134	Core	Base	295	161	Core	Subbase	351	56	Core
Eighth Line - Northbound Lane	662	0+470	Asphalt	156	Core	Base	291	135	Core	Subbase	358	67	Core
Eighth Line - Northbound Lane	667	0+475	Asphalt	136	Core	Base	287	150	Core	Subbase	350	64	Core
Eighth Line - Northbound Lane	672	0+480	Asphalt	132	Core	Base	281	149	Core	Subbase	337	56	Core
Eighth Line - Northbound Lane	677	0+485	Asphalt	131	Core	Base	282	150	Core	Subbase	331	49	Core
Eighth Line - Northbound Lane	682	0+490	Asphalt	122	Core	Base	281	159	Core	Subbase	341	60	Core
Eighth Line - Northbound Lane	687	0+495	Asphalt	126	Core	Base	276	150	Core	Subbase	370	94	Core
Eighth Line - Northbound Lane	692	0+500	Asphalt	123	Core	Base	258	135	Core	Subbase	395	137	Core
Eighth Line - Northbound Lane	697	0+505	Asphalt	125	Core	Base	249	124	Core	Subbase	413	164	Core
Eighth Line - Northbound Lane	702	0+510	Asphalt	124	Core	Base	259	135	Core	Subbase	419	161	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	707	0+515	Asphalt	125	Core	Base	263	138	Core	Subbase	429	166	Core
Eighth Line - Northbound Lane	712	0+520	Asphalt	111	Core	Base	253	142	Core	Subbase	437	185	Core
Eighth Line - Northbound Lane	717	0+525	Asphalt	105	Core	Base	237	132	Core	Subbase	442	205	Core
Eighth Line - Northbound Lane	722	0+530	Asphalt	105	Core	Base	230	126	Core	Subbase	452	221	Core
Eighth Line - Northbound Lane	727	0+535	Asphalt	107	Core	Base	248	142	Core	Subbase	453	205	Core
Eighth Line - Northbound Lane	732	0+540	Asphalt	101	Core	Base	264	163	Core	Subbase	442	178	Core
Eighth Line - Northbound Lane	737	0+545	Asphalt	95	Core	Base	265	170	Core	Subbase	431	165	Core
Eighth Line - Northbound Lane	742	0+550	Asphalt	98	Core	Base	265	167	Core	Subbase	423	158	Core
Eighth Line - Northbound Lane	747	0+555	Asphalt	98	Core	Base	255	157	Core	Subbase	418	164	Core
Eighth Line - Northbound Lane	752	0+560	Asphalt	99	Core	Base	247	148	Core	Subbase	422	175	Core
Eighth Line - Northbound Lane	757	0+565	Asphalt	102	Core	Base	248	146	Core	Subbase	413	166	Core
Eighth Line - Northbound Lane	762	0+570	Asphalt	108	Core	Base	265	157	Core	Subbase	409	144	Core
Eighth Line - Northbound Lane	767	0+575	Asphalt	109	Core	Base	262	153	Core	Subbase	401	139	Core
Eighth Line - Northbound Lane	772	0+580	Asphalt	118	Core	Base	264	146	Core	Subbase	395	132	Core
Eighth Line - Northbound Lane	777	0+585	Asphalt	116	Core	Base	269	153	Core	Subbase	397	128	Core
Eighth Line - Northbound Lane	782	0+590	Asphalt	116	Core	Base	269	153	Core	Subbase	388	119	Core
Eighth Line - Northbound Lane	787	0+595	Asphalt	113	Core	Base	274	161	Core	Subbase	395	121	Core
Eighth Line - Northbound Lane	792	0+600	Asphalt	114	Core	Base	271	157	Core	Subbase	398	126	Core
Eighth Line - Northbound Lane	797	0+605	Asphalt	120	Core	Base	275	156	Core	Subbase	405	130	Core
Eighth Line - Northbound Lane	802	0+610	Asphalt	126	Core	Base	274	148	Core	Subbase	416	142	Core
Eighth Line - Northbound Lane	807	0+615	Asphalt	118	Core	Base	273	156	Core	Subbase	418	145	Core
Eighth Line - Northbound Lane	812	0+620	Asphalt	112	Core	Base	263	151	Core	Subbase	440	177	Core
Eighth Line - Northbound Lane	817	0+625	Asphalt	119	Core	Base	266	146	Core	Subbase	451	186	Core
Eighth Line - Northbound Lane	822	0+630	Asphalt	113	Core	Base	266	153	Core	Subbase	450	184	Core
Eighth Line - Northbound Lane	827	0+635	Asphalt	134	Core	Base	270	136	Core	Subbase	453	183	Core
Eighth Line - Northbound Lane	832	0+640	Asphalt	137	Core	Base	270	133	Core	Subbase	461	191	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	837	0+645	Asphalt	143	Core	Base	263	120	Core	Subbase	480	217	Core
Eighth Line - Northbound Lane	842	0+650	Asphalt	149	Core	Base	255	106	Core	Subbase	500	245	Core
Eighth Line - Northbound Lane	847	0+655	Asphalt	163	Core	Base	260	97	Core	Subbase	506	246	Core
Eighth Line - Northbound Lane	852	0+660	Asphalt	179	Core	Base	251	72	Core	Subbase	472	221	Core
Eighth Line - Northbound Lane	857	0+665	Asphalt	186	Core	Base	251	65	Core	Subbase	468	217	Core
Eighth Line - Northbound Lane	862	0+670	Asphalt	178	Core	Base	241	63	Core	Subbase	465	224	Core
Eighth Line - Northbound Lane	867	0+675	Asphalt	194	Core	Base	242	48	Core	Subbase	444	202	Core
Eighth Line - Northbound Lane	872	0+680	Asphalt	172	Core	Base	246	74	Core	Subbase	428	182	Core
Eighth Line - Northbound Lane	877	0+685	Asphalt	113	Core	Base	259	147	Core	Subbase	445	186	Core
Eighth Line - Northbound Lane	882	0+690	Asphalt	117	Core	Base	256	139	Core	Subbase	458	203	Core
Eighth Line - Northbound Lane	887	0+695	Asphalt	124	Core	Base	253	129	Core	Subbase	465	212	Core
Eighth Line - Northbound Lane	892	0+700	Asphalt	129	Core	Base	238	109	Core	Subbase	491	253	Core
Eighth Line - Northbound Lane	897	0+705	Asphalt	129	Core	Base	221	92	Core	Subbase	492	271	Core
Eighth Line - Northbound Lane	902	0+710	Asphalt	124	Core	Base	222	99	Core	Subbase	474	252	Core
Eighth Line - Northbound Lane	907	0+715	Asphalt	128	Core	Base	220	92	Core	Subbase	464	244	Core
Eighth Line - Northbound Lane	912	0+720	Asphalt	122	Core	Base	211	89	Core	Subbase	466	255	Core
Eighth Line - Northbound Lane	917	0+725	Asphalt	104	Core	Base	218	114	Core	Subbase	466	247	Core
Eighth Line - Northbound Lane	922	0+730	Asphalt	105	Core	Base	216	110	Core	Subbase	464	248	Core
Eighth Line - Northbound Lane	927	0+735	Asphalt	125	Core	Base	212	87	Core	Subbase	449	237	Core
Eighth Line - Northbound Lane	932	0+740	Asphalt	118	Core	Base	220	102	Core	Subbase	458	238	Core
Eighth Line - Northbound Lane	937	0+745	Asphalt	108	Core	Base	211	103	Core	Subbase	478	267	Core
Eighth Line - Northbound Lane	942	0+750	Asphalt	105	Core	Base	207	102	Core	Subbase	487	280	Core
Eighth Line - Northbound Lane	947	0+755	Asphalt	99	Core	Base	204	106	Core	Subbase	515	310	Core
Eighth Line - Northbound Lane	952	0+760	Asphalt	99	Core	Base	211	112	Core	Subbase	514	304	Core
Eighth Line - Northbound Lane	957	0+765	Asphalt	97	Core	Base	206	109	Core	Subbase	513	308	Core
Eighth Line - Northbound Lane	962	0+770	Asphalt	99	Core	Base	207	108	Core	Subbase	511	304	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	967	0+775	Asphalt	94	Core	Base	192	98	Core	Subbase	507	315	Core
Eighth Line - Northbound Lane	972	0+780	Asphalt	99	Core	Base	187	88	Core	Subbase	461	274	Core
Eighth Line - Northbound Lane	977	0+785	Asphalt	103	Core	Base	185	82	Core	Subbase	458	273	Core
Eighth Line - Northbound Lane	982	0+790	Asphalt	109	Core	Base	197	88	Core	Subbase	463	265	Core
Eighth Line - Northbound Lane	987	0+795	Asphalt	111	Core	Base	202	91	Core	Subbase	467	265	Core
Eighth Line - Northbound Lane	992	0+800	Asphalt	107	Core	Base	199	92	Core	Subbase	461	262	Core
Eighth Line - Northbound Lane	997	0+805	Asphalt	102	Core	Base	201	99	Core	Subbase	456	256	Core
Eighth Line - Northbound Lane	1002	0+810	Asphalt	91	Core	Base	190	99	Core	Subbase	460	270	Core
Eighth Line - Northbound Lane	1007	0+815	Asphalt	86	Core	Base	189	103	Core	Subbase	448	260	Core
Eighth Line - Northbound Lane	1012	0+820	Asphalt	87	Core	Base	186	99	Core	Subbase	443	258	Core
Eighth Line - Northbound Lane	1017	0+825	Asphalt	90	Core	Base	187	98	Core	Subbase	456	269	Core
Eighth Line - Northbound Lane	1022	0+830	Asphalt	92	Core	Base	190	98	Core	Subbase	464	273	Core
Eighth Line - Northbound Lane	1027	0+835	Asphalt	98	Core	Base	193	95	Core	Subbase	458	265	Core
Eighth Line - Northbound Lane	1032	0+840	Asphalt	102	Core	Base	187	85	Core	Subbase	459	273	Core
Eighth Line - Northbound Lane	1037	0+845	Asphalt	101	Core	Base	194	93	Core	Subbase	454	260	Core
Eighth Line - Northbound Lane	1042	0+850	Asphalt	109	Core	Base	193	84	Core	Subbase	456	263	Core
Eighth Line - Northbound Lane	1047	0+855	Asphalt	109	Core	Base	203	94	Core	Subbase	461	258	Core
Eighth Line - Northbound Lane	1052	0+860	Asphalt	111	Core	Base	200	89	Core	Subbase	460	261	Core
Eighth Line - Northbound Lane	1057	0+865	Asphalt	102	Core	Base	201	98	Core	Subbase	461	260	Core
Eighth Line - Northbound Lane	1062	0+870	Asphalt	92	Core	Base	228	136	Core	Subbase	454	226	Core
Eighth Line - Northbound Lane	1067	0+875	Asphalt	89	Core	Base	228	139	Core	Subbase	461	233	Core
Eighth Line - Northbound Lane	1072	0+880	Asphalt	93	Core	Base	227	134	Core	Subbase	452	225	Core
Eighth Line - Northbound Lane	1077	0+885	Asphalt	93	Core	Base	238	145	Core	Subbase	446	207	Core
Eighth Line - Northbound Lane	1082	0+890	Asphalt	103	Core	Base	224	121	Core	Subbase	449	225	Core
Eighth Line - Northbound Lane	1087	0+895	Asphalt	107	Core	Base	195	89	Core	Subbase	447	252	Core
Eighth Line - Northbound Lane	1092	0+900	Asphalt	101	Core	Base	188	87	Core	Subbase	447	259	Core

Appendix C: GPR Layer Profile Graphs and Data

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	1097	0+905	Asphalt	101	Core	Base	197	96	Core	Subbase	446	249	Core
Eighth Line - Northbound Lane	1102	0+910	Asphalt	100	Core	Base	199	99	Core	Subbase	455	256	Core
Eighth Line - Northbound Lane	1107	0+915	Asphalt	95	Core	Base	194	98	Core	Subbase	462	268	Core
Eighth Line - Northbound Lane	1112	0+920	Asphalt	93	Core	Base	191	97	Core	Subbase	465	275	Core
Eighth Line - Northbound Lane	1117	0+925	Asphalt	71	Core	Base	189	117	Core	Subbase	462	274	Core
Eighth Line - Northbound Lane	1122	0+930	Asphalt	65	Core	Base	187	122	Core	Subbase	456	269	Core
Eighth Line - Northbound Lane	1127	0+935	Asphalt	65	Core	Base	183	118	Core	Subbase	454	272	Core
Eighth Line - Northbound Lane	1132	0+940	Asphalt	81	Core	Base	179	98	Core	Subbase	440	261	Core
Eighth Line - Northbound Lane	1137	0+945	Asphalt	94	Core	Base	175	81	Core	Subbase	432	257	Core
Eighth Line - Northbound Lane	1142	0+950	Asphalt	96	Core	Base	170	75	Core	Subbase	425	255	Core
Eighth Line - Northbound Lane	1147	0+955	Asphalt	96	Core	Base	174	78	Core	Subbase	422	248	Core
Eighth Line - Northbound Lane	1152	0+960	Asphalt	95	Core	Base	178	83	Core	Subbase	431	253	Core
Eighth Line - Northbound Lane	1157	0+965	Asphalt	82	Core	Base	187	105	Core	Subbase	434	248	Core
Eighth Line - Northbound Lane	1162	0+970	Asphalt	75	Core	Base	192	117	Core	Subbase	439	247	Core
Eighth Line - Northbound Lane	1167	0+975	Asphalt	75	Core	Base	194	119	Core	Subbase	437	243	Core
Eighth Line - Northbound Lane	1172	0+980	Asphalt	78	Core	Base	193	116	Core	Subbase	435	242	Core
Eighth Line - Northbound Lane	1177	0+985	Asphalt	88	Core	Base	195	107	Core	Subbase	438	243	Core
Eighth Line - Northbound Lane	1182	0+990	Asphalt	82	Core	Base	190	108	Core	Subbase	447	258	Core
Eighth Line - Northbound Lane	1187	0+995	Asphalt	74	Core	Base	203	128	Core	Subbase	447	245	Core
Eighth Line - Northbound Lane	1192	1+000	Asphalt	72	Core	Base	192	120	Core	Subbase	444	251	Core
Eighth Line - Northbound Lane	1197	1+005	Asphalt	80	Core	Base	186	106	Core	Subbase	439	253	Core
Eighth Line - Northbound Lane	1202	1+010	Asphalt	74	Core	Base	197	124	Core	Subbase	449	252	Core
Eighth Line - Northbound Lane	1207	1+015	Asphalt	77	Core	Base	211	133	Core	Subbase	450	240	Core
Eighth Line - Northbound Lane	1213	1+020	Asphalt	84	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1218	1+025	Asphalt	92	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1223	1+030	Asphalt	97	Core	Base			Core	Subbase			Core

Appendix C: GPR Layer Profile Graphs and Data

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Northbound Lane	1228	1+035	Asphalt	98	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1233	1+040	Asphalt	101	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1238	1+045	Asphalt	95	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1243	1+050	Asphalt	90	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1248	1+055	Asphalt	94	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1253	1+060	Asphalt	96	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1258	1+065	Asphalt	98	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1263	1+070	Asphalt	87	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1268	1+075	Asphalt	86	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1273	1+080	Asphalt	109	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1278	1+085	Asphalt	106	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1283	1+090	Asphalt	107	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1288	1+095	Asphalt	122	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1293	1+100	Asphalt	117	Core	Base			Core	Subbase			Core
Eighth Line - Northbound Lane	1298	1+105	Asphalt	106	Core	Base			Core	Subbase			Core

Appendix C: GPR Layer Profile Graphs and Data

Table C.2: Eighth Line - Southbound Lane

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	198	0+000	Asphalt	116	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	202	0+005	Asphalt	123	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	207	0+010	Asphalt	125	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	212	0+015	Asphalt	110	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	217	0+020	Asphalt	95	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	222	0+025	Asphalt	92	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	227	0+030	Asphalt	90	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	232	0+035	Asphalt	88	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	237	0+040	Asphalt	97	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	242	0+045	Asphalt	104	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	247	0+050	Asphalt	103	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	252	0+055	Asphalt	104	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	257	0+060	Asphalt	105	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	262	0+065	Asphalt	100	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	267	0+070	Asphalt	100	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	272	0+075	Asphalt	108	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	277	0+080	Asphalt	106	Core	Base			Core	Subbase			Core
Eighth Line - Southbound Lane	282	0+085	Asphalt	94	Core	Base	505	411	Core	Subbase			Core
Eighth Line - Southbound Lane	287	0+090	Asphalt	87	Core	Base	378	291	Core	Subbase			Core
Eighth Line - Southbound Lane	292	0+095	Asphalt	84	Core	Base	274	190	Core	Subbase	508	233	Core
Eighth Line - Southbound Lane	297	0+100	Asphalt	85	Core	Base	254	168	Core	Subbase	505	251	Core
Eighth Line - Southbound Lane	302	0+105	Asphalt	84	Core	Base	260	176	Core	Subbase	504	245	Core
Eighth Line - Southbound Lane	307	0+110	Asphalt	82	Core	Base	268	186	Core	Subbase	505	237	Core
Eighth Line - Southbound Lane	312	0+115	Asphalt	84	Core	Base	260	175	Core	Subbase	501	242	Core
Eighth Line - Southbound Lane	317	0+120	Asphalt	81	Core	Base	268	186	Core	Subbase	509	241	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	322	0+125	Asphalt	79	Core	Base	264	186	Core	Subbase	504	240	Core
Eighth Line - Southbound Lane	327	0+130	Asphalt	83	Core	Base	294	211	Core	Subbase	513	219	Core
Eighth Line - Southbound Lane	332	0+135	Asphalt	100	Core	Base	251	151	Core	Subbase	487	235	Core
Eighth Line - Southbound Lane	337	0+140	Asphalt	106	Core	Base	265	159	Core	Subbase	480	215	Core
Eighth Line - Southbound Lane	342	0+145	Asphalt	104	Core	Base	281	177	Core	Subbase	480	199	Core
Eighth Line - Southbound Lane	347	0+150	Asphalt	98	Core	Base	291	192	Core	Subbase	479	188	Core
Eighth Line - Southbound Lane	352	0+155	Asphalt	107	Core	Base	279	172	Core	Subbase	478	199	Core
Eighth Line - Southbound Lane	357	0+160	Asphalt	114	Core	Base	264	150	Core	Subbase	470	207	Core
Eighth Line - Southbound Lane	362	0+165	Asphalt	103	Core	Base	233	131	Core	Subbase	471	238	Core
Eighth Line - Southbound Lane	367	0+170	Asphalt	98	Core	Base	226	128	Core	Subbase	469	242	Core
Eighth Line - Southbound Lane	372	0+175	Asphalt	91	Core	Base	226	135	Core	Subbase	477	251	Core
Eighth Line - Southbound Lane	377	0+180	Asphalt	101	Core	Base	240	139	Core	Subbase	476	236	Core
Eighth Line - Southbound Lane	382	0+185	Asphalt	112	Core	Base	247	135	Core	Subbase	470	223	Core
Eighth Line - Southbound Lane	387	0+190	Asphalt	115	Core	Base	245	129	Core	Subbase	463	219	Core
Eighth Line - Southbound Lane	392	0+195	Asphalt	118	Core	Base	240	121	Core	Subbase	469	229	Core
Eighth Line - Southbound Lane	397	0+200	Asphalt	109	Core	Base	233	124	Core	Subbase	478	245	Core
Eighth Line - Southbound Lane	402	0+205	Asphalt	91	Core	Base	231	140	Core	Subbase	486	255	Core
Eighth Line - Southbound Lane	407	0+210	Asphalt	87	Core	Base	218	131	Core	Subbase	496	277	Core
Eighth Line - Southbound Lane	412	0+215	Asphalt	90	Core	Base	221	130	Core	Subbase	499	279	Core
Eighth Line - Southbound Lane	417	0+220	Asphalt	105	Core	Base	232	128	Core	Subbase	497	265	Core
Eighth Line - Southbound Lane	422	0+225	Asphalt	129	Core	Base	229	100	Core	Subbase	491	262	Core
Eighth Line - Southbound Lane	427	0+230	Asphalt	134	Core	Base	230	96	Core	Subbase	492	262	Core
Eighth Line - Southbound Lane	432	0+235	Asphalt	133	Core	Base	234	101	Core	Subbase	492	258	Core
Eighth Line - Southbound Lane	437	0+240	Asphalt	138	Core	Base	237	99	Core	Subbase	514	277	Core
Eighth Line - Southbound Lane	442	0+245	Asphalt	130	Core	Base	245	115	Core	Subbase	512	267	Core
Eighth Line - Southbound Lane	447	0+250	Asphalt	112	Core	Base	249	137	Core	Subbase	508	259	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	452	0+255	Asphalt	99	Core	Base	258	159	Core	Subbase	506	248	Core
Eighth Line - Southbound Lane	457	0+260	Asphalt	94	Core	Base	262	168	Core	Subbase	505	243	Core
Eighth Line - Southbound Lane	462	0+265	Asphalt	87	Core	Base	258	171	Core	Subbase	504	246	Core
Eighth Line - Southbound Lane	467	0+270	Asphalt	88	Core	Base	261	174	Core	Subbase	510	248	Core
Eighth Line - Southbound Lane	472	0+275	Asphalt	95	Core	Base	264	169	Core	Subbase	500	236	Core
Eighth Line - Southbound Lane	477	0+280	Asphalt	87	Core	Base	259	172	Core	Subbase	494	235	Core
Eighth Line - Southbound Lane	482	0+285	Asphalt	83	Core	Base	264	181	Core	Subbase	493	229	Core
Eighth Line - Southbound Lane	487	0+290	Asphalt	86	Core	Base	264	178	Core	Subbase	496	231	Core
Eighth Line - Southbound Lane	492	0+295	Asphalt	92	Core	Base	264	172	Core	Subbase	531	267	Core
Eighth Line - Southbound Lane	497	0+300	Asphalt	97	Core	Base	259	162	Core	Subbase	539	280	Core
Eighth Line - Southbound Lane	502	0+305	Asphalt	96	Core	Base	255	159	Core	Subbase	506	251	Core
Eighth Line - Southbound Lane	507	0+310	Asphalt	97	Core	Base	256	158	Core	Subbase	522	267	Core
Eighth Line - Southbound Lane	512	0+315	Asphalt	107	Core	Base	262	155	Core	Subbase	541	279	Core
Eighth Line - Southbound Lane	517	0+320	Asphalt	107	Core	Base	264	156	Core	Subbase	553	290	Core
Eighth Line - Southbound Lane	522	0+325	Asphalt	107	Core	Base	264	157	Core	Subbase	568	304	Core
Eighth Line - Southbound Lane	527	0+330	Asphalt	103	Core	Base	263	160	Core	Subbase	572	309	Core
Eighth Line - Southbound Lane	532	0+335	Asphalt	104	Core	Base	262	158	Core	Subbase	575	313	Core
Eighth Line - Southbound Lane	537	0+340	Asphalt	102	Core	Base	265	163	Core	Subbase	565	300	Core
Eighth Line - Southbound Lane	542	0+345	Asphalt	99	Core	Base	264	165	Core	Subbase	570	306	Core
Eighth Line - Southbound Lane	547	0+350	Asphalt	105	Core	Base	262	157	Core	Subbase	566	304	Core
Eighth Line - Southbound Lane	552	0+355	Asphalt	110	Core	Base	261	151	Core	Subbase	573	312	Core
Eighth Line - Southbound Lane	557	0+360	Asphalt	100	Core	Base	252	153	Core	Subbase	582	330	Core
Eighth Line - Southbound Lane	562	0+365	Asphalt	92	Core	Base	252	160	Core	Subbase	568	316	Core
Eighth Line - Southbound Lane	567	0+370	Asphalt	96	Core	Base	251	155	Core	Subbase	575	324	Core
Eighth Line - Southbound Lane	572	0+375	Asphalt	103	Core	Base	245	142	Core	Subbase	578	334	Core
Eighth Line - Southbound Lane	577	0+380	Asphalt	105	Core	Base	254	149	Core	Subbase	573	319	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	582	0+385	Asphalt	107	Core	Base	247	140	Core	Subbase	577	331	Core
Eighth Line - Southbound Lane	587	0+390	Asphalt	108	Core	Base	264	156	Core	Subbase	538	274	Core
Eighth Line - Southbound Lane	592	0+395	Asphalt	104	Core	Base	278	174	Core	Subbase	517	239	Core
Eighth Line - Southbound Lane	597	0+400	Asphalt	116	Core	Base	269	153	Core	Subbase	512	244	Core
Eighth Line - Southbound Lane	602	0+405	Asphalt	135	Core	Base	261	126	Core	Subbase	501	240	Core
Eighth Line - Southbound Lane	607	0+410	Asphalt	138	Core	Base	251	113	Core	Subbase	505	253	Core
Eighth Line - Southbound Lane	612	0+415	Asphalt	140	Core	Base	254	114	Core	Subbase	495	241	Core
Eighth Line - Southbound Lane	617	0+420	Asphalt	138	Core	Base	254	117	Core	Subbase	504	250	Core
Eighth Line - Southbound Lane	622	0+425	Asphalt	137	Core	Base	257	119	Core	Subbase	495	239	Core
Eighth Line - Southbound Lane	627	0+430	Asphalt	134	Core	Base	249	115	Core	Subbase	498	249	Core
Eighth Line - Southbound Lane	632	0+435	Asphalt	153	Core	Base	237	84	Core	Subbase	494	257	Core
Eighth Line - Southbound Lane	637	0+440	Asphalt	133	Core	Base	249	116	Core	Subbase	498	249	Core
Eighth Line - Southbound Lane	642	0+445	Asphalt	94	Core	Base	265	171	Core	Subbase	514	249	Core
Eighth Line - Southbound Lane	647	0+450	Asphalt	95	Core	Base	256	161	Core	Subbase	514	259	Core
Eighth Line - Southbound Lane	652	0+455	Asphalt	88	Core	Base	271	183	Core	Subbase	518	247	Core
Eighth Line - Southbound Lane	657	0+460	Asphalt	84	Core	Base	281	197	Core	Subbase	520	239	Core
Eighth Line - Southbound Lane	662	0+465	Asphalt	97	Core	Base	268	171	Core	Subbase	516	248	Core
Eighth Line - Southbound Lane	667	0+470	Asphalt	96	Core	Base	262	166	Core	Subbase	518	256	Core
Eighth Line - Southbound Lane	672	0+475	Asphalt	108	Core	Base	265	157	Core	Subbase	518	253	Core
Eighth Line - Southbound Lane	677	0+480	Asphalt	129	Core	Base	251	122	Core	Subbase	525	274	Core
Eighth Line - Southbound Lane	682	0+485	Asphalt	118	Core	Base	239	121	Core	Subbase	527	288	Core
Eighth Line - Southbound Lane	687	0+490	Asphalt	100	Core	Base	232	132	Core	Subbase	532	300	Core
Eighth Line - Southbound Lane	692	0+495	Asphalt	89	Core	Base	244	154	Core	Subbase	537	293	Core
Eighth Line - Southbound Lane	697	0+500	Asphalt	92	Core	Base	231	139	Core	Subbase	533	302	Core
Eighth Line - Southbound Lane	702	0+505	Asphalt	104	Core	Base	245	141	Core	Subbase	531	286	Core
Eighth Line - Southbound Lane	707	0+510	Asphalt	119	Core	Base	262	142	Core	Subbase	531	269	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	712	0+515	Asphalt	133	Core	Base	278	146	Core	Subbase	528	249	Core
Eighth Line - Southbound Lane	717	0+520	Asphalt	131	Core	Base	271	140	Core	Subbase	522	251	Core
Eighth Line - Southbound Lane	722	0+525	Asphalt	117	Core	Base	239	121	Core	Subbase	513	275	Core
Eighth Line - Southbound Lane	727	0+530	Asphalt	117	Core	Base	251	134	Core	Subbase	484	233	Core
Eighth Line - Southbound Lane	732	0+535	Asphalt	113	Core	Base	257	144	Core	Subbase	464	207	Core
Eighth Line - Southbound Lane	737	0+540	Asphalt	117	Core	Base	238	121	Core	Subbase	404	166	Core
Eighth Line - Southbound Lane	742	0+545	Asphalt	103	Core	Base	234	132	Core	Subbase	378	143	Core
Eighth Line - Southbound Lane	747	0+550	Asphalt	90	Core	Base	229	138	Core	Subbase	361	132	Core
Eighth Line - Southbound Lane	752	0+555	Asphalt	99	Core	Base	201	102	Core	Subbase	350	149	Core
Eighth Line - Southbound Lane	757	0+560	Asphalt	102	Core	Base	193	91	Core	Subbase	342	149	Core
Eighth Line - Southbound Lane	762	0+565	Asphalt	92	Core	Base	183	91	Core	Subbase	307	124	Core
Eighth Line - Southbound Lane	767	0+570	Asphalt	85	Core	Base	180	95	Core	Subbase	311	131	Core
Eighth Line - Southbound Lane	772	0+575	Asphalt	95	Core	Base	188	93	Core	Subbase	331	143	Core
Eighth Line - Southbound Lane	777	0+580	Asphalt	103	Core	Base	197	94	Core	Subbase	349	152	Core
Eighth Line - Southbound Lane	782	0+585	Asphalt	102	Core	Base	195	92	Core	Subbase	358	164	Core
Eighth Line - Southbound Lane	787	0+590	Asphalt	110	Core	Base	199	89	Core	Subbase	355	156	Core
Eighth Line - Southbound Lane	792	0+595	Asphalt	115	Core	Base	190	74	Core	Subbase	333	143	Core
Eighth Line - Southbound Lane	797	0+600	Asphalt	111	Core	Base	204	93	Core	Subbase	323	119	Core
Eighth Line - Southbound Lane	802	0+605	Asphalt	118	Core	Base	207	89	Core	Subbase	322	115	Core
Eighth Line - Southbound Lane	807	0+610	Asphalt	119	Core	Base	215	96	Core	Subbase	319	104	Core
Eighth Line - Southbound Lane	812	0+615	Asphalt	118	Core	Base	217	99	Core	Subbase	320	103	Core
Eighth Line - Southbound Lane	817	0+620	Asphalt	106	Core	Base	220	114	Core	Subbase	309	89	Core
Eighth Line - Southbound Lane	822	0+625	Asphalt	96	Core	Base	220	123	Core	Subbase	315	96	Core
Eighth Line - Southbound Lane	827	0+630	Asphalt	88	Core	Base	219	130	Core	Subbase	345	127	Core
Eighth Line - Southbound Lane	832	0+635	Asphalt	105	Core	Base	214	109	Core	Subbase	342	128	Core
Eighth Line - Southbound Lane	837	0+640	Asphalt	112	Core	Base	219	107	Core	Subbase	342	123	Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	842	0+645	Asphalt	121	Core	Base	215	94	Core	Subbase	351	137	Core
Eighth Line - Southbound Lane	847	0+650	Asphalt	124	Core	Base	216	91	Core	Subbase	370	155	Core
Eighth Line - Southbound Lane	852	0+655	Asphalt	130	Core	Base	228	98	Core	Subbase	404	176	Core
Eighth Line - Southbound Lane	857	0+660	Asphalt	130	Core	Base	238	108	Core	Subbase	410	172	Core
Eighth Line - Southbound Lane	862	0+665	Asphalt	123	Core	Base	241	118	Core	Subbase	420	178	Core
Eighth Line - Southbound Lane	867	0+670	Asphalt	128	Core	Base	240	112	Core	Subbase	421	180	Core
Eighth Line - Southbound Lane	872	0+675	Asphalt	133	Core	Base	244	111	Core	Subbase	422	178	Core
Eighth Line - Southbound Lane	877	0+680	Asphalt	121	Core	Base	230	108	Core	Subbase	426	197	Core
Eighth Line - Southbound Lane	882	0+685	Asphalt	121	Core	Base	235	114	Core	Subbase	431	196	Core
Eighth Line - Southbound Lane	887	0+690	Asphalt	132	Core	Base	233	101	Core	Subbase	433	201	Core
Eighth Line - Southbound Lane	892	0+695	Asphalt	148	Core	Base	239	90	Core	Subbase	444	206	Core
Eighth Line - Southbound Lane	897	0+700	Asphalt	157	Core	Base	237	81	Core	Subbase	458	221	Core
Eighth Line - Southbound Lane	902	0+705	Asphalt	145	Core	Base	225	80	Core	Subbase	456	231	Core
Eighth Line - Southbound Lane	907	0+710	Asphalt	126	Core	Base	214	88	Core	Subbase	455	241	Core
Eighth Line - Southbound Lane	912	0+715	Asphalt	126	Core	Base	225	99	Core	Subbase	460	234	Core
Eighth Line - Southbound Lane	917	0+720	Asphalt	120	Core	Base	227	107	Core	Subbase	467	240	Core
Eighth Line - Southbound Lane	922	0+725	Asphalt	105	Core	Base	214	110	Core	Subbase	475	260	Core
Eighth Line - Southbound Lane	927	0+730	Asphalt	103	Core	Base	209	106	Core	Subbase	480	271	Core
Eighth Line - Southbound Lane	932	0+735	Asphalt	109	Core	Base	216	107	Core	Subbase	490	274	Core
Eighth Line - Southbound Lane	937	0+740	Asphalt	114	Core	Base	216	103	Core	Subbase	495	278	Core
Eighth Line - Southbound Lane	942	0+745	Asphalt	106	Core	Base	216	110	Core	Subbase			Core
Eighth Line - Southbound Lane	947	0+750	Asphalt	112	Core	Base	209	97	Core	Subbase			Core
Eighth Line - Southbound Lane	952	0+755	Asphalt	118	Core	Base	219	102	Core	Subbase			Core
Eighth Line - Southbound Lane	957	0+760	Asphalt	124	Core	Base	234	109	Core	Subbase			Core
Eighth Line - Southbound Lane	962	0+765	Asphalt	117	Core	Base	237	120	Core	Subbase			Core
Eighth Line - Southbound Lane	967	0+770	Asphalt	103	Core	Base	239	136	Core	Subbase			Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	972	0+775	Asphalt	104	Core	Base	235	131	Core	Subbase			Core
Eighth Line - Southbound Lane	977	0+780	Asphalt	133	Core	Base	254	122	Core	Subbase			Core
Eighth Line - Southbound Lane	982	0+785	Asphalt	144	Core	Base	271	128	Core	Subbase			Core
Eighth Line - Southbound Lane	987	0+790	Asphalt	140	Core	Base	283	143	Core	Subbase			Core
Eighth Line - Southbound Lane	992	0+795	Asphalt	142	Core	Base	287	145	Core	Subbase			Core
Eighth Line - Southbound Lane	997	0+800	Asphalt	142	Core	Base	282	139	Core	Subbase			Core
Eighth Line - Southbound Lane	1002	0+805	Asphalt	143	Core	Base	285	142	Core	Subbase			Core
Eighth Line - Southbound Lane	1007	0+810	Asphalt	137	Core	Base	284	147	Core	Subbase			Core
Eighth Line - Southbound Lane	1012	0+815	Asphalt	144	Core	Base	283	139	Core	Subbase			Core
Eighth Line - Southbound Lane	1017	0+820	Asphalt	148	Core	Base	288	141	Core	Subbase			Core
Eighth Line - Southbound Lane	1022	0+825	Asphalt	147	Core	Base	288	141	Core	Subbase			Core
Eighth Line - Southbound Lane	1027	0+830	Asphalt	151	Core	Base	279	128	Core	Subbase			Core
Eighth Line - Southbound Lane	1032	0+835	Asphalt	141	Core	Base	264	123	Core	Subbase			Core
Eighth Line - Southbound Lane	1037	0+840	Asphalt	144	Core	Base	267	123	Core	Subbase			Core
Eighth Line - Southbound Lane	1042	0+845	Asphalt	138	Core	Base	271	133	Core	Subbase			Core
Eighth Line - Southbound Lane	1047	0+850	Asphalt	145	Core	Base	291	147	Core	Subbase			Core
Eighth Line - Southbound Lane	1052	0+855	Asphalt	160	Core	Base	290	130	Core	Subbase			Core
Eighth Line - Southbound Lane	1057	0+860	Asphalt	163	Core	Base	290	127	Core	Subbase			Core
Eighth Line - Southbound Lane	1062	0+865	Asphalt	162	Core	Base	289	127	Core	Subbase			Core
Eighth Line - Southbound Lane	1067	0+870	Asphalt	157	Core	Base	282	125	Core	Subbase			Core
Eighth Line - Southbound Lane	1072	0+875	Asphalt	155	Core	Base	279	125	Core	Subbase			Core
Eighth Line - Southbound Lane	1077	0+880	Asphalt	141	Core	Base	275	134	Core	Subbase			Core
Eighth Line - Southbound Lane	1082	0+885	Asphalt	117	Core	Base	301	184	Core	Subbase			Core
Eighth Line - Southbound Lane	1087	0+890	Asphalt	116	Core	Base	306	190	Core	Subbase			Core
Eighth Line - Southbound Lane	1092	0+895	Asphalt	112	Core	Base	321	209	Core	Subbase			Core
Eighth Line - Southbound Lane	1097	0+900	Asphalt	108	Core	Base	312	204	Core	Subbase			Core

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Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	1102	0+905	Asphalt	100	Core	Base	304	204	Core	Subbase			Core
Eighth Line - Southbound Lane	1107	0+910	Asphalt	103	Core	Base	310	207	Core	Subbase			Core
Eighth Line - Southbound Lane	1112	0+915	Asphalt	100	Core	Base	313	213	Core	Subbase			Core
Eighth Line - Southbound Lane	1117	0+920	Asphalt	100	Core	Base	321	221	Core	Subbase			Core
Eighth Line - Southbound Lane	1122	0+925	Asphalt	109	Core	Base	311	203	Core	Subbase			Core
Eighth Line - Southbound Lane	1127	0+930	Asphalt	107	Core	Base	308	201	Core	Subbase			Core
Eighth Line - Southbound Lane	1132	0+935	Asphalt	104	Core	Base	310	207	Core	Subbase			Core
Eighth Line - Southbound Lane	1137	0+940	Asphalt	103	Core	Base	314	211	Core	Subbase			Core
Eighth Line - Southbound Lane	1142	0+945	Asphalt	99	Core	Base	321	223	Core	Subbase			Core
Eighth Line - Southbound Lane	1147	0+950	Asphalt	104	Core	Base	314	209	Core	Subbase			Core
Eighth Line - Southbound Lane	1152	0+955	Asphalt	102	Core	Base	300	199	Core	Subbase			Core
Eighth Line - Southbound Lane	1157	0+960	Asphalt	94	Core	Base	303	209	Core	Subbase			Core
Eighth Line - Southbound Lane	1162	0+965	Asphalt	94	Core	Base	310	216	Core	Subbase			Core
Eighth Line - Southbound Lane	1167	0+970	Asphalt	95	Core	Base	313	218	Core	Subbase			Core
Eighth Line - Southbound Lane	1172	0+975	Asphalt	97	Core	Base	313	216	Core	Subbase			Core
Eighth Line - Southbound Lane	1177	0+980	Asphalt	107	Core	Base	314	207	Core	Subbase			Core
Eighth Line - Southbound Lane	1182	0+985	Asphalt	103	Core	Base	314	211	Core	Subbase			Core
Eighth Line - Southbound Lane	1187	0+990	Asphalt	96	Core	Base	292	196	Core	Subbase			Core
Eighth Line - Southbound Lane	1192	0+995	Asphalt	95	Core	Base	268	173	Core	Subbase			Core
Eighth Line - Southbound Lane	1197	1+000	Asphalt	100	Core	Base	259	160	Core	Subbase			Core
Eighth Line - Southbound Lane	1202	1+005	Asphalt	102	Core	Base	243	141	Core	Subbase			Core
Eighth Line - Southbound Lane	1207	1+010	Asphalt	95	Core	Base	221	126	Core	Subbase			Core
Eighth Line - Southbound Lane	1212	1+015	Asphalt	101	Core	Base	212	112	Core	Subbase			Core
Eighth Line - Southbound Lane	1217	1+020	Asphalt	111	Core	Base	202	91	Core	Subbase			Core
Eighth Line - Southbound Lane	1222	1+025	Asphalt	120	Core	Base	199	79	Core	Subbase			Core
Eighth Line - Southbound Lane	1227	1+030	Asphalt	123	Core	Base	221	98	Core	Subbase			Core

Appendix C: GPR Layer Profile Graphs and Data

Street	DMI	Station	Asphalt	Depth (mm)	Source	Base	Depth (mm)	Thickness (mm)	Source	Subbase	Depth (mm)	Thickness (mm)	Source
Eighth Line - Southbound Lane	1232	1+035	Asphalt	130	Core	Base	220	90	Core	Subbase			Core
Eighth Line - Southbound Lane	1237	1+040	Asphalt	123	Core	Base	189	66	Core	Subbase			Core
Eighth Line - Southbound Lane	1242	1+045	Asphalt	116	Core	Base	172	56	Core	Subbase			Core
Eighth Line - Southbound Lane	1247	1+050	Asphalt	111	Core	Base	205	94	Core	Subbase			Core
Eighth Line - Southbound Lane	1252	1+055	Asphalt	116	Core	Base	228	112	Core	Subbase			Core
Eighth Line - Southbound Lane	1257	1+060	Asphalt	121	Core	Base	219	98	Core	Subbase			Core
Eighth Line - Southbound Lane	1262	1+065	Asphalt	115	Core	Base	229	114	Core	Subbase			Core
Eighth Line - Southbound Lane	1267	1+070	Asphalt	114	Core	Base	231	117	Core	Subbase			Core
Eighth Line - Southbound Lane	1272	1+075	Asphalt	115	Core	Base	232	117	Core	Subbase	514	282	Core
Eighth Line - Southbound Lane	1277	1+080	Asphalt	114	Core	Base	244	130	Core	Subbase	492	248	Core
Eighth Line - Southbound Lane	1282	1+085	Asphalt	111	Core	Base	261	149	Core	Subbase	495	234	Core
Eighth Line - Southbound Lane	1287	1+090	Asphalt	113	Core	Base	242	128	Core	Subbase	487	246	Core
Eighth Line - Southbound Lane	1292	1+095	Asphalt	103	Core	Base	233	130	Core	Subbase	499	266	Core
Eighth Line - Southbound Lane	1297	1+100	Asphalt	103	Core	Base	238	135	Core	Subbase	497	260	Core
Eighth Line - Southbound Lane	1302	1+105	Asphalt	103	Core	Base	250	148	Core	Subbase	497	247	Core

Appendix D: Laboratory Results – Soil Testing

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Determination of Moisture Content of Soil

LS 701 or CSA A23.2-11A
ASTM D2216

Project: 8th Line Milton, Part 2
Project No.: 160311376

Date Tested: January 3, 2012
Tested By: A. Proulx

Moisture Content Worksheet

Borehole / Test Pit No.	BH14	BH15	BH19	BH20	BH23	BH23	BH6
Sample	M02	M03	M06	M08	M10	M11	M16
Tare No.							
Weight Sample (Wet+Tare) (g)	1196.6	1378.2	1030.9	1324.6	1452.7	1331.1	1356.8
Weight Sample (Dry+Tare) (g)	1114.9	1253.8	975.2	1188.3	1420.8	1306.5	1332.8
Weight of Water (g)	81.7	124.4	55.7	136.3	31.9	24.6	24
Tare Container	552.4	535.5	537.4	540.6	562.4	534.7	525.7
Weight Dry Sample (g)	562.5	718.3	437.8	647.7	858.4	771.8	807.1
Moisture Content (%)	**14.5**	**17.3**	**12.7**	**21.0**	**3.7**	**3.2**	**3.0**
Comments	350 - 1500 mm	300 - 1500 mm	460 - 700 mm	400 - 1500 mm	80 - 200 mm	200 - 430 mm	100 - 200 mm

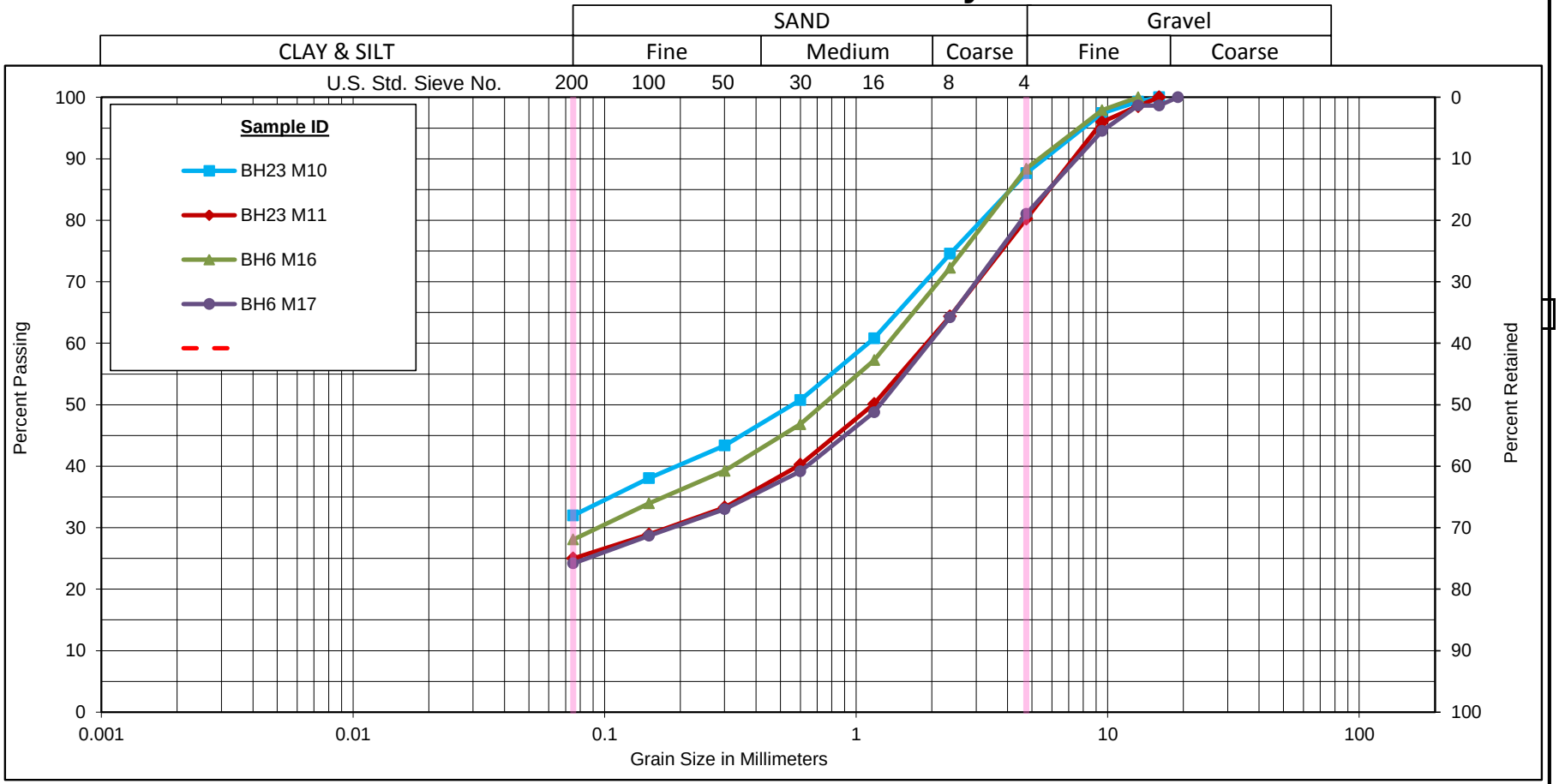
Borehole / Test Pit No.	BH6	BH6					
Sample	M17	M18					
Tare No.							
Weight Sample (Wet+Tare) (g)	1341.7	1661.8					
Weight Sample (Dry+Tare) (g)	1317.9	1489					
Weight of Water (g)	23.8	172.8					
Tare Container	531.4	514.4					
Weight Dry Sample (g)	786.5	974.6					
Moisture Content (%)	**3.0**	**17.7**					
Comments	200 - 360 mm	360 - 950 mm					

Borehole / Test Pit No.							
Sample							
Tare No.							
Weight Sample (Wet+Tare) (g)							
Weight Sample (Dry+Tare) (g)							
Weight of Water (g)							
Tare Container							
Weight Dry Sample (g)							
Moisture Content (%)							
Comments							

Borehole / Test Pit No.							
Sample							
Tare No.							
Weight Sample (Wet+Tare) (g)							
Weight Sample (Dry+Tare) (g)							
Weight of Water (g)							
Tare Container							
Weight Dry Sample (g)							
Moisture Content (%)							
Comments							

Reviewed By: _____ Date: _____

Unified Soil Classification System



Sample ID	Depth (m)	% Gravel	% Sand	% Silt and Clay:
BH23 M10	80 - 200 mm	12.3	55.7	32.0
BH23 M11	200 - 430 mm	19.8	55.2	25.0
BH6 M16	100 - 200 mm	11.6	60.3	28.1
BH6 M17	200 - 360 mm	19.0	56.9	24.2

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GRAIN SIZE DISTRIBUTION

Figure No. 2

Project No. 160311376

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Sieve Analysis
LS 602
ASTM C136

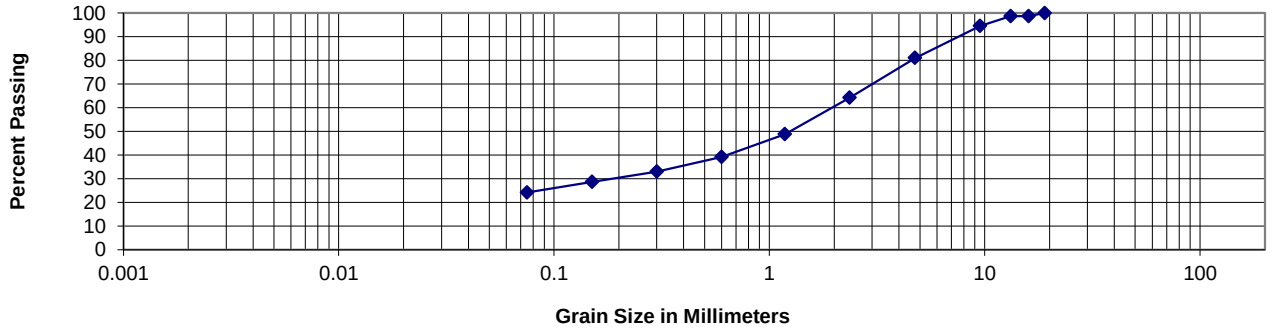
Client:	**Union Gas Ltd**	Project Number:	**160311376**
Project:	**8th Line Milton, Part 2**		
Material Type:	**Soils / Aggregates:**		
Proposed Use:	**Fill/Granulars**		
Source:	**BH6**		
Sample Number:	**M17**		
Sampled Depth:	**200 - 360 mm**		
Sampled By:	**D. Pettitt**	Tested By:	**A. Proulx**
Date Sampled :	**December 20, 2012**	Date Tested:	**January 4, 2012**

Sieve Test Data		Wash Test Data		
Sample Weight Before Sieve, (g):	**786.4**	Sample Weight Before Wash, (g):	**274.1**	**Corrected**
Sample Weight After Sieve, (g):	**786.2**	Sample Weight After Wash, (g):	**193.1**	
Percent Loss In Sieve, (%):	**0.03**	Percent Passing No. 200, (%):	**29.6**	**23.9**

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained	Cum Wt. Retained	Percent Passing	No Envelope	
	Inches	mm	g	g	%	Minimum	Maximum
	6	**150**					
	4	**106**					
	3	**76.2**					
	2	**53.0**					
	1	**26.5**					
	3/4	**19.0**	**0.0**	**0.0**	**100.0**		
	5/8	**16.0**	**10.6**	**10.6**	**98.7**		
	1/2	**13.2**	**0.0**	**10.6**	**98.7**		
	3/8	**9.5**	**32.4**	**43.0**	**94.5**		
+4	**0.187**	**4.75**	**106.1**	**149.1**	**81.0**		
		- 4.75	**637.1**	**786.2**			
8	**0.0937**	**2.36**		**56.9**	**64.2**		
16	**0.0469**	**1.18**		**109.1**	**48.8**		
30	**0.234**	**0.600**		**141.6**	**39.2**		
50	**0.0117**	**0.300**		**162.4**	**33.0**		
100	**0.0059**	**0.150**		**177.1**	**28.7**		
200	**0.0029**	**0.075**		**192.3**	**24.2**		
		Pan		**193.9**			

Classification of Sample: % Gravel: **19.0** % Sand: **56.9** % Silt and Clay: **24.2**



Remarks:

Laboratory Supervisor: _____ **Date:** _____

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Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Sieve Analysis
LS 602
ASTM C136

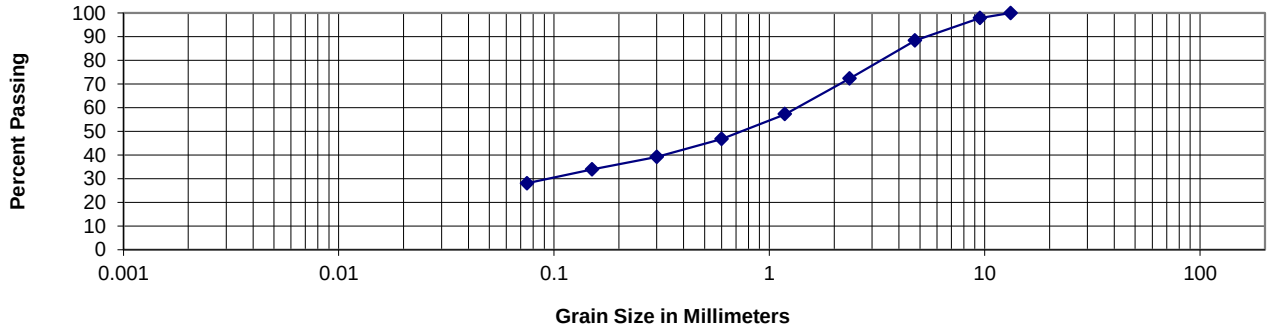
Client:	**Union Gas Ltd**	Project Number:	**160311376**
Project:	**8th Line Milton, Part 2**		
Material Type:	**Soils / Aggregates:**		
Proposed Use:	**Fill/Granulars**		
Source:	**BH6**		
Sample Number:	**M16**		
Sampled Depth:	**100 - 200 mm**		
Sampled By:	**D. Pettitt**	Tested By:	**A. Proulx**
Date Sampled :	**December 20, 2012**	Date Tested:	**January 4, 2012**

Sieve Test Data		**Wash Test Data**		
Sample Weight Before Sieve, (g):	**807.1**	Sample Weight Before Wash, (g):	**268.8**	**Corrected**
Sample Weight After Sieve, (g):	**807.1**	Sample Weight After Wash, (g):	**187**	
Percent Loss In Sieve, (%):	**0.00**	Percent Passing No. 200, (%):	**30.4**	**26.9**

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained	Cum Wt. Retained	Percent Passing	No Envelope	
	Inches	mm	g	g	%	Minimum	Maximum
	6	**150**					
	4	**106**					
	3	**76.2**					
	2	**53.0**					
	1	**26.5**					
	3/4	**19.0**					
	5/8	**16.0**					
	1/2	**13.2**	**0.0**	**0.0**	**100.0**		
	3/8	**9.5**	**17.0**	**17.0**	**97.9**		
+4	**0.187**	**4.75**	**76.7**	**93.7**	**88.4**		
		- 4.75	**713.4**	**807.1**			
8	**0.0937**	**2.36**		**49.0**	**72.3**		
16	**0.0469**	**1.18**		**94.7**	**57.2**		
30	**0.234**	**0.600**		**126.4**	**46.8**		
50	**0.0117**	**0.300**		**149.4**	**39.3**		
100	**0.0059**	**0.150**		**165.5**	**34.0**		
200	**0.0029**	**0.075**		**183.4**	**28.1**		
		Pan		**186.6**			

Classification of Sample: % Gravel: **11.6** % Sand: **60.3** % Silt and Clay: **28.1**



Remarks: **Sample contained asphalt**

Laboratory Supervisor: _____ **Date:** _____

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Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Sieve Analysis
LS 602
ASTM C136

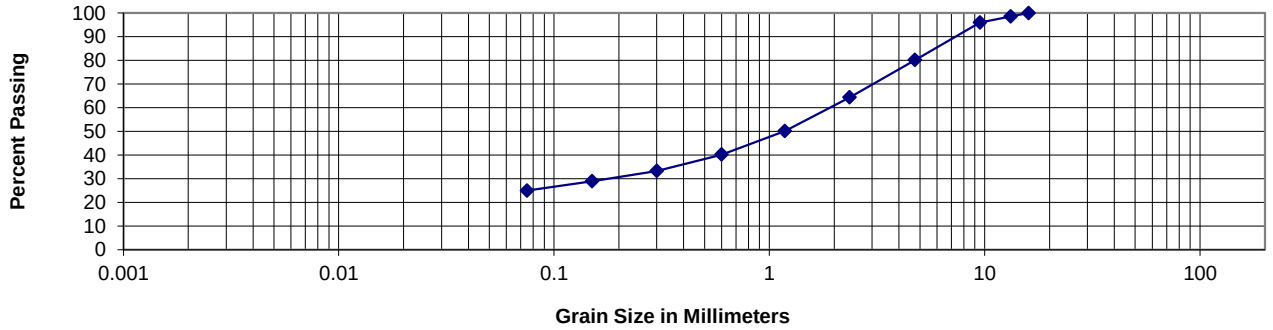
Client:	**Union Gas Ltd**	Project Number:	**160311376**
Project:	**8th Line Milton, Part 2**		
Material Type:	**Soils / Aggregates:**		
Proposed Use:	**Fill/Granulars**		
Source:	**BH23**		
Sample Number:	**M11**		
Sampled Depth:	**200 - 430 mm**		
Sampled By:	**D. Pettitt**	Tested By:	**A. Proulx**
Date Sampled :	**December 20, 2012**	Date Tested:	**January 4, 2012**

Sieve Test Data		Wash Test Data		
Sample Weight Before Sieve, (g):	**771.5**	Sample Weight Before Wash, (g):	**310.4**	**Corrected**
Sample Weight After Sieve, (g):	**771.4**	Sample Weight After Wash, (g):	**216.2**	
Percent Loss In Sieve, (%):	**0.01**	Percent Passing No. 200, (%):	**30.3**	**24.3**

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained	Cum Wt. Retained	Percent Passing	No Envelope	
	Inches	mm	g	g	%	Minimum	Maximum
	6	**150**					
	4	**106**					
	3	**76.2**					
	2	**53.0**					
	1	**26.5**					
	3/4	**19.0**					
	5/8	**16.0**	**0.0**	**0.0**	**100.0**		
	1/2	**13.2**	**11.2**	**11.2**	**98.5**		
	3/8	**9.5**	**19.9**	**31.1**	**96.0**		
+4	**0.187**	**4.75**	**121.4**	**152.5**	**80.2**		
		- 4.75	**618.9**	**771.4**			
8	**0.0937**	**2.36**		**61.4**	**64.4**		
16	**0.0469**	**1.18**		**116.5**	**50.1**		
30	**0.234**	**0.600**		**154.8**	**40.2**		
50	**0.0117**	**0.300**		**181.6**	**33.3**		
100	**0.0059**	**0.150**		**198.6**	**28.9**		
200	**0.0029**	**0.075**		**213.7**	**25.0**		
		Pan		**216.2**			

Classification of Sample: % Gravel: **19.8** % Sand: **55.2** % Silt and Clay: **25.0**



Remarks: **Sample contained asphalt**

Laboratory Supervisor: _____ **Date:** _____

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Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Sieve Analysis
LS 602
ASTM C136

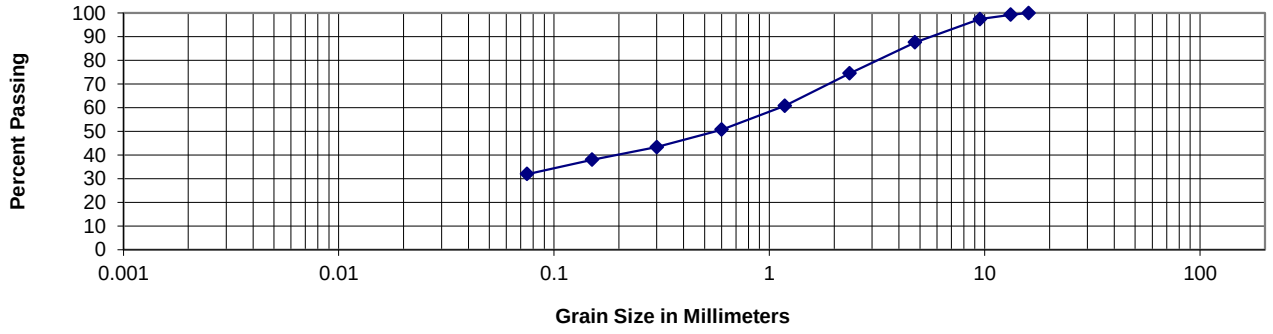
Client:	**Union Gas Ltd**	Project Number:	**160311376**
Project:	**8th Line Milton, Part 2**		
Material Type:	**Soils / Aggregates:**		
Proposed Use:	**Fill/Granulars**		
Source:	**BH23**		
Sample Number:	**M10**		
Sampled Depth:	**80 - 200 mm**		
Sampled By:	**D. Pettitt**	Tested By:	**A. Proulx**
Date Sampled:	**December 20, 2012**	Date Tested:	**January 4, 2012**

Sieve Test Data		Wash Test Data		
Sample Weight Before Sieve, (g):	**858.3**	Sample Weight Before Wash, (g):	**278**	**Corrected**
Sample Weight After Sieve, (g):	**858.2**	Sample Weight After Wash, (g):	**180.6**	
Percent Loss In Sieve, (%):	**0.01**	Percent Passing No. 200, (%):	**35.0**	**30.7**

Sieve Analysis

Sieve No.	Size of Opening		Wt. Retained	Cum Wt. Retained	Percent Passing	No Envelope	
	Inches	mm	g	g	%	Minimum	Maximum
	6	**150**					
	4	**106**					
	3	**76.2**					
	2	**53.0**					
	1	**26.5**					
	3/4	**19.0**					
	5/8	**16.0**	**0.0**	**0.0**	**100.0**		
	1/2	**13.2**	**6.1**	**6.1**	**99.3**		
	3/8	**9.5**	**16.0**	**22.1**	**97.4**		
+4	**0.187**	**4.75**	**83.7**	**105.8**	**87.7**		
		- 4.75	**752.4**	**858.2**			
8	**0.0937**	**2.36**		**41.6**	**74.6**		
16	**0.0469**	**1.18**		**85.2**	**60.8**		
30	**0.234**	**0.600**		**117.1**	**50.7**		
50	**0.0117**	**0.300**		**140.5**	**43.4**		
100	**0.0059**	**0.150**		**157.3**	**38.1**		
200	**0.0029**	**0.075**		**176.6**	**32.0**		
		Pan		**180.6**			

Classification of Sample: % Gravel: **12.3** % Sand: **55.7** % Silt and Clay: **32.0**

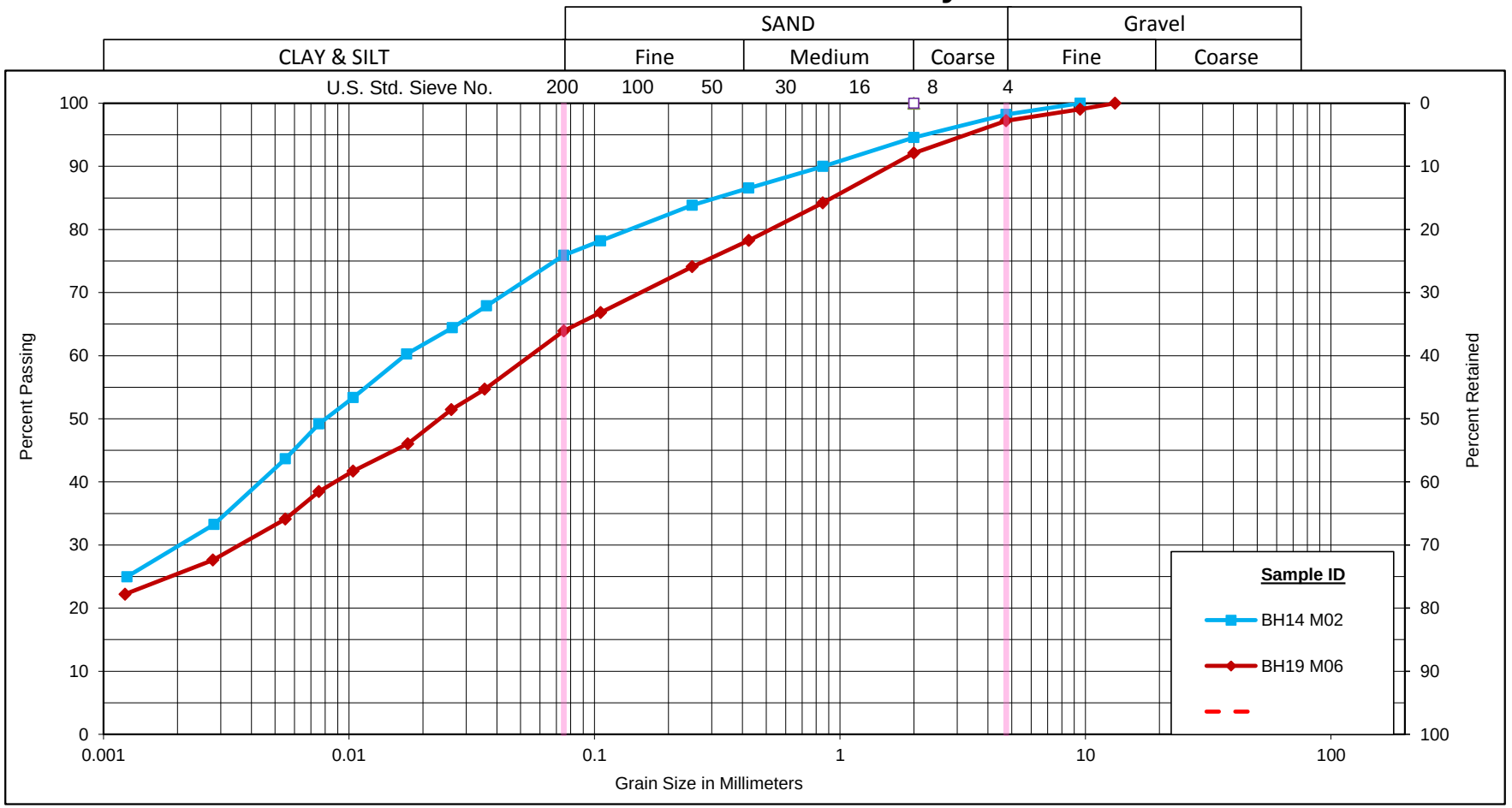


Remarks: **Sample contained asphalt**

Laboratory Supervisor: _____ **Date:** _____

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Unified Soil Classification System



Sample ID	Depth (m)	% Gravel	% Sand	% Silt	% Clay
BH14 M02	350 - 1500 mm	2.0	22.1	46.9	29.0
BH19 M06	460 - 700 mm	3.0	33.1	38.9	25.0

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GRAIN SIZE DISTRIBUTION

Figure No. 1

Project No. 160311376

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Particle-Size Analysis of Soils

LS702
ASTM D422

PROJECT DETAILS			
Client:	**Union Gas Ltd**	Project No.:	**160311376**
Project:	**8th Line Milton, Part 2**	Test Method:	**LS702**
Material Type:	**Soil**	Sampled By:	**D. Pettitt**
Sample No.:	**BH19 M06**	Date Sampled:	**December 20, 2012**
Sample Depth	**460 - 700 mm**	Tested By:	**A. Proulx**
Source:	**N/A**	Date Tested:	**January 4, 2012**

WASH TEST DATA	
Oven Dry Mass In Hydrometer Analysis (g)	83.20
Sample Weight after Hydrometer and Wash (g)	25.74
Percent Passing No. 200 Sieve (%)	**69.1**
Percent Passing Corrected (%)	**63.60**

PERCENT LOSS IN SIEVE	
Sample Weight Before Sieve (g)	**437.80**
Sample Weight After Sieve (g)	**436.30**
Percent Loss in Sieve (%)	**0.34**

SOIL INFORMATION		
Liquid Limit (LL)		
Plasticity Index (PI)		
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS	
Oven Dried Mass (W_o), (g)	33.85
Air Dried Mass (W_a), (g)	34.21
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9895
Air Dried Mass in Analysis (M_a), (g)	84.08
Oven Dried Mass in Analysis (M_o), (g)	83.20
Percent Passing 2.0 mm Sieve (P_{10}), (%)	92.10
Sample Represented (W), (g)	90.33

SIEVE ANALYSIS		
Sieve Size mm	**Cum. Wt. Retained**	**Percent Passing**
75.0		100.0
63.0		100.0
53.0		100.0
37.5		100.0
26.5		100.0
19.0		100.0
13.2	0.0	100.0
9.5	4.2	99.0
4.75	12.1	97.2
2.00	34.6	92.1
Total (C + F)[1]		
0.850	7.12	84.22
0.425	12.51	78.25
0.250	16.27	74.09
0.106	22.82	66.84
0.075	25.46	63.91
PAN	25.68	63.7

Note 1: (C + F) = Coarse + Fine

HYDROMETER DETAILS	
Volume of Bulb (V_B), (cm^3)	65.0
Length of Bulb (L_2), (cm)	13.98
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.7
Scale Dimension (h_s), (cm/Div)	0.162
Cross-Sectional Area of Cylinder (A), (cm^2)	28.37
Meniscus Correction (H_m), (g/L)	0.5

START TIME 8:22 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
4-Jan-12	8:23 AM	1	57.0	6.5	20.0	50.5	54.69	7.22942	10.09098	0.013286	0.03572
4-Jan-12	8:24 AM	2	54.0	6.5	20.0	47.5	51.45	7.71542	10.09098	0.013286	0.02610
4-Jan-12	8:27 AM	5	49.0	6.5	20.0	42.5	46.03	8.52542	10.09098	0.013286	0.01735
4-Jan-12	8:37 AM	15	45.0	6.5	20.0	38.5	41.70	9.17342	10.09098	0.013286	0.01039
4-Jan-12	8:52 AM	30	42.0	6.5	20.0	35.5	38.45	9.65942	10.09098	0.013286	0.00754
4-Jan-12	9:22 AM	60	38.0	6.5	20.0	31.5	34.12	10.30742	10.09098	0.013286	0.00551
4-Jan-12	12:32 PM	250	32.0	6.5	21.0	25.5	27.62	11.27942	9.84835	0.013126	0.00279
5-Jan-12	8:22 AM	1440	27.0	6.5	19.5	20.5	22.20	12.08942	10.21619	0.013369	0.00122

Remarks:

Reviewed By: _____
Date: _____

M:\01224\active\1603\160311376\Lab\20121220_Hydrometer_160311376.xlsx

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Particle-Size Analysis of Soils

LS702
ASTM D422

PROJECT DETAILS

Client:	**Union Gas Ltd**	Project No.:	**160311376**
Project:	**8th Line Milton, Part 2**	Test Method:	**LS702**
Material Type:	**Soil**	Sampled By:	**D. Pettitt**
Sample No.:	**BH14 M02**	Date Sampled:	**December 20, 2012**
Sample Depth	**350 - 1500 mm**	Tested By:	**A. Proulx**
Source:	**N/A**	Date Tested:	**January 4, 2012**

WASH TEST DATA

Oven Dry Mass In Hydrometer Analysis (g)	66.79
Sample Weight after Hydrometer and Wash (g)	13.39
Percent Passing No. 200 Sieve (%)	**80.0**
Percent Passing Corrected (%)	**75.62**

PERCENT LOSS IN SIEVE

Sample Weight Before Sieve (g)	**562.50**
Sample Weight After Sieve (g)	**561.30**
Percent Loss in Sieve (%)	**0.21**

SOIL INFORMATION

Liquid Limit (LL)		
Plasticity Index (PI)		
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS

Oven Dried Mass (W_o), (g)	39.03
Air Dried Mass (W_a), (g)	39.36
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9916
Air Dried Mass in Analysis (M_a), (g)	67.35
Oven Dried Mass in Analysis (M_o), (g)	66.79
Percent Passing 2.0 mm Sieve (P_{10}), (%)	94.58
Sample Represented (W), (g)	70.61

SIEVE ANALYSIS

Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5		100.0
26.5		100.0
19.0		100.0
13.2		100.0
9.5	0.0	100.0
4.75	10.0	98.2
2.00	30.5	94.6
Total (C + F)[1]		
0.850	3.25	89.98
0.425	5.67	86.55
0.250	7.58	83.84
0.106	11.57	78.19
0.075	13.18	75.91
PAN	13.33	75.7

Note 1: (C + F) = Coarse + Fine

HYDROMETER DETAILS

Volume of Bulb (V_B), (cm^3)	65.0
Length of Bulb (L_2), (cm)	13.98
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.7
Scale Dimension (h_s), (cm/Div)	0.162
Cross-Sectional Area of Cylinder (A), (cm^2)	28.37
Meniscus Correction (H_m), (g/L)	0.5

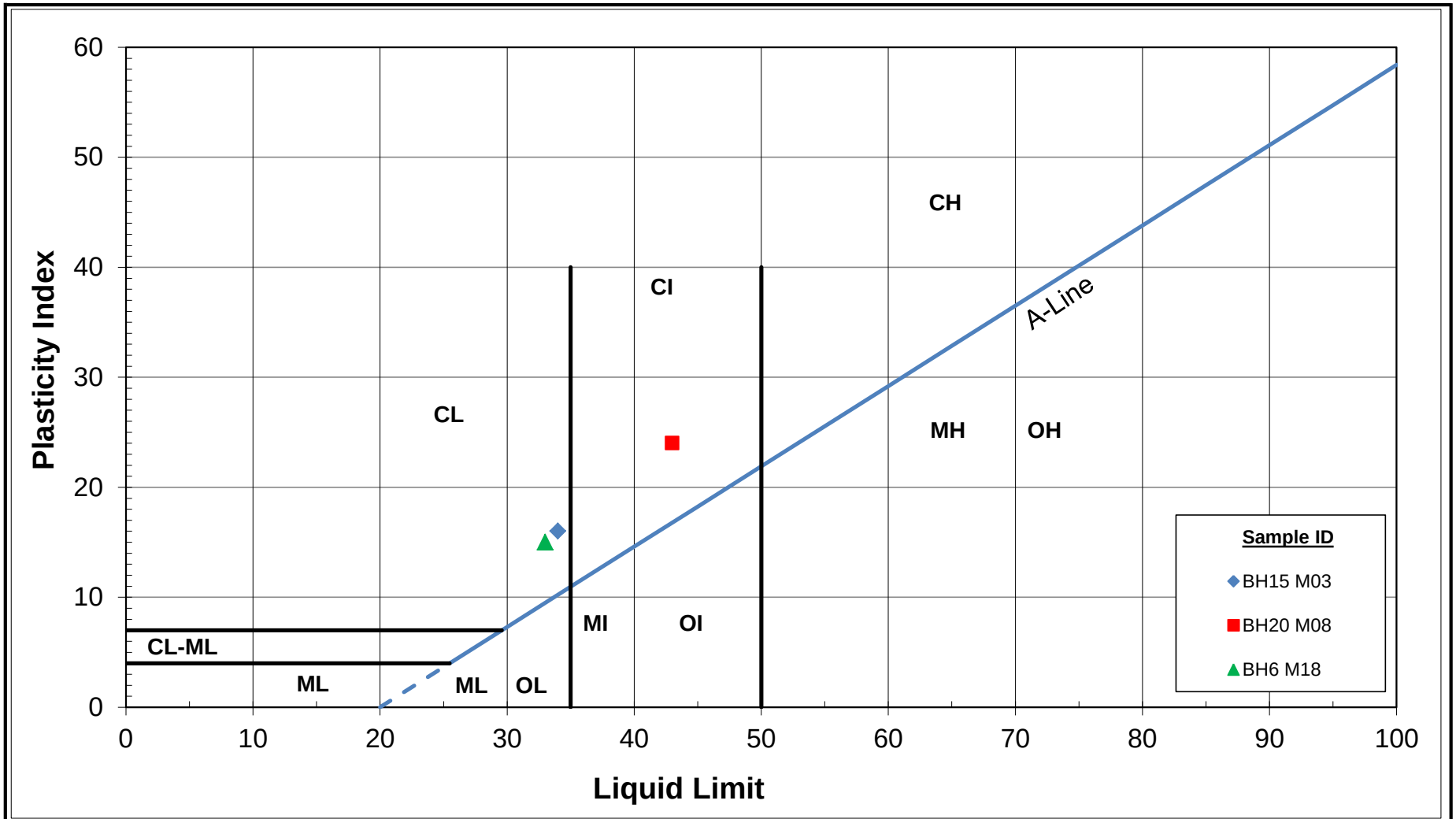
START TIME 8:27 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
04-Jan-12	8:28 AM	1	55.5	6.5	20.0	49.0	67.89	7.47242	10.09098	0.013286	0.03632
04-Jan-12	8:29 AM	2	53.0	6.5	20.0	46.5	64.43	7.87742	10.09098	0.013286	0.02637
04-Jan-12	8:32 AM	5	50.0	6.5	20.0	43.5	60.27	8.36342	10.09098	0.013286	0.01718
04-Jan-12	8:42 AM	15	45.0	6.5	20.0	38.5	53.34	9.17342	10.09098	0.013286	0.01039
04-Jan-12	8:57 AM	30	42.0	6.5	20.0	35.5	49.19	9.65942	10.09098	0.013286	0.00754
04-Jan-12	9:27 AM	60	38.0	6.5	20.0	31.5	43.64	10.30742	10.09098	0.013286	0.00551
04-Jan-12	12:37 PM	250	30.5	6.5	21.0	24.0	33.2524	11.52242	9.84835	0.013126	0.00282
05-Jan-12	8:27 AM	1440	24.5	6.5	19.5	18.0	24.9393	12.49442	10.21619	0.013369	0.00125

Remarks:

Reviewed By: _____
Date: _____



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PLASTICITY CHART

Figure No. 3

Project No. 160311376

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Atterberg Limit Determination

LS 703/704
ASTM D4318

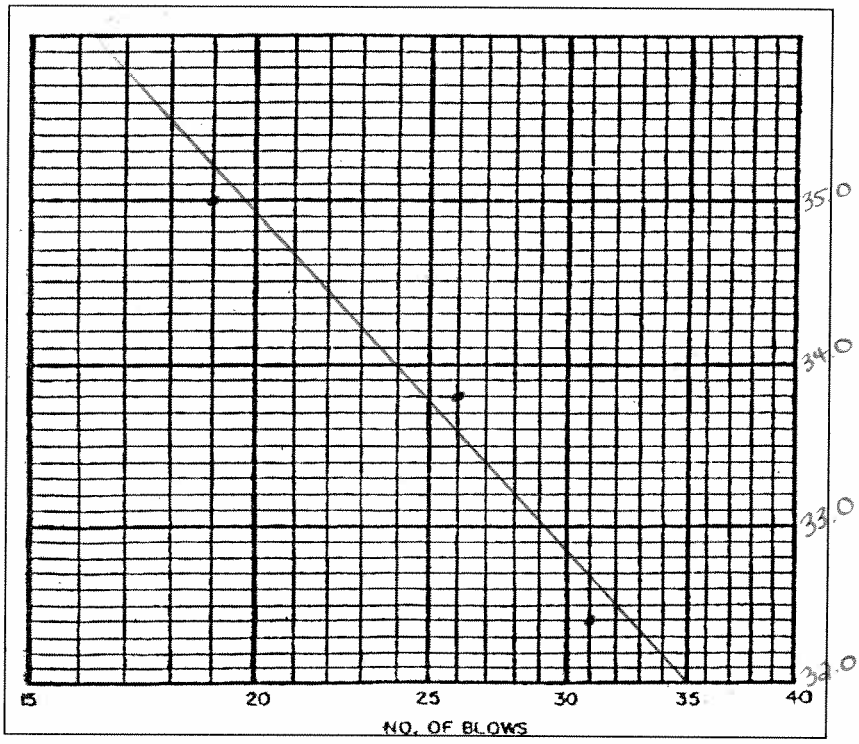
CLIENT	Union Gas Ltd	PROJECT No.	160311376
B.H. / T.P. No.	BH15	PROJECT	8th Line Milton, Part 2
SAMPLE No.	M03	DATE SAMPLED	December 20, 2012
SAMPLE DEPTH	300 - 1500 mm	SAMPLED BY	D. Pettitt
TESTED BY	A. Proulx	TEST DATE	January 7, 2013
SOIL DESCRIPTION			

LIQUID LIMIT DETERMINATION

CONTAINER NO.	1	2	3			
NO. OF BLOWS	31	26	19			
CAN + WET SOIL	27.83	29.22	31.92			
CAN + DRY SOIL	24.56	25.41	27.39			
WEIGHT OF WATER	3.27	3.81	4.53			
CAN - TARE WEIGHT	14.46	14.14	14.46			
WEIGHT OF DRY SOIL	10.10	11.27	12.93			
MOISTURE CONTENT (%)	32.4	33.8	35.0			

PLASTIC LIMIT DETERMINATION

TRIAL NO.	1	2	3			
CAN + WET SOIL	18.58	18.00	18.24			
CAN + DRY SOIL	17.93	17.40	17.66			
WEIGHT OF WATER	0.65	0.60	0.58			
CAN - TARE WEIGHT	14.23	13.97	14.37			
WEIGHT OF DRY SOIL	3.70	3.43	3.29			
MOISTURE CONTENT (%)	17.6	17.5	17.6			



ONE POINT FORMULA

$$LL = W_N (N/25)^{0.121}$$
or
$$LL^n = kW^n$$

N	k
20	0.973
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

REMARKS:

LIQUID LIMIT METHOD: **A**		**Multi-Point**
PLASTIC LIMIT METHOD:		**Hand**
	Results	Final Results
LIQUID LIMIT	**33.8**	**34**
PLASTIC LIMIT	**17.6**	**18**
PLASTICITY INDEX	**16.2**	**16**

Reviewed By: _____ Date: _____

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49 Frederick Street
Kitchener ON N2H 6M7
Tel: (519) 579-4410 Fax: (519) 579-6733

Atterberg Limit Determination

LS 703/704
ASTM D4318

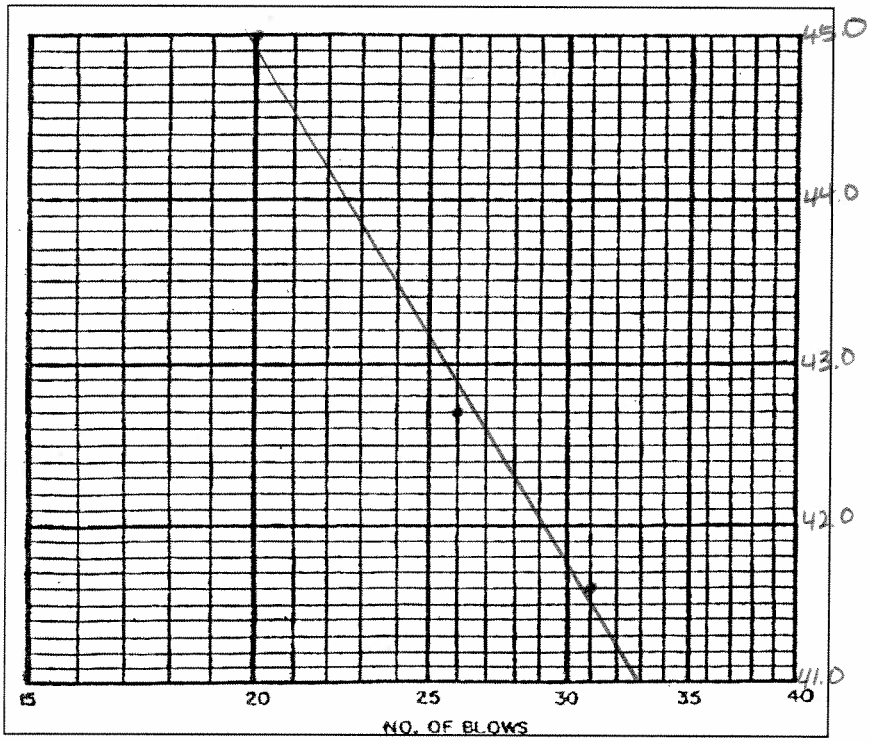
CLIENT	Union Gas Ltd	PROJECT No.	160311376
B.H. / T.P. No.	BH20	PROJECT	8th Line Milton, Part 2
SAMPLE No.	M08	DATE SAMPLED	December 20, 2012
SAMPLE DEPTH	400 - 1500 mm	SAMPLED BY	D. Pettitt
TESTED BY	A. Proulx	TEST DATE	January 7, 2013
SOIL DESCRIPTION			

LIQUID LIMIT DETERMINATION

CONTAINER NO.	1	2	3			
NO. OF BLOWS	31	26	20			
CAN + WET SOIL	30.89	32.93	35.10			
CAN + DRY SOIL	26.09	27.33	28.63			
WEIGHT OF WATER	4.80	5.60	6.47			
CAN - TARE WEIGHT	14.55	14.22	14.24			
WEIGHT OF DRY SOIL	11.54	13.11	14.39			
MOISTURE CONTENT (%)	41.6	42.7	45.0			

PLASTIC LIMIT DETERMINATION

TRIAL NO.	1	2				
CAN + WET SOIL	18.24	18.52				
CAN + DRY SOIL	17.55	17.89				
WEIGHT OF WATER	0.69	0.63				
CAN - TARE WEIGHT	13.97	14.62				
WEIGHT OF DRY SOIL	3.58	3.27				
MOISTURE CONTENT (%)	19.3	19.3				



ONE POINT FORMULA

$$LL = W_N (N/25)^{0.121}$$
or
$$LL^n = kW^n$$

N	k
20	0.973
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

REMARKS:

LIQUID LIMIT METHOD: **A**		**Multi-Point**
PLASTIC LIMIT METHOD:		**Hand**
	Results	Final Results
LIQUID LIMIT	**43.3**	**43**
PLASTIC LIMIT	**19.3**	**19**
PLASTICITY INDEX	**24.0**	**24**

Reviewed By: _____ Date _____

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Tel: (519) 579-4410 Fax: (519) 579-6733

Atterberg Limit Determination

LS 703/704
ASTM D4318

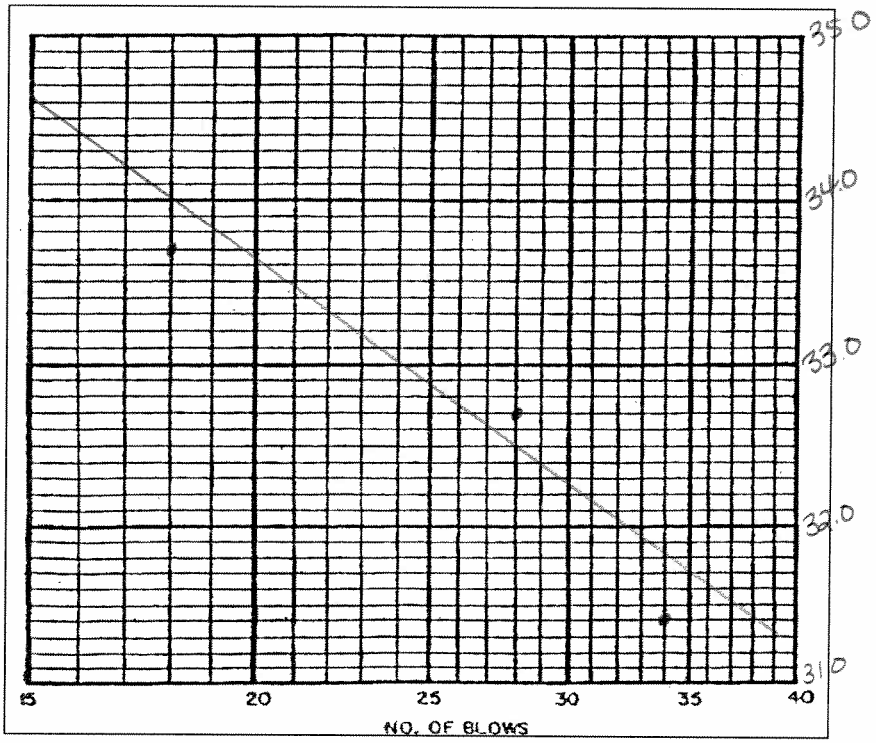
CLIENT	Union Gas Ltd	PROJECT No.	160311376
B.H. / T.P. No.	BH6	PROJECT	8th Line Milton, Part 2
SAMPLE No.	M18	DATE SAMPLED	December 20, 2012
SAMPLE DEPTH	360 - 950 mm	SAMPLED BY	D. Pettitt
TESTED BY	A. Proulx	TEST DATE	January 7, 2013
SOIL DESCRIPTION			

LIQUID LIMIT DETERMINATION

CONTAINER NO.	1	2	3			
NO. OF BLOWS	34	28	18			
CAN + WET SOIL	33.28	31.98	32.87			
CAN + DRY SOIL	28.81	27.69	28.17			
WEIGHT OF WATER	4.47	4.29	4.70			
CAN - TARE WEIGHT	14.58	14.59	14.23			
WEIGHT OF DRY SOIL	14.23	13.10	13.94			
MOISTURE CONTENT (%)	31.4	32.7	33.7			

PLASTIC LIMIT DETERMINATION

TRIAL NO.	1	2	3			
CAN + WET SOIL	18.41	18.30	18.76			
CAN + DRY SOIL	17.81	17.70	18.09			
WEIGHT OF WATER	0.60	0.60	0.67			
CAN - TARE WEIGHT	14.43	14.30	14.41			
WEIGHT OF DRY SOIL	3.38	3.40	3.68			
MOISTURE CONTENT (%)	17.8	17.6	18.2			



ONE POINT FORMULA

$$LL = W_N (N/25)^{0.121}$$
or
$$LL^n = kW^n$$

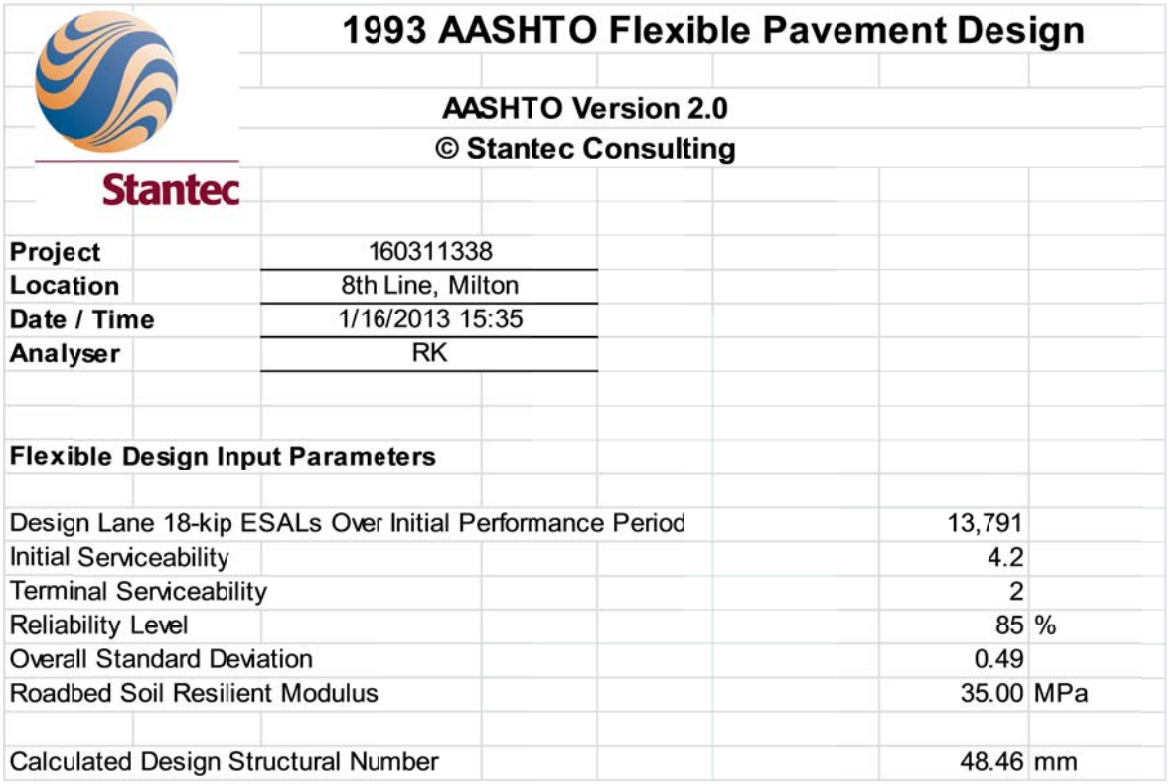
N	k
20	0.973
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

REMARKS:

LIQUID LIMIT METHOD: **A**		**Multi-Point**
PLASTIC LIMIT METHOD:		**Hand**
	Results	Final Results
LIQUID LIMIT	**32.9**	**33**
PLASTIC LIMIT	**17.9**	**18**
PLASTICITY INDEX	**15.0**	**15**

Reviewed By: _____ Date _____

Appendix E: Laboratory Results – AASHTO 1993 Analysis



1993 AASHTO Flexible Pavement Design

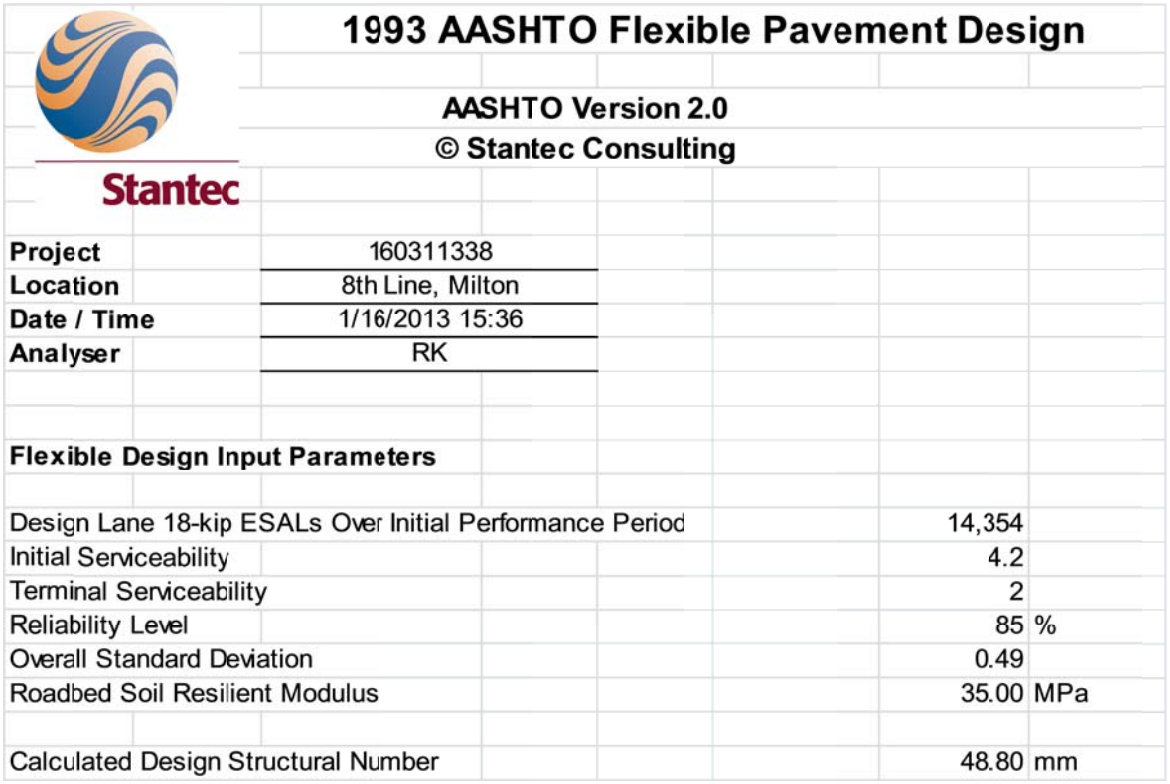
AASHTO Version 2.0

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Project	160311338		
Location	8th Line, Milton		
Date / Time	1/16/2013 15:35		
Analyser	RK		
Flexible Design Input Parameters			
Design Lane 18-kip ESALs Over Initial Performance Period		13,791	
Initial Serviceability		4.2	
Terminal Serviceability		2	
Reliability Level		85	%
Overall Standard Deviation		0.49	
Roadbed Soil Resilient Modulus		35.00	MPa
Calculated Design Structural Number		48.46	mm

Figure E.1: Required Structural Number – 1 year of Existing Traffic



1993 AASHTO Flexible Pavement Design

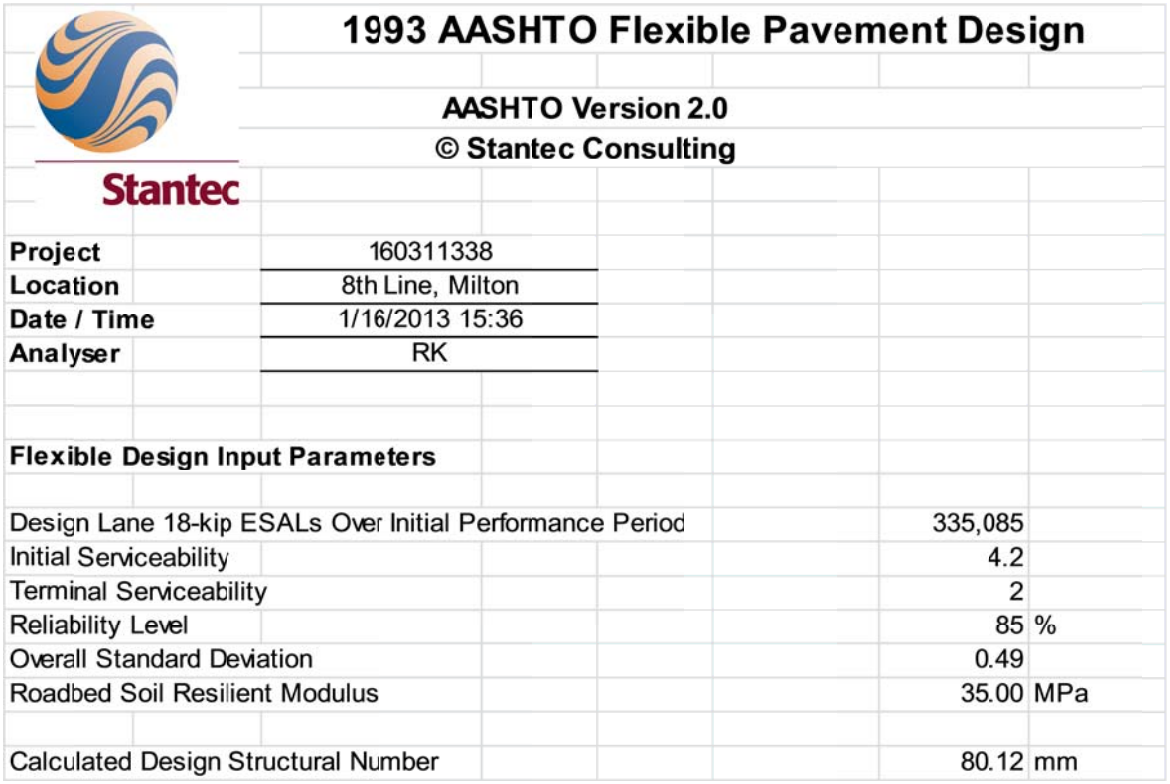
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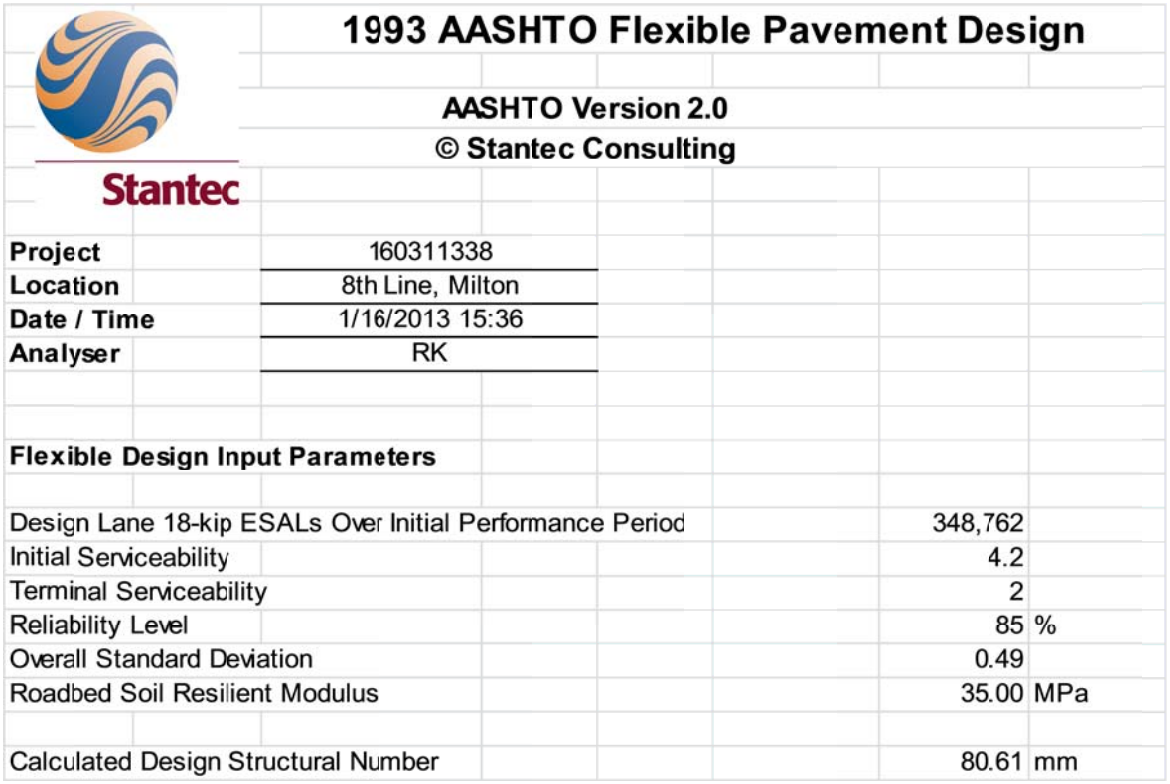
Project	160311338		
Location	8th Line, Milton		
Date / Time	1/16/2013 15:36		
Analyser	RK		
Flexible Design Input Parameters			
Design Lane 18-kip ESALs Over Initial Performance Period		14,354	
Initial Serviceability		4.2	
Terminal Serviceability		2	
Reliability Level		85	%
Overall Standard Deviation		0.49	
Roadbed Soil Resilient Modulus		35.00	MPa
Calculated Design Structural Number		48.80	mm

Figure E.2: Required Structural Number – 1 year of Projected Traffic



1993 AASHTO Flexible Pavement Design			
AASHTO Version 2.0			
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Project	160311338		
Location	8th Line, Milton		
Date / Time	1/16/2013 15:36		
Analyser	RK		
Flexible Design Input Parameters			
Design Lane 18-kip ESALs Over Initial Performance Period		335,085	
Initial Serviceability		4.2	
Terminal Serviceability		2	
Reliability Level		85	%
Overall Standard Deviation		0.49	
Roadbed Soil Resilient Modulus		35.00	MPa
Calculated Design Structural Number		80.12	mm

Figure E.3: Required Structural Number – 20 years of Existing Traffic



1993 AASHTO Flexible Pavement Design

AASHTO Version 2.0

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Project	160311338
Location	8th Line, Milton
Date / Time	1/16/2013 15:36
Analyser	RK

Flexible Design Input Parameters

Design Lane 18-kip ESALs Over Initial Performance Period	348,762	
Initial Serviceability	4.2	
Terminal Serviceability	2	
Reliability Level	85	%
Overall Standard Deviation	0.49	
Roadbed Soil Resilient Modulus	35.00	MPa
Calculated Design Structural Number	80.61	mm

Figure E.4: Required Structural Number – 20 years of Projected Traffic