2015 Annual Groundwater and Surface Water Monitoring Report, Hydro One - Clarington Transformer Station

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Sign-off Sheet

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Executive Summary

This 2015 Annual Monitoring Report presents data collected during the Spring and Fall semi-annual sampling events completed in April and October 2015. This report includes a summary of Project Area groundwater monitoring well and private well monitoring data collected during these semi-annual monitoring events, and discusses adaptive changes made to the Groundwater and Surface Water Monitoring Program, such as installation and decommissioning of monitoring wells.

Introduction

The Clarington Transformer Station is currently under construction on a Hydro One owned property located within the Regional Municipality of Durham, in the Municipality of Clarington, bordering the east side of the City of Oshawa, northeast of Concession Road 7 and Townline Road North.

The 11 ha Station Site is to include a drainage system to collect precipitation that falls within the Station Site in order to maintain dry ground and safe operating conditions. The drainage system will be constructed on an area to be graded within the Station Site limits.

The MOECC approved Groundwater and Surface Water Monitoring Program (Monitoring Program) for the Clarington TS included installation of groundwater monitoring wells, implementation of groundwater, surface water, and private well monitoring programs, and annual reporting. The Monitoring Program objectives include defining the hydraulic conductivity of geologic units, documenting pre-station construction hydrogeologic conditions within the Project Area, and continued monitoring of the hydrogeologic conditions within the Project Area and for private wells within 1,200 m of the Station Site during and following station construction.

Site preparation for the construction of Clarington TS began in Spring 2015. Shortly after mobilizing to the site, station construction crews prepared construction trailer and lay-down areas, as well as additional temporary access roads as required. Grading (cut/fill) of the site began in July 2015. As of November 1, 2015, the construction of the station has progressed with the topsoil having been removed, and the cut / file / grading of the site is nearing completion. The oil-water separator holding tanks have been installed and will be connected to the spill containment pits when they have been completed.

Local Hydrogeology

Since issuing the Baseline Conditions Report in November 2014, additional monitoring wells were installed in 2014, which included MW5-S(2), MW5-D, and MW5-D(2) as a condition of the municipal resolution to provide a permanent easement for the Clarington TS access road. In 2015, monitoring well MW4-15D was installed to verify the low groundwater level recorded in

MW4-13D, monitoring well MW8-15 was installed to confirm the borehole log results of the geotechnical borehole BH7D, and borehole BH9-15 was drilled to confirm geologic conditions at the location of the Clarington TS planned oil/water separator. The drilling, monitoring well installation, and hydraulic testing associated with the borehole and monitoring well installations completed since November 2014 have been provided in the Clarington Transformer Station - Addendum 2 Report (Stantec, 2015b), which was submitted to the MOECC and is publicly available on Hydro One's project website.

Within the Project Area, shallow groundwater flows to the west and southwest towards the Harmony Creek tributaries and their associated branches. East of the Station Site, a shallow groundwater divide extends from north-northwest to south-southeast, dividing shallow groundwater lateral flow between the Harmony Creek and the Farewell Creek sub-watersheds. At the eastern extent of the Project Area, groundwater flow within the Farewell Creek Sub-watershed is to the southeast toward Farewell Creek and is consistent with the overall ground surface topography.

The recorded water level elevation fluctuations indicate the monitoring wells have responded to normal seasonal changes, consistent with the findings presented in the Baseline Conditions Report (Stantec, 2014). Monitoring wells MW1-13S, MW6-14, and MW7-14 showed the greatest change in shallow water level elevation in 2015 as compared to 2014; lowering 1.9 m, 1.3 m, and 1.4 m in MW1-13S, MW6-14, and MW7-14, respectively. Given the proximity of these shallow monitoring wells to the side of the graded slope, a greater localized lowering of the water level within these wells was anticipated as grading of the Station Site progressed during construction. These levels continue to be monitored during Station construction, with data reported monthly to the MOECC.

Site observations and recorded water level elevations at drivepoint piezometers within nearby surface water features and adjacent monitoring wells indicated that the Harmony Creek tributaries flowed intermittently, and were supported primarily by surface water runoff.

No shallow private wells are located downgradient of the Station Area. All shallow private wells in the vicinity of the Clarington TS participating in the Private Well Monitoring Program are located in the Farewell Creek Watershed, with the exception of two (2) wells located north and upgradient of the Station Site. Monitoring wells at MW2-13, MW3-13, MW4-13, and MW5-14 are well positioned to serve as downgradient shallow groundwater monitoring wells for the Station Area.

Recorded water level elevations from pairs of shallow and intermediate depth wells were used to calculate vertical hydraulic gradients at monitoring well locations MW1, MW2, MW3, MW4, and MW5. The vertical hydraulic gradient within the shallow overburden across the Project Area in 2015 ranges from 0.03 m/m to 0.38 m/m, and is consistent with those presented in the Baseline Conditions Report (Stantec, 2014).

A downward vertical hydraulic gradient is interpreted from the surficial sand and weathered till units within the proposed Project Area to the underlying Thorncliffe Aquifer. The difference in recorded water levels in both deeper wells MW5-14I and MW5-14D, in conjunction with the stratigraphic model understanding for the Site, indicates these wells have little to no direct hydraulic connection to each other or the shallow groundwater system.

Thorncliffe Aquifer monitoring wells indicate deeper groundwater levels range from 208.1 m AMSL to 214.2 m AMSL with an overall southerly groundwater flow direction consistent with monitoring results from 2014 and consistent with regional mapping that indicates deep groundwater flow to the southeast across the Project Area as noted by CLOCA (2012).

Surface Water Quality

As part of the Monitoring Program, water quality monitoring was completed semi-annually in April and October, 2015. Surface water level elevations and water quality was monitored at three (3) locations on the Site (SW2, SW3 and SW4) in 2015. Hydro One technicians, under the direction of Stantec staff, completed surface water quality sampling within the nearby surface water features including the South Branch of the Tributary of Harmony Creek at SW2 , the Tributary of Harmony Creek at SW3 (adjacent to DP3-14), and at a drainage swale located south of the Station Site at SW4.

The surface water quality monitoring data in 2015 indicates that water quality is generally characterized by low concentrations of sodium, chloride, and nitrate and all parameters generally within the PWQO. Elevated concentrations of aluminum (SW4), iron (SW2), and phosphorous (SW2 and SW4) were detected in at least one (1) sample above the PWQO in 2015. Toluene was detected in one sample (SW2) in April, but was found to be below detectable limits in October, 2015.

Shallow Groundwater Quality

Since December 2013, a total of seventeen (17) Project Area groundwater monitoring wells (MW1-13S/D, MW2-13S/D, MW3-13S/D, MW4-13S/D/D(2), MW5-14S(2)/S/I/D/D(2), MW6-14, MW7-14, and temporary well MW8-15 (now decommissioned) were installed at seven (7) locations throughout the Project Area in order improve the understanding of the local geology and hydrogeology prior to construction and to monitor groundwater and surface water during and following construction of the Clarington TS.

In April and October 2015, all monitoring wells were sampled as part of the semi-annual Monitoring Program, with the exception of MW4-13D, as it was replaced by MW4-15D; and MW8-15 in October 2015, as this well was decommissioned in May 2015.

Project Area monitoring wells were monitored for general inorganic chemistry, total metals, petroleum hydrocarbons (PHCs) (F1 to F4) and benzene, toluene, ethylbenzene and xylene (BTEX) compounds, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) parameters.

Groundwater quality from the Project Area monitoring wells in 2015 met the ODWQS maximum acceptable concentration (MAC) for all tested health related parameters with the exception of nitrate which was detected at MW1-13S (20 mg/L and 17 mg/L in Spring and Fall 2015, respectively); MW5-14S(2) (14 mg/L and 11 mg/L in Spring and Fall 2015, respectively); and MW5-14S (13 mg/L in Spring 2015) above the ODWQS-MAC of 10 mg/L. The elevated nitrate concentrations at these locations are attributed to agricultural fertilizer use, are consistent with previous 2014 results as presented in the Baseline Conditions Report (Stantec, 2014), and are not attributed to Hydro One Station Site grading or construction activities.

Project Area monitoring wells did not exceed the ODWQS aesthetic objective (AO), the ODWQS operational guideline (OG), or ODWQS Medical Officer of Health (MOH) guidelines, with the exception of the following: aluminum in one (1) well, DOC in two (2) wells, hardness in all wells, iron in one (1) well, manganese in two (2) wells, sodium in five (5) wells, sulphate in one (1) well, TDS in two (2) wells, and turbidity in fourteen (14) wells. These detections are generally consistent with 2013/2014 results and do not indicate any significant change in groundwater quality in 2015 through the start of construction of the Clarington TS.

Historically in 2014, benzo(a)pyrene has been detected above the ODWQS. As presented in the Addendum Report (Stantec, 2015a), this compound adsorbs to soil particles and it was concluded that these detections are associated with the sediment collected within the sample. The Addendum Report recommended that water quality sampling protocols be amended to include low-flow sampling. This sampling protocol was adopted in the 2015 Spring and Fall sampling rounds, resulting in no detections of benzo(a)pyrene in any of the Project Area monitoring wells.

Limited phthalate, PAH, and VOC compounds were detected at low concentrations that remained below the Ontario Drinking Water Quality Standards and Ontario Regulation 153/04 (O.Reg.153/04) Table 6 and/or Table 8 Site Condition Standards. The number of detections and the concentration of detections of PAH and VOC compounds were reduced significantly in 2015 as compared to 2014 as a result of further well development and implementation of low-flow sampling methods. These results are consistent with the understanding that historic PAHs detections were associated with the sediment and not representative of dissolved groundwater concentrations.

Private Well Water Quality

Stantec completed semi-annual groundwater quality sampling at private wells that participated in the program in April and October 2015 for general inorganic chemistry, total metals, PHCs (F1 to F4) and BTEX compounds, PCBs, SVOC and VOC, and bacteriological water quality. Well owner consent was obtained from the owners of 25 private wells (24 well owners) as of October 2015.

Water quality trends for shallow private wells that were installed to a maximum depth of 16 m BGS indicated that 11 of the 15 wells (73%) sampled during the April and October 2015 rounds had total coliforms present on at least one occasion. E. Coli was detected in five (5) of 15 wells (33%) on at least one occasion in 2015. Comparatively, total coliforms were detected in 83% of shallow wells in 2014, with E. Coli. detected in 25% of shallow wells. Of the ten (10) drilled wells completed at depths below 50 m BGS, only one (1) well (10%) had detections of total coliform in 2015. E.coli was not detected in any of the samples collected in 2015. These results are consistent with results from 2014, when only one deep private well was found to have total coliforms and there were no detections of E.coli.

The following parameters were detected above the ODWQS-AO or ODWQS-MOH on at least one (1) occasion within shallow private wells: sodium (11 wells – MOH, and 3 wells AO)), chloride in two (2) wells, TDS in five (5) wells, and aluminum in one (1) well.

Water quality for all ten (10) deeper wells completed below 50 m BGS did not exceed the ODWQS-MAC for any tested inorganic parameter in both the April and October 2015 sampling rounds. Benzo(a)pyrene exceeded the ODWQS MAC a private well sample collected in April 2015 from a well completed below 50 m BGS. Subsequent sampling in October 2015 did not detect the compound.

Hardness was above the ODWQS-OG in the raw water from all deeper wells, which is common in groundwater quality from southern Ontario. The following parameters were detected above the ODWQS-AO or ODWQS-MOH on at least one (1) occasion in 2015 sampling within the deeper private wells: iron in eight (8) wells, turbidity in six (6) wells, sodium in three (3) wells.

Conclusions and Recommendations

Based on the results presented in this Groundwater and Surface Water Baseline Conditions Report, the following conclusions are provided:

- The Monitoring Program, initiated in December 2013, and completed through October 2015, allowed for characterization and monitoring of groundwater conditions within the Project Area, including shallow groundwater flow directions, shallow and deep hydraulic gradients, seasonal groundwater level and groundwater quality monitoring, and hydraulic conductivity estimates;

- The Monitoring Program continues to monitor hydrogeologic conditions across the Project Area and within surrounding private wells. Evaluating the data collected with respect to baseline conditions established pre-Station construction, site preparations, grading activities, and construction of the Clarington TS have not had an adverse effect on the shallow groundwater system and the surrounding private wells within 1,200 m of the Station Site;

- Groundwater and surface water level elevation and water quality monitoring through to October 2015 indicates no adverse effects on the shallow groundwater system or in shallow or deep private wells as a result of Station Site grading and construction of the Clarington TS.

The following recommendations are provided:

- Water level and water quality monitoring should continue semi-annually during station construction and post-station construction, as detailed in the Groundwater and Surface Water Monitoring Program;
- Sampling procedures for Project Area wells should continue with low-flow sampling protocols, as recommended in the Baseline Conditions Report Addendum;
- It is recommended that MW4-14D be removed from the Monitoring Program and decommissioned in accordance with O.Reg.903. The water level was very slow to recover from well development, does not have sufficient water in it to complete sampling for all analytical parameters, and has been replaced by MW4-15D. The need for removing or adding monitoring wells to the Monitoring Program should be reviewed annually; and
- The condition of the drive-point piezometers should be inspected as part of the regular Monitoring Program and upgrades/replacement completed, as necessary.

Abbreviations

AMSL	above mean sea level
BGS	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylene
BTOC	below top of casing
Class EA	Class Environmental Assessment
CLOCA	Central Lake Ontario Conservation Authority
EA	Environmental Assessment
ECA	Environmental Compliance Approval
ESR	Environmental Study Report
GTA	Greater Toronto Area
ha	hectares
HDPE	high-density polyethylene
Hydro One	Hydro One Networks Inc.
ID	Inner diameter
Lotowater	Lotowater Technical Services Inc.
Maxxam	Maxxam Analytics Inc.
MAC	Maximum Acceptable Concentration
Monitoring Program	Groundwater and Surface Water Monitoring Program
MNRF	Ministry of Natural Resources and Forestry

MOECC	Ontario Ministry of Environment and Climate Change
OCS	Oshawa WPCP Climate Station
OD	outer diameter
ODWQS	Ontario Drinking Water Quality Standards
OGS	Ontario Geological Survey
O. Reg. 153/04	Ontario Regulation 153/04
O. Reg. 903	Ontario Regulation 903
OWRA	Ontario Water Resources Act
PCBs	polychlorinated biphenyls
PHCs	petroleum hydrocarbons
Project Area	lands owned by Hydro One in the vicinity of the Clarington TS
PTTW	Permit to Take Water
PWQO	Provincial Water Quality Objectives
PVC	polyvinyl chloride
Stantec	Stantec Consulting Ltd.
Station Site	land area of the Clarington Transformer Station
SVOCs	semi-volatile organic compounds
TS	Transformer Station
TSS	Total suspended solids
VOCs	volatile organic compounds

1.0 INTRODUCTION

In 2014, Hydro One Networks Inc. (Hydro One, 2014) completed a Class Environmental Assessment for Minor Transmission Facilities (Class EA) for the construction of the Clarington Transformer Station (TS). The Clarington TS is required to ensure an adequate and reliable supply of power to the eastern portion of the Greater Toronto Area (GTA) as a result of the shutdown of the Pickering Nuclear Generating Station and to reinforce the regional reliability of power supply. The Clarington TS is currently being constructed on Hydro One owned property located in the Regional Municipality of Durham, in the Municipality of Clarington, bordering the east side of the City of Oshawa, northeast of Concession Road 7 and Townline Road North (Figure 1; Appendix A).

1.1 BACKGROUND

In a letter dated January 2, 2014, the Minister of the Environment informed Hydro One that an Individual Environmental Assessment was not required, and provided six (6) conditions to be undertaken during the detailed design and construction of the Clarington TS.

A condition of the MOECC letter required the submission of a Groundwater Monitoring Plan to the MOECC Central Region Director for review and approval. The Groundwater Monitoring Plan was to include water level and quality monitoring from wells located within the Project Area and adjacent private wells to document pre- and post-station construction conditions and to confirm no adverse effects are associated with the Clarington TS. To satisfy this condition, Stantec Consulting Ltd. (Stantec) was retained by Hydro One to prepare the monitoring plan. The Groundwater and Surface Water Monitoring Program (Monitoring Program) was submitted to the MOECC on June 13, 2014 (Appendix C).

Approval of the Monitoring Program was received from the MOECC Central Region Director on June 24, 2014 (Appendix C).

The first monitoring report to be prepared under the Monitoring Program was the Pre-Station Construction Groundwater and Surface Water Baseline Conditions Report (Baseline Conditions Report, Stantec, 2014). As per one of the recommendations of the Baseline Conditions Report, additional assessment of sampling methodology and the role of sediment in water quality results was completed, with the findings presented in an Addendum Report (Stantec, 2015a). Subsequent to the Baseline Conditions Report, additional drilling and installation of monitoring wells, hydraulic testing, and soil sampling were completed; with the findings of these investigations presented in an Addendum 2 Report (Stantec, 2015b).

This 2015 Annual Monitoring Report presents data collected during the Spring and Fall semi-annual sampling events completed in April and October 2015. This report includes a summary of Project Area groundwater monitoring well and private well monitoring data collected during these semi-annual monitoring events.

1.2 REPORT OUTLINE

The following 2015 Annual Groundwater and Surface Water Monitoring Report presents the results of the Monitoring Program for the Clarington TS. This report is arranged into seven (7) sections, including this introduction. Section 2 presents an overview of the infrastructure and construction schedule for the Station Site. Section 3 presents a summary of the groundwater and surface water monitoring program. Section 4 presents the study methods, and Section 5 presents the results of the baseline monitoring. Section 6 presents conclusions and recommendations, and Section 7 presents report references.

All Figures and Tables referenced throughout the report are presented in Appendices A and B, respectively. Appendix C contains a copy of the approved Groundwater and Surface Water Monitoring Program, associated correspondence from the MOECC and well owner notification letters. Appendices D and E include Private Well Hydrographs and Laboratory Certificate of Analyses, respectively.

2.0 CLARINGTON TRANSFORMER STATION

The following Clarington TS overview and summary of construction staging is provided by Hydro One.

2.1 OVERVIEW

The Clarington TS is currently being constructed on Hydro One owned property located within the Regional Municipality of Durham, in the Municipality of Clarington, bordering the east side of the City of Oshawa, northeast of Concession Road 7 and Townline Road North (Figure 1). For the purposes of this report, the lands owned by Hydro One in the vicinity of the Clarington TS are referred to as the Project Area, within which the area that will be occupied by the transformer station itself is referred to as the Station Site. The Station Site represents approximately 11 ha of the total 63 ha Project Area (Figure 2), which lies within the Harmony Creek watershed (Figure 3).

The Clarington TS will transform electricity voltages from 500 kV to 230 kV by connecting to two (2) of four (4) existing 500 kV circuits and to all five (5) of the existing 230 kV circuits located on or adjacent to the proposed Station Site. The Clarington TS will consist of two (2) 500/230 kV transformers, a 500 kV switchyard, a 230 kV switchyard, two relay buildings, one (1) electrical panel building, the associated buswork and equipment.

The 230 kV wood pole structures originally located on the property have been relocated and replaced with new 230 kV steel structures. An access road off Townline Road North has been constructed on the western edge of the Project Area. The access road is located at the municipal boundary between the Municipality of Clarington and the City of Oshawa. The Station Site will include a drainage system to collect precipitation that falls within the station in order to maintain dry ground and safe operating conditions. In the unlikely event of a release of mineral insulating oil from a transformer, a spill containment system and oil-water separator have been included in the transformer station design to prevent the loss of transformer mineral insulating oil from entering the surrounding environment. The drainage and containment system have received Environmental Compliance Approval (ECA) for Industrial Sewage Works as per the Ontario Water Resources Act (OWRA).

2.2 CURRENT STATION SITE CONSTRUCTION STAGING

Prior to construction of the Clarington TS, site preparation and 230 kV tower construction activities were required to relocate the existing 230 kV lines to the north and west of the proposed Clarington TS. The following provides a summary of the construction staging schedule for the Clarington TS:

Complete	Relocation of 230 kV transmission lines and construction of an access road.

Complete	Construct 500 kV Tower Foundations
Complete	Relocation of 500 kV lines
June 2015	Clarington TS Construction Started
Fall 2016 – Fall 2017	230 kV & 500 kV Connections and Commissioning
Spring 2018	Clarington TS - In-Service
Spring 2016 – Fall 2018	Habitat Creation and Visual Screening

Site preparation for the construction of Clarington TS began in Spring 2015. Shortly after mobilizing to the site, station construction crews prepared construction trailer and lay-down areas, as well as additional temporary access roads as required. Hedgerow clearing and topsoil removal began in April 2015, and was completed in June of the same year.

Grading (cut/fill) of the site began in July 2015. As of November 1, 2015, the construction of the station has progressed with the topsoil having been removed, and the cut / file / grading of the site is nearing completion. The 230kV east yard has seen progress with foundation, steel and drainage installation well underway. The foundations for the transformers are 50% complete. The oil-water separator holding tanks have been installed and will be connected to the spill containment pits when they have been completed.

3.0 GROUNDWATER AND SURFACE WATER MONITORING PROGRAM

The approved Groundwater and Surface Water Monitoring Program is included in Appendix C along with the approval letter for the program from the MOECC Central Region Director. The Monitoring Program consists of the following main components:

- Installation, development, and hydraulic testing of new groundwater monitoring wells;
- Implementation of a private well monitoring program;
- Surface water and groundwater monitoring; and,
- Annual reporting.

Groundwater and surface water data collected prior to Station construction have been used to define the relationship between the shallow and intermediate groundwater systems within the Project Area. The data also provide a baseline to which monitoring data collected during- and post-construction will be compared to evaluate potential effects of station construction on the natural environment and surrounding private wells. Specifically, the objectives of the Monitoring Program are to:

- Refine our understanding of the geology within the Station Site prior to construction of the Clarington TS;
- Define shallow and intermediate depth hydraulic conductivity of geologic units;
- Document seasonal shallow and intermediate groundwater levels within monitoring wells and private wells, including vertical hydraulic gradients between shallow and intermediate groundwater systems and surface water features within the Project Area;
- Document seasonal groundwater quality of the shallow and intermediate groundwater system within the Project Area; and
- Document the shallow groundwater conditions during planned Station Site grading and drainage activities, including the potential radius of influence and potential for impact to adjacent private wells.

The following sections provide a summary of the specific monitoring requirements, including any changes to the Monitoring Program that have been implemented since the program was approved in June 2014.

3.1 MONITORING WELLS

Monitoring well installations MW1-13 to MW4-13 were completed in the late fall of 2013 (Figure 4). Based on the results of the borehole and monitoring well drilling, four (4) additional monitoring wells were installed in 2014, and were added to the monitoring program. These new wells include MW5-14S/I, located just beyond the southwest corner of the Station Site, and MW6-14 and MW7-14 located along the northeastern boundary of the Project Area (Figure 4). Details of the drilling, monitoring well installation, and hydraulic testing associated with these twelve (12) wells were provided in the Baseline Conditions Report (Stantec, 2014).

Since issuing the Baseline Conditions Report in November 2014, additional monitoring wells were installed in 2014, which included MW5-S(2), MW5-D, and MW5-D(2) as a condition of the municipal resolution to provide a permanent easement for the Clarington TS access road.

In 2015, monitoring well MW4-15D was installed to verify the low groundwater level recorded in MW4-13D, monitoring well MW8-15 was installed to confirm the borehole log results of the geotechnical borehole BH7D, and borehole BH9-15 was drilled to confirm geologic conditions at the location of the Clarington TS planned oil/water separator.

The drilling, monitoring well installation, and hydraulic testing associated with the borehole and monitoring well installations completed since November 2014 have been provided in the Clarington Transformer Station - Addendum 2 Report (Stantec, 2015b), which was submitted to the MOECC and is publicly available on Hydro One's project website. Monitoring well details related to all monitoring installations, are provided in Table 1 of this report.

Project Area groundwater monitoring will continue semi-annually over the course of the station construction period (2014-2017) and the post-construction period (2018-2019).

3.2 WELL DECOMMISSIONING

MW8-15 was a temporary monitoring well installed to confirm hydrogeologic conditions in the vicinity of geotechnical borehole BH7D. It has since been decommissioned in advance of construction of the transformer station foundations. This monitoring well was decommissioned by a licensed well drilling contractor in accordance with the requirements under Ontario Regulation 903 (O. Reg. 903).

3.3 PRIVATE WELL MONITORING

The Private Well Monitoring Program included the completion of door to door visits to property (well) owners within 1,200 m of the Station Site (Figure 3). Details of the initial notification were presented by Stantec in the Baseline Conditions Report (Stantec, 2014). By October 2014, well owner consent was obtained from the owners of 23 private wells (22 well owners). Two additional wells have been added to the program in 2015. Well owner consent has now been obtained from the owners of 25 private wells (24 well owners) as of October 2015.

For private well owners that agreed to participate in the Monitoring Program, the following was completed in 2015:

- For the two (2) new well owners added in 2015, a voluntary well questionnaire to collect any relevant information about the private well; specifically type of well, total depth, water quality and quantity history;
- Automatic pressure transducers were installed within accessible private wells in 2014 and 2015 by a licensed water well contractor to record continuous (hourly) water level measurements.
- Water quality samples were collected semi-annually in 2015 (Spring and Fall); and
- Following each monitoring event, a letter is sent to each of the well owners presenting the results of their individual monitoring. To maintain confidentiality, we have included the results of the private well monitoring in this report but have not included the well identifications.

Private well monitoring will continue semi-annually over the course of the station construction period (2014-2017) and the post-construction period (2018-2019).

3.4 REPORTING

As noted above, the first monitoring report to be prepared under the Monitoring Program was the Pre-Station Construction Groundwater and Surface Water Baseline Conditions Report (Stantec, 2014). The findings of a subsequent assessment of sampling methodology and the role of sediment in water quality results were presented in an Addendum Report (Stantec, 2015a). An Addendum 2 Report (Stantec, 2015b) presents a summary of additional drilling and installation of monitoring wells, hydraulic testing, and soil sampling complete since issuing the Baseline Conditions Report.

This 2015 Annual Monitoring Report presents data collected during the Spring and Fall semi-annual sampling events completed in April and October 2015. This report includes a summary of private well monitoring data collected during these semi-annual monitoring events.

Subsequent annual monitoring reports will be prepared following the annual fall monitoring event during the station construction and post-station construction monitoring period to document potential changes in groundwater and surface water quantity and quality, and to confirm if station construction has adversely affected the groundwater and surface water systems.

4.0 METHODS

The Groundwater and Surface Water Monitoring Program monitoring included the following components in 2015:

- Borehole Drilling;
- Monitoring Well Installation;
- Hydraulic Response Testing;
- Groundwater and Surface Water Level Monitoring; and,
- Groundwater and Surface Water Quality Monitoring.

Methodologies employed during borehole drilling, well installations and hydraulic testing completed following the Baseline Conditions Report (Stantec, 2014) are presented in the Addendum 2 Report (Stantec, 2015b). The following sections present a summary of the study methodology for the water level and water quality monitoring.

4.1 MONITORING WELL INSTALLATION

Since December 2013, a total of seventeen (17) monitoring wells (MW1-13S/D, MW2-13S/D, MW3-13S/D, MW4-13S/D/D(2), MW5-14S(2)/S/I/D/D(2), MW6-14, MW7-14, and temporary well MW8-15 (now decommissioned) were installed at seven (7) locations throughout the Project Area in order improve the understanding of the local geology and hydrogeology prior to construction and to monitor groundwater and surface water during and following construction of the Clarington TS. The monitoring well locations are presented on Figure 4. Well completion details are presented in Table 1.

4.2 DRIVE-POINT PIEZOMETER INSTALLATION

Three (3) drive-point piezometers (DP2-14, DP3-14 and DP4-13) were installed within surface water features in the Project Area to provide an indication of groundwater levels and vertical hydraulic gradients beneath the surface water features. A drive-point piezometer was not installed adjacent to MW1-13 as there is no directly adjacent surface water feature. The drive-point piezometer locations are presented on Figure 4.

In April 2015, Stantec replaced the drive-point at SW2 (DP2-14 replaced by DP2-15), as the initial drive-point was installed at an angle due to difficult ground conditions and it was difficult to obtain accurate water level readings. In April 2015, Stantec also replaced the drive point piezometer at SW3 (DP3-14 replaced by DP3-15), as this monitor was found to be within a dry creek bed in 2014. Installation details are summarized in Table 1.

4.3 GROUNDWATER AND SURFACE WATER LEVEL MONITORING

Groundwater level monitoring was completed using a combination of manual and automated techniques, while surface water level monitoring was completed using manual techniques alone. Monitoring wells and drive-point piezometers were instrumented by Stantec with Solinst® LT Leveloggers® and were set to record at 1-hour intervals. The Leveloggers® are not vented to the atmosphere and therefore record total pressure. As a result, data obtained from the Leveloggers® were corrected for atmospheric pressure to obtain the actual height of water above the sensor. The atmospheric corrections were made using data collected from a Solinst Barologger®, which was located at MW1-13S. For the period of time from December 2013 to May 2014, the Barologger malfunctioned and atmospheric corrections were completed using data from the Oshawa Climate Station.

Manual water level measurements were collected at all wells using a battery operated probe and calibrated tape. Water depths were recorded in metres below the top of the well casing (BTOC). Water level hydrographs for the monitoring wells and surface water drive-point piezometers within the Project Area are presented in Figure 5 through Figure 8.

4.4 GROUNDWATER AND SURFACE WATER QUALITY MONITORING

4.4.1 Surface Water

Surface water quality was monitored at three (3) locations on the Site (SW2, SW3 and SW4) in 2015. Hydro One technicians, under the direction of Stantec staff completed surface water quality sampling within the nearby surface water features including the South Branch of the Tributary of Harmony Creek at SW2 (adjacent to DP2-14), the Tributary of Harmony Creek at SW3 (adjacent to DP3-14), and at a drainage swale located south of the Station Site (SW4). Surface water sampling at SW2 and SW3 was completed in April 2015 and October 2015. Surface water was only present at SW4 (adjacent to DP4-13) at the time of drive-point installation and during the April 2015 monitoring event. This location was dry during all other sampling events.

Surface water samples were collected directly from the creek into laboratory provided sample containers. Samples containers for mercury were field filtered. All other sample bottles were not field filtered. Field measurements of specific conductivity, temperature and pH were recorded using an YSI Quattro Pro, YSI 556 multi-parameter meter or Hanna pH pen, depending on the sampling date. The meters were calibrated prior to use according to the manufacturers' specifications with the appropriate calibration standards. Following sampling, a bottle was filled for field analysis of dissolved oxygen.

All samples collected were packed into sample coolers, which were refrigerated using ice, and delivered to Maxxam Analytics Inc. for laboratory analyses. All surface water samples were analyzed for general inorganic chemistry, total metals, PHCs (F1 to F4) and BTEX compounds. The lab also analyzed for dissolved calcium, magnesium, potassium and sodium as part of ion balance calculations. Chain of custody forms were completed and included with the sample submissions. The results of the surface water quality testing are presented in Table 3 with copies of the Laboratory Certificates of Analysis provided in Appendix E.

4.4.2 Groundwater Monitoring Wells

Hydro One technicians, under the direction of Stantec staff, completed groundwater quality sampling within the shallow and deep monitoring wells within the Project Area. Results of previous water level and water quality monitoring were detailed by Stantec (2014, 2015a, 2015b).

New monitoring wells MW4-15D, MW5-14S(2), MW5-15D, and MW8-15 were sampled in February 2015 along with the existing monitoring well MW5-14I as part of well development. In April and October 2015. All monitoring wells were sampled as part of the semi-annual Monitoring Program, with the exception of MW4-13D, as it was replaced by MW4-15D; and MW8-15 in October 2015, as this well was decommissioned in May 2015.

In April and October 2015, prior to sampling Project Area monitoring wells, (MW1-13S/D, MW2-13S, MW4-13S, MW5-14S MW5-14S(2), MW5-14S, MW5-14D, MW6-14, MW7-14 and MW8-15) pre-purging occurred where between one (1) and three (3) volumes of water were removed using the Waterra™ inertial lift system. Well sampling was completed after pre-purging using GeoTech Bladder Pump for low flow sampling with Teflon-lined, bonded low-density polyethylene (LDPE) tubing using low flow sampling techniques. Where well recovery was extremely low, sampling was completed immediately with no prior purging (MW2-13D, MW3-13S/D, MW4-14S, and MW4-15D, and MW5-14I).

Field measurements of specific conductivity, temperature and pH were recorded using a YSI Quattro Pro meter, YSI 556 multi-parameter meter or Hanna pH pen, depending on the sampling date. These meters were calibrated prior to use according to the manufacturers' specifications with the appropriate calibration standards. Field parameters were monitored during purging and following sampling, a bottle was filled for field analysis of dissolved oxygen.

Following purging, groundwater samples were collected directly from the HDPE tubing, Teflon-lined LDPE tubing, or bailers into the sample containers. Groundwater samples for metals were field filtered and preserved.

All groundwater samples collected were packed into sample coolers, which were refrigerated using ice and delivered to Maxxam for laboratory analyses. Groundwater samples were analyzed for general inorganic chemistry, dissolved metals, PHCs (F1 to F4), BTEX compounds, PCBs, VOCs and SVOCs. Chain of custody forms were completed and included with the sample submissions. The results of the groundwater quality testing at the monitoring wells are presented in Table 4 with a copy of the Laboratory Certificates of Analysis being provided in Appendix E.

4.4.3 Quality Control Protocol

During the 2015 groundwater sampling events, QA/QC sampling was completed and included one or more field duplicates, field blanks and/or trip blanks to evaluate potential sources of error during sample collection. The following QA/QC samples were completed:

- Field Blank for VOCs, SVOCs and BTEX parameters on April 10, 2015; and
- Field Blank and trip blank for VOCs, SVOCs and BTEX parameters on October 7, 2015.

Field duplicate samples for groundwater were also collected at a frequency of one (1) field duplicate per ten (10) samples during each sampling event. For surface water samples, field duplicates were collected during the April and October 2015 sampling events.

Results for all field and trip blanks were below the RDL. The analytical results for the field and trip blanks are included in Table 4.

Maxxam followed internal QA/QC protocols, which included internal replicates, process blanks, process recovery, and matrix spike analyses. A surrogate spike was added for the SVOC analysis to document recovery within lab filtered samples. Maxxam reported that the results for their internal QA/QC were within acceptable limits, and these results were considered acceptable for use in the report. The results of the lab replicates are not presented in Table 1, but included in the detailed laboratory certificates of analyses in Appendix E.

4.5 PRIVATE WELL MONITORING

The following sections present the detail of the 2015 Private Well Monitoring Program completed in April and October 2015.

4.5.1 Water Level Monitoring

Lotowater Technical Services Inc. (Lotowater), a licensed well contractor, completed water level monitoring, Levelogger® installation, and downloading within the private wells. All equipment was disinfected prior to use within any of the private wells.

Construction details for the private wells are presented in Table 2 with private well hydrographs included in Appendix D.

4.5.2 Water Quality Monitoring

The Private Well Monitoring Program was initiated in 2014, with sampling was completed to document conditions prior to and during station construction. Stantec completed semi-annual groundwater quality sampling within the private wells in April 2015 and October 2015.

Stantec attempted to collect water quality samples from a raw water tap; however, this was not always feasible. Based on water quality results, it is concluded that water samples from several locations were collected following treatment by a water softener.

The sample location was typically an outdoor tap or a kitchen faucet, depending on the availability. Prior to sample collection, the tap was disinfected with a dilute bleach solution and allowed to run for approximately 10 minutes or until water quality stabilized. Water samples were collected directly into laboratory supplied containers. The samples were not filtered, and results represent total concentrations.

All private well water samples collected were packed into sample coolers, which were refrigerated using ice packs, and delivered to Maxxam for laboratory analyses. Groundwater samples from private wells were analyzed for bacteriological analyses, general inorganic chemistry, total metals, petroleum hydrocarbons and BTEX compounds, PCBs, VOCs and SVOCs. Chain of custody forms were completed and included with the samples.

The results of the groundwater quality testing at the private wells are presented in Table 5 with a copy of the Laboratory Certificates of Analysis being provided in Appendix E.

Maxxam followed internal QA/QC protocols, which included internal replicates, process blanks, process recovery, and matrix spike analyses. Maxxam reported that the results for their internal QA/QC were within acceptable limits, and these results were considered acceptable for use in the report. The results of the lab replicates are not presented in Table 5, but included in the detailed laboratory certificates of analyses in Appendix E.

5.0 RESULTS

The following sections present the results of the Groundwater and Surface Water Monitoring Program based on data collected from 2015 semi-annual monitoring as part of the approved program.

5.1 LOCAL HYDROGEOLOGY

Groundwater and surface water level monitoring was completed within the Project Area from October 2014 to October 2015 as part of the Monitoring Program documenting groundwater level elevation and groundwater quality prior to and during construction of the Clarington TS. The groundwater elevation data consist of water level measurements from three (3) drive-point piezometers, sixteen (16) monitoring wells, and twenty-three (23) available private wells (2 private well were inaccessible) as presented on Figure 4. The following sections detail the groundwater level analyses, groundwater flow, and hydraulic gradient calculations within the Project Area.

Groundwater hydrographs presenting water levels from monitoring wells are shown on Figure 5 through Figure 8. Shallow groundwater elevations are presented along with interpreted groundwater contour lines on Figure 9, with Thorncliffe depth well water level elevations shown on Figure 10.

5.1.1 Shallow Groundwater Level Monitoring

5.1.1.1 Shallow Monitoring Wells

Shallow groundwater level elevations within the Project Area have been obtained from the date of well completion through to Fall 2015 from groundwater monitoring wells installed within the Upper Aquifer/Aquitard (MW1-13S, MW2-13S, MW3-13S, MW4-13S, MW5-14S, MW6-14, and MW7-14).

Overall, water level elevations were observed to increase in all shallow monitoring wells in the Spring of 2015, rising to near ground surface in response to snow melt and increased precipitation (Figures 5 to7). Water level were also observed to decrease in all shallow wells during periods of minimal precipitation (late April and May), and increase following periods of more precipitation (late May and June), decreasing again in the late summer / early fall. These shallow groundwater conditions are consistent with the fluctuations observed at shallow private wells located upgradient of the Project Area, which are further discussed in Section 5.1.4. The recorded water level fluctuations indicate the monitoring wells have responded to normal seasonal changes, consistent with the findings presented in the Baseline Conditions Report (Stantec, 2014).

The following discussion reflects shallow groundwater level elevation observations recorded in 2015 and compares them with comparable observations from October 2014. An average water level elevation from data recorded within each individual well over a two to ten day period was used for the purpose of evaluating changes in water level elevations between October 2014 and October 2015. The average values for October 2014 monitoring used in this comparison differed slightly from the data presented in the Baseline Condition Report (Stantec, 2014), as several of these wells had just been installed, and seasonal normal trends had not yet been established at the time the report was issued.

Shallow Well Hydrographs

Shallow monitoring wells MW1-13S, MW6-14, and MW7-14 are located approximately 20 m upgradient of the graded slope on the east side of the Station Site, and showed similar responses to seasonal changes and precipitation with each other due to their proximity and that they are screened to similar depths within silty sand to sandy silt till. These monitoring wells showed the greatest change in shallow water level elevation in 2015 as compared to 2014; lowering 1.9 m, 1.3 m, and 1.4 m in MW1-13S, MW6-14, and MW7-14, respectively (Figure 5).

Given the proximity of these shallow monitoring wells to the side of the graded slope, a greater localized lowering of the water level within these wells was anticipated as grading of the Station Site progressed during construction. These levels continue to be monitored during Station construction, with monthly reporting to the MOECC.

Temporary monitoring well MW8-15 was installed at the location of former geotechnical borehole BH7D to confirm the geologic material encountered at that location. The installed temporary monitoring well showed a similar response to the spring snow melt as shallow wells MW1-13S, MW6-14, and MW6-17, before being decommissioned in April 2015.

MW2-13S is located on the north side of the Station Site, within Wetland Area 1 and beside the South Branch of the Tributary of Harmony Creek. Shallow water level elevations recorded within this monitor remained close to ground surface for most of 2015, fluctuating less than 1 m over the course of the entire year. Very little change in water level elevation was recorded (0.06 m increase) from October 2014 to October 2015 (Figure 6).

MW3-13S is located west of the Station Site and on the top of the eastern bank of the Tributary of Harmony Creek. MW4-13S is located south of the Station Site in a drainage swale that has intermittent flow during spring snow melt and periods of significant precipitation, but is otherwise dry for most of the year. Both MW3-13S and MW4-13S responded similarly to seasonal changes and precipitation, with a maximum fluctuation in 2015 of 2.3 m and 2.1 m, respectively. MW3-13S and MW4-13S had October 2015 water level elevation changes with respect to October 2014 of 0.1 m (increase) and -0.3 m (decrease), respectively (Figure 6).

Shallow monitoring wells MW5-14S and MW5-14S(2) are installed immediately adjacent to the southwest corner of the Station Site. Shallow water level elevations in these two wells responded similarly to other shallow wells installed across the Project Area since their installation in late 2014 and early 2015, respectively. Typical seasonal responses were recorded, with lower water level elevations recorded in the winter months, followed by normal seasonal increases (maximum fluctuation of 1.4 m and 1.2 m, respectively) in response to spring snow melt and decreases during periods of reduced precipitation.

Shallow Well Hydraulic Gradients

Recorded water level elevations from pairs of shallow and intermediate or deep wells were used to calculate vertical hydraulic gradients at monitoring well locations MW1, MW2, MW3, MW4, and MW5. At MW1-13S/D, MW2-13S/D, and MW5-14S(2)/S, predominantly weak downward vertical hydraulic gradients were calculated in October 2015, ranging from 0.03 to 0.05 m/m. The deeper wells at MW3 and MW4 are all installed within a dense till, slowing the well's recovery following installation and subsequent sampling events. As a result, the calculated downward vertical hydraulic gradients at MW3-13S/D and MW4-14S/D in October 2015 were inherently greater at 2.4 m/m and 1.1 m/m, respectively than what would be expected once the water level elevations in these deeper wells recovers to their static level. The difference in recorded water levels in both deeper wells, MW5-14I and MW5-14D, in conjunction with the stratigraphic model understanding for the Site indicates these wells have little to no direct hydraulic connection.

The overall downward hydraulic gradients observed within shallow wells across the Project Area in 2015 are consistent with those presented in the Baseline Conditions Report (Stantec, 2014). The hydraulic gradients in all wells will continue to be monitored as the construction of the Clarington TS progresses.

5.1.2 Groundwater / Surface Water Interaction

Drive-point piezometers were installed at three (3) locations throughout the Project Area to evaluate groundwater / surface water interaction in the immediate vicinity of the surface water features associated with the Tributary of Harmony Creek. Observations at each location are discussed below with respect to the groundwater contours.

5.1.2.1 Tributary of Harmony Creek

Drive-point piezometers were installed at surface water monitoring locations within the South Branch of the Tributary to Harmony Creek at SW2, and within the Tributary to Harmony Creek at SW3 (Figure4). Hydrographs for DP2 and DP3 are presented on Figure 8.

Within Wetland Area 1 at SW2, groundwater level elevations recorded in drive-point DP2-14 did not show a clear response to precipitation events and were consistently lower than the surface water level elevations (Figure 8) indicating downward vertical hydraulic gradients and groundwater recharge conditions.

Stantec (2014) indicated that a possible explanation for the slow response in DP2-14 was that during installation, there was smearing of the fine material within the well screen at this location and recommended further monitoring and replacement, if necessary. DP2-14 was replaced in April 2015 with DP2-15, which showed higher groundwater elevations. Minimal seasonal or precipitation impacts may be noted at DP2-15. This drive point piezometer will continue to be monitored, noting its responses to seasonal changes and precipitation events. The downward hydraulic gradients observed at DP2-14 suggest that the South Branch of the Tributary of Harmony Creek and Wetland Area 1 are predominantly supported by surface water runoff.

Within the Tributary of Harmony Creek at SW3, groundwater level elevations recorded in the drive-point piezometer DP3-14 did not show a clear response to snow melt and precipitation events and was found to be below the manually recorded surface water elevation, indicating a predominantly downward hydraulic gradient throughout most of 2015. It is noted that the minimal response to precipitation at DP3-14 may be due to smearing of the fine material within the well screen at this location, as noted at DP2-14. A replacement drive point piezometer, DP3-15, was installed in April 2015 in an attempt to confirm the observed water levels.

Water level elevations recorded in the newly replaced DP2-15 and DP3-15 are very close to ground surface, suggesting that it is possible for groundwater discharge to occur seasonally when the shallow groundwater table approaches the elevation of water in the creek.

5.1.2.2 Drainage Swale

A drive-point piezometer was installed within a mapped drainage swale to the south of the Project Area at SW4. At the time of installation in December 2013, there was some surface water drainage noted due to recent snow melt; however, surface water was not present at this location during further field visits in 2014. In 2015, surface water was only present in April, but not in October. The groundwater level elevation at DP4-14 remained consistently below ground surface and responds quickly to precipitation events, indicating the drainage swale receives surface water runoff during Spring snow melt and precipitation events (Figure 8) and is an area of groundwater recharge.

Site observations and recorded water level elevations at nearby drive-points and monitoring wells indicated that Harmony Creek tributaries were supported primarily by surface water runoff. Shallow water levels recorded within the surficial silty sand and the upper portion of the weathered till indicated predominantly downward vertical hydraulic gradient with the potential for short term seasonal upward vertical hydraulic gradients occurring within the low lying valley associated with the tributary of Harmony Creek on the west side of the Project Area. Due to the limited thickness and discontinuous nature of the surficial silty sand and low permeability of the underlying weathered till, limited groundwater discharge occurs in surface water features within the Project Area to sustain consistent baseflow conditions. This is consistent with the findings presented in the Baseline Conditions Report (Stantec, 2014).

5.1.3 Shallow Private Wells

Shallow groundwater level data were also available from nearby private wells installed at depths of less than 16 m BGS. These wells are interpreted to be screened within thin sand layers within the surficial sand or the underlying weathered to compact Newmarket Till. Water level data from the shallow private wells show effects due to pumping of the well, which was characterized by rapid, regular drawdown and recovery that ranged from 0.2 m up to 1.0 m (Appendix D). The extent of water level fluctuation recorded in 2015 was generally consistent with that recorded in 2014 within each individual well, and available data did not suggest any change in well performance over the monitoring period. At private wells installed to depths of less than 10 m BGS, precipitation effects were more clearly evident, similar to what was observed within the shallow monitoring wells within the Project Area.

5.1.4 Shallow Groundwater Flow

Shallow groundwater level elevations and available surface water levels within the Project Area are presented on Figure 9. Water level data are presented for October, 2015, (an average of October 1 to 2, 2015 elevation data).

Within the Station Site, shallow groundwater flows to the west and southwest towards the tributary of Harmony Creek and its associated branches. East of the Station Site, a shallow groundwater divide shown as a dashed line on Figure 9 extends from north to south, dividing shallow groundwater lateral flow between the Harmony Creek and the Farewell Creek sub-watersheds.

The change in water level elevations within Project Area monitoring wells from October 2014 to October 2015 varies from increases observed at MW2-13S and MW3-13S of 0.1 m each, to water levels decreases at MW1-13S, MW6-14, MW7-14, MW4-13S, and MW5-14S of 1.3 m, 1.4 m, 1.4 m, 0.7 m, and 0.7 m, respectively. As noted above, given the proximity of MW1, MW6, and MW7 to the side of the graded slope, a greater localized lowering of the water level within these wells was anticipated as grading of the Station Site progressed during construction, and will continue to be monitored closely as part of the PTTW obtained by Hydro One.

Water levels recorded in shallow private wells closest to the Project Area are located within the Farewell Creek watershed (Figure9) and indicate a general lowering of the water level of 0.2 m to 0.4 m, with the exception of one well (not closest to the Station Site) that recorded a lowering of 1.9 m from the previous year.

Shallow private wells within Harmony Creek watershed and located upgradient of the Project Area recorded a lowering of water levels between 0.9 m and 1.7 m in October 2015 as compared to October 2014, indicating there was a general reduction of water levels within shallow wells in the area due to normal seasonal and climate effects.

Based on the shallow groundwater contours and surface water features, the area downgradient of the Station Site is shaded in light blue. Monitoring wells at MW2-13, MW3-13, MW4-13, and MW5-14 are well positioned to serve as downgradient shallow groundwater monitoring wells for the Station Area. Notably, there are no shallow private wells located downgradient of the Station Area, with only one deep private well located downgradient (Figure 9).

All shallow private wells in the vicinity of the Clarington TS participating in the Private Well Monitoring Program are located in the Farewell Creek Watershed, with the exception of two (2) well located north and upgradient of the Station Site. At the eastern extent of the Project Area, groundwater flow within the Farewell Creek Sub-watershed is to the southeast toward Farewell Creek and is consistent with the overall ground surface topography.

The horizontal hydraulic gradients across the Station Site calculated from water elevations recorded in October, 2015 are 0.028 m/m (MW6 to MW2-13S), 0.025 m/m (MW1-13S to MW3-13S), and 0.047 m/m (MW7-14 to MW4S-13), and remain consistent with horizontal hydraulic gradients measured in 2014, which ranged from 0.03 m/m to 0.05 m/m.

5.1.5 Thorncliffe Aquifer

In December 2014, monitoring well MW5-14I and MW5-14 D were added to the Monitoring Program, allowing for water levels within the Newmarket Till (MW5-14I) and a deeper sandy aquifer unit within a transition between the Newmarket Till and the Thorncliffe Aquifer (MW5-14D) to be monitored. In addition, a number of nearby private wells are interpreted to be installed within the Thorncliffe Aquifer (Figure 10). Continuous water level data were obtained at nine (9) nearby private wells completed at a depth greater than 50 m.

Water level elevation data from the deep private wells typically indicated effects due to operation of the private well pump, which was characterized by rapid, regular drawdown and recovery (Appendix D). Effects due to pumping were more clearly visible in these drilled wells due to the smaller well diameter as compared to shallow dug wells. Fluctuations due to private well pumping within the deep wells ranged from approximately 0.5 m up to 14 m (Appendix D). The extent of water level fluctuation due to well pumping was generally consistent within each deeper private well over the monitoring period, and available data did not suggest any change in well performance since monitoring began.

Static groundwater levels within the Thorncliffe Aquifer through the Project Area are presented on Figure 10. Average water level data are presented for October 1 to 2, 2015 following a period of minimal precipitation, to remove significant effects due to pumping. Groundwater levels range from 208.1 m AMSL to 214.2 m AMSL with an overall southerly groundwater flow direction consistent with monitoring results from 2014 and consistent with regional mapping that indicates groundwater flow to the southeast across the Project Area as noted by CLOCA (2012).

A downward vertical hydraulic gradient is interpreted from water level elevations recorded in the surficial sand and weathered till units within the proposed Project Area to the underlying Thorncliffe Aquifer. Assuming a shallow groundwater level of 249.7 m AMSL within the Station Site in the vicinity of MW5-14S (Figure 9) and a groundwater level of 212.3 m AMSL from MW5-14D (Figure 10); the difference in recorded water levels in these monitoring wells, in conjunction with the stratigraphic model understanding for the Site, indicates these wells have little to no direct hydraulic connection.

5.2 GROUNDWATER AND SURFACE WATER QUALITY

As part of the Monitoring Program, water quality monitoring has been completed within surface water and groundwater monitoring wells from the Project Area since December 2013. In 2015, water quality was monitored semi-annually in April and October. Private water wells were also sampled in April and October 2015. Surface water quality data are presented in Table 3, with groundwater quality data from Project Area monitoring wells presented in Table 4, and water quality data from the private wells in Table 5. To maintain confidentiality for the private well results, we have removed the well identification in Table 5. Laboratory certificates of analysis for all water quality sampling are included in Appendix E. The following section presents a review of the available water quality data.

5.2.1 Surface Water Quality

Surface water quality data are presented in Table 3 with results compared to Provincial Water Quality Objectives (PWQO), which are the applicable regulatory criteria for surface water within the Project Area. Water quality results are discussed below for each monitoring location and are presented in Table 3.

The South Branch of the Tributary of Harmony Creek flows through Wetland Area 1, and is approximately 0.2 m wide at SW2. During the field visits, surface water was consistently noted at SW2 (adjacent to DP2-14/DP2-15), ranging in depth from 0.01 m in April to 0.16 m in October 2015; however, minimal flow was observed. Due to the limited amount of water present, it is challenging to collect samples without allowing some sediment to enter the bottles. As a result, the sample results for metals are not considered representative of dissolved phase water quality. Water quality at SW2 in 2015 was characterized by:

- The water quality results exceeded the PWQO criteria for iron in April and October 2015, and phosphorous in the April 2015 sample;
- In April 2015, toluene was detected at concentration above the PWQO; however, the October 2015 sample was found to be below detectable limits;
- Low level detection of sodium with no other detection of dissolved metals above PWQO in both April and October 2015 samples; and

- All other parameters were found to be below the PWQO criteria for both rounds of sampling.

The surface water sample at SW3 was collected from the tributary of Harmony Creek along the western Project Area boundary. At this location, the creek ranged from 0.5 to 1.0 m in width, with the actual channel being approximately 1.5 m wide. Surface water was flowing at SW3 during the two (2) sampling rounds in 2015, with a creek depth ranging from 0.45 in April to 0.06 m in October. Water quality at SW3 in 2015 was characterized by:

- Both samples from April and October were found to have all tested parameters below the PWQO at SW3;
- Low level detection of sodium with no other detection of dissolved metals above PWQO in both April and October 2015 samples; and
- No detection of PHC or BTEX compounds in both rounds of sampling in 2015.

Surface water was present at SW4 (within surficial drainage swale adjacent to DP4-13) at the time of drive-point installation in 2013; however, it was noted as being dry during all sampling visits in 2014. Surface water was flowing in April 2015 with a surficial drainage depth of 0.04 m, but dry again in October. Water quality at SW4 in April 2015 was characterized by:

- The water quality results exceeded the PWQO criteria for aluminum and phosphorous in April 2015. All other tested parameters were below the PWQO criteria;
- Low level detection of sodium with no other detection of dissolved metals above PWQO in the April 2015 sample; and
- No detection of PHC or BTEX compounds in the April round of sampling in 2015.

The surface water quality monitoring data indicates that water quality is generally characterized by low concentrations of sodium (< 10 mg/L at SW2 and SW3 and 24 mg/L at SW4), chloride (< 25 mg/L at SW2 and SW3 and 48 mg/L at SW4), and nitrate (< 4 mg/L) and all tested parameters generally below the PWQO. The detection of aluminum, iron, and phosphorous above the PWQO is attributed to sediment within the samples.

5.2.2 Monitoring Well Water Quality

Water quality sampling of the groundwater monitoring wells was completed in December 2013; March, May, August, and October 2014. Monitoring wells MW5-14 S/I, MW6-14, and MW7-14 were installed in October 2014, MW5-14 S(2)/D/D(2) in December 2014, and MW4-15 and MW8-15 (temporary) were installed and added to the Monitoring Program in 2015 as part of the adaptive nature of the Monitoring Program. The deep bedrock depth well at MW5-14D(2) was installed as part of an agreement between Hydro One and the Municipality of Clarington, and is not part of the Monitoring Program for the Clarington TS. The following presents the results from semi-annual monitoring in April and October 2015, and these wells will continue to be sampled to further evaluate water quality.

Groundwater quality results from 2013 through 2015 are presented in Table 4 and are compared to the Ontario Drinking Water Quality Standards (ODWQS). For a number of SVOC and VOC there are no criteria in the ODWQS and as a result the results were also compared to applicable criterion under O.Reg. 153/04. Tables 6 and 8 of the Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, dated April 15, 2011 (henceforth the SCS) were selected as the applicable criterion for the Project Area as the Station Site is located within 30 m of tributaries of Harmony Creek, has a shallow groundwater table, and is situated in an area in which groundwater is used as a potable source. Criteria for coarse grained material were used, as more than 33% of material is sand or coarser, even though the matrix is till.

5.2.2.1 Inorganic Water Quality

Groundwater quality from the Project Area monitoring wells in 2015 met the ODWQS maximum acceptable concentration (MAC) for all health related parameters with the exception of nitrate which was detected at MW1-13S (20 mg/L and 17 mg/L in Spring and Fall 2015, respectively); MW5-14S(2) (14 mg/L and 11 mg/L in Spring and Fall 2015, respectively); and MW5-14S (13 mg/L in Spring 2015) above the ODWQS-MAC of 10 mg/L. The elevated nitrate concentrations at these locations are attributed to agricultural fertilizer and consistent with previous results.

The following parameters were detected above the ODWQS aesthetic objective (AO), ODWQS operational guideline (OG) or ODWQS Medical Officer of Health (MOH) guidelines on at least one (1) occasion in 2015:

- Aluminum (100 µg/L OG) within MW5-14I;
- DOC (5 mg/L AO) within MW4-15D and MW5-14D;
- Hardness (80 to 100 mg/L OG) within all monitoring wells;
- Iron (300 µg/L AO) within MW8-15;
- Manganese (50 µg/L AO) within MW2-13S and MW6-14;
- Sodium (20 mg/L MOH) within MW2-13D, MW3-13S/D, MW4-15D, MW5-14I, and MW5-14D;
- Sulphate (500 mg/L AO) within MW3-13D;
- Total Dissolved Solids (TDS) (500 mg/L AO) within MW3-13D and MW4-13S; and,
- Turbidity (5 NTU AO) within all monitoring wells with the exception of MW3-13S.

These detections are generally consistent with 2013/2014 results and do not indicate any significant change in groundwater quality in 2015 through the start of construction of the Clarington TS.

To visually compare 2015 water quality results, October 2015 inorganic water quality data from the monitoring wells are presented as a piper plot on Figure 9. The water quality distribution within the piper plot is consistent with the results from 2014 presented in the Baseline Conditions Report (Stantec, 2014). Results indicated that water quality at MW6-14 and MW7-14 was similar to other shallow monitoring wells, with the water characterized as calcium and magnesium bicarbonate water. The deep monitoring wells indicate greater variation in water quality, primarily due to differences in sulphate and sodium concentrations. Results indicated similar groundwater chemistry at deeper monitoring wells MW4-15D, and MW5-14I.

5.2.2.2 Organic Water Quality

Groundwater samples from the monitoring wells were also analyzed for petroleum hydrocarbons, BTEX compounds, PBCs, VOCs and SVOCs and compared to ODWQS (Table 4). Historically in 2014, benzo(a)pyrene has been detected above the ODWQS. As presented in the Addendum Report (Stantec, 2015a), this compound adsorbs to soil particles and it was concluded that these detections are associated with the sediment collected within the sample. The Addendum Report recommended that water quality sampling protocols be amended to include low-flow sampling. This sampling protocol was adopted in the 2015 Spring and Fall sampling rounds, resulting in no detections of benzo(a)pyrene in any of the Project Area monitoring wells.

Certain other VOCs and SVOCs compounds were detected within the monitoring wells in Spring and/or Fall 2015 sampling in low concentrations either below the ODWQS criteria, or there were no applicable ODWQS criteria. The following provides a summary of these parameters and a comparison with respect to the SCS criteria.

Water Quality – Upgradient of Station Site

Monitoring Wells MW1-13S/D, MW6-14 and MW7-14 are located upgradient (East) of the Station Site and indicated the following water quality results for 2015:

- No PCBs were detected within any of the samples;
- No PHCs were detected within any of the samples;
- No phthalate compounds were detected within any of the samples;
- No PAH compounds were detected within any of the samples; and
- No VOC compounds were detected within any of the samples.

Water Quality – North of Station Site

Monitoring Wells MW2-13S/D are located at the northern extent of the Station Site and indicated the following water quality results:

- No PCBs were detected within any of the samples;
- No PHCs were detected within any of the samples; however, BTEX compounds were detected at low levels at MW2-13D on both sampling dates in concentrations below the SCS criteria. Overall, the concentration of BTEX compounds continued to decrease through 2015 sampling from those observed in 2013 and early 2014;
- Low level detection of phthalate compounds within MW2-13D with concentrations remaining below the SCS criteria. Concentrations of phthalate compounds have decreased over the sampling period at MW2-13S/D;
- No PAH compounds were detected within either wells in 2015; and
- No VOC compounds were detected within any of the samples.

Water Quality – Southwest of Station Site

Monitoring Wells MW3-13S/D, MW4-13S, and MW4-15D (replacing MW4-14D) are located downgradient of the Station Site and indicated the following water quality results:

- No PCBs were detected within any of the samples;
- No PHCs or BTEX compounds were detected within any of the samples;
- Low level detection of phthalate compounds within MW3-13D and MW4-15D, with concentrations remaining below the ODWQS and SCS criteria in both the April and October 2015 sampling rounds;
- Low level detections of PAHs within MW4-15D, with concentrations remaining below the ODWQS and SCS criteria in both the April and October 2015 sampling rounds; and
- Low level detections of a VOC compound (trichloromethane) within MW4-15D. The concentration remained below the SCS criteria in the April sample, and was found to be below detectable limits in the October 2015 sample.

Water Quality – Adjacent to Station Site

The four monitoring wells at MW5 (MW5-14S(2)/S/I/D are located immediately on the southwest side of the Station Site and generally central to the Project Area. Water quality results indicated the following water quality results:

- No PCBs were detected within any of the samples;
- No PHCs were detected in any of the wells; however, BTEX compounds were detected at low levels within MW5-14D in concentrations below the SCS criteria;
- Low level detection of phthalate compounds within MW5-14S, MW5-14I and MW5-14D, with concentrations remaining below the ODWQS and SCS criteria in both the April and October 2015 sampling rounds;
- No detection of PAHs within any of the wells; and
- Low level detections of a VOC compound (trichloromethane) within MW5-14D. The concentration remained below the SCS criteria in the February 2015 sample, and was found to be below detectable limits in the April and October 2015 samples.

Summary

The organic water quality results for on-site monitoring wells continued to show a general decrease in detections and concentrations. The 2015 results did not indicate any exceedances of the ODWQS or SCS criteria.

5.2.3 Private Well Water Quality

Water quality monitoring was completed at private wells participating in the Monitoring Program in April and October 2015. During sample collection, Stantec attempted to collect a raw water quality (untreated) sample at each residence; however, based on discussions with well owners and water quality results, it is evident that treated samples were collected at select locations. Water quality results are presented in Table 5 and compared to the ODWQS, which are the applicable criterion for drinking water in Ontario. For privacy reasons, sample identifications are not given and the samples are labeled based on aquifer unit and either raw or treated, as appropriate.

Following receipt of the water quality results, Stantec notified individual well owners of any health related exceedances within their water sample. A follow-up letter was provided to each well owner following each monitoring event detailing the full water quality results. The sections below summarize key raw water quality characteristics only.

5.2.3.1 Bacteriological Water Quality

Water quality trends for shallow private wells that were installed to a maximum depth of 16 m BGS indicated that 11 of the 15 wells (73%) sampled during the April and October 2015 rounds had total coliforms present on at least one occasion. E. Coli was detected in five (5) of 15 wells (33%) on at least one occasion in 2015. Comparatively, total coliforms were detected in 83% of shallow wells in 2014, with E. Coli. detected in 25% of shallow wells.

Of the ten (10) drilled wells completed at depths below 50 m BGS, only one (1) well (10%) had detections of total coliform in 2015. E.coli was not detected in any of the samples collected in 2015. These results are consistent with results from 2014, when only one deep private well was found to have total coliforms and there were no detections of E.coli.

A greater number of total coliform detections were noted within shallow dug wells when compared to drilled wells completed at depths greater than 50 m. The total coliform and E.coli detections within the shallows dug wells are interpreted to be related to local sources associated agricultural activities (fertilizer, manure storage, and animal feedlots), septic systems, or potential surface influences. All residents were notified by phone of the bacteriological results and directed to follow any recommendations from the Durham Region Health Unit regarding water and well treatment, follow-up sampling, and well maintenance.

Of note, some laboratory bacteriological results were identified as no data due to bacterial overgrowth. This result indicates the target bacterial growth (total coliform and E. Coli) on the laboratory petri plate could not be counted due to excessive growth of either non-target bacteria (NDOGN), or excessive growth of the target bacteria, E. Coli. or total coliforms (NDOGT), thereby preventing the target bacteria cultures to be counted. Results of NDOGT are considered a positive detection, and NDOGN are considered as a potential positive result. Well owners were notified of these results and directed to follow any recommendation from the Durham Region Health Unit.

5.2.3.2 Inorganic Water Quality

Water quality from the fourteen (14) shallow wells participating in the Monitoring Program did not exceed the ODWQS-MAC for any tested parameter in both the April and October 2015 sampling rounds. Hardness was above the ODWQS-OG in all shallow wells, which is common in groundwater quality from southern Ontario. The following parameters were detected above the ODWQS-AO or ODWQS-MOH on at least one (1) occasion within shallow private wells:

- Sodium exceeded the ODWQS - MOH of 20 mg/L in eleven (11) wells with water quality results from three (3) wells also exceeding ODWQS-AO of 200 mg/L AO, with one of these wells reported as treated by a water softener;
- Chloride exceeded the ODWQS-AO guideline of 250 mg/L in two (2) wells;
- Total Dissolved Solids (TDS) (500 mg/L ODWQS-AO) in six (5) wells with concentrations of up to 1,010 mg/L;
- Dissolved Organic Carbon exceeded the ODWQS-AO of 5 mg/L in one well in April 2015. The same well had a DOC concentration below the ODWQS-AO in October 2015; and
- Aluminum exceeded the ODWQS-OG of 0.1 mg/L in one (1) shallow well.

Water quality for all ten (10) deeper wells completed below 50 m BGS did not exceed the ODWQS-MAC for any tested inorganic parameter in both the April and October 2015 sampling rounds. Hardness was above the ODWQS-OG in the raw water from all deeper wells, which is common in groundwater quality from southern Ontario. The following parameters were detected above the ODWQS-AO or ODWQS-MOH on at least one (1) occasion in 2015 sampling within the deeper private wells:

- Iron exceeded the ODWQS-AO (0.3 mg/L) in eight (8) wells with concentrations up to 2.6 mg/L. Elevated iron is common in Thorncliffe-derived water in many areas in Southern Ontario, including within the Harmony Creek watershed (CLOCA, 2011).
- Turbidity exceeded the ODWQS-AO (5 NTU) in six (6) of 10 deeper wells.
- Sodium was above the ODWQS-MOH guideline in the three (3) deeper wells that corresponded to treated water (softener).

5.2.3.3 Organic Water Quality

Water quality samples from private wells were tested for VOCs, SVOCs, PHCs and PCBs and results compared to ODWQS. A summary of results is detailed below with the data presented in Table 5.

Benzo(a)pyrene exceeded the ODWQS MAC in the sample collected in April 2015 from a well completed below 50 m BGS. Subsequent sampling in October 2015 did not detect the compound. No other VOC or SVOC parameters were detected above the ODWQS in this well on either April or October 2015.

Low level concentrations of trihalomethanes (THMs) including bromoform, bromodichloromethane, dibromochloromethane and chloroform were detected within at least one (1) sample from eleven (11) private wells with the highest concentrations well below the ODWQS-MAC. These compounds are commonly by-product of disinfection and are created by the reaction of chlorine with organic carbon within the groundwater. Discussions with well owners indicated that prior to the October 2015 sampling, at least one (1) well owner had recently disinfected their well to address bacteriological detections.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results presented in this 2015 Groundwater and Surface Monitoring Report, the following conclusions are provided:

- The Groundwater and Surface Water Monitoring Program, initiated in December 2013, and completed through October 2015, allowed for characterization and monitoring of groundwater conditions within the Project Area; including shallow groundwater flow directions; shallow, intermediate, and deep hydraulic gradients, seasonal groundwater levels and groundwater quality monitoring;

- The Monitoring Program continues to monitor surface water and hydrogeologic conditions across the Project Area, and monitors water quality data for private wells within 1,200 m of the Station Site;

- Since issuing the Baseline Conditions Report in November 2014, additional monitoring wells were installed in 2014, which included MW5-14S(2), MW5-14D, and MW5-14D(2) as a condition of the municipal resolution to provide a permanent easement for the Clarington TS access road. In 2015, monitoring well MW4-15D was installed to verify the low groundwater level recorded in MW4-13D, monitoring well MW8-15 was installed to confirm the borehole log results of the geotechnical borehole BH7D, and borehole BH9-15 was drilled to confirm geologic conditions at the location of the Clarington TS planned oil/water separator.

- Groundwater levels within the shallow overburden mimic topography, with shallow groundwater flow within the Station Site are to the west and southwest towards the tributary of Harmony Creek and its associated branches. Monitoring wells at MW2-13, MW3-13, MW4-13, and MW5-14 are well positioned to serve as downgradient shallow groundwater monitoring wells for the Station Area. No shallow private wells are located immediately downgradient of the Station Site, as all shallow wells in the vicinity of the Clarington TS participating in the Private Well Monitoring Program are located in the Farewell Creek Watershed, with the exception of two (2) wells located north and upgradient of the Station Site;

- Downward vertical hydraulic gradients were consistently present within the shallow and deep pairs of monitoring wells within the surficial sand and underlying weathered till;

- Site observations and recorded water level elevations at surface water monitoring locations SW2, SW3, and SW4 and nearby monitoring wells indicate that Harmony Creek tributaries are supported primarily by surface water runoff. Due to the limited thickness and discontinuous nature of the surficial silty sand and low permeability of the underlying weathered till, limited groundwater discharge occurred in surface water features within the Project Area to sustain consistent baseflow conditions and was consistent with the findings presented in the Baseline Conditions Report (Stantec, 2014);

- Groundwater levels from private wells and Project Area wells completed within the Thorncliffe Formation indicate a southerly flow direction consistent with regional mapping;

- The surface water quality monitoring data in 2015 indicates that water quality is generally characterized by low concentrations of sodium, chloride, and nitrate and all parameters generally within the PWQO. Elevated concentrations of aluminum (SW4), iron (SW2), and phosphorous (SW2 and SW4) were detected in at least one (1) sample above the PWQO in 2015. Toluene was detected in one sample (SW2) in April, 2015, but was found to be below detectable limits in October, 2015;

- Groundwater quality from the Project Area monitoring wells were analyzed for general inorganic chemistry, dissolved metals, PHCs (F1 to F4) and BTEX compounds, PCBs, and SVOC and VOC parameters. Groundwater quality met the ODWQS for all health related parameters with the exception of nitrate in three (3) monitoring wells, which is attributed to agricultural fertilizer. Low level detection of phthalate compounds and several PAHs were detected at concentrations well below the SCS. These detections are generally consistent with 2013/2014 results and do not indicate any significant change in groundwater quality in 2015 through the start of construction of the Clarington TS;

- Historically in 2014, benzo(a)pyrene has been detected within some monitoring wells above the ODWQS. As presented in the Addendum Report (Stantec, 2015a), this compound adsorbs to soil particles and it was concluded that these detections are associated with the sediment collected within the sample. Stantec (2015a) recommended that water quality sampling protocols be amended to include low-flow sampling. This sampling protocol was adopted in the 2015 Spring and Fall sampling rounds, resulting in no detections of benzo(a)pyrene in any of the Project Area monitoring wells;

- Private water quality monitoring was completed within the private wells in April and October 2015, with samples collected at each location and submitted for general inorganic chemistry, total metals, PHCs (F1 to F4) and BTEX compounds, PCBs, and SVOC and VOC, and bacteriological water quality. Bacteriological water quality was generally poor within the shallow private wells with 11 of the 15 wells (73%) having total coliforms present and 5 of 15 samples (33%) having E.coli present on at least one occasion. Water quality for wells completed within wells deeper than 50 m had only 1 (10%) detection of total coliform and no detections of E.coli. The total coliform and E.coli detections within the shallow dug wells are interpreted to be related to local sources associated agricultural activities (fertilizer, manure storage, and animal feedlots), septic systems, or potential surface influences;

- Water quality for deeper private wells completed below 50 m BGS met the ODWQS-MAC for all inorganic parameters in 2015 sampling.

- Benzo(a)pyrene exceeded the ODWQS MAC in a sample collected in April 2015 from one (1) deep well. Subsequent sampling in October did not detect the compound. Several VOC compounds were detected within at least one (1) sample from eleven (11) private wells with the highest concentrations well below the ODWQS-MAC. The majority of these compounds are a by-product of disinfection; and

- Water level and water quality monitoring through to October 2015 indicates no adverse effects on the shallow groundwater system or in shallow or deep private wells as a result of Station Site grading and construction of the Clarington TS.

The following recommendations are provided:

- Water level and water quality monitoring should continue semi-annually during station construction and post-station construction, as detailed in the Monitoring Program;

- Sampling procedures for Project Area well should continue with low-flow sampling protocols, as recommended in the Baseline Conditions Report Addendum;

- It is recommended that MW4-14D be removed from the Monitoring Program and decommissioned in accordance with O.Reg.903. The water level was very slow to recover from well development, does not have sufficient water in it to complete sampling for all analytical parameters, and has been replaced by MW4-15D. The need for removing or adding monitoring wells to the Monitoring Program should be reviewed annually; and

- The condition of the drive-point piezometers should be inspected as part of the regular Monitoring Program and upgrades/replacement completed, as necessary.

7.0 REFERENCES

CLOCA, 2011. Black / Harmony / Farewell Creek Watershed Existing Conditions Report, Chapter 14 – Hydrogeology. CLOCA, April 2011.

CLOCA, 2012. Approved Assessment Report, Central Lake Ontario Source Protection Area. Approved January 18, 2012.

exp, 2012. Geotechnical Report – Clarington TS, Municipality of Clarington. Project No. BAR-00025036-AO. exp Services Inc., June 19, 2012.

Gerber, R.E. and K. Howard, 2002. Hydrogeology of the Oak Ridges Moraine aquifer system: implications for protection and management from the Duffins Creek watershed. Can. J. Earth Sci. 39: 1333-1348.

Hydro One, 2014. Class Environmental Assessment Environmental Study Report, Clarington Transformer Station, Report Number 590-CLEA-12-11. Hydro One Networks Inc., January 2014.

Inspec-Sol, 2013. Geotechnical Investigation – Clarington Transformer Station (TS). Report T04077a1. Inspec-Sol Inc., January 23, 2013.

Ministry of Environment (MOE), 2011. Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. Ontario Ministry of the Environment, April 15, 2011. PIBS #7382e01.

Ministry of Natural Resources and Forestry (MNRF) 2006 Digital Elevation Model.

Ontario Geological Survey (OGS), 1991. Bedrock geology of Ontario, southern sheet; Ontario Geological Survey, Map 2544, scale 1: 1 000 000.

Ontario Geological Survey (OGS), 2003. Surficial Geology of Southern Ontario.

Stantec Consulting Ltd. 2014. Clarington Transformer Station Baseline Conditions Report. Prepared for Hydro One Networks Inc., November 2014.

Stantec Consulting Ltd. 2015a. Clarington Transformer Station Baseline Conditions Report Addendum. Prepared for Hydro One Networks Inc., February 2015.

Stantec Consulting Ltd. 2015b. Clarington Transformer Station Baseline Conditions Report Addendum. Prepared for Hydro One Networks Inc., September 2015.