REPORT

REGIONAL MUNICIPALITY OF DURHAM

DURHAM YORK ENERGY CENTRE: 2022 ANNUAL GROUNDWATER AND SURFACE WATER MONITORING REPORT

RWDI #2202597.08

April 21, 2023

SUBMITTED TO

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April 21, 2023

Mr. Andrew Evans
Regional Municipality of Durham
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605 Rossland Road East
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RE: 2022 Annual Groundwater and Surface Water Monitoring Report
Durham York Energy Centre
RFP-528-2016
RWDI Reference No. 2202597.08

Dear Mr. Evans,

RWDI AIR Inc. (RWDI) is pleased to provide this 2022 Annual Groundwater and Surface Water Monitoring Report (GWSW) for the Durham York Energy Centre (DYEC).

The 2022 Annual Groundwater and Surface Water Monitoring Report provides details of the monitoring program completed in 2022 for DYEC and an interpretation of the 2022 monitoring data, including our conclusions and recommendations. Relevant 2022 and historical technical data are appended.

In November 2010, the Ministry of the Environment (MOE) issued the Technical Guidance Document entitled "*Monitoring and Reporting for Waste Disposal Sites, Groundwater and Surface Water"* (MOE, 2010). Appended to this report is a completed Monitoring and Screening Checklist from the above Technical Guidance Document, which provides certification of the Competent Environmental Practitioner (CEP). The Monitoring and Screening Checklist is provided in **Appendix F**.

We trust that this 2022 Annual Groundwater and Surface Water Monitoring Report for DYEC provides sufficient information for your requirements. Should there be any questions or comments, please contact us.

Sincerely,

RWDI AIR Inc.

Khalid Hussein, P.Eng.
Project Manager

KAMH/kta

Attach.

EXECUTIVE SUMMARY

The Regional Municipality of Durham (hereinafter "Region") and The Regional Municipality of York own the Durham York Energy Centre (DYEC), which is in the Municipality of Clarington, Ontario. DYEC is located at municipal address 1835 Energy Drive in Courtice, Ontario (hereinafter the "Site").

DYEC is a thermal treatment energy from waste facility and is approved to process up to 140,000 tonnes of solid, non-hazardous, municipal waste per year. Covanta operates DYEC, which began operation in February 2015 when the first load of waste was received.

Operating requirements for DYEC are governed by the Ministry of Environment, Conservation and Parks (MECP) Environmental Assessment (EA) Notice of Approval (File No. 04-EA-02-08) (hereinafter "EA Approval") and the Multi-Media Environmental Compliance Approval (ECA) Number 7306-8FDKNX, issued on June 28, 2011, and amended to March 14, 2016 (Notice No. 5) (hereinafter "ECA").

The EA Approval, ECA, and the MECP-approved *Groundwater and Surface Water Monitoring Plan*, prepared by Stantec Consulting Ltd. and dated September 14, 2011, outline the groundwater and surface water monitoring and reporting requirements for DYEC. This *2022 Annual Groundwater and Surface Water Monitoring Report* (GWSW) has been prepared in accordance with Condition 20.8 of the EA Approval, Condition 15 of the ECA, and the *Groundwater and Surface Water Monitoring Plan* to provide details of the monitoring program completed in 2022.

With MECP approval via a letter dated May 17, 2016, the routine surface water monitoring program (i.e., placement and monitoring of sondes in Tooley Creek) for DYEC was suspended due to construction activities for the Highway 401/Courtice Road interchange. The MECP approved the suspension of the sondes placement and are holding the surface water monitoring program in abeyance.

Based on the findings presented in this report, the following conclusions are provided.

- Based on the 2022 groundwater elevations, the shallow and deeper groundwater flow direction at the Site was interpreted to be generally toward the southwest.
- Groundwater levels at the location of monitoring well MW1 are interpreted to be influenced by the trunk sewer located less than 10 metres west and adjacent to the western DYEC property boundary. Coarse backfill material that surrounds the 2.1 metre diameter trunk sewer was placed at a greater depth than the bottom of monitoring well MW1. As such, groundwater is interpreted to be induced to move toward the more porous media of the trunk sewer thereby lowering groundwater levels at monitoring well MW1 and indicating a perceived preferential flow direction toward the west.
- Concentrations of chloride and sodium within the groundwater at upgradient monitoring well MW2B and at internal assessment monitoring well MW5B have generally increased since 2014/2015. The onset of the increasing trends appears to coincide with the approximate time of construction of Energy Drive north and west of the Site, as well as the on-site roadways and parking lot. As such, the increasing chloride and sodium concentrations are interpreted to be attributed to the application of de-icing salt during the winter season to Energy Drive, Osborne Road, and/or the on-site roadways/parking lots. It is noted that, although there is an apparent increasing concentration trend for both chloride and sodium within the groundwater at monitoring wells MW2B and MW5B, the 2022 and historical chloride and sodium concentrations at MW2B and MW5B have satisfied their respective Ontario Drinking Water Quality Standards (ODWS) criteria.

- In 2022, the groundwater analytical results for the required parameters of analysis satisfied their respective ODWS, except for the chloride and sodium concentrations within the groundwater at monitoring well MW4. Based on the interpreted groundwater flow direction and the analytical results for chloride and sodium at downgradient monitoring wells in closer proximity to the DYEC facility, there is no indication that the elevated concentrations of chloride within the groundwater at MW4 migrated downgradient as a result of DYEC waste treatment operations. As discussed, the elevated concentrations of chloride detected at MW4 in 2022 are interpreted to be attributed to the seasonal exfiltration of salt-impacted surface water from the East SWMP that is interpreted to more easily migrate through the relatively permeable sandy silt and into the screened interval of monitoring well MW4. The fluctuating/increasing chloride trend appears to have begun around 2016. The increase wasn't noted until nearly two (2) years after DYEC was constructed, which could indicate the residence time it took the salt-impacted surface water to accumulate in the SWMP and subsequently migrate in the subsurface toward MW4. Therefore, no remedial actions are warranted to address the noted chloride concentrations.
- Overall, based on a review of 2022 and historical groundwater analytical results for the Site, the data suggests that DYEC waste treatment operations have not had an adverse effect on groundwater quality at the Site.
- An evaluation of potential road salt application impacts within the groundwater was completed using the method proposed by *Panno et al*. (2005, 2006). Based on the November 2022 groundwater quality results, the Chloride/Bromine (Cl/Br) ratios within the groundwater at monitoring wells MW2B, and MW5B indicates that groundwater quality is alluding toward surface salt application impacts. At MW4 the Cl/Br ratio indicates groundwater quality is affected by surface salt application. Concentrations of chloride and sodium within the groundwater at monitoring locations MW2B, MW4, and MW5B, have been increasing since 2014, which coincides with the construction of Energy Drive north and west of the Site, as well as on-Site roadways and parking lots.
- In 2020, an inspection of monitoring well MW4 determined that the surface seal was in good condition and that its location along the inner downslope of the East SWMP is such that overland runoff from the adjacent roadway cannot directly enter the well. Given the capture area of the East SWMP and its interpreted design as an exfiltration pond, it is interpreted that stormwater entering the East SWMP is impacted by on-site road/parking lot de-icing practices during the winter months. The impacted stormwater is interpreted to exfiltrate into the shallow subsurface, which subsequently migrates downgradient toward MW4, which is screened within a more permeable upper soil unit in comparison to monitoring nest MW3, which are screened within the deeper more impermeable silty clay unit near the southwest pond.
- The routine surface water monitoring program (i.e. placement and monitoring of sondes in Tooley Creek) for DYEC remained in suspension during the 2022 monitoring year as a result of on-going construction activities in the immediate area.

Based on the findings of the 2022 monitoring program, the following recommendations are provided for consideration.

- As on-going construction related activities in the immediate area, outlined in **SECTION 1.2.2.1**, will directly impact the Surface Water Monitoring Program, it is recommended to hold the surface water program in abeyance until construction in the area subsides. An evaluation of the Surface Water Monitoring Program should be undertaken upon the completion of construction related impacts.
- The concentrations of salt-related parameters chloride, sodium, calcium, magnesium, and potassium within the groundwater at the Site should continue to be evaluated on an ongoing basis to confirm effects of roadway and parking lot de-icing practices on groundwater and verify that impacts are not attributed to DYEC waste treatment operations. Part of the ongoing assessment of de-icing influences on groundwater at DYEC would require that the parameter bromide be incorporated into the groundwater quality evaluation parameter suite such that the proposed methodology to assess for road salt impacts in groundwater by *Panno et al*. (2005, 2006) may be utilized.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

The Regional Municipality of Durham (hereinafter "Region") and The Regional Municipality of York own the Durham York Energy Centre (DYEC), which is in the Municipality of Clarington, Ontario. DYEC is a thermal treatment energy from waste facility and is operated by Covanta.

DYEC began operation in February 2015 when the first load of waste was received. DYEC is approved to process up to 140,000 tonnes of solid, non-hazardous, municipal waste per year.

Operating requirements for DYEC are governed by the Ministry of Environment, Conservation and Parks (MECP) Environmental Assessment (EA) Notice of Approval (File No. 04-EA-02-08) (hereinafter "EA Approval") and the Environmental Compliance Approval (ECA) Number 7306-8FDKNX, issued on June 28, 2011, and amended March 14, 2016 (Notice No. 5) (hereinafter "ECA"). The EA Approval, as well as the ECA and its supporting documents, are posted on DYECs' website and can be accessed at the following link: www.durhamyorkwaste.ca. Correspondence with the MECP as it relates to the comments and subsequent responses to comments by RWDI on the *2019 Annual Groundwater and Surface Water Monitoring Report* (RWDI, 2020) are provided in **APPENDIX A-3**, **APPENDIX A**. This 2022 groundwater and surface water (GWSW) monitoring report was prepared in consideration of the MECP comments on the 2019 GWSW monitoring report.

The EA Approval, ECA, and the MECP-approved *Durham-York Energy Centre Groundwater and Surface Water Monitoring Plan*, prepared by Stantec Consulting Ltd. and dated September 14, 2011, outline the groundwater and surface water monitoring and reporting requirements for DYEC. The groundwater and surface water monitoring programs for DYEC are outlined in the *Groundwater and Surface Water Monitoring Plan* (Stantec, 2011). The *Groundwater and Surface Water Monitoring Plan* was prepared in accordance with Condition 20 of the EA Approval and Condition 7(14) of the ECA.

This 2022 GWSW report has been prepared in accordance with Condition 20.8 of the EA Approval, Condition 15 of the ECA, and the *Groundwater and Surface Water Monitoring Plan* to provide details of the monitoring program completed in 2022.

RWDI AIR Inc. (RWDI) was retained by the Region to complete the groundwater monitoring and the 2022 Annual GWSW monitoring report for DYEC. This report is organized in consideration of historical reporting frameworks including, but not limited to, site geologic details, to maintain a level of consistency and provide a familiarity to reviewers whereby historical reports can be easily referenced to this report.

1.1 Location

DYEC is located at municipal address 1835 Energy Drive in Courtice, Ontario (Site). The Site is situated at the southwest corner of the Energy Drive and Osborne Road intersection, southeast of the Courtice Road interchange of Highway 401. The area of the Site is approximately 12.1 hectares.

A Site Location Map that identifies the location of the Site and surrounding area features is provided in **FIGURE 1**. A Site Plan that identifies detailed information of the Site, such as monitoring locations, is provided in **FIGURE 2**.

1.2 Monitoring and Reporting Program Objectives and Requirements

1.2.1 Groundwater Monitoring Objective

The principal objectives of the 2022 monitoring and reporting programs for DYEC are as noted below.

- To evaluate groundwater and surface water quality at and nearby the Site and assess the potential for impacts to nearby water resources as a result of DYEC operations.
- To determine whether remedial actions are required in consideration of monitoring findings.
- To assess the adequacy of the existing monitoring program with respect to evaluating the potential for impacts at nearby water resources.
- To provide a report presenting the findings of the monitoring program to the Region, whereby the report will be provided to the MECP and posted on the DYEC website (www.durhamyorkwaste.ca).

The primary aspects of the environmental monitoring and reporting programs are data collection, analysis, and interpretation. This 2022 GWSW report documents the data collected as part of the 2022 monitoring program and the 2022 data was interpreted in consideration of historical data. In accordance with the *Groundwater and Surface Water Monitoring Plan*, groundwater results from 2022 were compared to the Ontario Drinking Water Quality Standards (ODWS), per the *Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines* (MOE, 2006).

Unprocessed waste is stored indoors in a sealed concrete pit, set 5.5 metres below grade, which precludes leachate from coming into contact with groundwater. Ash is transported to a dedicated storage building with concrete floors using fully enclosed conveyors and is subsequently removed for off-site disposal. The primary means by which groundwater could potentially be affected would be through an upset condition at DYEC. The primary purpose of the groundwater monitoring program is to provide an early warning for potential adverse effects from DYEC operations (Stantec, 2011).

1.2.1.1 Changes to the Groundwater Monitoring Plan

In a letter to the MECP dated January 9, 2019, the Regional Municipalities of Durham and York (hereinafter "Regions") requested a change to the *Groundwater and Surface Water Monitoring Plan* for DYEC. The DYEC facility design includes engineering controls and operating procedures for the protection of groundwater. As historically presented and since 2012, monitoring results to date have demonstrated the effectiveness of the groundwater protection measures and have shown no adverse impacts to groundwater from DYEC waste treatment operations. As such, the Regions requested that the *Groundwater and Surface Water Monitoring Plan* be amended to reduce the required groundwater monitoring frequency from three (3) times per year to once per year, commencing in 2019. Approval to reduce the groundwater monitoring frequency was received on May 7, 2019, which reduces the groundwater monitoring frequency from three (3) times annually to once annually in the fall. A copy of the Regions' request and the MECP's Approval Letter are provided in **APPENDIX A-1**, **APPENDIX A**.

1.2.2 Surface Water Monitoring Objective

DYEC is a Zero Process Water Discharge Facility (Stantec, 2011). DYEC is designed such that there will be no discharge of water from inside the facility buildings other than sanitary sewer discharges from the washrooms. Stormwater drainage from outdoor surfaces, such as rooftops, driveways, and landscaped areas, are collected in two (2) stormwater management ponds (SWMPs). Discharge from the on-site SWMPs is conveyed westward via an existing swale within the CN Rail right-of-way prior to discharging into a small tributary of Tooley Creek approximately 700 m southwest of the Site. The primary purpose of the surface water monitoring program is to monitor the effectiveness of stormwater management controls in mitigating adverse impacts to Tooley Creek receiving waters (Stantec, 2011).

1.2.2.1 Changes to the Surface Water Monitoring Plan

In a letter to the MECP dated April 29, 2016, the Regions requested a change to the *Groundwater and Surface Water Monitoring Plan* for DYEC. The surface water monitoring program outlined in the *Groundwater and Surface Water Monitoring Plan* outlines that sondes are required to be placed in Tooley Creek upstream and downstream of the drainage swale that receives stormwater flow from DYEC to monitor select parameters. The section of Tooley Creek where the sondes should be placed was scheduled for realignment as part of construction by the Ministry of Transportation to improve the Highway 401/Courtice Road interchange. The construction activity and creek re-alignment was anticipated to cause significant disruption and prevent the placement of the sondes in the creek. As such, the Regions requested that the requirement to place the sondes in Tooley Creek be suspended until the interchange construction activities are complete. In a letter response dated May 17, 2016, from the MECP to the Regions, the MECP approved the suspension of the sondes placement and monitoring until the interchange construction activities are completed.

The MECP noted that surface water monitoring completed to-date has indicated that DYEC is not having an adverse effect on Tooley Creek. A copy of the letters from the Regions and the MECP are provided in **APPENDIX A-2**, **APPENDIX A**.

Although the Courtice Road and Highway 401 interchange was completed in 2020, other construction activities in the immediate area have since developed. The construction of a 200,000 square foot battery warehouse located north of DYEC was largely completed in 2021. The Tooley Creek culvert at Highway 401 is being rehabilitated with ongoing repairs. As a result of these other construction related activities, the suspension of the surface water monitoring program will continue for 2023.

1.3 Assumptions and Limitations

Historical data collected by others has been relied upon by RWDI for the purposes of preparing this 2022 GWSW report. RWDI has assumed that the information provided was factual and accurate as presented.

2 PHYSICAL SETTING

2.1 Geology and Hydrogeology

The Site is in the physiographic region defined as the Iroquois Plain (Chapman and Putnam, 1984). Near the Site, the Iroquois Plain is comprised of silty lacustrine deposits and tills. Mapping by the Ontario Geological Survey (OGS) indicates that the Site is underlain by Newmarket Till, which is described as a dense till comprised of clayey silt and sand till (Stantec, 2011). The layer of Newmarket Till is estimated to be between 20 and 25 metres in depth. The Newmarket Till is underlain by an approximately a 5-metre-thick layer of intertill sediment, including both the Thorncliffe and Scarborough formations, which is underlain by the Lindsay Formation shale bedrock.

As part of a geotechnical investigation completed by Jacques Whitford at the Site in 2008, seventeen (17) boreholes were advanced (Stantec, 2011). The boreholes were advanced to depths ranging from 5 to 12 metres below ground surface (mbgs). The subsurface stratigraphy encountered at the boreholes generally included topsoil up to approximately 0.6 metres in depth, which was underlain by dense to very dense silty sand. Bedrock was not encountered during the advancement of the boreholes. As part of a geotechnical investigation conducted on the adjacent Courtice Water Pollution Control Plant (WPCP) property, which is located approximately 75 metres southwest of the Site, bedrock was encountered during borehole drilling at a depth of approximately 16 metres (Stantec, 2011).

Generally, ground surface elevations near the Site gradually decrease from the northeast to southwest towards Lake Ontario, which is located approximately 450 metres south of the Site. Near the Site, ground surface elevations generally range from approximately 95 metres above sea level (mASL) to 102 mASL.

Regionally, shallow groundwater flow near the Site is anticipated to reflect surface topography and generally flow in a northeast to southwest direction towards Lake Ontario. Shallow groundwater flow may be influenced by local features including, but not limited to, Tooley Creek and its tributaries, surface water ponds and ditches, and underground utilities. Deep groundwater flow near the Site is anticipated to reflect bedrock topography and flow in a southerly direction towards Lake Ontario.

2.2 Surface Water Features

The Site is located within the Tooley Creek watershed and is in the Central Lake Ontario Conservation Authority (CLOCA) jurisdiction. On-site surface water features include SWMPs in the southwest (West SWMP) and southeast (East SWMP) corners of the Site. The nearest natural surface water body to the Site is a tributary of Tooley Creek, located approximately 150 metres northwest of the Site. At its nearest point, Tooley Creek is located approximately 700 metres southwest of the Site. The Tooley Creek watershed has an approximate length of five (5) kilometres from its headwaters near Highway 2 to its discharge point at Lake Ontario (Stantec, 2011). Lake Ontario is located approximately 450 metres south of the Site.

3 DESCRIPTION OF MONITORING PROGRAM

The 2022 groundwater and surface water monitoring program for DYEC included groundwater monitoring only. As noted in **Section 1.2.2.1**, the surface water monitoring program for DYEC (i.e., placement and monitoring of sondes in Tooley Creek) was suspended until the Highway 401/Courtice Road interchange construction activities are complete. In 2020, the Courtice Road and Highway 401 interchange was completed, however other construction activities in the immediate area have since developed and the suspension of the surface water monitoring program continued during 2022.

The groundwater monitoring program generally consists of the measurement of groundwater levels and the collection of groundwater samples for the relevant monitoring locations. The required monitoring locations, sampling frequency, and parameters of analysis are outlined in the *Groundwater and Surface Water Monitoring Plan*. Monitoring locations for the Site are shown in **Figure 2**.

3.1 Monitoring Locations

3.1.1 Groundwater

A total of eight (8) groundwater monitoring wells were installed at five (5) monitoring locations at the Site. Construction details for the monitoring wells are presented in **Table B-1**, **Appendix B**. The locations for the monitoring wells are shown in **Figure 2**.

Two (2) monitoring wells, one (1) shallow and one (1) deep, are installed at different depths at locations MW2, MW3, and MW5. The shallow well is designated with the postscript "B" (e.g., MW2B) and the deeper well is designated with the postscript "A" (e.g., MW1A). It is noted that monitoring wells MW3A/B were decommissioned in September 2013 due to infrastructure construction activities in the area. Monitoring wells MW3A/B were replaced in March 2014 in a nearby location and designated as MW3A-R and MW3B-R, respectively.

As further discussed in **Section 4.2**, groundwater elevations have changed as a result of the influence on the groundwater flow due to the presence of the trunk sewer installed to the west of the Site. As a result of the groundwater flow pattern change, the following summary details the monitoring wells' current assigned positions (e.g., downgradient) with respect to the DYEC facility based on the most recent monitoring completed at the Site in November 2022.

- MW1 is located within the northwest corner of the Site and is hydraulically downgradient of DYEC.
- MW2A and MW2B are located within the northeast corner of the Site and are hydraulically upgradient of DYEC.
- MW3A-R and MW3B-R are located within the southwest corner of the Site and are hydraulically downgradient of DYEC.
- MW4 is located within the southeast corner of the Site and is hydraulically downgradient of DYEC.
- MW5A and MW5B are located within the central area of the Site and are internal assessment monitoring wells for DYEC.

Historically, groundwater monitoring location MW1 was noted to be hydraulically upgradient of DYEC. As a result of the trunk sewer installation, which required the relocation of groundwater monitoring location MW3, groundwater monitoring location MW1 is now interpreted as presented above.

3.2 Monitoring Frequency

3.2.1 Groundwater

As noted in **Section 1.2.1.1** the MECP has amended the *Groundwater and Surface Water Monitoring Plan* to reduce the frequency of groundwater monitoring from three (3) times per year to once annually in the fall, beginning with the 2020 monitoring period.

The groundwater monitoring event was conducted between November 9 and 10, 2022, and included the measurement of groundwater levels and collection of groundwater samples at the relevant monitoring locations.

3.3 Field and Laboratory Parameters and Analysis

3.3.1 Groundwater

In 2022, the field parameters temperature, pH, electrical conductivity (EC), and oxidation-reduction potential (ORP) were analyzed and recorded at the time of sample collection for each monitoring well. Collected groundwater samples were submitted to Eurofins Scientific (Eurofins) in Ottawa, Ontario, for analysis of the required parameters noted in the summary below. Eurofins is a Canadian Association for Laboratory Accreditation (CALA) certified environmental laboratory. The required parameters for laboratory analysis are outlined in the *Groundwater and Surface Water Monitoring Plan*.

Parameter Group	Parameters
Major Anions	Carbonate, Bicarbonate, Chloride, Sulphate
Major Cations	Calcium, Magnesium, Potassium, Sodium
Metals	Boron, Cadmium, Cobalt, Lead, Mercury

3.4 Monitoring and Sampling Procedures

3.4.1 Groundwater

3.4.1.1 Groundwater Level Measurements

Groundwater levels were manually measured at the accessible monitoring wells at the Site using an electric contact meter with an accuracy of 10 millimetres. The meter was decontaminated between monitoring wells with an anionic detergent and rinsed with distilled water to mitigate the potential for cross-contamination between sampling/monitoring points.

The groundwater levels measured in 2022 and historically are presented in **Table C-1**, **Appendix C**, and plotted in **Figures C-1** to **C-3**, **Appendix C**. Shallow groundwater flow contours are shown in **Figure 2**.

3.4.1.2 Groundwater Sampling

Groundwater samples were collected using dedicated inertial-lift pumps and tubing. Prior to monitoring well purging, the static groundwater level was measured and the groundwater volume within the well casing was calculated. The monitoring well was then purged with the dedicated inertial-lift pump until three (3) volumes were removed. If a discontinuous flow of groundwater was observed prior to removing three (3) well volumes, the monitoring well was allowed to recover, and then purged for a second and final time until three (3) well volumes had been removed or discontinuous flow was observed.

The monitoring wells were purged on the first day of the monitoring event in 2022. Sampling was completed after the removal of three (3) static volumes of groundwater or following a period of recovery (next day at a minimum) after discontinuous flow was observed for a second time. At the time of sample collection, field indicator parameters temperature, pH, EC, and oxidation reduction potential (ORP) were recorded onto dedicated field forms. The 2022 groundwater field analytical results are presented in **Table D-1**, **Appendix D**.

The groundwater samples were collected directly into bottles provided by the laboratory. Groundwater sample aliquots collected for metals analysis were filtered in the field using 45 micrometres in-line disposable filters.

Collected samples were submitted to Eurofins for analysis. The 2022 groundwater analytical results are summarized in **Table D-2**, **Appendix D**. It is noted that the dates presented in **Tables D-1** and **D-2**, **Appendix D**, represent the actual date of sample collection for the relevant monitoring well. Laboratory Certificates of Analysis are provided in **Appendix E**.

3.5 Quality Assurance and Quality Control for Sampling and Analysis

In accordance with the *Groundwater and Surface Water Monitoring Plan*, one (1) field-prepared duplicate sample was collected during the sample collection procedure for a select monitoring well as a quality assurance and quality control (QA/QC) measure.

The field duplicate samples and their respective original sample collected in 2022 are presented in the summary below.

Monitoring Event	Original Sample ID	Duplicate Sample ID
November 2022	MW2A	GW8000

The selection of the groundwater well for the collection of field duplicates was based on volume availability at the time of sampling, as well as visual observations of colour and turbidity. The methodology used to collect the groundwater samples (inertial lift pumps) would produce turbulent flow through the well screen, increasing particulate in the sample aliquots, which would affect colour and turbidity measurements. As such, for the purposes of QA/QC measures, the groundwater collected should be as transparent and free of suspended particulates as possible to accurately assess the adequacy of laboratory analytical equipment. Where possible, the collection of field duplicates is rotated between sampling wells year-over-year.

4 MONITORING RESULTS AND EVALUATION

4.1 Quality Assurance and Quality Control

QA/QC measures for the groundwater monitoring program completed for DYEC in 2022 included field-prepared duplicate samples, laboratory duplicates, laboratory spiked samples, as well as percent recovery of analysis and data review.

The laboratory analyzed several control samples to verify that their analytical equipment was functioning properly and reporting results accurately at the time of analysis for the samples collected at the Site. The control samples had an expected target value, which was compared against pre-determined data quality objectives. For the laboratory control samples, the results were within acceptable laboratory data quality criteria.

For the field-prepared duplicate samples, the analytical results for the required parameters were evaluated for the relative precent difference (RPD) of parameter concentrations using the applicable performance standards for sampling duplicates noted in Tables 5.1 to 5.15 of the MECP's *Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act*, prepared by the MECP, dated March 8, 2004, and amended on February 19, 2021 (MECP Sampling Protocol). The RPD screening mechanism is such that for concentrations greater than five (5) times the method reporting limit (MRL), a concentration difference of less than or equal to the applicable Required Performance Standard is deemed acceptable. As the measured result approaches the MRL, uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five (5) times the MRL. Where QA/QC RPD screening mechanism is not identified within the MECP Sampling Protocol, the results for the required parameters of analysis are compared to the screening evaluation by the US EPA National Functional Guidelines (US EPA 540-R-20-005/US EPA 540-R-20-006) as a general QA/QC RPD screening mechanism.

4.1.1 Groundwater QA/QC

For the 2022 monitoring event, QA/QC evaluations were completed for the analytical results of the original sample and their respective duplicate sample, as outlined in **Section 3.5**. The analytical results of the original and duplicate sample collected satisfied the QA/QC tolerances.

Therefore, the results of the QA/QC evaluations indicated that the concentrations for the original samples were accurate as presented and acceptable for interpretive purposes.

In summary, acceptable QA/QC data for the field-prepared duplicate sample, laboratory duplicate, laboratory spiked sample, as well as percent recovery of analysis indicated that the detected parameter concentrations were accurate and reflected actual conditions at the time of sample collection.

4.2 Groundwater Levels and Flow

Groundwater levels have been measured in the groundwater monitoring wells at the Site since December 2011. The 2022 and historical groundwater level data are summarized in **Table C-1**, **Appendix C**. Hydrographs of the groundwater elevations at the Site are plotted in **Figures C-1** to **C-3**, **Appendix C**. Monitoring well locations are shown in **Figure 2**. It is noted that for the purposes of comparing groundwater levels and evaluating the groundwater flow direction at the Site, the top of each monitoring well riser pipe has been surveyed to an assumed Site datum.

The groundwater elevations measured at the Site have remained generally consistent since monitoring began at each monitoring well, with exceptions noted below for monitoring wells MW1 and MW4. Overall, the groundwater elevations for each monitoring well have been generally stable or have fluctuated, with no consistent increasing or decreasing trends over time. The fluctuating groundwater elevations are attributed to seasonal effects.

At downgradient monitoring well MW1, the groundwater elevation decreased by more than 5 metres between the July 2013 and April 2014 monitoring events. The decrease in groundwater levels at MW1 is attributed to the installation of a trunk sewer to the west of the Site with construction interpreted to have begun around the same time and extended to 2018. Based on construction drawings obtained from the Region, approximately 11 to 12 metres of the native soil was excavated along the western boundary of the Site. A 2.1 metre diameter trunk sewer was installed and backfilled with 19-millimetre (mm) crusher run limestone from approximately 0.1 metre below the designed depth of the trunk install to at least 0.3 metre above the top of the trunk sewer. As such, there is an interpreted minimum of 2.5 metres of porous media within the trunk sewer trench from approximately 11 mbgs to 8.5 mbgs.

The bottom of the screened interval for MW1 is approximately 7.6 mbgs. Monitoring MW1 is also located approximately 8 to 10 metres laterally from the trunk sewer trench. Consequently, the replacement of native clayey silt to silty clay soil with a more porous stone and sandy backfill material to a depth that is greater than the nearby monitoring well MW1 is expected to induce groundwater to flow towards the trunk sewer trench. Given the proximity of monitoring well MW1 to the trunk sewer coupled with the presence of more porous subsurface conditions surrounding the trunk sewer pipe, groundwater levels at the location of MW1 are expectedly influenced by the presence of the trunk sewer trench. Continued liquid level monitoring at the location of MW1 should be completed to evaluate overall groundwater conditions and determine whether the groundwater within the porous media of the trunk sewer may increase in elevation and eventually stabilize over time.

Between April 2014 and April 2015 following the installation of the trunk sewer, the groundwater elevation at MW1 recovered by approximately 2.6 metres. Since April 2015, the groundwater elevation at MW1 has generally fluctuated, where higher and lower groundwater levels are attributed to prolonged periods of precipitation and lower than average precipitation, respectively. The fluctuating groundwater level trend noted at MW1 suggests that the influence from the nearby trunk sewer is such that historical levels fluctuated seasonally by over 1 metre. Based on the currently approved groundwater monitoring program, seasonal groundwater level monitoring interpretations will refer to historical monitoring findings as groundwater monitoring is completed once annually in the fall.

Groundwater monitoring wells MW3A/A-R and MW3B/B-R also show fluctuating groundwater level trends though at a lesser magnitude compared to levels at monitoring well MW1. This difference in magnitude fluctuation may be due to monitoring well nest MW3 being located at a greater distance (nearly 40 metres) from the trunk sewer trench than MW1 (<10 metres).

At downgradient monitoring well MW4, the groundwater elevation decreased by approximately 2 metres between the March and November 2012 monitoring events. This decrease is interpreted to be attributed to the construction of the East SWMP at that time. Since November 2012, groundwater levels at MW4 have fluctuated and remain slightly higher than the interpreted base elevation of the East SWMP.

The November 2022 liquid level monitoring results showed that most of the groundwater levels measured were near their respective lower limits of their historical level ranges except for monitoring well nest MW3. Seasonal groundwater fluctuations have been observed to occur at the Site whereby groundwater levels are typically greater in elevation during the spring than in the fall. As such, the groundwater condition monitored at the Site moving forward will represent that of typical fall conditions.

Based on the 2022 groundwater elevations, the shallow groundwater flow direction at the Site was interpreted to be generally towards the southwest, though it appeared to flow radially away from the central portion of DYEC. Contour mapping of the shallow groundwater elevations and the interpreted groundwater flow direction, based on the November 2022 groundwater elevations, is presented in **FIGURE 2**. The interpreted groundwater flow regime presented in **FIGURE 2** is consistent with historical observations made for the fall monitoring season. Based on the limited information available, the deeper groundwater flow direction at the Site was also interpreted to be toward the southwest in 2022.

4.2.1 Groundwater Hydraulic Gradients

Each of the monitoring wells at the Site are positioned within overburden material. For the nested groundwater monitoring wells at the Site, the midpoints of the screen intervals for the deeper monitoring wells (MW2A, MW3A-R, and MW5A) are approximately 2.6 to 3.1 metres deeper than the midpoints of the screen intervals for their respective shallow monitoring well counterpart. For the nested monitoring well locations, the historical and 2022 vertical hydraulic gradients were calculated. The calculated vertical hydraulic gradients are summarized in **Table C-2**, **Appendix C**.

The hydraulic gradient at monitoring nest MW2, shows a slight upward hydraulic gradient. The hydraulic gradient at monitoring nest MW3, calculated for the 2022 groundwater elevation, shows a prominently downward gradient between the shallow and deeper monitoring wells. Between the shallow and deeper monitoring wells at monitoring nest MW5, there was a slight downward hydraulic gradient. The vertical gradients in 2022 ranged between - 0.03 metres per metre (upward direction) at MW2 and 0.26 metres per metre in a downward direction at MW3. Vertical hydraulic gradients at the Site have historically been generally downward at monitoring nests MW2 and MW3 with occasional, slightly upward, vertical gradients. At monitoring nest MW5, the vertical hydraulic gradient has historically fluctuated between slightly upward, neutral, and slightly downward.

4.3 Groundwater Quality

The 2022 groundwater field analytical results are tabulated in **Table D-1**, **Appendix D**. The 2022 and historical groundwater laboratory analytical results are tabulated in **Table D-2**, **Appendix D**. Laboratory Certificates of Analysis are provided in **Appendix E**.

4.3.1 Concentration Trends

Concentration vs. time plots for chloride, sodium, sulphate, calcium, magnesium, potassium, boron, and bicarbonate are presented in **Figures D-1** to **D-8**, **Appendix D**, respectively. As shown in **Figures D-1** to **D-8**, the concentrations of each relevant parameter have remained generally stable since monitoring began at each monitoring location, with exceptions noted below.

- As shown in **Figures D-1** and **D-2**, **Appendix D**, the concentrations of parameters chloride and sodium, respectively, within the groundwater at upgradient monitoring well MW2B increased from 2014 to 2018. Chloride concentrations within the groundwater at monitoring well MW2B have decreased in recent years since reaching the historical upper limit concentration in April 2018. The beginning of the increasing trend of chloride and sodium concentrations within the groundwater at MW2B and MW5B coincides with the approximate time of construction of Energy Drive north and west of the Site, as well as the on-site roadways and parking lots. As such, the increasing concentrations of chloride and sodium are interpreted to be attributed to the application of de-icing salt during the winter season. It is noted that the 2022 and historical concentrations of chloride and sodium within the groundwater at MW2B and MW5B have satisfied their respective ODWS aesthetic objectives.

- As shown in **Figure D-1**, **Appendix D** the concentration of the salt-related parameter chloride within the groundwater at downgradient monitoring well MW4 was generally stable since monitoring began until it began increasing in November 2016. Elevated concentrations of chloride have been observed since 2017. As shown in **Figures D-2**, **D-4**, **D-5**, and **D-6**, **Appendix D**, the concentrations of additional salt-related parameters sodium, calcium, magnesium, and potassium, respectively, within the groundwater at monitoring well MW4, were also generally stable until they started increasing in November 2017. For the salt-related parameters, only chloride and sodium have an ODWS aesthetic objective. In November 2022, the concentration of chloride (1130 milligrams per litre (mg/L)) was greater than the ODWS aesthetic objectives of 250 mg/L for chloride. Sodium concentration (444 mg/L) at MW4 was also greater than the ODWS aesthetic objectives of 200 mg/L for sodium.
- The internal assessment and downgradient monitoring locations MW5 and MW3, respectively, are in closer proximity to the DYEC facility than MW4. As shown in **Figures D-1**, **D-2**, **D-4**, **D-5** and **D-6**, **Appendix D**, the concentrations of chloride, sodium, calcium, magnesium, and potassium, have been consistently lower within the groundwater at monitoring nests MW5 and MW3 compared to that of the groundwater at monitoring location MW4. As such, there is no indication that the elevated concentrations of these above-noted parameters detected within MW4 have migrated downgradient within the shallow groundwater.
- In 2022, magnesium and boron concentrations within the groundwater across the site have decreased or remained the same when compared to the 2021 monitoring event, with the exception of magnesium at monitoring well MW4. Historically, magnesium and boron concentrations within the monitoring wells have tended to fluctuate with similar trends, as was the case in 2022.

As requested by the MECP, an evaluation of salt-related parameters within the groundwater was completed using the method proposed by Panno *et al*. (2005, 2006). The method for determining whether groundwater may be impacted by de-icing salts is to calculate the chloride to bromide ratio (Cl/Br ratio) such that ratios that are greater than 1,000 suggest that the groundwater quality is affected by de-icing salts or road salts. For the purposes of the assessment, where a constituent concentration is reported as being lower than its laboratory MRL, half the laboratory MRL value is used to perform the calculation.

Based on the November 2022 groundwater quality results, the Cl/Br ratios within the groundwater at monitoring wells MW2B and MW5B were noted to be less than 1,000. However, calculations indicate that groundwater quality, as it relates to de-icing salt impacts, is approaching a Cl/Br ratio of 1,000; suggesting that surface salt application may be impacting these monitoring locations. Moreover, the Cl/Br ratio calculated for monitoring well MW4 was well over 1,000 indicating that the groundwater quality is affected by de-icing salts or road salts. The Cl/Br ratios are presented below.

- MW2B: –> Cl/Br Ratio = 832
- MW4: –> Cl/Br Ratio = 9040
- MW5B: –> Cl/Br Ratio = 632

Concentrations of chloride and sodium within the groundwater at monitoring locations MW2B, MW4, and MW5B, have increased since 2014, which coincides with the construction of Energy Drive north and west of the Site, as well as on-Site roadways and parking lots. Groundwater conditions at monitoring locations MW2B, MW4, and MW5B will continue to be monitored to assess for potential sources that may be contributing to the increase in chloride and sodium concentrations within the groundwater.

In summary, since groundwater monitoring began at the Site in 2011, concentrations of most required parameters of analysis in the shallow and deeper groundwater monitoring wells have generally fluctuated or been stable with no apparent increasing or decreasing trend, exclusive of those trends outlined above. The concentrations of mineral parameters chloride, sodium, calcium, magnesium, and potassium detected within the groundwater, each cross gradient and downgradient of DYEC, are not attributable to DYEC waste treatment operations, but rather are related to de-icing salt application to Energy Drive, Osborne Road, the nearby off-site roadway to the Courtice WPCP, and/or the on-site roadways/parking lots.

It is noted that elevated chloride concentrations, as well as the concentrations of the other salt-related parameters sodium, calcium, potassium and magnesium, are commonly elevated in groundwater where a monitoring well is situated near roads or parking lots that are surface treated with brine or salt for dust control or de-icing. It is expected that the concentrations of the salt-related parameters will continue to fluctuate and/or increase over time with the continued practice of roadway and/or parking lot de-icing. As only salt-related parameters show elevated concentrations compared to concentrations for metal parameters within the groundwater, no remedial action is warranted to address the noted concentrations for the salt-related parameters.

4.3.2 Monitoring Well Condition Assessment at MW4

Based on a recommendation in the 2018 GWSW report, monitoring well MW4 was inspected with a down-well closed-circuit television (CCTV) camera on September 12, 2019, to visually assess the integrity of the monitoring well and to determine if the monitoring well installation may be compromised such that surface water infiltration could be occurring. A visual inspection of the above-grade portion of MW4 was completed as part of the inspection. Based on the visual inspection, the riser pipe, steel protective casing, and surface seal appeared competent. There were no indications of surface depressions or surface seal cracks that could otherwise contribute to surface water infiltration into the well. Based on the CCTV camera inspection, no visible compromises or damage was observed within the inspected interval of the monitoring well riser pipe and screened interval. Liquid was not observed to enter the well through the pipe joint at the time of the CCTV camera inspection. Overall, MW4 appeared to be competent and constructed according to O. Reg. 903. As such, there was no indication that the rapid increase of concentrations of salt-related parameters within the groundwater at MW4 was due to stormwater runoff influenced by de-icing salt directly entering the well casing from surface as previously interpreted.

Monitoring well MW4 is located along the inside downslope of the East SWMP. Since the construction of the East SWMP, the groundwater elevations at MW4 have been interpreted to be near the base elevation of the East SWMP. As such, the surface water elevation within the East SWMP is interpreted to be higher than the groundwater elevation at MW4. Based on the interpreted shallow groundwater flow direction at the Site and the position of MW4 in relation to the East SWMP, it is interpreted that MW4 would be cross-gradient to downgradient of shallow groundwater flow from a portion of the East SWMP.

The East SWMP receives stormwater runoff from on-site drainage ditches. It is interpreted that runoff that is impacted by de-icing practices during the winter months enters the East SWMP whereby it will, by design, exfiltrate into the shallow subsurface and subsequently migrate to monitoring well MW4.

To elaborate on the above-noted observations, and to re-iterate the response to the MECPs comments on the 2019 GWSW report (see **APPENDIX A-3**), salt-related impacts were not observed within the groundwater at monitoring locations MW3A and MW3B based on a few key differences between their construction, as summarized below.

Monitoring Well	Well Depth (mbgs)	Well Depth (mBTOP)	Stick up (m)	Screened Unit
MW4	3.8	4.8	1.0	Sandy Silt Till
MW3A-R	8.9	9.9	1.0	Clayey Till
MW3B-R	6.3	7.3	1.0	Clayey Till

Notes: mbgs denotes metres below ground surface; mBTOP denotes meters below top of pipe; m denotes metres.

As noted in the above summary, not only are the monitoring well depths of both MW3 monitoring wells deeper below surface in comparison to that of MW4, they are also screened within a lower, finer-grained stratigraphic unit than that of MW4. As such, the groundwater within MW3A-R and MW3B-R is less subject to surface water infiltration effects than the overlaying more permeable stratigraphic unit.

Future groundwater quality monitoring findings at monitoring well nest MW3 will be interpreted for any emerging chemical trends with focus on salt-related impacts due to asphaltic surface treatment at the Site.

4.3.3 Spatial Variability in Groundwater Quality

As requested by the MECP, Piper plots were prepared to evaluate the overall water chemistry for groundwater at the Site. Piper plots prepared using the November 2022 groundwater quality results are presented in **FIGURE D-9**, **APPENDIX D**.

Overall, the groundwater quality monitored at the Site in 2022 appeared to cluster into two water types: 'magnesium bicarbonate enriched' groundwater and 'mixed type' groundwater. Groundwater collected from monitoring wells MW2B, MW3A, and MW5B, slightly border on the 'magnesium bicarbonate enriched' groundwater, but plot into the 'mixed type' groundwater. Groundwater from monitoring locations MW1, MW2A, MW3B, and MW5A plot within the 'magnesium bicarbonate enriched' groundwater. For groundwater at monitoring location MW4, the chemical constituent distribution plots is close to the border of the 'sodium chloride type', however is plotted within the 'mixed type' groundwater.

Groundwater collected from shallow groundwater monitoring wells typically displayed greater spatial variability, where on-site groundwater data from monitoring wells MW1, MW2A, and MW5B, displayed mixing of magnesium bicarbonate and calcium chloride enriched groundwater. At downgradient monitoring well MW3B-R, the groundwater favoured a more magnesium bicarbonate enriched type of groundwater.

There was more significant temporal variability in water quality for groundwater at the location of shallow groundwater monitoring well MW4 than other monitoring wells at the Site. Groundwater quality noted for the April 2019 monitoring event favoured a more 'magnesium bicarbonate enriched' type of groundwater compared to a 'mixed type' type of groundwater for subsequent monitoring events. This is likely attributed to seasonal flushing cycles within the well of highly mobile cations from the soil and unsaturated zone (Wallick, *et. al.* 1984).

4.4 Regulatory Criteria

In accordance with the *Groundwater and Surface Water Monitoring Plan* for DYEC, groundwater quality at the Site is required to be evaluated by comparing the groundwater quality data to the respective criteria provided in the *Technical Support Document for Ontario Drinking Water, Standards, Objectives, and Guidelines* (MOE, 2006). These standards are collectively referred to as the ODWS. For the required parameters of analysis, their respective ODWS are presented in **Table D-2**, **Appendix D**.

It is noted that the aesthetic objective for sodium is 200 milligrams per litre (mg/L). However, as indicated in the ODWS (MOE, 2006), the local Medical Officer of Health should be notified when the sodium concentration (in drinking water) exceeds 20 mg/L so that this information may be communicated to local physicians for their use in notifying patients on sodium restricted diets. Groundwater is not used as a drinking water source at or downgradient of DYEC and therefore, the aesthetic objective of 200 mg/L for sodium is deemed appropriate to assess the overall groundwater quality.

For the 2022 monitoring events, the groundwater analytical results for the required parameters of analysis satisfied their respective ODWS, except for the results summarized below.

Monitoring Well	Monitoring Event	Parameter	ODWS (mg/L)	Analytical Result (mg/L)
MW4	November 10, 2022	Chloride	250	**1130**
		Sodium	200	**444**

Note: 1) mg/L denotes milligrams per litre.

As discussed in **Sections 4.2** and **4.3**, based on the interpreted groundwater flow direction and the analytical results for chloride and sodium at downgradient monitoring wells in closer proximity to the DYEC facility, there is no indication that the elevated 2022 concentration of chloride and sodium within the groundwater at MW4 migrated downgradient as a result of DYEC waste treatment operations. The elevated concentrations of chloride and sodium detected at MW4 in 2022 are interpreted to be attributed to the exfiltration of salt-impacted stormwater runoff from the East SWMP. Therefore, no immediate remedial actions are warranted to address groundwater quality at monitoring well MW4.

Based on a review of 2022 and historical groundwater analytical results for the Site, the data suggests that DYEC waste treatment operations have not had an adverse effect on groundwater quality at the Site. For the remaining monitoring wells and parameters, there are currently no emerging chemical concentration trends of concern that would suggest an impending exceedance of an ODWS within the downgradient groundwater quality at the Site as a result of DYEC waste treatment operations.

5 CONTINGENCY MEASURES

In accordance with Condition 17 of the EA Approval, a *Spill Contingency and Emergency Response Plan* has been developed for the Site. The *Spill Contingency and Emergency Response Plan* documents remedial actions that are required in the event of a spill or upset condition (Stantec, 2011). It is understood that a spill or upset condition requiring remedial action did not occur at the Site in 2022.

6 2023 MONITORING PROGRAM

The proposed 2023 monitoring program considers the findings of this report and the MECP approved *Groundwater and Surface Water Monitoring Plan* for the Site. Details of the monitoring programs for the Site, including analytes, are summarized in **Section 3** of this report. The groundwater monitoring locations for the Site are shown in **Figure 2**.

As discussed in **Section 1.2.1.1**, in 2019 the Regions requested that the *Groundwater and Surface Water Monitoring Plan* be amended to reduce the frequency of groundwater monitoring from three (3) times per year to once annually in the fall. The MECP approved the reduction of groundwater monitoring frequency on May 7, 2019.

As discussed in **Section 1.2.2.1**, with MECP approval, the routine surface water monitoring program for DYEC (i.e., placement and monitoring of sondes in Tooley Creek) has been suspended until the Highway 401/Courtice Road interchange construction activities are complete. Other construction activities in the immediate area have since developed. The construction of a 200,000 square foot battery warehouse located north of DYEC was largely completed in 2021. The Tooley Creek culvert at Highway 401 is being rehabilitated with ongoing repairs. As a result of these construction related activities, the surface water monitoring program will remain in abeyance for 2023.

An annual monitoring report that details the findings of the 2023 monitoring period will be prepared and submitted to the MECP by April 30, 2024. The annual report should be prepared in consideration of historical report submissions while acknowledging the purpose and objectives of the monitoring program, which are summarized in **Section 1.2** of this report.

7 CONCLUSIONS

Based on the findings presented in this report, the following conclusions are presented.

- Based on the 2022 groundwater elevations, the shallow and deeper groundwater flow direction at the Site was interpreted to be generally toward the southwest.
- Groundwater levels at the location of monitoring well MW1 are interpreted to be influenced by the trunk sewer located less than 10 metres west and adjacent to the western DYEC property boundary. Coarse backfill material that surrounds the 2.1 metre diameter trunk sewer was placed at a greater depth than the bottom of monitoring well MW1. As such, groundwater is interpreted to be induced to move toward the more porous media of the trunk sewer thereby lowering groundwater levels at monitoring well MW1 and indicating a perceived preferential flow direction toward the west.
- Concentrations of chloride and sodium within the groundwater at upgradient monitoring well MW2B and at internal assessment monitoring well MW5B have generally increased since 2014/2015. The onset of the increasing trends appears to coincide with the approximate time of construction of Energy Drive north and west of the Site, as well as the on-site roadways and parking lot. As such, the increasing chloride and sodium concentrations are interpreted to be attributed to the application of de-icing salt during the winter season to Energy Drive, Osborne Road, and/or the on-site roadways/parking lots. It is noted that, although there is an apparent increasing concentration trend for both chloride and sodium within the groundwater at monitoring wells MW2B and MW5B, the 2022 and historical chloride and sodium concentrations at MW2B and MW5B have satisfied their respective Ontario Drinking Water Quality Standards (ODWS) criteria.
- In 2022, the groundwater analytical results for the required parameters of analysis satisfied their respective ODWS, except for the chloride and sodium concentrations within the groundwater at monitoring well MW4. Based on the interpreted groundwater flow direction and the analytical results for chloride and sodium at downgradient monitoring wells in closer proximity to the DYEC facility, there is no indication that the elevated concentrations of chloride within the groundwater at MW4 migrated downgradient as a result of DYEC waste treatment operations. As discussed, the elevated concentrations of chloride detected at MW4 in 2022 are interpreted to be attributed to the seasonal exfiltration of salt-impacted surface water from the East SWMP that is interpreted to migrate through the relatively permeable sandy silt and into the screened interval of monitoring well MW4. The fluctuating/increasing chloride trend appears to have begun around 2016. The increase wasn't noted until nearly two (2) years after DYEC was constructed, which could indicate the residence time it took the salt-impacted surface water to accumulate in the SWMP and subsequently migrate in the subsurface toward MW4. Therefore, no remedial actions are warranted to address the noted chloride concentrations.
- Overall, based on a review of 2022 and historical groundwater analytical results for the Site, the data suggests that DYEC waste treatment operations have not had an adverse effect on groundwater quality at the Site.

- An evaluation of potential road salt application impacts within the groundwater was completed using the method proposed by *Panno et al*. (2005, 2006). Based on the November 2022 groundwater quality results, the Chloride/Bromine (Cl/Br) ratios within the groundwater at monitoring wells MW2B, and MW5B indicates that groundwater quality is alluding toward surface salt application impacts. At MW4 the Cl/Br ratio indicates groundwater quality is affected by surface salt application. Concentrations of chloride and sodium within the groundwater at monitoring locations MW2B, MW4, and MW5B, have been increasing since 2014, which coincides with the construction of Energy Drive north and west of the Site, as well as on-Site roadways and parking lots.
- In 2020, an inspection of monitoring well MW4 determined that the surface seal was in good condition and that its location along the inner downslope of the East SWMP is such that overland runoff from the adjacent roadway cannot directly enter the well. Given the capture area of the East SWMP and its interpreted design as an exfiltration pond, it is interpreted that stormwater entering the East SWMP is impacted by on-site road/parking lot de-icing practices during the winter months. The impacted stormwater is interpreted to exfiltrate into the shallow subsurface, which subsequently migrates downgradient toward MW4, which is screened within a more permeable upper soil unit in comparison to monitoring nest MW3, which are screened within the deeper more impermeable silty clay unit near the southwest pond.
- The routine surface water monitoring program (i.e. placement and monitoring of sondes in Tooley Creek) for DYEC is expected to remain in suspension for the 2023 monitoring year as a result of on-going construction activities in the immediate area.

8 RECOMMENDATIONS

Based on the findings of the 2022 monitoring program, the following recommendations are provided for consideration.

- As on-going construction related activities in the immediate area, outlined in **Section 1.2.2.1**, will directly impact the Surface Water Monitoring Program, it is recommended to hold the surface water program in abeyance until construction in the area subsides. An evaluation of the Surface Water Monitoring Program should be undertaken upon the completion of construction related impacts.
- The concentrations of salt-related parameters chloride, sodium, calcium, magnesium, and potassium within the groundwater at the Site should continue to be evaluated on an ongoing basis to confirm effects of roadway and parking lot de-icing practices on groundwater and verify that impacts are not attributed to DYEC waste treatment operations. Part of the ongoing assessment of de-icing influences on groundwater at DYEC would require that the parameter bromide be incorporated into the groundwater quality evaluation parameter suite such that the proposed methodology to assess for road salt impacts in groundwater by *Panno et al*. (2005, 2006) may be utilized.

9 STUDY LIMITATIONS AND USE OF REPORT

This Annual Water Monitoring Report (Annual Report) was prepared by RWDI AIR, Inc., ("RWDI") for the Regional Municipality of Durham, the Regional Municipality of York (Regions) ("**Client**") and the Ministry of the Environment, Conservation and Parks (MECP). The findings and conclusions presented in this report have been prepared for the Client for the objectives and purposes described in the Annual Report (the "**Intended Purpose**"). In relation to the specific portions of the Site identified herein and subject to the limitations of the scope of RWDI's services described in the Report (the "**Scope of Services**"). At the request of the Client, we have conducted a groundwater and surface water monitoring program in accordance with Condition 7.14 of the Environmental Compliance Approval Number 7306-8FDKNX.

The investigations, assessments and studies performed and summarized in this Annual Report have been conducted in accordance with generally accepted engineering and environmental consulting in the Province of Ontario as of the date of this Report (the "**Standard of Care**"). No other warranty, expressed or implied, is intended or made and this Report is not to be construed as legal advice.

The conclusions and recommendations contained in this Annual Report are based on conditions at the Site observed by RWDI during site inspections and on information: (1) supplied by the Client (including its representatives, employees, independent contractors and other consultants engaged by the Client) in relation to the Site at the time the Report was prepared ("**Client Supplied Information**"); and (2) information made available by governmental authorities and other authoritative sources ("**Third Party Information**"). RWDI assumes that the Client Supplied Information and Third-Party Information is accurate and reliable and does not accept responsibility for any deficiency, misstatement or inaccuracy contained in this Annual Report as a result of errors, omissions, misrepresentations, or inaccuracies in the Client Supplied Information or Third-Party Information. Investigations to determine the truth or accuracy of the Client Supplied Information or Third-Party Information are outside of RWDI's Scope of Services.

In the event that additional information becomes available which differs significantly from our understanding of conditions presented in this Annual Report, RWDI is not obligated to update the conclusions in this Annual Report and shall not do so unless engaged by the Client for that purpose.

The applicability and reliability of any of the conclusions, recommendations, or opinions expressed in this Report, are only in relation to the Intended Purpose, and only to the extent that there has been no material alteration to or variation to: (1) the physical conditions on the portions of the Site analyzed by RWDI: (2) any of the stated assumptions described in the Report; (3) the Client Supplied Information or Third Party Information; or (4) changes to applicable laws and/or standards after the date of this Report governing the matters that are the subject of this Report. RWDI assumes no responsibility for any deficiency or inaccuracy in Client Supplied Information or Third-Party Information.

The investigations and evaluations of the Site conditions, soils, groundwater, sediments, contaminants and their quantities have been performed in accordance with the Standard of Care and utilizing scientific principles and professional judgment and estimations. Nevertheless, there is still an inherent risk that some conditions will not be detected. Furthermore, the investigations and evaluations of the Site may be subject to factors beyond RWDI's control including but not limited to restrictions caused by physical obstructions, precipitation or other adverse or anomalous weather conditions, denied access, inaccessible areas, time constraints, limitations in the Scope of Services and, readily available documentation. It is therefore RWDI's intent that the conclusions and recommendations contained in this Annual Report be utilized as guidance in relation to the Intended Purpose and not as instructions for a firm course of action, unless explicitly stated otherwise in the Annual Report.

RWDI relied in part, upon information and documentation (Data) provided by municipal, provincial, and federal resources, as well as Site representatives, independent sources, historical documentation, the Client as well as other third parties. It is assumed by RWDI that the Data provided are complete and accurate. RWDI was not retained to, nor has it conducted any independent verification of the accuracy, completeness or suitability of the Data. As such, RWDI assumes no liability for losses, damages, or claims of any nature arising from inaccurate, incomplete or unsuitable Data provided on this project. The Regions by receipt of this Report agrees to indemnify and hold harmless RWDI with respect thereto.

It is noted that regulatory guidelines, standards and related documents as referenced in this report are subject to interpretation and may change over time.

This report was prepared using scientific principles and professional judgement in assessing available facts and presenting subjective interpretations. The professional judgements presented within this document and based on available facts within the limits of the existing information, budgeting scope of work, and schedule. It is RWDI's intent that the professional judgement and interpretive conclusions be utilized as guidance and not be necessarily construed as a firm course of action, unless explicitly stated otherwise. RWDI makes no warranties, expressed or implied, including without limitations, or warranties as to merchantability or fitness of the property for a particular purpose. The information presented in this report should not construed as legal advice.

It is important that the reader of this Annual Report, recognize that subsurface, environmental and/or geotechnical conditions may vary geographically and temporally. This is a natural phenomenon, which is not fully accommodated in the limited testing conducted by RWDI. In addition, the analysis of the collected data, by necessity, incorporates simplifying assumptions of site conditions and analytical solutions that assume uniformity in site conditions. The opinions, conclusions, and recommendations contained within the Annual Report therefore represent RWDI's professional judgment in-light of these limitations.

This Annual Report is to be considered confidential and is for the sole use of the Regions and the MECP. As such, the Annual Report shall not be relied upon by third parties, except where agreed in writing between RWDI and the Region; where required by law; or where used for governmental review. RWDI accepts no responsibility, and denies any liability whatsoever, to parties other than the Regions who may obtain access to the Annual Report, for any injury, loss, or damage suffered by such parties arising from their use of, reliance upon, decisions or actions based on the Report or any of its contents, except to the extent where those parties have obtained prior written consent of RWDI to use and rely upon the Report and its contents. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This statement of Qualifications and Limitations is attached to, and forms part of the Report and any use of the Report are subject to the terms thereof.

10 CLOSURE

We trust that this 2022 Annual Groundwater and Surface Water Monitoring Report, prepared in accordance with Condition 20.8 of the Environmental Assessment Notice of Approval and Condition 15 of the Environmental Compliance Approval Number 7306-8FDKNX for the Durham York Energy Centre in the Municipality of Clarington, Ontario, is satisfactory for your requirements. Should there be any questions or comments, please contact us.

Sincerely,

RWDI AIR Inc.

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Attach.

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