# **APPENDIX**

# STORMWATER DRAINAGE ASSESSMENT



Environmental Assessment Study of Arterial Roads within the Highway 427 Industrial Secondary Plan Area (Area 47)

Part A: Stormwater Drainage Assessment

City of Brampton and Region of Peel TP115086



# Part A: Stormwater Drainage Assessment

Environmental Assessment Study of Arterial Roads within the Highway 427 Industrial Secondary Plan Area (Area 47)

#### TP115086

#### **Prepared for:**

City of Brampton & Region of Peel

# Prepared by:

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#### 9/27/2022

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#### **Preface**

Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited (Wood), has been retained by the City of Brampton and Region of Peel to conduct a Schedule C Municipal Class EA for a future arterial road network within Secondary Plan Area 47.

The City of Brampton, to accommodate future growth in north-east Brampton, has approved a secondary plan for Area 47. The area is bound by Mayfield Road to the north, Castlemore Road to the south, Regional Road 50 (RR50) to the east and The Gore Road to the west.

The City of Brampton has identified through its Transportation and Transit Master Plan (TTMP, 2009), and supporting studies the need for additional road network capacity up to 2031. As part of these studies, road network improvements within Secondary Plan Area 47 were recommended. The recommended road improvements are being addressed by the current Class EA in two parts:

#### Part A (Region owned R.O.W.s<sup>1</sup>):

- 1. A new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50; and,
- 2. Widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50; and,

#### Part B (City owned R.O.W.s):

- 1. A new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial);
- 2. Widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with possible continuous centre turn lane; and
- 3. Widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50.

In order to service this growth, new infrastructure must be provided that recognizes the capacity needs of planned growth and the objectives of protecting established communities and businesses from threats created by surface water drainage. As per Section 4.2.1.1 and Figure 4.4 of the MESP (ref. Aquafor Beech, 2016) the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the required water quantity, water quality, and erosion control SWM requirements. This approach has been adopted as the overall premise for design of the stormwater quantity, quality and erosion features required for all the roadways within the Study Area. Notwithstanding, the following negotiations are still ongoing:

- The Region and City are in discussion to formalize acceptance of stormwater discharge of the Region's roadway drainage systems to City owned drainage systems and SWM facilities; and,
- The Region, City and land owner's are in discussion regarding the overall premise for stormwater management for the Study Area, particularly along Coleraine Drive. This has driven the evaluation of alternatives focused on a stormwater management facility located near the intersection of Coleraine Drive and Arterial A2.

Decisions regarding these ongoing negotiations are a prerequisite to developing a preferred alternative for stormwater management for the Study Area. As such, alternative solutions will be developed and assessed in detailed design leading to a preferred approach and the road drainage as per the catchments divide provided in this report will be the responsibility of the R.O.W. adjacent land owners to accommodate.

1 R.O.W. = road right-of-way

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# 1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited (Wood), has been retained by the City of Brampton and Region of Peel to conduct a Schedule C Municipal Class EA (Class EA) for a future arterial road network within Secondary Plan Area 47.

The City of Brampton continues to grow and urbanize, and to accommodate future growth in north-east Brampton, Council has approved a secondary plan for Area 47. Area 47 is bound by Mayfield Road to the north, Castlemore Road to the south, Regional Road 50 (RR50) to the east and The Gore Road to the west (ref. Figure 1-1). In order to service this growth, new infrastructure must be provided that recognizes the capacity needs of planned growth and the objectives of protecting established communities and businesses from threats created by surface water drainage.

The City of Brampton has identified through its Transportation and Transit Master Plan (TTMP, 2009), and supporting studies (including the Highway 427 Extension Area Transportation Master Plan and the Highway 427 Industrial Secondary Plan (Area 47) Transportation Master Plan) the need for additional capacity in the road network up to the planning horizon year of 2031. As part of these studies, road network improvements within Secondary Plan Area 47 were recommended. The recommended road improvements are being addressed by the current Class EA in two parts:

#### Part A (Region owned R.O.W.s<sup>2</sup>):

- 3. A new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50; and,
- 4. Widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50; and,

#### Part B (City owned R.O.W.s):

- 4. A new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial);
- 5. Widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with possible continuous centre turn lane; and
- 6. Widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50.

The Part A and Part B features, as described above, are illustrated in Figure 1-1, as well as Plans 1 and 5 (ref. Appendix C).

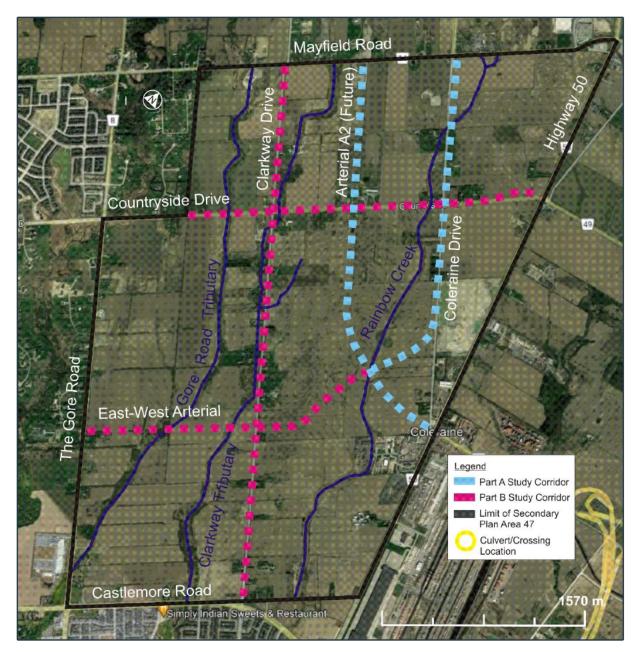
The Highway 427 Industrial Secondary Plan (Area 47) Transportation Master Plan has satisfactorily completed Phases 1 and 2 of the Municipal Class EA process for the recommended arterial road network improvements and recommended commencement of Phases 3 and 4 of the EA process. The current study will satisfy Phases 3 and 4 of the Class EA requirements for the identified arterial road improvements.

This report has been prepared to document the stormwater drainage conditions for Part A of the Study Area. The following sections describe the background review, the assessment of existing and proposed hydraulic structures within Part A of the Study Area including hydraulic analyses, establish the proposed arterial road R.O.W. drainage conditions, and summarize stormwater management criteria for the proposed arterial road improvements, and new arterial roads. Part A of the Study Area includes drainage to Rainbow Creek (a tributary of the Humber River).

Stormwater drainage conditions for Part B of the Study Area are documented under separate cover.

2 R.O.W. = road right-of-way

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**Figure 1-1 Study Corridors** 

(background image source Google Earth Pro™)

#### 2.0 BACKGROUND REVIEW

#### 2.1 Previous Studies

Several previous studies have been completed which are relevant to the current project as summarized below.

#### Humber River Hydrology Update, Civica Infrastructure Inc., June 2015

This study, prepared as a joint effort between the Toronto and Region Conservation Authority (TRCA) and Civica Infrastructure Inc. (Civica), was an update to the hydrologic model of the Humber River Watershed. The update was completed to reflect the increase in urban development, including stormwater management facilities constructed within the last 15 years, and included significantly refined subcatchment discretization. The hydrologic model was developed in Visual OTTHYMO 4 (VO4) for existing land uses and future land uses based on approved Regional and local municipality Official Plans. The model for the Humber River Watershed was a new model which superseded the previous SWMHYMO model developed by Aquafor Beech Limited (ref. Humber River Watershed Hydrology Update, November 2002). Peak flows were reported for the 2 to 500-year return periods and the Regional Storm event (Hurricane Hazel). The model was calibrated using rainfall-runoff data from recent storm events. Of the 6-hour, 12-hour, and 24-hour AES distribution design storms simulated, the 6-hour and 12-hour storms were found to be the critical storms (i.e. these storms generated the highest peak flows). The study found that the 2 to 100-year unit flow relationship equations provided in the TRCA Stormwater Management Criteria (2012) are sufficient to maintain existing conditions peak flows under the proposed future land use condition.

# Master Environmental Servicing Plan: Highway 427 Industrial Secondary Plan Area ("Area 47"), Aquafor Beech Limited, May 9, 2016

This Master Environmental Servicing Plan (MESP) was prepared for the "Area 47" study area to address the constraints and opportunities associated with the proposed land use changes. The MESP provides a comprehensive management plan including stormwater and natural heritage strategies to protect the natural environment resources within the Study Area. Part of the MESP involved extending and updating TRCA generated HEC-RAS models of The Gore Road Tributary, the Clarkway Tributary, and Rainbow Creek.

# Addendum to the Master Environmental Servicing Plan, Highway 427 Industrial Secondary Plan (Area 47), Savanta Inc., January 2018

This addendum to the MESP was prepared to provide an alternative plan for the Rainbow Creek restoration and enhancement. The addendum presents a plan to realign the Rainbow Creek corridor from Mayfield Road to Old Castlemore Road. The addendum provides a comprehensive management plan outlining how objectives relative to hydraulics, natural channel design, geomorphology, etc. will be achieved. Part of the addendum involved revisions to the HEC-RAS model to reflect the proposed realigned corridor and preliminary sizing of watercourse crossings, which was completed by Candevcon Limited (CDC) and The Municipal Infrastructure Group (TMIG) (ref. CDC, TMIG, dated July 2018).

# 2.2 Data, Mapping & Models

In addition to the reporting described in Section 2.1, additional background data, mapping and models have been provided by the City of Brampton, TRCA, Aquafor Beech, and Wood's Geotechnical Team. The following summarizes the data relevant to this assessment:

#### City of Brampton

- Various digital GIS base mapping layers including roads, property, watercourses, subwatershed boundaries, Official Plan land use, etc.
- Aerial photography
- Digital terrain mapping

#### **TRCA**

- Various digital GIS mapping layers including watercourses, TRCA regulation limit, meander belt, floodplain limits, etc.
- Visual OTTHYMO 4.0 hydrologic model of the Humber River Watershed (2015)
- Approved HEC-RAS hydraulic model of the Rainbow Creek (January 2018)
- Existing Conditions 6-hour AES 2 year 100-year Design Storm Peak Flows (March 2018) from revised Humber River Hydrology Update
- Existing & Future Conditions Regional Storm Peak Flows (March 2018) from revised Humber River Hydrology Update

#### **Aquafor Beech**

- HEC-RAS hydraulic models of The Gore Road Tributary, the Clarkway Tributary, and Rainbow Creek (2016 - Superseded by CDC. TMIG, dated July 2018).
- Various digital GIS base mapping layers including contours, watercourses, HEC-RAS section lines, and floodlines.

#### Wood's Geotechnical Team

 Borehole logs - 47 borehole logs were advanced by Wood's Geotechnical Team in the period January 2020 to April 2020 along the Coleraine Drive and Arterial A2 R.O.W.s. Relevant borehole logs are provided in Appendix A.

### 2.3 Headwaters Drainage Features

The Headwaters Drainage Features (HDF) Assessment is documented in the following report:

FINAL REPORT: MASTER ENVIRONMENTAL SERVICING PLAN:
HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA ("AREA 47")
Aquafor Beech Limited (Reference: 64608.1)
09 May 2016

Please reference Section 2.2.2 of the above noted report for details.

Please note that the hydraulic model of Rainbow Creek used for the current Part5 A study was updated to include relevant HDFs as directed by TRCA (ref. Figure 2-1) in the 2018/2019 timeframe.



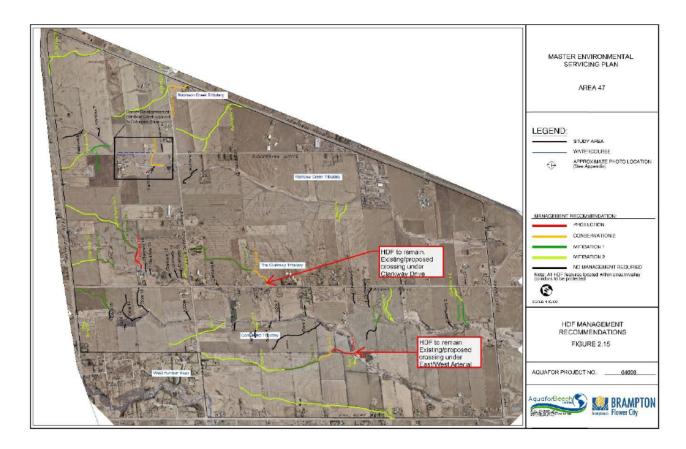


Figure 2-1 HDFs relevant to Area 47 Environmental Assessment

#### 3.0 STORMWATER MANAGEMENT

#### 3.1 **Existing Conditions Storm Drainage**

The Part A Study Area is located within the Humber River Watershed and contributes drainage to the Main Humber subwatershed. There is one (1) tributary that drains through the Study Area, namely a tributary of the Rainbow Creek (ref. Figure 3-1).

Under existing conditions, approximately 9.35 ha of existing R.O.W. (imperviousness = 22.03%) (i.e. Coleraine Drive and Countryside Drive) contributes stormwater runoff to Rainbow Creek. The existing R.O.W. alignments are illustrated in Plans 1 to 4 (ref. Appendix C). Please note that the drainage boundaries shown on these Figures are not representative of the existing conditions drainage boundaries. Additional details are provided in Section 3.6.

The existing R.O.W.s consist of rural cross-sections with ditches. Overland drainage from external lands enters the existing R.O.W.s at various points and is conveyed by the existing ditches to the watercourse receiver (i.e. Rainbow Creek).

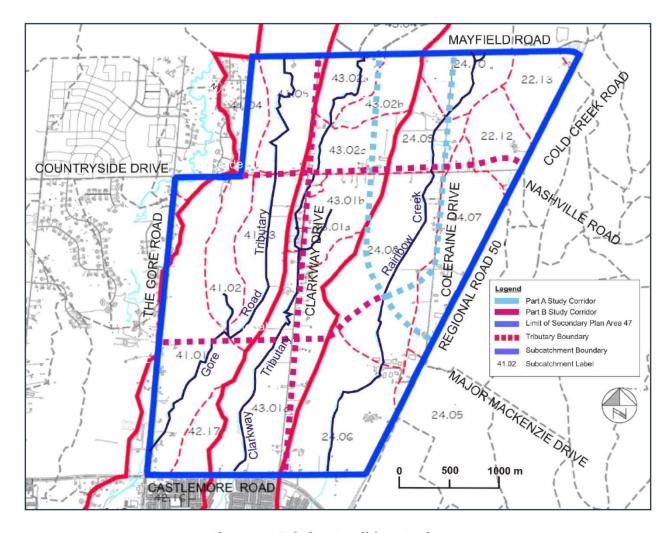


Figure 3-1 Existing Conditions Drainage



# 3.2 Future Conditions Storm Drainage

As outlined in Section 1.0, the future conditions for Part A of the Study Area proposes a new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50, and widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50. Urbanized cross-sections are proposed for all R.O.W.s.

A proposed road profile was developed by the City, Region, and Wood. The future conditions storm drainage boundaries were developed based on the proposed road profile and are illustrated in Plans 5 to 8 (ref. Appendix C).

Under future conditions, approximately 27.14 ha of future R.O.W. (imperviousness = 74.10%) (i.e. Coleraine Drive and Arterial A2) is proposed to contribute stormwater runoff to Rainbow Creek. This proposes an increase of 17.79 ha of R.O.W. drainage and impervious area of 18.05 ha relative to existing conditions. The increase is made up of the new and widened R.O.W.s.

Under future ultimate development conditions, external drainage will not enter the R.O.W.s. Notwithstanding, the proposed roadways may be constructed prior to the development of adjacent blocks. As such, and until development of adjacent blocks commences, temporary conveyance (e.g. ditches and culverts) to the downstream receiving systems under the interim conditions will be required.

#### 3.3 Soils and Groundwater

Wood has advanced and prepared 47 borehole logs along the Part A road alignments. The soil types encountered within the Study Area are dominated by imperfectly drained stone-free clays, underlain by silty sand. These soils types have a typical saturated hydraulic conductivity value ranging between 7 x  $10^{-5}$  and 2 x  $10^{-4}$  (ref. User's Guide to SWMM5,  $13^{th}$  Edition).

Borehole logs indicate that groundwater was encountered within 9 boreholes, ranging in depths of 2.4 m to 8.2 m below ground surface for Coleraine Drive and depths of 1.2 m to 5.8 m for Arterial A2. The remaining boreholes indicate that groundwater was not encountered to the depth of the borehole.

In general, the future conditions road profile proposes to raise grades within the R.O.W. limits. Therefore, depths from surface to groundwater levels will increase under future conditions, ranging in depths of 3.1 m to 8.7 m below the proposed ground surface for Coleraine Drive and depths of 1.2 m to 9.7 m for Arterial A2. A summary of the borehole logs, groundwater levels and separation from existing and proposed grades is provided in Appendix A.

#### 3.4 Stormwater Management Design Criteria

The stormwater management analyses of the Study Area has considered design criteria from several agencies including, the Regional of Peel (Region), the Toronto and Region Conservation Authority (TRCA), the Ministry of Transportation (MTO). In addition to agency design criteria, the stormwater management analyses of the Study Area will also consider design criteria outlined in the MESP (ref. Aquafor Beech, 2016). The stormwater management criteria relevant to the Study Area are outlined below.

# 3.4.1 Region of Peel (2019)

- Minor System: Storm sewers are to convey the 10-year storm event, and are to be designed using Region of Peel IDF information;
- *Major System:* Regional road R.O.W.s, including both urban and rural, are to convey flows generated by the R.O.W. itself, up to the 100-year storm event;
- External lands should not drain to the Region's storm sewer system;



- Water Balance: For Low Volume Groundwater Recharge Areas (LGRA), provided the site does not impact a sensitive ecological feature, or require a subwatershed study, or Environmental Impact Study (EIS), the proponent has the option to:
  - provide a minimum post development recharge of the first 5 mm for any precipitation event, or;
  - o complete a site-specific water balance to identify pre-development groundwater recharge rates

As per Figure C.10 from the TRCA Stormwater Management Guidelines (ref. TRCA, August 2012) the Study Area is located within a LGRA. Refer to Appendix A for Figure C.10 of (TRCA, August 2012).

- Road Reconstruction: New linear projects without restrictions and subject to the approved Source
  Protection Plan, that results in the creation of impervious surface(s) and/or fully reconstructs the
  existing impervious surfaces, shall control per the mandatory control hierarchy the larger of the
  following:
  - The runoff generated from the geographically specific 90<sup>th</sup> percentile rainfall event (27 mm) from the new and/or fully reconstructed impervious surfaces on the site. The site shall be required to maintain the pre-development water balance, or;
  - The runoff generated from the geographically specific 90<sup>th</sup> percentile rainfall event (27 mm) from the net increase in impervious area(s) on the site. The site shall be required to maintain the predevelopment water balance.

As per Map 3.4 of the "Approved Source Protection Plan: CTC Source Protection Region", prepared by the CTC Source Protection Committee, dated March 25, 2019 (ref. Appendix A), the Study Area is located outside of the nearest Wellhead Protection Area (WHPA-Q1/Q2), and is therefore not subject to the approved Source Protection Plan. As such, the road reconstruction criteria as stated above would not apply to the Study Area. Despite this, the Region has noted to Wood that the road reconstruction criteria should still be applied to the Regional owned R.O.W.s within the Study Area (ref. Email correspondence Bubas-Khan, dated October 28, 2020). As such, this criterion is to be applied to the Part A R.O.W.s (i.e. Coleraine Drive and Arterial A2).

 Safety: Section III "STORM DRAINAGE AND SEWER DESIGN" of the City of Brampton Subdivision Design Manual Part (18) "Overland Flow"; clause (f) ii reads as follows:

"In the event that the major storm overland flow from a subdivision exceeds the capacity of the maximum number of catchbasins as specified above, major storm overland flow shall be allowed to flow onto the arterial or major collector roads with the condition that the additional flow from the subdivisions would not cause the ponding depth to exceed 0.15 m above the gutter along the arterial or major collector roads. A minimum of 2 lanes of roadway pavement must be flood-free at all times for emergency vehicles during the major storm event. However, the major overland flow shall not be permitted to flow across any arterial or major collector roads under any circumstances."

• *Climate Change*: Per Section 7.2.2 of the Region's SWM Criteria (2019), the Region has a four (4) step process for considering climate change resiliency in the design of SWM infrastructure.

# 3.4.2 Toronto and Region Conservation Authority (2012)

- A review of the information presented in Appendix C of TRCA's Stormwater Management Criteria (ref. TRCA, August 2012) indicates the following:
  - The study area is not located in proximity to any Wellhead Protection Areas (ref Figure C.2 of the TRCA Guidelines).



- Average Annual Recharge in the study area is categorized in the Low range (ref Figure C.3 of the TRCA Guidelines).
- The study area is not considered to be located within a Significant Groundwater Recharge Areas (ref. Figure C.7 of the TRCA Guidelines).
- The study area is not considered to be located within an Ecologically Significant Groundwater Recharge Area (ref Figure C.8 of the TRCA Guidelines).
- The study area is not considered to be located within a High Volume Groundwater Recharge Area (ref Figure C.9 of the TRCA Guidelines).
- The study area is considered to be located within a Low Volume Groundwater Recharge Area (ref Figure C.10 of the TRCA Guidelines).
- Quantity Control: Control post-development peak flows to target rates established using the unit flow relationships for Sub Basin 36 (Equation F) for all storms up to and including the 100-year storm (i.e., 2, 5, 10, 25, 50, and 100-year storms);
- Quality Control: MOE Enhanced Level (Level 1) Water Quality Control (80% Average Annual Removal of Total Suspended Solids [TSS])<sup>3</sup>. A treatment train solution is to be implemented.
- Water Balance: For sites located within a LGRA best efforts to maintain recharge are expected, provided the site does not impact an ecological feature.
- *Erosion Control:* Minimum infiltration of 5 mm is required. For sites with a SWM pond, extended detention of the 25 mm event for a period of 48 hours may also be required.
- Sizing and design of future bridge structures is to be completed using the TRCA Crossings Guideline for Valley and Stream Corridors (September 2015)<sup>4</sup>. TRCA's objectives for natural hazards pertain to the avoidance and mitigation of flood risk, geotechnical risk from slope instability, and geomorphic risk from channel migration over time.

# 3.4.3 Master Environmental Servicing Plan (2016)

- Quantity Control: TRCA Criteria Control post-development peak flows to target rates established using
  the unit flow relationships for Sub Basin 36 (Equation F) for all storms up to and including the 100-year
  storm (i.e., 2, 5, 10, 25, 50, and 100-year storms).
- Quality Control: MOE Enhanced Level (Level 1) Water Quality Control.
- Water Balance: Infiltration of runoff from a 5 mm storm event using Low-Impact Development (LID)
  Best Management Practices (BMPs).
- Erosion Control: For drainage to Rainbow Creek, Clarkway Tributary, and Gore Road Tributary, extended
  detention of the 25 mm storm event for a period of 48 hours is required. For drainage to Headwater
  Drainage Features (HDFs), extended detention of the 25 mm storm event for a period of 120 hours is
  required.

As per Section 4.2.1.1 and Figure 4.4 of the MESP (ref. Aquafor Beech, 2016) the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements noted above. As such, Wood has not

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<sup>3</sup> Please note that this requirement is also consistent with MECP expectations for quality control.

<sup>4</sup> Available via URL <a href="https://trca.on.ca/dotAsset/214493.pdf">https://trca.on.ca/dotAsset/214493.pdf</a>

addressed these SWM criteria in this report as it is assumed to be addressed by the reporting prepared for the Area 47 development blocks.

Based on the foregoing, the water balance criteria (ref. Section 3.6), and road reconstruction criteria (ref. Section 3.7) are addressed with this report.

It should be noted that if any of the development blocks that are intended to provide the water quantity, water quality, and erosion control SWM requirements for a portion of the City and Region R.O.W.s be developed with privately owned SWM infrastructure, the City and Region R.O.W. drainage cannot drain into the development block without a formal agreement. If a formal agreement is not established, then the requisite water quantity, water quality, and erosion control SWM requirements for the R.O.W. drainage must be implemented within the R.O.W. These details are to be determined as each development block advances to the detailed design stage.

Notwithstanding, it should be noted that conveyance of R.O.W. drainage to the SWM facilities within the development blocks may not be feasible (e.g., grading constraints). In addition, the proposed roadways may be constructed prior to the development of adjacent blocks. Therefore, consideration of management of stormwater runoff within the R.O.W. is required.

In this context, discussions between the City and Region are ongoing on the issue of possible management of roadway stormwater runoff from each other's R.O.W.'s. Further discussions are required in this regard and any agreement may influence the design of SWM systems for this development area.

# 3.4.4 Master Environmental Servicing Plan Addendum (2018)

As has been noted, this Addendum to the Block 47 MESP advanced an alternative Rainbow Creek restoration and enhancement plan to that described in the May 2016 MESP (Aquafor Beech 2016). The MESP Addendum does not advance any specific or additional stormwater management criteria or objectives.

# 3.4.5 Ministry of the Environment, Conservation and Parks (MECP)

The MECP is in the process of issuing a Stormwater Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA) to the Region of Peel. The Stormwater CLI ECA covers storm assets servicing regional roads, namely storm sewers, ditches, stormwater management facilities and low impact development, and Stormwater Pumping Stations. The Stormwater CLI ECA sets forth conditions for alterations to the stormwater system as well as ongoing operation of the system. The ECA comes with criteria for design of alterations to the Region's existing stormwater system. At the time of completion of the Class EA study, the CLI ECA template and criteria were not available, therefore the Class EA recommendations do not guarantee compliance with the CLI ECA conditions and criteria. It is recommended that at the detailed design stage, the Engineering Consultant re-assess the Class EA recommendations against the CLI ECA criteria and make the necessary adjustments and changes to the stormwater recommendations to be in compliance, where feasible.

#### 3.5 Water Balance

As outlined in Section 3.4, the Region, TRCA, and MESP have water balance criteria which requires the onsite retention of the larger of the runoff volume from a 5 mm storm event and the pre-development water balance/groundwater recharge volume. Table 3-1 below outlines the volumes for each subcatchment, with an identification of the larger volume requirement.

Pre-development water balance volumes were calculated using Table 3.1 (Urban Lawns/Shallow Rooted Crops) of the Ministry of the Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual (SWMPDM, 2003), and historical rainfall data obtained from the Environment



Canada rainfall gauge located at the Toronto Lester B. Pearson International Airport (Gauge A). Monthly and daily precipitation data was obtained for the years 1995 to 2019 and converted into an annual average rainfall depth. The pre-development water balance volumes were calculated using the proposed R.O.W. subcatchments and existing impervious conditions (ref. Plans 1 to 4, Appendix C). Supporting calculations are provided in Appendix B.

Post-Development runoff volumes from the 5 mm storm event were calculated using the proposed R.O.W.s and proposed imperviousness (ref. Figures 5 to 8, Appendix C).

As outlined in Table 3-1, the runoff volumes from the 5 mm storm event govern the water balance retention volume requirements, compared to the pre-development groundwater recharge volume. Water Balance retention volume requirements are discussed further in Section 3.7, and a long list of stormwater management practices suitable to achieving the water balance criteria are outlined in Section 3.8.

Subcatchment	Pre-Development Water Balance/Groundwater Recharge Volume (Average Daily Volume in m³)	Post-Development Runoff Volume from 5 mm Storm Event (m³)
A1	9	82
A2	7	70
A3	7	72
A4	9	82
A5	9	84
A6	9	76
A7	22	211
CR1	9	103
CR2	6	61
CR3	4	41
CR4	8	66
CR5	5	52

Table 3-1 Water Balance Retention Volume Requirements

#### Note(s)

1. Bolded values indicate governing water balance volume

As outlined in Section 3.4.1, the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements. Information pertaining to the manner in which the major and minor systems of the City and Region R.O.W.s would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the subcatchments represented on Figures 1 to 8 (ref. Appendix C), and the corresponding water balance volume requirements, should be reviewed and refined when this information becomes available. This is expected to occur at the detailed design stage.

#### 3.6 Road Reconstruction

As outlined in Section 3.4.1, the Region's road reconstruction criterion is to be applied to the Part A R.O.W.s. The road reconstruction criterion requires new linear projects that result in the creation of impervious surface(s) and/or fully reconstructs the existing impervious surface, to provide storage for the greater volume associated with the following scenarios:



- 1. The runoff generated from the geographically specific 90<sup>th</sup> percentile rainfall event (27 mm) from the new and/or fully reconstructed impervious surfaces on the site. The site shall be required to maintain the pre-development water balance, or;
- 2. The runoff generated from the geographically specific 90<sup>th</sup> percentile rainfall event (27 mm) from the net increase in impervious area(s) on the site. The site shall be required to maintain the predevelopment water balance.

Based on a review of the proposed R.O.W.s, scenario #1, as described above, would generate larger runoff volume as the new and/or fully reconstructed impervious surface area is larger than the net increase in impervious surface area. Therefore, calculations of the runoff from the 90<sup>th</sup> percentile rainfall event were completed for this scenario. The impervious coverages and resulting runoff volumes are summarized in Table 3-2 below. Supporting calculations for both scenarios are provided in Appendix B.

Subcatchment	Total Proposed Impervious Area (ha)	Runoff Volume from 27 mm Storm Event (m³)
A1	1.64	444
A2	1.41	379
A3	1.44	388
A4	1.64	442
A5	1.67	451
A6	1.53	412
A7	4.22	1140
CR1	2.07	558
CR2	1.23	331
CR3	0.82	221
CR4	1.31	354
CR5	1.05	283

Table 3-2 Region's Volume Control Requirements for Linear Developments (m³)

It is concluded from a comparison of the water balance retention requirements, presented in Table 3-1, to the road reconstruction runoff volume control requirements, presented in Table 3-2, that the latter criterion governs. Retention volume requirements are discussed further in Section 3.8, along with a long list of stormwater management practices suitable for the study area.

# 3.7 Stormwater Management Opportunities

## 3.7.1 General Stormwater Management Opportunities

Stormwater Management practices (SWMPs) for the management of roadway runoff generally fall into two categories: those that address stormwater quantity (including erosion) and those that manage stormwater quality of surface runoff. In addition, Low Impact Development (LID) best management practices are designed to provide water quality treatment and quantity control for smaller, more frequent storm events, and water retention.

As outlined in Section 3.4.1, stormwater quantity, quality and erosion criteria for the Study Area are to be provided by the internal development blocks within Area 47. As such, proposed works for the current study are limited to water balance and road reconstruction criteria.

In terms of water balance and road reconstruction criteria, the SWMPs relate to the retention (i.e. infiltration) of runoff from the new pavement, and where possible, runoff from the existing pavement; however, current legislation solely relates to the former. Typically, the required retention volumes are dictated by agency standards, and are also often defined in a watershed or subwatershed planning study. Water balance and road reconstruction retention volume requirements for the Study Area are outlined in Table 3-1 and Table 3-2 respectively, and it has been determined that the Region's road reconstruction criteria govern the retention volume requirements.

Various Best Management Practices or Stormwater Management practices are available to address the water balance retention volume requirements of runoff from roadways. Due to the linear nature of roadway corridors however, not all stormwater management practices are considered appropriate. Typically, suitable BMPs for linear roadway corridor come in the form of Low-Impact Development (LID) BMPs. Various LID BMPs are reviewed in the following section. The review was completed to determine suitability of each LID BMP in managing the water balance retention volume requirements, taking into consideration the Study Area topography, soils, groundwater level, and future conditions land use.

# 3.7.2 Low Impact Development Best Management Practices

Low Impact Development represents the application of a suite of BMPs normally related to source and conveyance storm water management controls to promote infiltration and pollutant removal on a local site by site basis. These measures rely on eliminating the direct connection between impervious surfaces such as roads and the storm drainage system, as well as the promotion of infiltration of road drainage. General design guidelines and considerations for source and conveyance controls have been advanced since the early 1990's as part of the Ministry of Municipal Affairs and Housing (MMAH) "Making Choices" and in 1994 as part of the Ministry of the Environment's original Best Management Practices Guidelines.

Subsequent to the 1994 MOE Guidelines, technologies and standards have been developed further for the application of source and conveyance controls. These have evolved into a class of BMPs referred to as Low Impact Development (LID) practices, which have advanced as an integrated form of site planning and storm servicing to maintain water balance and providing storm water quality control for urban developments. Initial results from studies in other settings have demonstrated that LID practices provide benefits by way of reducing the erosion potential within receiving watercourses and thereby reducing the total volume of end-of-pipe storm water erosion control requirements. In addition, due to volumetric controls afforded by LID BMP's, water quality is also improved through a reduction in mass loading. The benefits from LID storm water management practices are generally focused on the more frequent storm events (e.g. 2-year storm) of lower volumes as opposed to the less frequent storm events (e.g. 100-year storm) with higher volumes. It is also recognized that the forms of LID practices which promote infiltration or filtration through a granular medium provide thermal mitigation for storm runoff.

Guidelines regarding the application of LID practices and techniques have been developed within various jurisdictions in the United States and Canada. The Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) have produced the 2010 Low Impact Development Stormwater Management Manual, for the design and application of LID measures, various LID techniques, as well as their function that are applicable to road projects. While most of these are typically implemented to provide water quality and/or water quantity control, they can also be utilized to provide water balance retention given their ability to capture and retain runoff volume. Descriptions of various LID BMPs with infiltration capabilities are provided below.

#### Infiltration Trenches

Infiltration trenches can be positioned at surface level or below ground (i.e. subsurface). At-surface infiltration trenches are designed to receive surface runoff, while subsurface infiltration trenches receive



runoff that has been captured by catchbasins and/or storm sewers. Infiltration trenches are preferred in areas that have reasonable infiltration properties (15 mm/ hr, 1 x  $10^{-6}$  cm/s), but can be implemented in all soil types as long as they are large enough to store the design volume.

For R.O.W.s, at-surface infiltration trenches are restricted to the pervious areas within the boulevards or island areas (if proposed). Subsurface infiltration trenches can be positioned beneath impervious areas such as sidewalks and multi-use pathways. For subsurface infiltration trenches receiving drainage from catchbasins, all catchbasins should be fitted with Goss traps to filter floatable debris.

Infiltration trenches are restricted in depth by local groundwater levels. As per the Low Impact Development Stormwater Management Planning and Design Guide (ref. CVC, TRCA, 2010), the minimum separation between the underside of an infiltration trench and the seasonally high groundwater level is 1.0 m. As outlined in Section 3.4, depths from surface to groundwater levels will increase under future conditions, ranging in depths of 1.2 m – 9.7 m below proposed ground surface. Infiltration trenches will likely require a depth of at least 500 mm. Therefore, in order to implement an infiltration trench, the minimum depth from surface to groundwater level would have to be at least 1.5 m. Many boreholes did not encounter groundwater during drilling, indicating that there are no restrictions to the depth of infiltration trenches in those areas, up to the termination of the borehole. Infiltration trench feasibility would need to be considered on a location by location basis based on the preceding identified depths.

#### Permeable Pavers/ Pavement

Permeable pavement could be implemented for the entirety, or for sections, of the proposed sidewalks and multi-use trails. Permeable paved sidewalks and multi-use trails would reduce the runoff volume from paved surfaces within the urban road R.O.W. As a standalone LID BMP, however, it would not be able to meet the water balance criteria, as it would treat a limited area and would not treat the roadway itself (which would be expected to generate the largest portion of runoff). It is understood that the Region does not prefer to implement permeable pavement on their projects due to operations/maintenance issues and performance concerns. As such, permeable pavement is not recommended for implementation.

#### **Pervious Pipes**

Pervious pipes could be used in combination with either bioretention systems or infiltration trenches. As a standalone SWM measure, pervious pipes can be a cost-effective and relatively simple method to achieve water balance requirements, while eliminating the need for surface space within the right-of-way.

# Conventional Underground Storage (Cellular Systems)

Modular style plastic chambers (e.g. Brentwood<sup>TM</sup>, StormTech<sup>TM</sup>, Triton<sup>T,</sup> or other equivalent and approved systems), could be considered to achieve water balance requirements. Conventional underground storage can be implemented in a similar manner to subsurface infiltration trenches, receiving runoff that has been captured by catchbasins and/or storm sewers. Conventional underground storage is typically implemented to achieve water quantity requirements; however, these systems often serve also to achieve water balance requirements by making the bottom of the storage tank infiltrative.

#### **Bioretention Systems**

Bioretention systems can be implemented in the pervious areas within the boulevards or island areas (if proposed), similar to at-surface infiltration trenches. Bioretention systems should be approximately 10% to 20% in size of the contributing drainage area, with typical drainage areas of 0.50 ha and a maximum drainage area of 0.80 ha. Slopes within bioretention systems are typically 1% to 5%. Bioretention systems are also preferred in areas that have reasonable infiltration properties



(15 mm/hr, 1 x  $10^{-6}$  cm/s), but can be implemented in all soil types as long as the water quality event can be temporarily stored (typical depths 0.15 m to 0.25 m) before infiltrating and an underdrain is provided. Bioretention systems should have forebays for a form of surface water pre-treatment. Catchbasins fitted with goss traps can be used to filter out floatable debris before directing runoff to the infiltrative component of the bioretention system.

#### **Enhanced Grassed Swales**

Grassed swales designed with a trapezoidal geometry and flat longitudinal profiles with largely unmaintained turf can provide infiltration, similar to bioretention cells. Their application in linear corridors is particularly appropriate and can be further enhanced through the introduction of check dams to provide additional on-line storage. Their application in urbanized roadway cross-sections (i.e. curb and gutter) often requires alternative grading and roadway configurations which can compromise the function of the roadway itself and are therefore typically not preferred in those cases. Notwithstanding, gutter outlets along outside lanes have been demonstrated to function effectively where the right-of-way can accommodate the design. Based on the proposed ultimate urbanized road R.O.W., enhanced grassed swales are likely not a practical water balance measure.

#### Filter Strips

Filter strips are typically designed for small drainage areas (less than 2 ha  $\pm$ ) and are applied as part of a treatment train. Filter strips require flat areas with slopes ranging from 1 to 5% and are usually in the range of 10 to 20 m in length in the direction of flow. Flow leaving filter strips should be a maximum of 0.10 m depth, based on a 10 mm storm event. Based on the limited space within the proposed R.O.W.s, filter strips are likely not a practical water balance measure.

Based on the foregoing review, the following LID BMPs have been short-listed:

- Infiltration Trenches
- Pervious Pavers/Pavement
- Pervious Pipes
- Conventional Underground Storage
- Bioretention Systems

As outlined in Section 3.4.1, the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements. Information pertaining to the manner in which the major and minor systems of the City and Region R.O.W.s would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the advantages and disadvantages of the short-listed LID BMPs should be further reviewed and refined when this information becomes available. This is expected to occur at the detailed design stage.

# 3.8 Assessment of Alternative Drainage Plans

As noted in Section 3.4.3, the MESP recommended that the SWM facilities within the Area 47 development blocks be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements (ref. Figure 3-2). This approach requires formal agreement between the City, Region, and private landowners to allow for R.O.W. drainage to enter development blocks. However, the City and Region advised that these discussions with private landowners have not yet reached a positive conclusion by the time of writing of this report. As a result, the SWM approach advanced in the MESP may no longer be a viable approach.



As a formal agreement has not, to date, been established between the City, Region, and landowners, the requisite water quantity, water quality, and erosion control SWM requirements for the R.O.W. drainage may need to be implemented within the R.O.W. In this context, discussions between the City and Region are ongoing on the issue of possible management of roadway stormwater runoff from each other's R.O.W.'s. Further discussions are required in this regard and any agreement may influence the design of SWM systems for this development area.

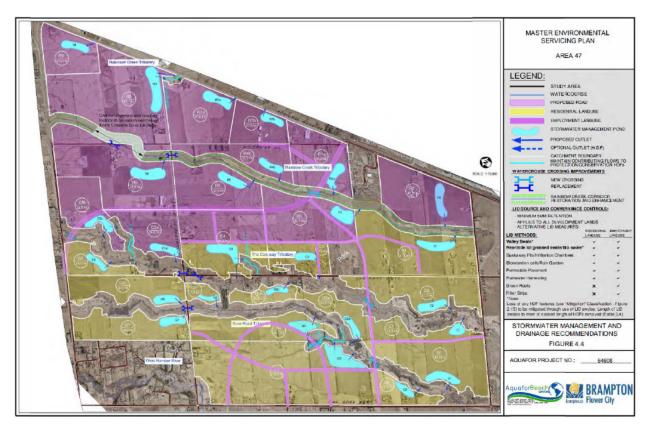


Figure 3-2 MESP SWM and Drainage Recommendations – Locations of Facilities

As noted in Section 1.0, the study scope of this assessment includes both City and Region roadways. Part A includes Region owned R.O.W.'s and Part B includes City owned R.O.W.'s. As has been noted, R.O.W.'s included as components of Part A are:

- 1. Arterial A2, a new six-lane north-south major arterial road, extending from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50; and,
- 2. Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50.

A general evaluation of stormwater management alternatives will typically include the following scenarios:

- Do nothing
   For this evaluation, the *Do Nothing* scenario cannot be advanced as it would not address Region and/or City requirements for stormwater management.
- All LIDs within the ROW
   Similarly, LIDs facilitate stormwater control promote infiltration and pollutant removal on a local site by site basis. The benefits from LID storm water management practices are focused on more frequent



storm events (e.g., 2-year storm) of lower volumes as opposed to the less frequent storm events (e.g., 100-year storm) with higher volumes. As such, some form of SWM controls is required to address the less frequent storm events.

Combination of LIDs and adjacent land SWM facilities

As noted in Section 3.4.1, a premise for design of the stormwater quantity, quality and erosion features required for all the roadways within the Study Area is that these control features/facilities are provided by the internal development blocks within Area 47. This approach is recommended for the Arterial A2 R.O.W. is consistent with the *Combination of LIDs and adjacent land SWM facilities* scenario.

However, the feasibility of internal development blocks SWM controls servicing the R.O.W. along Coleraine Drive has been brought into question by the adjacent landowners. As such, preliminary evaluation of alternatives has been completed as outlined in Section 3.8.1.

# 3.8.1 Coleraine Drive Drainage Planning

Two alternative stormwater management options have been considered for the Coleraine Drive R.O.W., namely (ref Appendix E):

- 1. Alternative #1 Redirecting R.O.W. drainage from Subcatchments CR4, CR5, CR6, CS6 and A7, away from SWMFs R7b and R4b, to SWMF R4a.
  - A high-level review of alternative (1) has been completed based on the following:
  - **a**) Determine Technical Feasibility of Alternative Drainage Plan: confirmation of sufficient elevation to support a gravity conveyance system to SWMF R4a.
  - b) Preliminary Storm Sewer Design for Alternate Drainage Plan: preparation of a preliminary storm sewer design and layout for the noted drainage scenario.
  - c) Hydrologic Modelling: development of a hydrologic model to simulate the 100-year stormwater runoff in support of the assessment of the feasibility of redirection of runoff to SWMF R4a.
  - d) Costing: development of a high-level cost of the preliminary storm sewer design and alternate storage framework for the noted drainage concept.
  - Each of these component tasks is documented in Appendix E.
- 2. Alternative #2 Redirecting R.O.W. drainage to a new SWM facility to be located (under discussion) in the north-west quadrant of the intersection of Coleraine Drive and Arterial A2 as illustrated in Figure 3-2.

The multi-lateral discussions have not reached conclusion, regarding SWM facility location, at the time of writing of this report. However, the developer group has generally agreed to locate the proposed stormwater management near the intersection of Coleraine Drive and future Arterial Road A2 that will accommodate storm runoff from the realigned Coleraine Drive (ref. Agreement from

in Appendix D). Further, the exact facility location, dimensions and design details will be determined during future phases of work. Discussions between the Region of Peel and City of Brampton have concluded that the Region of Peel will arrange for the design and construction of the stormwater management pond and the City of Brampton will accept conveyance and maintenance of the pond after the maintenance/warranty period. As Alternative #1 is considered viable, as demonstrated by the assessment outlined in Appendix E, it is presupposed that Alternative #2 will also be found to be viable technically and should be of similar cost. As such, this scenario should be further evaluated during detailed design and the R.O.W. drainage, per the catchments divide provided in this



SWM report (ref Appendix C Plans 6, 7 and 8), be the responsibility of the adjacent landowners to accommodate.



Figure 3-3 Approximate Location of Possible Future SWM Facility

(background image source Google Earth  $Pro^{TM}$ )

#### 4.0 HYDRAULICS

# 4.1 Purpose

Hydraulics relates to the calculation of water surface elevations and velocities for the design storm peak flows generated by the hydrologic models and supports assessment of hydraulic structure performance (i.e. capacity, overtopping conditions, etc.) and delineation of floodplains. Structures included in this evaluation are outlined in Table 4-1 and illustrated in Figure 4-1.

This report section documents the evaluation of crossings G, H and I.

**HEC-RAS Reference Project** Crossing Watercourse **Crossing Location** Reference Component River Reach Section ı Reach-1 24.4425 River-4 Coleraine Drive proposed intersection of Part A G River-4 Reach-1 24.343 Rainbow Creek Coleraine Drive and E-W Arterial A2 River-4 24.424 Н Reach-1 Countryside Drive В Gore Road Trib Reach1 1412.42 Countryside Drive Gore Road Tributary Α Gore Road Trib Reach1 1410.052 E-W Arterial A2 Part B Ε Clarkway Trib Reach3 1512.505 Countryside Drive D Clarkway Trib Reach2 1512.372 Clarkway Drive Clarkway Tributary F Reach 11 356.6 River11 Clarkway Drive C Clarkway Trib Reach31 1510.123 E-W Arterial A2

Table 4-1 Structures included for Assessment for Parts A and B

# 4.2 Methodology

TRCA provided Wood with the current Rainbow Creek HEC-RAS models (ref. email correspondence Chekol-Parajuli, dated Mach 11, 2019). It is understood that the models were most recently updated by Candevcon Limited (CDC) and The Municipal Infrastructure Group (TMIG) in January 2018 to reflect the Rainbow Creek realignment proposed by the MESP Addendum (ref. Savanta, January 2018). As per the email correspondence, Wood is of the understanding that the provided models are approved for use in the current study.

Two (2) models were provided by TRCA. It is understood that the two models are identical, with the exception of the steady flow files assigned in each model. One (1) model contains steady flow files for the 2-year to 100-year storm events and the other model contains the steady flow files for the Regulatory conditions. It is understood that the Regulatory model is to be utilized to simulate the Regional Storm steady flow profile. Lastly, as per the model description box, it is understood that the steady flow files are representative of the 2016 TRCA hydrology update (for River-4 Reach 1, only). It is noted that, to Wood's knowledge, the steady flow values contained in the steady flow files are not reflective of climate change projections. Per Section 7.2.2 of the Region's SWM Criteria (2019), the Region has a four (4) step process for considering climate change resiliency in the design of SWM infrastructure. As such, Wood recommends that climate change influences be assessed at the detailed design stage.

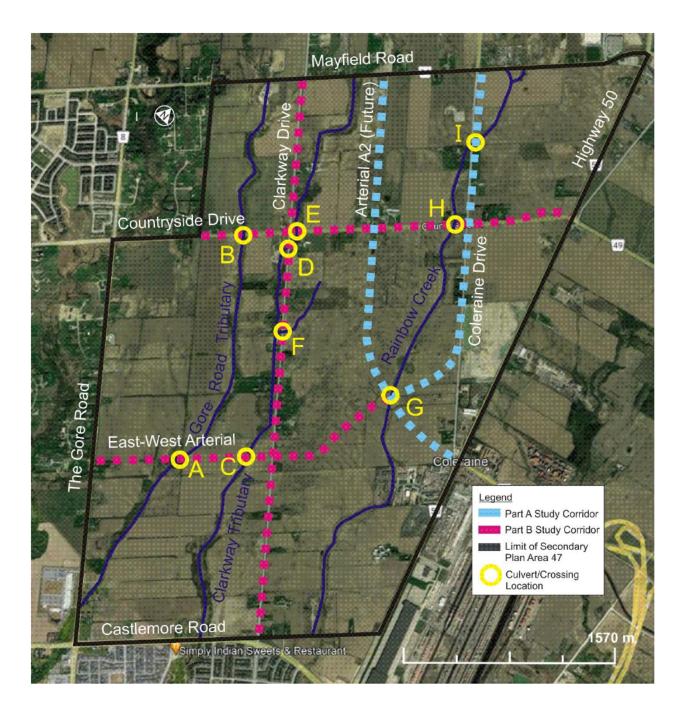


Figure 4-1 Structures included for Assessment for Parts A and B

(background image source Google Earth Pro™)

The model representing the 2-year to 100-year storm events contains six (6) plans. It is understood that the plan file named "Existing Condition Updated Flows" is representative of the geometry and flow conditions for the existing conditions of the Study Area, and the plan named "Scenario A" is representative of the geometry and flow conditions for the proposed conditions of the realigned Rainbow Creek through the Study Area. Similarly, the model representing the Regulatory conditions contains three (3) plans. It is understood that the plan file named "Existing Condition Updated Flows" is representative of the geometry and flow conditions for the existing conditions of the Study Area, and the plan named "Proposed Ultimate Condition" is representative of the geometry and flow conditions for the proposed conditions of the realigned Rainbow Creek through the Study Area. As such, hydraulic assessments of the existing and proposed conditions have been carried out using these plan files.

The Rainbow Creek hydraulic model extends from its confluence with the Main Humber River at Highway 407 (downstream limit) to about Kirby Road (upstream limit). Only one (1) of the west branches of the Rainbow Creek model is relevant to the current study as it is the only branch that drains Part A of the Study Area. This branch of the Rainbow Creek is designated River4-Reach 1 in the HEC-RAS model.

The provided HEC-RAS models have been revised for the evaluation of the proposed structures. Revisions include adjustments to the Coleraine Drive culvert (ref. Figure 4-1, Culvert I) and an additional structure added at the proposed intersection of Coleraine Drive and Arterial A2 (ref. Figure 4-1, Culvert G). Note that the Rainbow Creek crossing at Countryside Drive (ref. Figure 4-1, Culvert H) has also been sized and included in the proposed conditions model to ensure that the hydraulic impact of this proposed crossing is represented. The Countryside Drive crossing evaluation, however, is included as a component of the Part B Report.

Note that boundary conditions in the TRCA provided HEC-RAS models were not changed for this evaluation.

# 4.3 Hydraulic Structure Performance Assessment

# 4.3.1 Hydraulic Structure Sizing Criteria

The hydraulic assessment of the Study Area has considered design criteria from several agencies including, the Region, the MTO, and the Ministry of Natural Resources and Forestry (MNRF) as follows.

#### Region of Peel

No overtopping of the roadway during the Regional Storm Event is to occur at culverts and bridges.

#### **MTO**

MTO guidelines for culvert and bridge hydraulic design are based on providing a set freeboard and clearance. Freeboard is measured from the design event water surface elevation to the edge of travelled way. Clearance is measured from the design event water surface elevation to the obvert of the crossing. The design event, freeboard and clearance required consider the road classification and the total structure span. MTO guidelines are summarized in Table 4-2. The existing crossings have been assessed based on the future road classifications which are proposed to be classified as Urban Arterial.

#### **MNRF**

The MNRF's guidelines relate to the safe passage of pedestrians and passenger and emergency vehicles across the length of road over which the Regulatory storm event may overtop. Safe passage is determined by overtopping depths, overtopping velocities and consideration for the combined impact (i.e. product of depth and velocity) and represents 'low risk' to the method of transportation (i.e. pedestrian or vehicle). Table 4-3 summarizes the maximum allowable depths and velocities.



Table 4-2 Design Flow Return Period for Bridges and Culverts (Years) – Standard Road Classification

	MT	O <sup>1</sup>		Classian	Clearance Criteria for Open-Footing Culverts (m) <sup>1,2</sup>	
Functional Road Classification	Total Span less than or equal to 6.0 m	Total Span greater than 6.0 m	Freeboard Criteria (m) <sup>1</sup>	Clearance Criteria for Bridges (m) <sup>1</sup>		
Freeway, Urban Arterial	50	100	1.0	1.0	0.3	
Rural Arterial, Collector	25	50	1.0	1.0	0.3	
Local	10	25	0.3	0.3	0.3	

#### Note(s)

- 1. Highway Drainage Design Standard (MTO, January 2008)
- 2. It is noted that there are no clearance criteria for closed-footing culverts

Table 4-3 Design Criteria for Pedestrian and Vehicular Access

Access	Maximum Overtopping Depth (m)	Maximum Overtopping Velocity (m/s)	Maximum Product (m²/s)
Pedestrian	0.3	1.7	0.4
Passenger Vehicle	0.3	3.0	N/A <sup>1</sup>
Emergency Vehicle	09	4.5	N/A <sup>1</sup>

#### Note(s)

1. Highway Drainage Design Standard (MTO, January 2008)

# 4.3.2 Existing Conditions

All existing roads within the Study Area are proposed to be classified as Urban Arterial in the future and have been assessed on this basis. It is noted that the MNRF criteria are not relevant for the proposed conditions since the travelled way is required to be flood-free for the Regional Storm (ref. Section 4.3.1) as directed by Region of Peel requirements. However, the existing conditions assessment has considered these criteria for information purposes. The criteria for safe passage have been applied assuming ingress/egress for pedestrians. The results of the hydraulic structure performance assessment are summarized in Table 4-4. The HEC-RAS model is provided in Appendix B.

The results outlined in Table 4-4 indicate that the existing Study Area crossing does not meet either the MTO or MNRF design criteria, nor the Region's design criteria to convey the Regional Storm event without overtopping the roadway. Therefore, the existing crossing must be resized for the proposed conditions, in addition to the new crossing for Arterial A2.

Table 4-4 Coleraine Drive Culvert I – Existing Performance

Structure – Culvert I					
Type/Configuration	Concrete Box Culvert Closed Bottom				
Size (m)	2.40 (W) x 0.60 (H) x 10.0 (L)				

MTO Desig	Existing Performance	
Design Event (Return Period)	50 Year	< 2 Year
Freeboard (m)	1 m	Overtopped
Clearance (m)	N/A	N/A

MNRF Design Crite	Existing Performance	
Access mode	Pe	edestrian
Maximum Overtopping Depth (D)	0.3 m	0.16 m
Maximum Overtopping Velocity (V)	1.70 m/s	1.85 m/s
Maximum Product (D x V)	0.4	0.3

#### Note(s)

- 1. Values in this table reference the design storm conveyance requirement
- 2. The existing conditions Coleraine Drive culvert is referenced as HEC-RAS section 24.475

# 4.3.3 Proposed Conditions

As outlined in Section 1.0, the future conditions for Part A of the Study Area proposes a new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50 and widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50. Due to the realignment of the Rainbow Creek, Culvert I is proposed to be relocated under Coleraine Drive, and has a HEC-RAS reference of River-4/Reach-1/24.4425 under proposed conditions. The proposed Arterial A2 roadway and reconstructed Coleraine Drive are proposed to intersect at Rainbow Creek (ref. Plans 4 and 8, Appendix C), therefore an additional crossing along Rainbow Creek is required at this location (Culvert G having HEC-RAS reference River-4/Reach-1/24.343).

The proposed crossings have been sized using the Rainbow Creek HEC-RAS model provided by TRCA. The geometry files representing the proposed conditions of the realigned Rainbow Creek have been revised, including adjustments to structure coding, as well as the addition, removal and adjustment to bounding cross sections. Geometries for the added cross sections have been estimated by interpolating between two (2) original cross sections contained in the received model (ref. Appendix B for HEC-RAS model details). The Part A crossings have been sized to meet the criteria outlined under Section 4.3.1 with the proposed configurations outlined in Table 4-5.

**Table 4-5 Culvert I and G Proposed Configurations** 

Culvert	Span (m)	Rise (m)	Length (m)	Description
I (Coleraine Drive)	17.0 m	2.2 m	47.3 m	Bridge to replace the existing culvert crossings at Coleraine Drive (Culverts at HEC-RAS Section 24.475 in the existing conditions model)
G (Arterial A2/ Coleraine Drive)	25.0 m	2.5 m	75.0 m	New bridge crossing proposed at the intersection of Arterial A2 and Coleraine Drive.

The hydraulic performance of the proposed Crossing I and G is summarized in Table 4-6. The results indicate that the proposed sizes for the two (2) crossings within the Study Area satisfy both the MTO and Region design criteria. As previously noted, the MNRF criteria are not relevant for the proposed conditions as the travelled way is required to be flood-free for the Regional Storm (ref. Section 4.3.1). As such, the results for the MNRF criteria have not been presented.

Coleraine	Drive - Culvert I	MTO Desi	gn Criteria	Hydraulic Performance
Type/Configuration	Bridge	Design Event (Return Period)	100-Year	Regional
Size (m)	17.0 (\A() \cdot 2.2 (\L) \cdot 47.2 (\L)	Freeboard (m)	1 m	1.54 m
Size (m)	17.0 (W) x 2.2 (H) x 47.3 (L)	_		

Clearance (m)

0.3 m

0.8 m

Table 4-6 Part A Crossings - Proposed Configuration Hydraulic Performance

Countryside	Drive – Culvert G	MTO Desi	gn Criteria	Hydraulic Performance
Type/Configuration Bridge		Design Event (Return Period)	100-Year	Regional
Ciza (m)	25 0 (M) × 2 5 (H) × 75 0 (H)	Freeboard (m)	1 m	2.84
Size (m)	25.0 (W) x 2.5 (H) x 75.0 (L)	Clearance (m)	1.0 m	1.39

Tables 4-7 and 4-8 summarize the comparison of existing and proposed conditions along Rainbow Creek from Highway 50 to Mayfield Road. It is noted that there are no changes in computed water surface elevations or computed channel velocities between proposed and existing conditions downstream of Old Castlemore Road, where no changes are contemplated as part of the Area 47 development plans.

Between Old Castlemore Road and Mayfield, channel alterations are contemplated, as are new and replaced watercourse crossings at roadways (specifically culverts G, H and I). In this reach of Rainbow Creek, the reconfiguration of the HEC-RAS model to model proposed conditions does not allow direct comparison, section for section, with the existing conditions model, however, the following observations are noted:

- Between Old Castlemore Road and the new structure proposed at the intersection of Arterial A2 and Coleraine Drive, computed water surface elevations for proposed conditions are generally lower than those computed under existing conditions, for both Regional and 100-year flood conditions.
- Between the new structure proposed at the intersection of Arterial A2 and the new Countryside Drive culvert, computed water surface elevations for proposed conditions are generally higher than those computed under existing conditions, for both Regional and 100-year flood conditions.
- Between the new Countryside Drive culvert and the new culvert on Coleraine Drive, computed water surface elevations for proposed conditions are generally higher than those computed under existing conditions, for both Regional and 100-year flood conditions.
- Between the new culvert on Coleraine Drive and Mayfield Road, computed water surface elevations for proposed conditions are generally higher than those computed under existing conditions, for both Regional and 100-year flood conditions.
- At Mayfield Road, water surface elevations are computed as being 18 cm and 15 cm higher, respectively, for the Regional Flood and 100-year Flood conditions.

Table 4-7 Rainbow Creek (River-4/Reach-1) – Comparison of Existing and Proposed Hydraulic Conditions – Regional Flood Event

		Proposed Conditions		Existing Conditions		Change in	
HEC-RAS Section	Profile	Water Surface Elevation (m)	Channel Velocity (m/s)	Water Surface Elevation (m)	Channel Velocity (m/s)	Water Surface Elevation (m)	Channel Velocity (m/s)
		A	В	C	D	=A-C	=B-D
24.52	Regional	228.90	3.00	228.72	3	0.18	0
24.51	Regional	226.96	2.58	226.73	1.89	0.23	0.69
24.5	Regional	226.11	1.87	225.57	2.9	0.54	-1.03
24.49	Regional	225.05	2.11	223.92	2.2	1.13	-0.09
24.46	Regional	224.00	3.02	222.72	1.42	1.28	1.6
24.45	Regional	223.05	0.98	222.19	2.55	0.86	-1.57
24.445*	Regional	222.91	2.04				
24.4425	Coleraine Drive		<u> </u>	<u> </u>		<u> </u>	
24.4419*	Regional	222.10	3.70				
24.441	Regional	221.59	1.94				
24.44	Regional	221.23	1.51	221.2	1.49	0.03	0.02
24.432*	Regional	220.48	2.46				
24.424 24.417*	Countryside Dr Regional	219.20	2.82			1	
24.417	Regional	218.33	0.80				
24.411	Regional	218.13	1.44	217.8	2.8	0.33	-1.36
24.401	Regional	217.86	1.87	217.0	2.0	0.55	1.50
24.4	Regional	217.08	2.82	216.73	2.52	0.35	0.3
24.391	Regional	216.70	1,22	210170	LIDE	0.00	0.5
24.39	Regional	216.12	3.02	215.83	2.24	0.29	0.78
24.381	Regional	215.61	1.03				
24.38	Regional	215.16	3.07	214.53	2.12	0.63	0.95
24.372	Regional	214.66	2.30				
24.371	Regional	213.96	3.63				
24.37	Regional	213.54	1.72	212.61	2.52	0.93	-0.8
24.362	Regional	212.93	2.31				
24.361	Regional	212.45	1.53				
24.36	Regional	212.28	1.28	211.69	1.01	0.59	0.27
24.351	Regional	211.63	3.47				
24.35	Regional	210.99	2.18	210.92	3.48	0.07	-1.3
24.348*	Regional	210.84	1.50	+			
24.3459	Regional	210.84	0.78				
24.344 24.343	Regional	210.76 on of Coleraine & Arteria	1.31				
24.342	Regional	210.06	2.68	T		T	
24.3415	Regional	209.94	1.97				
24.3409*	Regional	209.72	2.88				
24.34	Regional	209.58	1.95	210.27	1.13	-0.69	0.82
24.33	Regional	208.77	1.77	210.13	1	-1.36	0.77
24.328	Regional	208.58	1.39				
24.322	Regional	208.38	1.61				
24.32	Regional	208.30	1.63	209	4.15	-0.7	-2.52
24.31	Regional	207.95	2.09	208.56	1.65	-0.61	0.44
24.3	Regional	207.78	1.85	208.28	2	-0.5	-0.15
24.29	Regional	207.46	1.76	207.6	2.56	-0.14	-0.8
24.28	Regional	206.61	2.12	207.09	1.42	-0.48	0.7
24.27	Regional	205.72	1.73	206.09	3.1	-0.37	-1.37
24.26	Regional	204.48	2.54	205.12	1.84	-0.64	0.7
24.25	Regional	204.18	1.00	204.18	2.72	0	-1.72
24.24	Regional	204.14	0.66	204.08	1.15	0.06	-0.49
24.235	Old Castlemore		2 27	202.42	2 27	1 ^	^
24.23 24.22	Regional Regional	203.43 203.09	2.37 2.30	203.43 203.09	2.37 2.3	0	0
24.22	Regional	203.09	1.92	203.09	1.92	0	0
24.21	Castlemore Ro		1,34	202.13	1.34		<u> </u>
24.203	Regional	201.79	3.10	201.79	3.1	0	0
24.19	Regional	201.58	1.87	201.58	1.87	0	0
24.18	Regional	201.58	0.41	201.58	0.41	0	0
24.17	Regional	201.58	0.2	201.58	0.2	0	0
24.16	Regional	201.57	0.27	201.57	0.27	0	0
24.155	Highway 50						



Table 4-8 Rainbow Creek (River-4/Reach-1) – Comparison of Existing and Proposed Hydraulic Conditions – 100-Year Flood Event

		Proposed Conditions Existing Conditions Change					e in
		Water Surface	Channel	Water Surface	Channel	Water Surface	Channel
HEC-RAS	Profile	Elevation	Velocity	Elevation	Velocity	Elevation	Velocity
Section		(m)	(m/s)	(m)	(m/s)	(m)	(m/s)
		Α	В	С	D	=A-C	=B-D
24.52	100-yr	228.93	3.18	228.78	3.11	0.15	0.07
24.51	100-yr	227.01	2.6	226.79	1.94	0.22	0.66
24.5	100-yr	226.16	1.93	225.61	3.02	0.55	-1.09
24.49	100-yr	225.11	2.15	223.97	2.26	1.14	-0.11
24.46	100-yr	224.03	3.18	222.77	1.47	1.26	1.71
24.45	100-yr	223.34	0.84	222.23	2.65	1.11	-1.81
24.445*	100-yr	223.24	1.82				
24.4425	Coleraine Drive	2					
24.4419*	100-yr	222.16	3.91				
24.441	100-yr	221.65	1.96				
24.44	100-yr	221.31	1.52	220.94	2.05	0.37	-0.53
24.432*	100-yr	220.58	2.56				
24.424	Countryside Dr	rive					
24.417*	100-yr	219.27	2.95				
24.411	100-yr	218.39	0.8				
24.41	100-yr	218.19	1.52	217.86	2.88	0.33	-1.36
24.401	100-yr	217.91	1.94				
24.4	100-yr	217.11	2.97	216.76	2.64	0.35	0.33
24.391	100-yr	216.73	1.33				
24.39	100-yr	216.12	3.05	215.84	2.25	0.28	0.8
24.381	100-yr	215.63	1.03				
24.38	100-yr	215.18	3.08	214.53	2.13	0.65	0.95
24.372	100-yr	214.67	2.32				
24.371	100-yr	213.98	3.65				
24.37	100-yr	213.55	1.74	212.62	2.54	0.93	-0.8
24.362	100-yr	212.95	2.28				
24.361	100-yr	212.42	1.64				
24.36	100-yr	212.24	1.26	211.66	0.99	0.58	0.27
24.351	100-yr	211.6	3.38				
24.35	100-yr	210.94	2.16	210.9	3.39	0.04	-1.23
24.348*	100-yr	210.78	1.51				
24.3459	100-yr	210.78	0.77				
24.344	100-yr	210.71	1.28				
24.343		on of Coleraine & Arteria					
24.342	100-yr	210.03	2.6				
24.3415	100-yr	209.92	1.92				
24.3409*	100-yr	209.7	2.81				
24.34	100-yr	209.54	1.93	210.14	1.26	-0.6	0.67
24.33	100-yr	208.74	1.72	209.97	1.03	-1.23	0.69
24.328	100-yr	208.54	1.41				
24.322	100-yr	208.31	1.73				
24.32	100-yr	208.22	1.55	208.93	3.77	-0.71	-2.22
24.31	100-yr	207.88	2.03	208.61	1.38	-0.73	0.65
24.3	100-yr	207.71	1.79	208.2	1.83	-0.49	-0.04
24.29	100-yr	207.37	1.75	207.56	2.43	-0.19	-0.68
24.28	100-yr	206.44	2.08	206.9	1.2	-0.46	0.88
24.27	100-yr	205.64	1.48	205.9	3.06	-0.26	-1.58
24.26	100-yr	204.18	3.32	204.87	1.78	-0.69	1.54
24.25	100-yr	203.98	0.74	203.97	2.31	0.01	-1.57
24.24	100-yr	203.96	0.45	203.95	0.82	0.01	-0.37
24.235	Old Castlemore		3.05	202.2	3.05	^	^
24.23	100-yr	203.2	2.05	203.2	2.05	0	0
24.22	100-yr	202.51	3.01	202.51	3.01	0	0
24.21	100-yr	202.23	1.51	202.23	1.51	0	0
24.205 24.2	Castlemore Ro	201.61	2.21	201.61	2.21	^	0
	100-yr	201.61	2.21 2.98	201.61 200.84	2.21 2.98	0	0
24.19 24.18	100-yr 100-yr	200.84	2.98 0.64	200.84	2.98 0.64	0	0
						0	0
24.17 24.16	100-yr 100-yr	200.61 200.42	0.24 1.83	200.61 200.42	0.24 1.83	0	0
24.16		200,42	1.05	200,42	1.00	U	U
24,133	Highway 50						



For Tables 4-7 and 4-8, please note that there is not direct section to section comparison available at all locations between the proposed and existing conditions models. This due to the addition of proposed and/or relocated crossings in the proposed model resulting in new sections being added to the model.

The noted increases in computed water surface elevations are limited in spatial extend and are considered easily addressed with limited re-grading and/or landscaped flood proofing measures to ensure no impacts to the adjacent developable lands.

As well, computed channel velocities in some reaches may necessitate implementation of erosion controls.

Figure 4-2 illustrates the existing and proposed condition computed water surface elevation information presented in Table 4-7. As visualized, computed flood extents at the downstream limit of the assessment identify a reduced flooded area. There is some expansion of the floodplain in the mid-reach area south of Countryside Drive, but it is expected that, as noted above, these areas can be easily addressed with limited re-grading and/or landscaped flood proofing measures to ensure no impacts to the adjacent developable lands. Lands north of Countryside Drive benefit from channel realignment to facilitate new crossings which results in reduced roadway flooding and reduced flooding of adjacent lands.

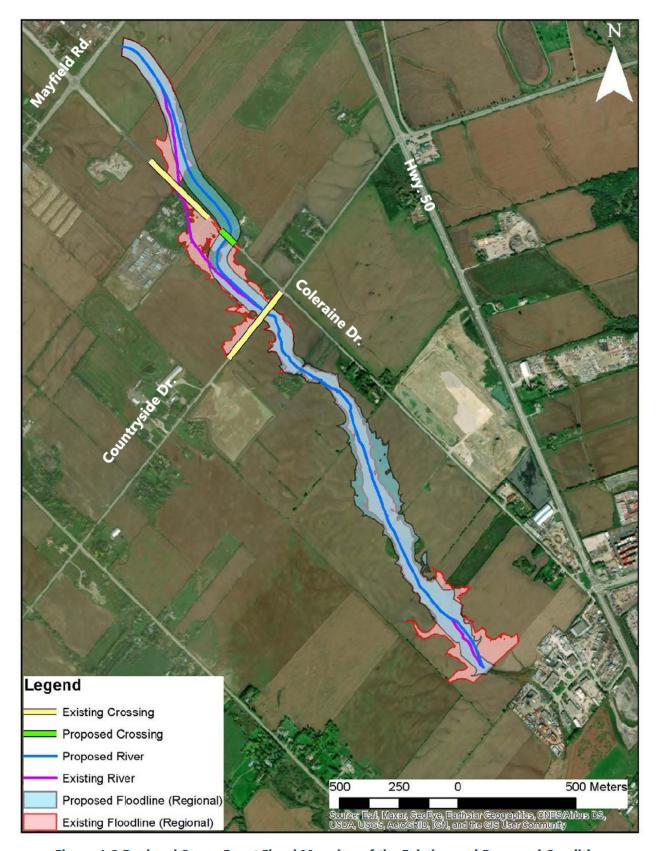


Figure 4-2 Regional Storm Event Flood Mapping of the Existing and Proposed Condition

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# 5.0 CONCLUSIONS AND RECOMMENDATIONS

The City of Brampton has identified through its Transportation and Transit Master Plan (TTMP, 2009), and supporting studies (including the Highway 427 Extension Area Transportation Master Plan and the Highway 427 Industrial Secondary Plan (Area 47) Transportation Master Plan) the need for additional capacity in the road network up to the planning horizon year of 2031. As part of these studies, road network improvements within Secondary Plan Area 47 were recommended. The recommended road improvements are being addressed by the current Class EA in two parts:

#### Part A (Region owned R.O.W.s<sup>5</sup>):

- 1. A new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50; and,
- Widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50; and,

#### Part B (City owned R.O.W.s):

- 3. A new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial);
- Widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with possible continuous centre turn lane; and,
- 5. Widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50.

The following conclusions and recommendations stem from the foregoing hydrologic and hydraulic assessments for the **Part A** right-of-ways.

#### 5.1 Conclusions

- Stormwater management design criteria for the following organizations and sources have been reviewed and integrated as relevant into this evaluation; Toronto and Region Conservation Authority (TRCA), Ministry of Environment and Parks (MECP), Region of Peel, City of Brampton, and the Master Environmental Servicing Plan (2016) and the Master Environmental Servicing Plan Addendum (2018). It has also been noted that the MECP is in the process of issuing a Stormwater Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA) to the Region of Peel.
- 2. The MESP noted that stormwater management planning for this study area be based on the SWM facilities proposed within the Area 47 development blocks being designed to service the City of Brampton and Region of Peel owned right-of-ways for the water quantity, water quality, and erosion control SWM requirements. This approach requires formal agreement between the City, Region, and private landowners to allow for R.O.W. drainage to enter development blocks. However, the City and Region advised that these discussions with private landowners have not yet reached a positive conclusion by the time of writing of this report. As a result, the SWM approach advanced in the MESP may no longer be a viable approach.

As a formal agreement has not, to date, been established between the City, Region, and landowners, the requisite water quantity, water quality, and erosion control SWM requirements for the R.O.W. drainage may need to be implemented within the R.O.W. In this context, discussions between the City and Region are ongoing on the issue of possible management of roadway stormwater runoff from each

5 R.O.W. = road right-of-way



other's R.O.W.'s. Further discussions are required in this regard and any agreement may influence the design of SWM systems for this development area.

- 3. Two alternate stormwater management options for Coleraine Drive have been advanced, namely:
  - a) Alternative #1 Redirecting R.O.W. drainage from Subcatchments CR4, CR5, CR6, CS6 and A7, away from SWMFs R7b and R4b, to SWMF R4a.
  - b) Alternative #2 Redirecting R.O.W. drainage to a new SWM facility to be located in the north-west quadrant of the intersection of Coleraine Drive and Arterial A2.
- 4. The right-of-ways are required to control the runoff from the 90<sup>th</sup> percentile storm event, as per the Region of Peel road reconstruction criteria.
- 5. Based on available borehole logs and groundwater information, the runoff from the 90<sup>th</sup> percentile storm event can be controlled via on-site retention by implementing Low-Impact Development Best Management Practices within the right-of-way.
- 6. The existing crossing of Coleraine Drive does not meet the applicable Ministry of Transportation criteria for freeboard and conveyance, and the applicable Region of Peel criteria for conveyance.
- The proposed crossings of Coleraine Drive and Arterial A2 have been sized to meet the applicable Ministry of Transportation criteria for freeboard, clearance, and conveyance, and the applicable Region of Peel criteria for conveyance.
- 8. A comparison of computed water surface elevations and computed channel velocities under existing and proposed conditions, indicates that changes are expected, within Area 47. HEC-RAS results at the upstream boundary, at Mayfield Road, indicate a small increase in computed water surface elevations of 20 cm and 15 cm, respectively, for the Regional and 100-year Flood events.
- Increases in computed water surface elevations along the study reach are limited in spatial extend and are considered easily addressed with limited re-grading and/or landscaped flood proofing measures to ensure no impacts to the adjacent developable lands.
- 10. Computed channel velocities in some reaches may necessitate implementation of erosion controls.

## 5.2 Recommendations

- 1. The SWM facilities proposed within the Area 47 development blocks are to be designed to service the City of Brampton and Region of Peel owned right-of-ways for the water quantity, water quality, and erosion control SWM requirements. Information pertaining to the manner in which the major and minor systems of the City of Brampton and Region of Peel owned right-of-ways would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the road reconstruction retention volume requirements, as well as the short-listed Low-Impact Development Best Management Practices, should be further reviewed and refined when this information becomes available.
- 2. The developer group has agreed to locate the proposed storm water management pond near the intersection of Coleraine Drive and future Arterial Road A2 that will accommodate storm run-off from the realigned Coleraine Drive (generally drainage areas encompass the Coleraine Drive R.O.W. from north of Countryside Drive, south, to the facility [ref Appendix A for plans depicting catchments]). Further, the exact pond location, dimensions and design details will be determined during future phases of work. Discussions between the Region of Peel and City of Brampton have concluded that the Region of Peel will arrange for the design and construction of the stormwater management pond

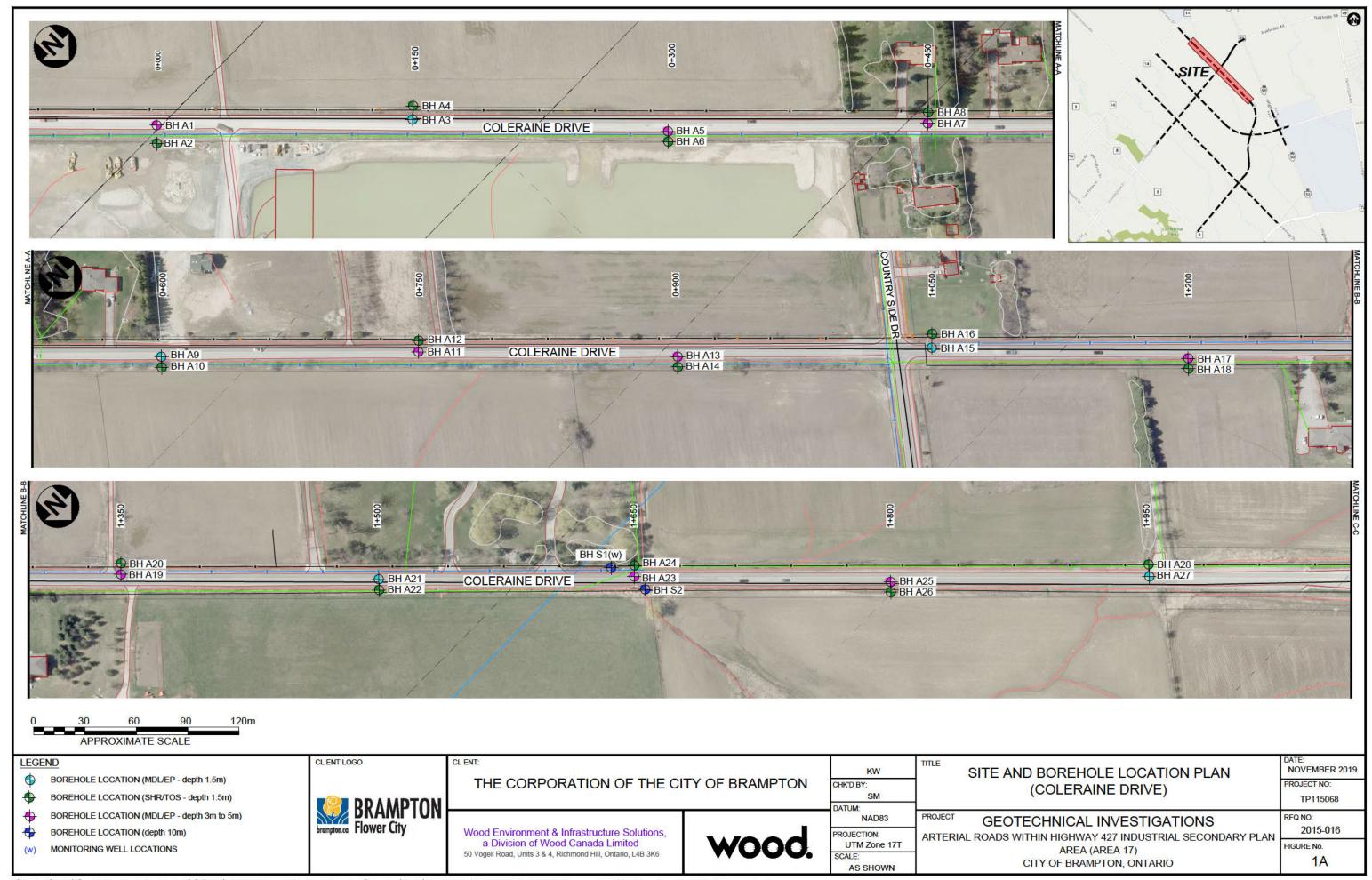


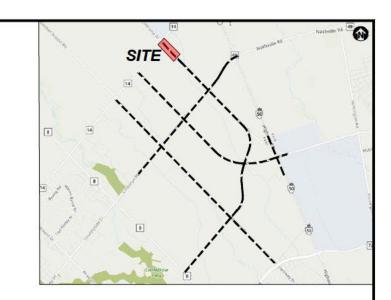
- and the City of Brampton will accept conveyance and maintenance of the pond after the maintenance/warranty period.
- 3. It is recommended that the proposed crossings of Coleraine Drive and Arterial A2 be advanced to the detailed design stage.
- 4. It is recommended that the Region's four (4) step process for considering climate change resiliency in the design of SWM infrastructure should be implemented at the detailed design stage.
- 5. It is recommended that Rainbow Creek alterations or floodproofing measures associated with adjacent developable lands for the reach from Coleraine Drive to Mayfield Road be designed/implemented to achieve a near zero change in computed results between existing and proposed conditions or to accommodate minor changes in computed water surface elevations.
- 6. At the time of completion of the Class EA study, the CLI ECA template and criteria were not available, therefore the Class EA recommendations do not guarantee compliance with the CLI ECA conditions and criteria. It is recommended that at the detailed design stage, the Engineering Consultant re-assess the Class EA recommendations against the CLI ECA criteria and make the necessary adjustments and changes to the stormwater recommendations to be in compliance, where feasible.

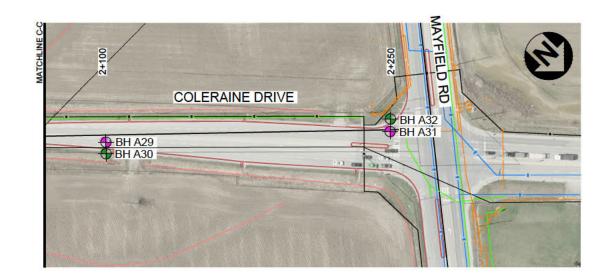
TP115086 | 9/27/2022 Page 35

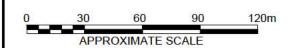
# Appendix A: Background Information











BOREHOLE LOCATION (MDL/EP - depth 1.5m) BOREHOLE LOCATION (SHR/TOS - depth 1.5m) BOREHOLE LOCATION (MDL/EP - depth 3m to 5m) BOREHOLE LOCATION (depth 10m)

MONITORING WELL LOCATIONS

CL ENT LOGO

THE CORPORATION OF THE CITY OF BRAMPTON

Wood Environment & Infrastructure Solutions,

a Division of Wood Canada Limited

50 Vogell Road, Units 3 & 4, Richmond Hill, Ontario, L4B 3K6

**WOOD.** 

CHK'D BY: DATUM:

NAD83 PROJECTION: UTM Zone 17T AS SHOWN

SITE AND BOREHOLE LOCATION PLAN (COLERAINE DRIVE)

**NOVEMBER 2019** 

TP115068

2015-016

1B

PROJECT NO:

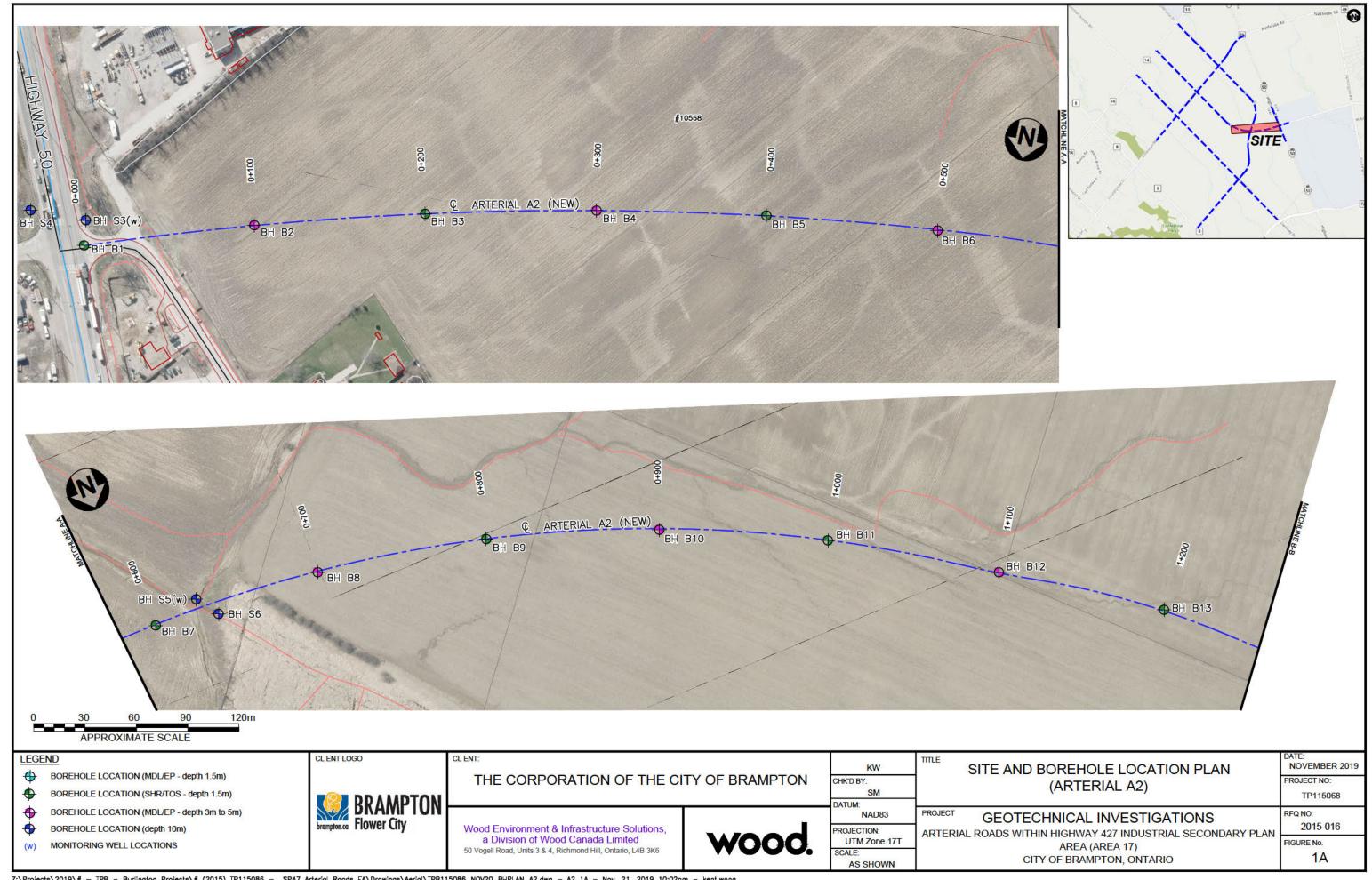
RFQ NO:

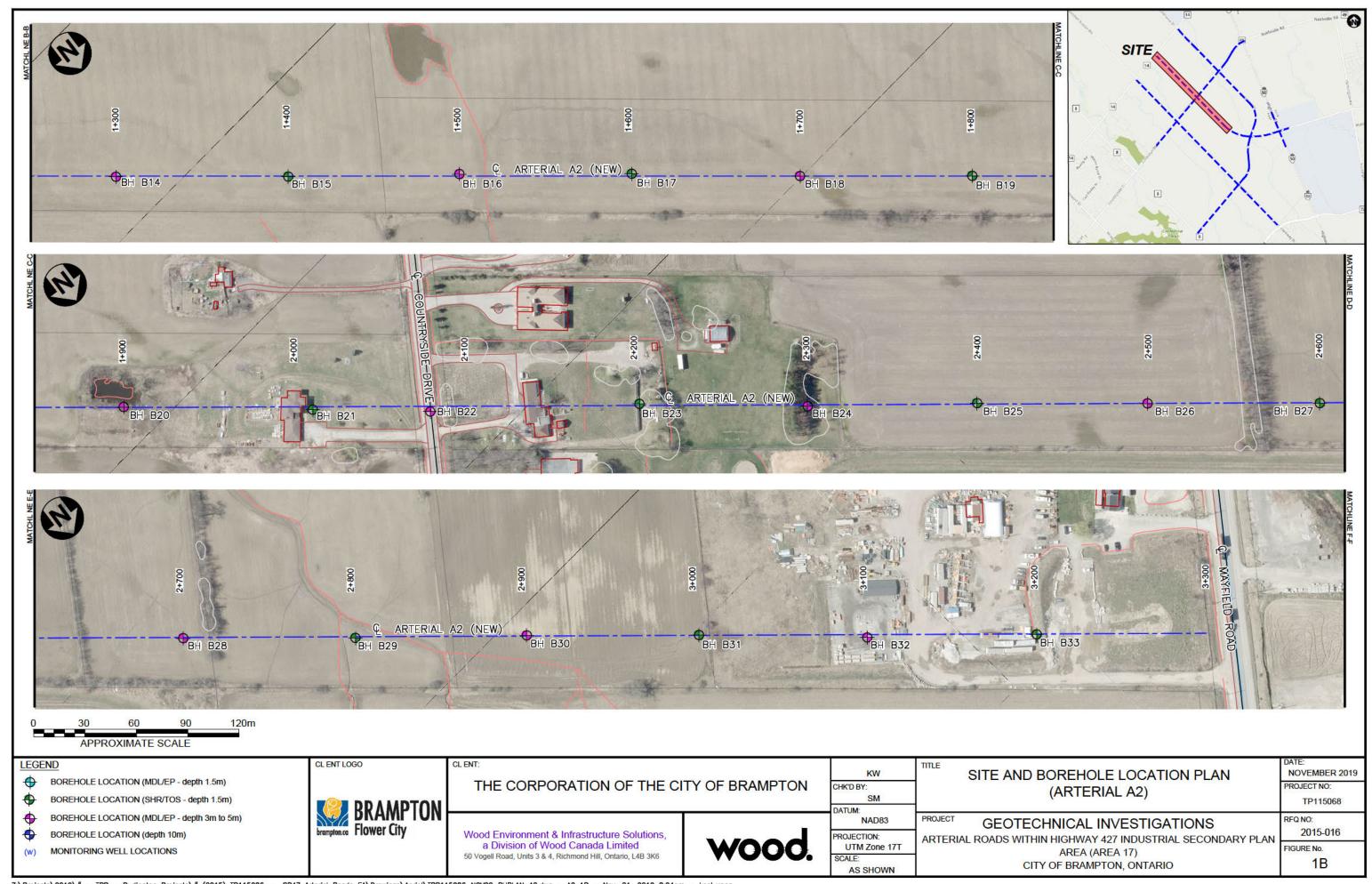
FIGURE No.

**GEOTECHNICAL INVESTIGATIONS** ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA (AREA 17) CITY OF BRAMPTON, ONTARIO

Z:\Projects\2019\# - TPB - Burlington Projects\# (2015) TP115086 - SP47 Arterial Roads EA\Drawings\Aerial\TPB115086\_NOV20\_BHPLAN\_COLERAINE.dwg - COLERAINE 1B - Jan. 09, 2020 7:27am - kent.wong

BRAMPTON Flower City





### RECORD OF BOREHOLE No. BH A1 Project Number TP115086 **Drilling Location** Coleraine Drive E:605646 N:4853212 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name Truck Mounted Drill** Reviewed by SM Area (Area 47) 0, 8/14/20 Coleraine Drive, Brampton, Ontario Jan 21, 2020 Date Completed Jan 21, 2020 Revision No Project Location **Date Started** LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING LAB TESTING** COMMENTS 8 Penetration esting ▲ COV (LEL) ■ TOV (LEL) RUMEN A E O SPT PPT DCPT **GRAIN SIZE** Numbe ROD DESCRIPTION Recovery (%) M O Vane\* Nilcon Vane\* △ Intact ◇ Intact ▲ Remould ◆ Remould <u>y</u> Lithology Plo **ELEVATION** E DISTRIBUTION ż Wp w (%) Sample \* Undrained Shear Strength (kPa) 20 40 60 80 Plastic 20 Liquid 80 SNS GR SA CL 60 SI etic Ground Surface Elevation: 215.5 m about 180 mm ASPHALT 215 3 Sand and Gravel FILL moist dark grey/brown Silty Clay FILL trace gravel trace organics 215 25 10 0 SS 100 014 SS 2 25 83 0 214 0 214 brown/grey SILTY CLAY / CLAYEY SILT TILL SS 3 100 37 0 018 very sti to hard 2 cobbles/boulders 213 014 SS 83 37 0 SS 100 38 012 212 grey sandy SS 6 100 25 0 10 30 45 22 211 °13 SS 7 100 33 0 END OF BOREHOLE

Wood E&IS, a Division of Wood Canada Limited

 $\stackrel{\textstyle 
abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	ECORD OF BOREHOLE N	0.	BH	<b>A2</b>									W	00d.
Pro	ject Number TP115086						Drilling	g Location	Coleraine D	rive E:605	648 N:4853213	3	Logged by	MS
Pro	ject Client City of Brampton						Drilling	g Method	150 mm So	lid Stem A	ugers		Compiled by	PR
Pro	ject Name Arterial Roads within Highway	427 In	dustria	al Seco	ndary l	Plan	Drilling	g Machine	Truck Moun	ted Drill			Reviewed by	SM
Pro	Area (Area 47) ject Location Coleraine Drive, Brampton, On	tario					Date :	Started	Jan 21, 2020	Date	Completed Jan	n 21, 20	20 Revision No	0, 8/14/20
	LITHOLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING		TESTING apour Reading	7	COMMEN	TO
			1.00		(%)		2	The second secon	tion esting	▲ COV (LE	L) TOV (LEL)	NO	COMMEN &	15
Q	DESCRIPTION	ype	Sample Number	(%)	OD (	•	E) N	M O Vane*	PPT DCPT Nilcon Vane*	△ COV (ppr	m) □ TOV (ppm) 00 300 400	RUMEN A	GRAIN SI	
ogy F			e N	very (	N'/ ROD	H (m)	ATIC	△ Intact ▲ Remould	♦ Intact Remould	W <sub>P</sub>	W WL	ALLA	DISTRIBUT	ION
Lithology Plo	Geodetic Ground Surface Elevation: 215.4 m	Sample	Samp	Recovery (%)	8	DEPTH	ELEVATION	* Undrained Sh 20 40	ear Strength (kPa) 60 80	Plastic 20 4	Liquid 0 60 80	SNS	GR SA	SI CL
	Sand and Gravel FILL moist	-	-						1				Ground rozen to about below sur ace	t 300 mm
₩	214 9	SS	1	100	61	-	215 -		0	<b>a</b> )(			bolow sur dec	
▓	dark grey/brown 0.5 Silty Clay FILL													
₩	trace sand trace gravel with oxidation	SS	2	100	10									
₩	214 1	in the second		10.000		- 1	8							
	brown 12 SILTY CLAY / CLAYEY SILT TILL			20.00			214 -							
	trace sand tarce gravel very sti	SS	3	100	29			0						
22	END OF BOREHOLE 18				7	<u>.</u>		<del></del>						
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 $\stackrel{\textstyle 
abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

## RECORD OF BOREHOLE No. BH A3 Project Number TP115086 **Drilling Location** Coleraine Drive E:605516 N:4853330 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Truck Mounted Drill Reviewed by SM Area (Area 47) Coleraine Drive, Brampton, Ontario Date Completed Jan 21, 2020 Revision No 0, 8/14/20 Project Location **Date Started** Jan 21, 2020 LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING LAB TESTING** COMMENTS o Penetration esting ▲ COV (LEL) ■ TOV (LEL) RUMEN A E O SPT PPT DCPT **GRAIN SIZE** Numbe ROD DESCRIPTION M O Vane\* Nilcon Vane\* △ Intact ◇ Intact ▲ Remould ◆ Remould y pe Recovery (%) Lithology Plo **ELEVATION** E DISTRIBUTION ż Wp w W (%) Sample \* Undrained Shear Strength (kPa) 20 40 60 80 Plastic 20 Liquid 80 SNS GR SA CL 60 SI detic Ground Surface Elevation: 216.3 m about 200 mm ASPHALT Sand and Gravel FILL 216 moist dark grey/brown Silty Clay FILL trace gravel trace organics 9 0 SS 50 °29 °26 SS 2 100 12 0 215 SS 3 100 7 0 022 2 214 SILTY CLAY / CLAYEY SILT TILL some sand trace gravel very sti $\overline{\nabla}$ SS 100 20 0 3 18 52 27 END OF BOREHOLE

Wood E&IS, a Division of Wood Canada Limited

Groundwater encountered on completion o drilling on 1/21/2020 at a depth o 2 7 m

R	ECORD	OF BORE	0.	BH	<b>A5</b>									W	000	<b>5</b> .	
Pro	ject Number	TP115086							Drilling	Location	Coleraine Driv	ve E:605408	N:4853441	(i)	Logged by	MS	_
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Soli	id Stem Auge	ers		Compiled by	PR	
Pro	ject Name	Arterial Roads wit	thin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mounte	ed Drill			Reviewed by	SM	
Pro	ject Location	Coleraine Drive, E	Brampton, On	tario					Date S	Started	Jan 21, 2020	Date Con	npleted Jar	21, 2020	Revision No	0, 8/14/	20
	LITH	OLOGY PROFIL	E	SC	IL SA	MPLII	NG			FIELD	TESTING	LAB TE		- C <sub>2</sub>			
					Tex		(%)		-		The state of the s	Soil Vapour  COV (LEL)  2  4	Reading TOV (LEL) 6 8	No.	COMMEN &	ITS	
9		DESCRIPTION		уре	Sample Number	(%)	(c)	(1	E) N	O SPT   M O Vane*	PPT DCPT		TOV (ppm)	RUMEN A	GRAIN SI		
Lithology Plo					ole Nu	Recovery (%)	'N' / ROD (	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact Remould	W <sub>P</sub> W	W <sub>L</sub>	ALLA	(%)	ION	
Litho	Geodetic Ground S	urface Elevation: 216.5 m		Sample	Samp	Reco	8	.daa	e.e.	* Undrained She 20 40	ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	SN	GR SA	SI	CL
XXX	. 100	oout 200 mm ASPHAL Sand and Gravel FILL	216 3				0.00	8 8	- 1		1						
▓		moist brown	21 <b>6 2</b> 0 3				300		216 -			11					
畿	tra	Silty Clay FILL ce gravel trace organi	cs	SS	1	79	12		35	0							
▓			1000000				1	_ 1	35								
%	011 771	brown	2153	SS	2	100	18			0			ļ				
XX	\ silly	CLAY / CLAYEY SILT race sand trace grave very sti	215 0 1 5				- 1		215 -								
	1	END OF BOREHOLE															
										1 1	2 3	3 3	5 35				

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abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	ECORD	ORD OF BOREHOLE No. BH A7																		W	O	0	d.
Pro	oject Number TP115086					Drilling	Locat	tion	Cole	raine D	rive	E:60	5353 N	N:485349	1		Logged by		MS				
Pro	ject Client	City of Brampton							Drilling	Metho	bo	150	mm Sc	olid S	Stem A	ugers				Compiled b	y	PR	
Pro	ject Name	Arterial Roads wi	thin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Mach	ine	Truc	k Moun	nted	Drill				<u>.</u>	Reviewed I	у	SM	
Pro	ject Location	Area (Area 47) Coleraine Drive, I	Brampton, Ont	tario					Date S	Started		Jan 2	21, 2020	0	Date	Compl	leted Ja	n 21, 20	20	Revision N	0	0, 8/1	4/20
	LITH	OLOGY PROFIL	E	SO	IL SA	MPLII	NG			FII	ELD :	TEST	ING		LAB	TEST	ING	· ·					
											enetrat				Soil V	apour Re L)	eding TOV (LEL)	8		COMM		S	
0		DESCRIPTION		•	nber	9	(%) QC	100	E	NI SOUTH PRODUCT			• DCPT	Δ	COV (pp	4 6 om) 🗆	TOV (ppm)	RUMEN A		GRAIN	SIZ		
Sgy PI				e ype	e Nur	ery (9	'N' / ROD (	H (H	EVATION	M O\ △ Inta ▲ Re	act	♦ In	n Vane* tact emould	H	W <sub>P</sub>	00 300 W	0 400 W <sub>L</sub>	SUME		DISTRIB (%	UTI ()	ON	
Lithology Plo	Geodetic Ground	Surface Elevation: 218.2 m		Sample	Sample Number	Recovery (%)	8	DEPTH (m)	E EV	* Undrai			gth (kPa) 80		Plastic 20 4	40 60	Liquid 80	NS NS NS	GR		s	1	CL
_	ai	oout 180 mm ASPHAL	T 218 0		.,		-	-	218 -	-	-			Т									
畿	\	Sand and Gravel FILL moist	21 <b>0 2</b> 0 3					-		1000		mi in			·)								
$\overset{\infty}{\approx}$		dark grey Silty Clay FILL		SS	1	75	11			0				•	ģ	ļ.,							
❈		trace gravel	217 2 0 9					_ 1							.i	ļļ							
	SILTY	CLAY / CLAYEY SILT race sand trace grave very sti	TTILL	SS	2	100	20		217	0				•	ļ								
XX		END OF BOREHOLE	216 6 1 5								+	+		-	•								
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 $\stackrel{\textstyle \nabla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	ECORD	OF BOREHOL	E No	o. ]	BH	<u> </u>												W	20	d
Pro	ject Number	TP115086							Drilling	g Location	Coleraine I	Drive	E:605	353 N:	:4853490	)	Lo	ogged by	MS	
Pro	ject Client	City of Brampton							Drilling	Method	150 mm S	Solid	Stem Au	ugers			c	ompiled by	PR	
Pro	ject Name	Arterial Roads within Hi	ghway	427 In	dustria	al Seco	ndary	Plan	Drilling	g Machine	Track Mou	nted	Drill				R	eviewed by	SM	
Pro	ject Location	Area (Area 47) Coleraine Drive, Brampt	ton, On	tario					Date	Started	Jan 23, 202	20	_Date 0	Comple	eted Ja	n 23, 202	20 R	evision No	0, 8/1	14/20
	LITHO	DLOGY PROFILE	2	SO	IL SA	MPLII	NG			FIELD	TESTING		LAB	TESTI	NG	4 1				
							(0				ation esting		Soil Var	pour Read	ding FOV (LEL)	8		COMMEN	ITS	
		DESCRIPTION		Ф	nber	(9	(%) Q	1000000	E	1,531040000 55940	PPT • DCP	Δ	COV (ppm	6 n) 🗆 T	FOV (ppm)	RUMEN A		GRAIN S		
Jy Pk		DESCRIPTION		уре	Nu	ery (%	'N' / ROD (	(m)	Į.	M O Vane*  △ Intact  ▲ Remould	Nilcon Vane	-	100 20 W <sub>P</sub>	0 300 W	400 W <sub>L</sub>	UME	ı	DISTRIBU (%)	TION	
Lithology Plo				Sample	Sample Number	Recovery (%)	SP OS	DEPTH (m)	ELEVATION	* Undrained Si	near Strength (kPa	)	Plastic	0	Liquid	NS NS A	GR	SA	SI	CL
<u>¬</u>		and and Gravel FILL		S	O	œ	S	_	ш	20 40	60 80	+	20 40	60	80	22	GR	SA	31	CL
₩		trace organics moist	217 5	SS	1	100	14		3	0			dad							
▓		brown Silty Clay FILL	05				1020	-												
₩		trace gravel		SS	2	83	8		217 -											
▓			2167		10. <del>0</del> 0			- 1 -				20.0								
		brown CLAY / CLAYEY SILT TILL	12		-															
		ace sand trace gravel very sti		SS	3	25	20	Ē		0		•								
2/1/2		END OF BOREHOLE	216 1 1 8	-			2		55				1 1							
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### RECORD OF BOREHOLE No. BH A9 Project Number TP115086 **Drilling Location** Coleraine Drive E:605252 N:4853597 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Truck Mounted Drill Reviewed by SM Area (Area 47) 0, 8/14/20 Coleraine Drive, Brampton, Ontario Jan 21, 2020 Date Completed Jan 21, 2020 Revision No Project Location **Date Started** LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING LAB TESTING** COMMENTS o Penetration esting ▲ COV (LEL) ■ TOV (LEL) RUMEN A E O SPT PPT DCPT **GRAIN SIZE** Sample Numbe ROD DESCRIPTION Recovery (%) M O Vane\* Nilcon Vane\* △ Intact ◇ Intact ▲ Remould ◆ Remould y pe Lithology Plo **ELEVATION** E DISTRIBUTION ż Wp w (%) \* Undrained Shear Strength (kPa) 20 40 60 80 Plastic 20 Liquid 80 SNS GR SA CL 60 SI etic Ground Surface Elevation: 219.1 m about 190 mm ASPHALT Sand and Gravel FILL moist dark grey/dark brown 013 10 0 SS 75 Silty Clay FILL trace gravel brown/grey SILTY CLAY / CLAYEY SILT TILL 218 017 SS 2 21 trace sand trace gravel trace cobbles very sti to hard 63 0 012 SS 3 100 72 2 217 SS 100 44 0 013 216 °13 SS 100 66 0 grey SS 6 100 34 215 0 011 7 33 SS 100 0 °11 END OF BOREHOLE

Wood E&IS, a Division of Wood Canada Limited

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abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	ECORD OF BOR	D OF BOREHOLE No. BH A10																	W	ood.
Pro	oject Number TP115086							Drilling	Loca	ation	Cole	eraine D	rive	E:605	253 N	:4853600	)	Lo	gged by	MS
Pro	oject Client City of Bram	pton						Drilling	Meth	nod	150	mm Sc	olid S	Stem A	ugers			Co	ompiled by	PR
Pro	oject Name Arterial Road Area (Area 4	ds within Highway	427 In	dustri	al Seco	ndary	Plan	Drilling	Mac	hine	Trac	k Moun	nted	Drill				Re	eviewed by	SM
Pro		rive, Brampton, On	tario					Date \$	Starte	d	Jan	23, 202	0	_Date	Comple	eted Ja	n 23, 202	20 Re	evision No	0, 8/14/20
	LITHOLOGY PRO	OFILE	SC	OIL SA	MPLI	NG			F	IELD	TEST	ΠNG	2	LAB	TEST	ING	2, 8			
						(9)		_			ation e	Contract of the second	0.0000	COV (LE		TOV (LEL)	S		COMMEN &	ITS
0	DESCRIPTI	ON	уре	mber	(%	(%) do	•	E	1,500,000	T □ Vane*		DCPT on Vane*	Δ	COV (pp	m) 🗆	TOV (ppm)	RUMEN A		<b>GRAIN S</b>	
ogy P				le Nu	/ery (	'N' / ROD (	DEPTH (m)	ELEVATION	Δ In		<b>0</b>	Intact Remould	H	W <sub>P</sub>	00 300 W	400 W <sub>L</sub>	ALLA MLLA		DISTRIBU (%)	IION
Lithology Plo	Geodetic Ground Surface Elevation: 2	19.0 m	Sample	Sample Number	Recovery (%)	8	DEPT	E EV			near Stre	ngth (kPa) 80		Plastic 20 4	0 60	Liquid 80	NS	GR	SA	SI CL
፟፠	Gravelly Sand some ines some	FILL topsoil 218.8											T					27	60	(13)
燚	moist brown/grey	07	SS	1	100	8		- 8	0		1000			)		*******				
❈	Silty Clay Fil trace grave	LL				3														
₩			SS	2	83	12	_ 1	218 -	. 0											
燚	brown	217 8						210	<b>.</b>											
	SILTY CLAY / CLAYE' trace sand trace	Y SILT TILL	SS	3	83	24		8.	1	0										
	very sti	217 2																		
0.688	END OF BORE	HOLE 18																		
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	L									- 8	- 4	.09		90 9	8 80	0.85				

 $\stackrel{\textstyle \nabla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

RI	ECORD OF BOREHOLE N	0.	BH	A11									W	ood	
Pro	ect Number TP115086						Drilling	g Location	Coleraine Dr	ive E:60511	7 N:4853720	ii .	Logged by	MS	_
Pro	ect Client City of Brampton						Drilling	g Method	150 mm Sol	lid Stem Aug	ers		Compiled by	PR	
Pro	ect Name Arterial Roads within Highway Area (Area 47)	427 In	dustria	al Seco	ndary	Plan	Drilling	g Machine	Truck Mount	ted Drill			Reviewed by	SM	_
Pro	ect Location Coleraine Drive, Brampton, On	tario					Date S	Started	Jan 21, 2020	Date Co	mpleted <u>Jar</u>	21, 2020	_ Revision No	0, 8/14/20	0_
_	LITHOLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING		ESTING ur Reading	-	COMMEN	T0	
			_		(%)		Œ	The second secon	tion esting		■ TOV (LEL) 6 8	8	COMMEN &	15	
olo	DESCRIPTION	уре	Sample Number	(%)	'N' / RQD (	•		M O Vane*	Nilcon Vane*	△ COV (ppm)	□ TOV (ppm)	RUMEN A	GRAIN SI DISTRIBUT		
ogy F			Se Z	Recovery (%)	N. /	(m) HJ	ELEVATION	△ Intact ▲ Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> </ul>	W <sub>p</sub> V	The second second	ALLA	(%)	ioit	
Lithology Plo	Geodetic Ground Surface Elevation: 219.9 m	Sample	Samp	Reco	8	DEPTH	P E	* Undrained She 20 40	ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	so so	GR SA	SI C	L
	about 200 mm ASPHALT						- 52								
₩	Sand and Gravel FILL 210 0 moist 0 3														
▩	dark grey Silty Clay FILL	SS	1	25	12			0		24					
燚	Silty Clay FILL trace gravel trace organics trace cobbles 219 0				- 3	١,	219 -								
	brown 0 9 SILTY CLAY / CLAYEY SILT TILL trace sand trace gravel cobbles/boulders	SS	2	58	14	— 1 -		0							
	sti to hard	33	-		17					14					
								1							
		SS	3	83	28	-	218 -	0		14					
					1	_ 2	85								
							35								
		SS	4	100	38			0							
	216 8	33	-	100	30		217 -			14					
A-Z-V	END OF BOREHOLE 3 0					3		1							

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abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD	OF BOREF	IOLE N	0.	BH	A13									WC	000	<b>)</b> .
Pro	oject Number	TP115086						1	Drilling	Location	Coleraine Dri	ve E:605006 I	N:4853836		Logged by	MS	_
Pro	oject Client	City of Brampton						1	Drilling	Method	150 mm Soli	id Stem Augers			Compiled by	PR	
Pro	oject Name	Arterial Roads wit	hin Highway	427 In	dustria	al Seco	ndary P	lan	Drilling	Machine	Truck Mounte	ed Drill			Reviewed by	SM	_
Pro	oject Location	Coleraine Drive, B	rampton, On	tario				1	Date S	Started	Jan 21, 2020	Date Comp	leted Jan	21, 2020	Revision No	0, 8/14/2	0
	LITH	OLOGY PROFILE		SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TEST	TING	- 1			
										Penetra	ation esting	Soil Vapour Re	TOV (LEL)	S	COMMEN &	TS	
9		DESCRIPTION		уре	Sample Number	(%	OD (%)	-	E N	O SPT   M O Vane	PPT • DCPT _ Nilcon Vane*	2 4 6 △ COV (ppm) □ 100 200 30	TOV (ppm)	RUMEN A	<b>GRAIN SI</b>	ZE	
ogy P					le Nu	Recovery (%)	'N' / RQD	(m) H	ELEVATION	△ Intact ▲ Remould	♦ Intact ♦ Remould	W <sub>p</sub> W	W <sub>L</sub>	ALLA	DISTRIBUT (%)	ION	
Lithology Plo	Geodetic Ground S	urface Elevation: 220.2 m		Sample	Samp	Reco	8	DEPTH	E EV	* Undrained St 20 40	near Strength (kPa) 0 60 80	Plastic 20 40 60	Liquid 80	(O) (O)	GR SA	sı c	L
***	ab	out 200 mm ASPHALT	220 0				-		220 -								
▓	<b>1</b>	Sand and Gravel FILL moist	21 <b>9 9</b> 0 3									)()					
▓	trace sar	dark grey/grey Silty Clay FILL and trace gravel trace o	manics	SS	1	67	9			0							
燚		ia adoo gravor adoo o	guino					- 1									
畿				SS	2	83	14		219 -	0	a						
❈		brown	218 6 1 5				l-E										
		CLAY / CLAYEY SILT sand to sandy trace gra	TILL	SS	3	100	36			0							
		cobbles/boulders hard						- 2	040								
							E		218 -								
				SS	4	100	82	=			0 4						
		END OF BOREHOLE	2173 29	5220		03440					1 1		+				
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 $\frac{\nabla}{\pi}$  Groundwater encountered on completion o drilling on <u>1/21/2020</u> at a depth o <u>2.4 m</u>

K	ECORD	ORD OF BOREHOLE No. BH A15													W	000	d. I
Pro	ject Number	TP115086							Drilling	Location	Coleraine Dri	ive E:604898 N	1:4853934	8	Logged by	MS	_
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Soli	id Stem Augers			Compiled by	PR	
Pro	ect Name	Arterial Roads with	nin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mounte	ed Drill			Reviewed by	SM	
Pro	ect Location	Area (Area 47) Coleraine Drive, B	rampton, On	tario					Date S	Started	Jan 22, 2020	Date Compl	eted Jan	22, 2020	Revision No	0, 8/14/	/20
	LITH	OLOGY PROFILE		SO	II SA	MPLII	NG			FIELD	TESTING	LAB TEST	ING	4			
ĺ									-			Soil Vapour Rea	eding	S	COMMEN	ITS	
8		DESCRIPTION			per	•	(%) Q		E	O SPT	PPT • DCPT	2 4 6 △ COV (ppm) □	8	4 N	& GRAIN S	ZE	
ly Plo		DESCRIPTION		уре	Nun	"y (%	'N' / ROD (	Œ	NOIT	M O Vane*  △ Intact	Nilcon Vane*  ♦ Intact	100 200 300 W <sub>P</sub> W	400 W <sub>L</sub>	RUMEN A	DISTRIBUT (%)	TION	
Lithology Plo				Sample	Sample Number	Recovery (%)		DEPTH (m)	ELEVATION	▲ Remould  * Undrained Sh	near Strength (kPa)	Plastic	Liquid	NS N			
	Geodetic Ground S ab	Surface Elevation: 221.5 m Dout 190 mm ASPHALT	221 3	ď	ď	œ	ಹಿ	_		20 40	60 80	20 40 60	80	ZZ	GR SA	SI	CL
888	Abo	out 110 mm CONCRE I		-			- 3										
▓	tra	Silty Clay FILL ce gravel trace organic	29/00	SS	1	46	10	-	221 -	0							
▩		oo graver aaso organis	220 6	Princestia		CTION .											
	SILTY	CLAY / CLAYEY SILT	TILL 09	1000		779721		- 1									
	tı	race sand trace gravel sti	000.0	SS	2	100	8			0							
XX		END OF BOREHOLE	220 0 1 5	10				-	220 -								
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R	ECORD OF BOREHOLE N	о.	ВН	A17									W	ood.
Pro	ject Number TP115086						Drilling	Location	Coleraine Dri	ive E:60478	5 N:4854053		Logged by	MS
Pro	ject Client City of Brampton						Drilling	Method	150 mm Sol	id Stem Aug	ers		Compiled by	PR
Pro	ject Name Arterial Roads within Highway Area (Area 47)	427 In	dustri	al Seco	ndary	Plan	Drilling	Machine	Truck Mount	ed Drill			Reviewed by	SM
Pro	ject Location Coleraine Drive, Brampton, On	tario					Date \$	Started	Jan 22, 2020	Date Co	mpleted Jar	22, 2020	Revision No	0, 8/14/20
	LITHOLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING		ESTING ur Reading			
					(%)		Œ		tion esting	▲ COV (LEL)	TOV (LEL)	8	COMMEN &	
90	DESCRIPTION	уре	Sample Number	(%)	SQD (	•		M O Vane*	Nilcon Vane*		TOV (ppm) 300 400	RUMEN A	GRAIN SI DISTRIBUT	
Lithology Plo			ple N	Recovery (%)	'N' / RQD	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact Remould	W <sub>P</sub> W	And the second	ALLA	(%)	
Litho	Geodetic Ground Surface Elevation: 222.5 m about 200 mm ASPHALT	Sample	Sam	Reco	8	DEP	ELE	* Undrained She 20 40	ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	SSS	GR SA	SI CL
×××	about 200 mm ASPHALT 222 3  Sand and Gravel FILL 220 2					Ē					1777			
▩	moist 0.3					Ē	000							
₩	Silty Clay FILL trace sand and gravel	SS	1	83	9	ŧ	222 -	0	•	°23				
₩	and said and signature					F_1								
₩		SS	2	83	6	Ē		0		32				
燚	221 0 brown 1 5					ŧ	221 -							
	SILTY CLAY / CLAYEY SILT TILL trace sand trace gravel	SS	3	100	20	Ē	FE2:00	0		0				
	very sti to hard	00		100	20	_ 2				26				
	cobbles /boulders					}								
	Southern / Boundary	SS	4	100	41	Ē	220 -	0		1 0 <sub>13</sub>				
			<u> </u>	0.05-00		Ė				13				
						- 3			404					
		SS	5	100	101	Ē			101	014				
						ŧ	219 -							
						Ŧ								
	greyish brown	SS	6	100	45	- 4			) .	<sup>1</sup> 0 <sub>11</sub>				
						ŧ								
		30000	E V/8	6099995	PACE D	E	218 -							
	217 5	SS	7	100	34	E		0		25				
	END OF BOREHOLE 5 0													
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are en	d Fole a Didalon of Wood	-	_		_	_			F-7 - 19		Fn 12#5	d. 55		

Wood E&IS, a Division of Wood Canada Limited 50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www woodplc com  $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	RECORD OF BOREHOLE				BH	A18									W	<b>/</b> C	00	d.
	ject Number	TP115086							1000000000	g Location	Coleraine Driv	network two			Logged by		MS	
Pro	ject Client	City of Brampton							Drillin	g Method	150 mm Solid	d Stem Auge	ers		Compiled	by	PR	
Pro	ject Name	Arterial Roads within Hig Area (Area 47)	ghway	427 In	dustri	al Seco	ndary	Plan	Drillin	g Machine	Truck Mounte	d Drill			Reviewed	by	SM	
Pro	ject Location		on, Ont	tario					Date	Started	Jan 22, 2020	Date Cor	npleted <u>Jar</u>	1 22, 2020	Revision N	lo	0, 8/1	4/20
	LITH	OLOGY PROFILE	20	SO	IL SA	MPLI	NG				TESTING	LAB TE	Reading	NO	COMN	IEN	TS	
Lithology Plo		DESCRIPTION		Sample ype	Sample Number	Recovery (%)	SP 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane* △ Intact ▲ Remould  * Undrained She	PPT ● DCPT  Nilcon Vane*  ◇ Intact ◆ Remould  ear Strength (kPa)	2 4 COV (ppm) 100 200 W <sub>P</sub> W Plastic	W <sub>L</sub>	NS ALLA ON	GRAIN DISTRII (%	BUT 6)		CL
፟፠		Surface Elevation: 222.9 m Sand and Gravel FILL		O	o)	Œ	o,	-	ш	20 40	60 80	20 40	60 80		OK SA		31	OL.
**	tra	trace organics moist brown/dark brown Silty Clay FILL ace gravel with oxidation	222 5 0 4	SS	1	100	17			0			·					
<b>※</b>				SS	2	83	12	1	222 -	0								
Ä	OU 77	brown	12					-					·}···}					
		race sand trace gravel very sti	221 1	SS	3	100	22			0								
12.2		END OF BOREHOLE	18															

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abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

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RI	ECORD OF BOREHOLE N	0.	ВН	A19									WC	ood.
Pro	ject Number TP115086						Drilling	Location	Coleraine Dr	ive E:60470	1 N:4854134	<u> </u>	Logged by	MS
Pro	ject Client City of Brampton						Drilling	Method	150 mm Sol	id Stem Aug	ers		Compiled by	PR
Pro	ject Name Arterial Roads within Highway Area (Area 47)	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mount	ed Drill			Reviewed by	SM
Pro	ject Location Coleraine Drive, Brampton, On	tario					Date \$	Started	Jan 22, 2020	Date Co	mpleted <u>Jar</u>	22, 2020	Revision No	0, 8/14/20
	LITHOLOGY PROFILE	SC	IL SA	MPLII	NG			FIELD	TESTING	LAB TE		_		
			1.00		(%)		-		ion esting	Soil Vapou  COV (LEL)  2  4	TOV (LEL)	S	COMMEN &	TS
0	DESCRIPTION	уре	mper	(%	9	0	E) N	O SPT   M O Vane*	PPT • DCPT. Nilcon Vane*	△ COV (ppm)	□ TOV (ppm) 300 400	RUMEN A	<b>GRAIN SI</b>	
Sgy P			e Nu	ery (	'N' / ROD	H (m	ATIO	△ Intact ▲ Remould	♦ Intact ♦ Remould	W <sub>P</sub> W	WL	ALLA KLA	DISTRIBUT (%)	ION
Lithology Plo	Condition Committee Contract C	Sample	Sample Number	Recovery (%)	8	DEPTH (m)	ELEVATION	* Undrained She 20 40	ar Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	NS		SI CL
Ī	Geodetic Ground Surface Elevation: 222.6 m about 200 mm ASPHALT		.,					20 40			3.0			
₩	Sand and Gravel FILL 220 2 moist 0 3				- 9	E .								
₩	dark grey/brown Silty Clay FILL	SS	1	100	12	Ē	222 -	0		28	4			
₩	trace sand trace organics	- 6				Ė	8							
₩		SS	2	67	12	-1		0						
₩	221 1	33	2	67	12					<sup>0</sup> 17				
	brown 15 SILTY CLAY / CLAYEY SILT TILL						221 -				1 1			
	trace sand trace gravel hard	SS	3	100	34			0		15				
					- 1	_ 2								
		SS	4	100	57		220 -		0					
	219 6	33	4	100	51	-	8.			10°10				
X	END OF BOREHOLE 3 0					_ 3		1	1 8	1 1				

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R	ECORD	OF BORE	HOLE N	0.	BH	A20												W	00	d.
Pro	oject Number	TP115086							Drilling	Location	Colerain	ne Driv	e E:604	693 N	:4854133	3	Lo	ogged by	MS	
Pro	oject Client	City of Brampton	<u> </u>						Drilling	Method	150 mn	n Solid	Stem A	ugers			Co	ompiled by	PR	
Pro	oject Name	Arterial Roads w	ithin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Track M	ounte	d Drill				Re	eviewed by	SM	
Pro	oject Location	Area (Area 47) Coleraine Drive,	Brampton, On	tario					Date S	Started	Jan 23,	2020	Date	Comple	eted Ja	n 23, 202	20 Re	evision No	0, 8/1	4/20
	LITH	OLOGY PROFIL	F I	SO	II SA	MPLII	NG			FIFL D	TESTIN	G	LAB	TEST	ING	S 1				
		020011110111							-	1000	ation esting		Soil Va	pour Rea		NO		COMMEN	ITS	
8		DESCRIPTION			per	~	(%) Q		E	O SPT	PPT •	DCPT	2 4	6	8 TOV (ppm)	4NO		GRAIN S	IZE	
Lithology Plo		DESCRIPTION		ype	Sample Number	Recovery (%)	'N' / ROD (	Œ	EVATION	M O Vane  △ Intact  ▲ Remould	Intact	ane*	100 20 W <sub>P</sub>	00 300 W	400 W <sub>L</sub>	RUMEN A		DISTRIBU (%)	TION	
tholog				Sample	ample	BCOVE		DEPTH (m)	EVA	* Undrained Si	near Strength	(kPa)	Plastic	0	Liquid	NS R	00		01	~
❈	Geodetic Ground	Surface Elevation: 222.4 m Sand and Gravel FILL		Ø	ď	œ	ಹಿ	-	В	20 4	0 60 8	0	20 4	0 60	80	22	GR	SA	SI	CL
₩		moist dark grey/brown	222 1 0 3	SS	1	100	26		222 -	0			)							
❈	trace grav	Silty Clay FILL rel trace organics trace	2450				4760	Ē	222											
**				SS	2	100	12						i							
<b>※</b>		brown	221 3 22 <b>1 2</b>	33		100	12	- 1		1										
AZX.		CLAY / CLAYEY SILT race sand trace grave	T TILL 12	- 4	1				-0.											
	<u> </u>	sti END OF BOREHOLE																		
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R	ECORD	OF BOREHO	DLE N	0.	BH	A21															W	00	d.
Pro	oject Number	TP115086							Drilling	Locatio	n	Coler	aine Dr	rive E	E:604	576 N	N:485425	7	20	Logg	ed by	MS	
Pro	oject Client	City of Brampton							Drilling	Method	t	150 r	nm So	lid Ste	em Au	ugers				Com	piled by	PR	
Pro	oject Name	Arterial Roads within	n Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machin	ie	Truck	Mount	ted Dr	ill					Revie	ewed by	SM	
Pro	oject Location	Area (Area 47) Coleraine Drive, Bra	mpton, On	tario					Date S	Started		Jan 2	2, 2020		Date C	Comp	leted Ja	n 22, 20	20	Revis	sion No	0, 8/	14/20
	LITH	OLOGY PROFILE	ř	SC	IL SA	MPLII	NG			FIE	LD 1	ESTI	NG	L	AB 1	TEST	ING						
												ion est		▲ CC	Soil Vap DV (LEL	pour Re	ading TOV (LEL)	8		C	OMMEN	TS	
0		DESCRIPTION		Φ	nber	(9	(%) QC	10742100	E	O SPT				2 △ CC	OV (ppm	6 1) 🗆	TOV (ppm) 0 400	RUMEN A			& RAIN S		
gy Pk		DESCRIPTION		в уре	N e	ery (9	'N' / ROD (	(m)	EVATION	M O Va  △ Intact  ▲ Remo	t	♦ Int	Vane*	10 W	_	0 300 W	0 400 W <sub>L</sub>	UME		DIS	TRIBUT (%)	ION	
Lithology Plo				Sample	Sample Number	Recovery (%)	ds ds	DEPTH (m)	ELEV/	* Undraine	ed She	ar Streng	gth (kPa)	Pla	astic	0 00	Liquid	NS NS A	GR	2	SA	SI	CL
	Geodetic Ground S	out 200 mm ASPHALT	223 0	0)	0)	Œ	O)	-		20	40	60	80	20	40	60	80		- Oi		- Cont	OI.	OL.
***	\	Sand and Gravel FILL moist	22 <b>0 9</b> 0 3				0		223 -														
❈		dark grey Silty Clay FILL		SS	1	50	10		85	0													
❈	tra	ace sand trace organics					- 8	Ι,	8.			ala.											
❈				SS	2	58	9	_ 1	222 -	0													
<b>※</b>		greyish brown	221 9 221 <b>4</b>	1880	-	10000010		Ė															
	SILTY	CLAY / CLAYEY SILT TI race sand trace gravel	15			Î	2							1				1					
	L	sti END OF BOREHOLE																					
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R	ECORD	OF BOREHO	LE N	0.	BH	A23	/ B	HS	1											W	00	od.
Pro	ject Number	TP115086							Drilling	g Loca	ition	Cole	raine D	rive E:60	04481	N:48543	43		Lo	gged by	MS	
Pro	ject Client	City of Brampton							Drilling	g Meth	od	150	mm So	olid Stem	Augers	5			Co	mpiled b	y PF	1
Pro	ject Name	Arterial Roads within Area (Area 47)	Highway	427 In	dustria	al Seco	ondary	Plan	Drilling	g Mach	nine	Truc	k Moun	ted Drill					Re	eviewed I	by SN	1
Pro	ject Location	Coleraine Drive, Bram	pton, On	tario					Date	Started	1	Jan	20, 2020	Date	Comp	oleted J	Jan 20	, 2020	Re	vision N	o <u>0,</u>	8/14/20
	LITH	OLOGY PROFILE	2	SC	IL SA	MPLI	NG			FI	ELD	TEST	ING		TES Vapour R							
Lithology Plo	Goodetic Ground S	DESCRIPTION  Surface Elevation: 222.8 m		Sample ype	Sample Number	Recovery (%)	SP 'N' RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT  M O  △ Int  ▲ Re	Vane* tact emould ained St	Nilco	● DCPT on Vane* ntact Remould ngth (kPa) 80	△ COV (L 2 △ COV (p 100 W <sub>p</sub>	EL) ■ 4 €	TOV (LEL 8 TOV (ppn 0 400 W <sub>L</sub> Liquid		ALLA ON		GRAIN ISTRIB (%	SIZE	<b>N</b>
~	al	oout 200 mm ASPHALT	222 6 22 <b>0 3</b>		.,			_										534 3434				
***	Silt	brown Sand and Gravel FILL trace to some silt moist dark grey/brown ty Clay / Clayey Silt FILL	03	SS	1	100	7		222 -	0				o °24			, <u>, , , , , , , , , , , , , , , , , , </u>					
	ua	ce gravel trace organics		SS	2	100	5			0				°23								
<b>**</b>		brown	220 6	SS	3	100	8	- - - 2	221 -	0				a 0	31							
	SILTY	CLAY/CLAYEY SILT TILL to some sand trace gravel cobbles/boulders very sti to hard		SS	4	100	30	- 3	220 -		0			<sup>03</sup> 016				ı				
				SS	5	83	53					0		a ₽ <u>16</u> •					1	18	48	33
		grey		SS	6	100	28	- 4 - 4 	219 –		0			<sup>2</sup> 21				I				
				SS	7	100	71	- - - - - 5	218 -				0	o 0 13				ı				
								6	217 -													
				SS	8	100	33		216 -		0			o 22								
								- 7 - 1														
				SS	9	100	86 / 280mm	- 8	215 -				86 280	mm 13								
								- 9	= 214 -													
		END OF BOREHOLE	213 4 9 4	SS	10	80	50 / 100mm					100 г	nm	0 17								
Woo	od E&IS, a Divis ada Limited			ater en	countere	ed on co	ompletio	on o dr	illing on	1/20/20				. Cav	ve in de	pth a ter r	remova	lo auç	gers <u>9 1</u>	<u>l m</u>		

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

## RECORD OF BOREHOLE No. BH A23 / BH S1 Project Number TP115086 Project Name Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)

W	0	0	
VV			•

 Calanaina Daina Bassastan Ontaria				

LITHOLOGY PROFILE										
			MPLI	NG.		3	FIELD TESTING	LAB TESTING  Soil Vapour Reading  COV (LEL) ■ TOV (LEL)	S	COMMENTS
		1.00		(%		-	Penetration esting	▲ COV (LEL) ■ TOV (LEL) 2 4 6 8		&
DESCRIPTION	Ф	ige.	9	) QC		5	O SPT PPT DCPT	△ COV (ppm) □ TOV (ppm)	ZO	<b>GRAIN SIZE</b>
DESCRIPTION	8	N	6)	'N' / RQD (%)	E	2	M O Vane* Nilcon Vane*  △ Intact ◇ Intact → Remould ◆ Remould	100 200 300 400	RUMEN A	DISTRIBUTION
	oldu	ple	over		E	NA.		W <sub>P</sub> W W <sub>L</sub>	A A	(%)
	San	San	Rec	SP	DEF	EE	* Undrained Shear Strength (kPa) 20 40 60 80	Plastic Liquid 20 40 60 80	SS	GR SA SI
50 mm dia monitoring well with lushmount										
sur ace)										
Concrete 00-03 m										
Sand 03-06 m										
Sand Filter 55-61 m										
Screen 61-91m										
	Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m	Sur ace)  Concrete 0 0 - 0 3 m Sand 0 3 - 0 6 m Bentonite 0 6 - 5 5 m Sand Filter 5 5 - 6 1 m	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 0 0 - 0 3 m Sand 0 3 - 0 6 m Bentonite 0 6 - 5 5 m Sand Filter 5 5 - 6 1 m	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m	*Undrained Shear Strength (kPa)  50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m	Somm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m	So mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Concrete 0.0 - 0.3 m Sand 0.3 - 0.6 m Sentonite 0.6 - 5.5 m Sand Filter 5.9 - 6.1 m Screen 6.1 - 9.1 m

R	ECORD	OF BOREHOLE N	0.	BH	A25								WC	od.
	ject Number	TP115086						Drilling	g Location	Coleraine Dr	ive E:604381 N:4854447	<u>il</u>	Logged by	MS
	ject Client	City of Brampton							Method	277200000000000000000000000000000000000	lid Stem Augers		Compiled by	PR
552	ject Name	Arterial Roads within Highway Area (Area 47)	an est	dustria	al Seco	ondary	Plan	1992 1790	200-200-200	Truck Mount	I SATERIA PORTA PERMITA MA RE-		Reviewed by	SM
Pro	ject Location	Coleraine Drive, Brampton, On	tario					Date	Started	Jan 22, 2020	Date Completed	1 22, 2020	_ Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING Soil Vapour Reading	_		
Lithology Plo	Geodetic Ground S	DESCRIPTION  surface Elevation: 225.0 m	Sample ype	Sample Number	Recovery (%)	SP 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT   M O Vane*  A Intact  Remould	tion esting PPT • DCPT Nilcon Vane* • Intact • Remould ear Strength (kPa) 60 80	A COV (LEL) TOV (LEL) 2 4 6 8  a COV (ppm) □ TOV (ppm) 100 200 300 400  W, W W,  B U Ulqid 20 40 60 80	NS RUMEN A ON NS ALLA ON	COMMEN' & GRAIN SI DISTRIBUT (%) GR SA	ZE
	al	oout 200 mm ASPHALT					-	30						
		Sand and Gravel FILL 229 2 2 2 2 2 3 2 3 3 3 3 3 3 3 3 3 3 3	SS	1	100	13			0		13			
	SILTY trace sand	brown/grey 0 9 CLAY / CLAYEY SILT TILL it trace gravel cobbles/boulders very sti to hard	SS	2	100	25	_ 1 _	224 -	0		<sup>3</sup> °13			
			SS	3	75	31	2	223 -	0		a ° 13			
			SS	4	100	76 / 180mm				76 180 mr	n °13			
			SS	5	100	91	_ 3	222 -		0:				
		grey				1000	-	221 -						
		g.cy	SS	6	92	57		221		0 1	<sup>1 0</sup> 11			
		220 0 END OF BOREHOLE 5 0	SS	7	100	74	- - - 5	220 -		0	ı O <sub>12</sub>			

 $\frac{\nabla}{\overline{z}}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD OF BOREHOLE N	0.	BH	A26	Ó								WC	ood.
Pro	oject Number TP115086						Drilling	g Location	Coleraine Dr	rive E:60438	84 N:4854450		Logged by	MS
Pro	oject Client City of Brampton						Drilling	g Method	150 mm So	lid Stem Aug	gers		Compiled by	PR
Pro	oject Name Arterial Roads within Highway Area (Area 47)	427 Ir	ndustri	al Seco	ondary I	Plan	Drilling	g Machine	Truck Mount	ted Drill			Reviewed by	SM
Pro	oject Location Coleraine Drive, Brampton, Or	ntario					Date	Started	Jan 22, 2020	Date Co	ompleted Jar	22, 2020	Revision No	0, 8/14/20
	LITHOLOGY PROFILE	SC	OIL SA	MPLI	NG			FIELD	TESTING		ESTING			
			T @d		(%)		2	The second secon	tion esting		ur Reading TOV (LEL) 6 8	8	COMMEN &	TS
90	DESCRIPTION	уре	Sample Number	(%)	(OD)	•	(m) NC	M O Vane*	PPT DCPT Nilcon Vane*	△ COV (ppm)	□ TOV (ppm) 300 400	RUMEN A	GRAIN SI DISTRIBUT	ZE
Lithology Plo			ole N	Recovery (%)	N'/ ROD	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact Remould	W <sub>P</sub> V		ALLA	(%)	ion
Litho	Geodetic Ground Surface Elevation: 224.4 m	Sample	Sam	Reco	တ္တ	DEP	ELE		ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	SSS	GR SA	SI CL
畿	Sand and Gravel FILL trace organics	-00		400	40		8							
畿	moist 224 0 dark grey/brown 0 4	SS	1	100	19		224 -		,,	1				
▓	Silty Clay FILL trace gravel trace cobbles						8							
▓		SS	2	100	18	- - 1		0						
×	223 2 brown 1 2													
	SILTY CLAY / CLAYEY SILT TILL trace sand trace gravel	SS	3	100	40		223 -							
	hard 222 6 END OF BOREHOLE 1 8									- i - i				
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50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

227134		OF BOREI	HOLE N	0.	BH	A27		D	rilling Locat	ion	Coleraine D	rive E:60425	0 N:485456	3	Logged by	od.
	Project Client City of Brampton								rilling Metho		200000 100000	olid Stem Aug			Compiled by	PR
. 100	ject Name	dustria	al Seco	ndary Pl	_	rilling Mach		Truck Moun				Reviewed by	SM			
-050	ject Location	Area (Area 47) Coleraine Drive,	.tpg	107 191	uuoun	0000	induity i i	99.6	ate Started		Jan 22, 2020	E SEED NO.	mpleted Ja	n 22, 202	Ten 2000 PRODE Stee	0, 8/14/20
	LITH	OLOGY PROFIL	F I	SO	II SA	MPLI	NG	-	FI	FLD	TESTING	LARTE	STING	4		
Lithology Plo		DESCRIPTION		Sample ype	Sample Number	Recovery (%)	(%) Qt	DEPTH (m)	P O SPT  M O \( \Delta \) Inta  A Re	vane*	PPT ● DCPT  Nilcon Vane*  Intact Remould ear Strength (kPa)	Soil Vapo	TOV (LEL) 6 8 D TOV (ppm) 300 400	NS RUMEN A ON	COMMEN & GRAIN SI DISTRIBUT (%)	ZE
1	al	urface Elevation: 226.8 m oout 250 mm ASPHAI	LT 226 6	0,	0,		E		- :	-		20 40				
		brown Silty Clay FILL ace gravel trace cobble	22 <b>6 3</b> 0 3	SS	1	100	13	2	226			o 16				
			225 3	SS	2	100	29	1		0		o <sub>13</sub>				
		brown CLAY / CLAYEY SIL I trace gravel cobble: hard		SS	3	100	41	2	225	0		9 0 <sub>12</sub>				
				SS	4	100	57	2	124		0	<sup>8</sup> 0 <sub>12</sub>				
XX		END OF BOREHOLE	223 8 3 0				1	3		- 1		1 1				

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD	OF BOREHOL												W	00	d				
Pro	ject Number	TP115086							Drilling	Location	Coleraine	Drive	E:604	250 N	l:4854566	6	L	ogged by	MS	
Pro	ject Client	City of Brampton							Drilling	Method	150 mm	Solid	Stem A	ugers			c	ompiled by	PR	
Pro	ject Name	Arterial Roads within H	lighway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mou	unted	Drill				R	eviewed by	SM	
Pro	ject Location	Area (Area 47) Coleraine Drive, Bramp	oton, Ont	tario					Date \$	Started	Jan 22, 20	20	Date	Compl	eted Ja	n 22, 202	20 R	evision No	0, 8/	14/20
	LITH	OLOGY PROFILE	3	SO	IL SA	MPLII	NG			FIELD	TESTING		LAB	TEST	ING	4 .				
							(9		_		tion esting		Soil Va		TOV (LEL)	S		COMMEN &	ITS	
0		DESCRIPTION		9	mber	(%	(%) do	•	E	O SPT   M O Vane*	PPT   DCI  Nilcon Vane	Δ	COV (pp	m) 🗆	TOV (ppm) 400	RUMEN A		<b>GRAIN S</b>		
ogy P				le ype	le Nu	/ery (	'N' / ROD (	H (F	ELEVATION	△ Intact ▲ Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> </ul>		Wp	W 300	W <sub>L</sub>	ALLA MLLA		DISTRIBU (%)	IION	
Lithology Plo	Geodetic Ground S	Surface Elevation: 226.8 m		Sample	Sample Number	Recovery (%)	85	DEPTH (m)	E EV		ear Strength (kP	a)	Plastic 20 4	0 60	Liquid 80	SSS	GR	SA	SI	CL
$\otimes$	ocodeno oronia	Sand and Gravel FILL moist						-												
▓				SS	1	100	46				)		)(							
▓		brown	226 2 0 6	-				-												
▩		Silty Clay FILL trace gravel		SS	2	100	12	_ 1	226 -	0			- j)							
₩		END OF BOREHOLE	225 6			30		•	- 3.			-								
		END OF BOREHOLE	12																	
										1 1										
										1					-					
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										1					-					

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abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

RECORD OF BOREHOLE No. BH A29																	W	00	d
Pro	ject Number	TP115086							Drilling	Location	Colerain	e Driv	e E:6041	157 N:485467	5	Lo	ogged by	MS	
Pro	ject Client	City of Brampton							Drilling	Method	150 mm	Solid	d Stem Au	gers		C	ompiled by	PR	
Pro	ject Name	Arterial Roads wit	hin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mo	ounte	d Drill			R	eviewed by	SM	
Pro	ject Location	Area (Area 47) Coleraine Drive, B	Brampton, On	tario					Date S	Started	Jan 22, 2	2020	Date C	completed Ja	n 22, 20	20 R	evision No	0, 8/1	14/20
	LITH	OLOGY PROFILE	E I	SC	IL SA	MPLII	NG			FIELD	TESTING	•		ESTING	-8 - 1				
							(9)			Penetr	ation esting	4	Soil Vap	our Reading TOV (LEL)	S		COMMEN &	ITS	
0		DESCRIPTION		Q	nber	(%	(%) QC		E		PPT ● D	4	2 4 2 COV (ppm	6 8 ) □ TOV (ppm) ) 300 400	RUMEN A		<b>GRAIN S</b>		
gy P				е уре	e Nur	ery (%	'N' / ROD (	H (m)	EVATION	M O Vane¹ △ Intact ▲ Remould	♦ Intact	-	Wp	W W <sub>L</sub>	LLA		DISTRIBUT (%)	ION	
Lithology Plo	0-14-0-15			Sample	Sample Number	Recovery (%)	SP P	DEPTH (m)	ELEV.	* Undrained Si	near Strength (k	Pa)	Plastic 20 40	Liquid 60 80	NS NS	GR	SA	SI	CL
	Geodetic Ground S	Surface Elevation: 228.6 m Dout 200 mm ASPHAL	228 4	0)	0,	ш.	0,	_		20 4	00 80	+	20 40	00 00				-	
***	\ '	Sand and Gravel FILL moist	22 <b>8 3</b> 0 <b>3</b>				3												
▓		brown Silty Clay FILL		SS	1	100	44	-	228 -		0								
▓	tra	ace gravel trace cobble	s			10	2000			1	Ei.								
**				SS	2	100	10	- 1 -											
$\overset{\infty}{}$			227 1	33	2	100	18			0					1				
***		END OF BOREHOLE	15			5	8		-0.			-	77		1				
													: :						
	Who are a series as a series a		****	- 1	_							-		E1 13875	NG 6				

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

RE	CORD	OF BOREHOLE N	о.	ВН	A30									WC	ood.
Proj	ect Number	TP115086						Drilling	g Location	Coleraine Dr	rive E:604159 N:4854679		20	Logged by	MS
Proj	ect Client	City of Brampton						Drilling	Method	150 mm So	lid Stem Augers		-	Compiled by	PR
Proj	ect Name	Arterial Roads within Highway Area (Area 47)	427 In	dustria	al Seco	ndary	Plan	Drilling	g Machine	Track Mount	ted Drill		<u></u>	Reviewed by	SM
Proj	ect Location	Coleraine Drive, Brampton, On	tario					Date \$	Started	Jan 23, 2020	Date Completed Ja	n 23, 20	20	Revision No	0, 8/14/20
- 0	LITH	OLOGY PROFILE	SC	OIL SA	MPLI	NG			FIELD	TESTING	LAB TESTING				
				1.00		(%)		-	The second secon	tion esting	Soil Vapour Reading  COV (LEL) TOV (LEL)  2 4 6 8	S		COMMEN &	TS
90		DESCRIPTION	ype	Sample Number	(%)	COD (	6	(E) NO	O SPT   M O Vane*	PPT • DCPT Nilcon Vane*	△ COV (ppm) □ TOV (ppm) 100 200 300 400	RUMEN A		GRAIN SI DISTRIBUT	
Lithology Plo			ple y	ple N	Recovery (%)	'N' / ROD	DEPTH (m)	EVATION	△ Intact ▲ Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> </ul>	W <sub>P</sub> W W <sub>L</sub>	RUM		(%)	ION
	Geodetic Ground S	Surface Elevation: 228.7 m	Sample	Sam	Reco	8	DEP	8.6	* Undrained She 20 40	ear Strength (kPa) 60 80	Plastic Liquid 20 40 60 80	SSS	GR	SA	SI CL
	s	Gravelly Sand FILL ome ines some topsoil	00		100	10	-						30	57	(13)
▓		moist 228 2	SS	1	100	16		1	0				30	57	(13)
₩		dark grey/brown 0 5 Silty Clay FILL						228 -							
₩	tra	ce gravel with oxidation	SS	2	100	13	- 1	8.	0						
₩	200.000	brown 12					-								
	trace sand	trace gravel cobbles/boulders	SS	3	100	38	-				<b>a</b>				
		hard 226 9  END OF BOREHOLE 1 8					_	227 -							
		END OF BOREFICEE													
									1						
									1						
									1						
			1				l		7 1	8 8	3 3 5 5				

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abla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

### RECORD OF BOREHOLE No. BH A31 Project Number TP115086 **Drilling Location** Coleraine Drive E:604075 N:4854743 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Truck Mounted Drill Reviewed by SM Area (Area 47) 0, 8/14/20 Coleraine Drive, Brampton, Ontario Date Completed Jan 22, 2020 Revision No Project Location **Date Started** Jan 22, 2020 LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING LAB TESTING** COMMENTS o Penetration esting ▲ COV (LEL) ■ TOV (LEL) RUMEN A E O SPT PPT DCPT **GRAIN SIZE** Numbe ROD DESCRIPTION M O Vane\* Nilcon Vane\* △ Intact ◇ Intact ▲ Remould ◆ Remould y pe Recovery (%) Lithology Plo **ELEVATION** E DISTRIBUTION ż Wp w (%) Sample \* Undrained Shear Strength (kPa) 20 40 60 80 Plastic 20 Liquid 80 SNS GR SA CL 60 SI etic Ground Surface Elevation: 230.7 m about 200 mm ASPHALT 230 5 Sand and Gravel FILL moist 100 38 SS 05 230 2298 grey/brown Silty Clay FILL SS 2 100 16 0 021 229 2 brown/brownish grey SILTY CLAY / CLAYEY SILT TILL 229 trace sand trace gravel cobble SS 3 100 27 0 very sti to hard 2 SS 100 29 0 °15 228 SS 100 39 227 013 SS 6 92 44 0 226 013 7 36 SS 100 0 END OF BOREHOLE

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 $\frac{\nabla}{\partial x}$  No reestanding groundwater measured in open borehole on completion o drilling

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R	ECORD	OF BORE	HOLE N	0.	BH	<u>S2</u>												WC	00	d.
Pro	ject Number	TP115086							Drilling	g Location	Culvert at	Colerai	ne Dr	rive	E:604486	N:485434	3 Logg	ed by	MS	
Pro	ject Client	City of Bramptor	1						Drilling	g Method	150 mm	Solid St	em A	ugers			Com	piled by	PR	
Pro	ject Name	Arterial Roads w Area (Area 47)	ithin Highway	427 In	dustri	al Seco	ondary	Plan	Drilling	g Machine	Track Mor	unted Dr	ill				Revie	ewed by	SM	
Pro	ject Location	Coleraine Drive,	Brampton, On	tario					Date	Started	Jan 20, 20	20 [	Date (	Comp	leted Ja	an 20, 2020	Revis	sion No	0, 8/1	4/20
_	LITH	OLOGY PROFIL	E	SO	IL SA	MPLI	NG			FIELD	TESTING	L	AB	TES	TING	3-4				
							9		_	Penetr	ation esting			apour Re L) ■	eading TOV (LEL)		C	OMMEN &	TS	
۰		DESCRIPTION		<b>Q</b>	nber	9	(%) QC		E	STATE STATE OF STATE	PPT • DC	A CO	OV (ppr	m) 🗆	TOV (ppm)	RUMEN A		RAIN SI		
ygy Pi				е уре	e Nur	ery (°	N'/ ROD	H (m)	EVATION	M O Vane  △ Intact  ▲ Remould	♦ Intact	200		00 30 W	0 400 W <sub>L</sub>	LLA ME	DIS	TRIBUT (%)	ION	
Lithology Plo	Condetta Commed S	urface Elevation: 222.4 m	1	Sample	Sample Number	Recovery (%)	SP -	DEPTH (m)	ELEV.		hear Strength (kP	a) Pl	astic	0 60	Liquid 80	NS NS	GR		SI	CL
-	al	oout 200 mm ASPHA	LT 222 3	0,			-	-												
₩	1	brown Sand and Gravel FILI trace to some silt	22 <b>0 2</b> 0 3				3		222 -			) :				20				
₩	L	moist		SS	1	100	8	E		0			°24							
₩	Silt	dark grey/brown by Clay / Clayey Silt F ce gravel trace organ	ILL					_ 1								-				
₩				SS	2	42	8	Ė		0			026							
₩									221 -											
₩		hanne		SS	3	75	7	E	8	0			0							
₩		brown		00		,,,		_ 2	8				°26							
<b>※</b>		brown CLAY / CLAYEY SIL	220 2 2 2				5	Ė												
	trace sand	trace gravel cobble very sti to hard	s/boulders	SS	4	100	29		220 -	0		• ° <sub>1</sub>	2							
		rony our to many					1						•		ender.					
				,				<b>- 3</b>								43				
				SS	5	46	42		219 -		o	- B O				25				
								Ē	213							23				
		grey					1	E ,												
				SS	6	100	28	F *	8	0			21							
								Ē	218 -							301				
				18.218876.218	- 303	Actionates	i de	Ė												
				SS	7	100	19	_ _ 5		0		•	6			- 3				
																<del>1</del> 9				
								Ē	217 -							-0				
								-												
							- 8	6								ia.				
				SS	8	100	35		240				21			a.				
					10.50	0.550	0.00		216 -				21			20				
							Í	<u> </u>	3											
								- <b>7</b>		1										
								Ē	215 -						1	5.0				
								-								52				
				SS	9	100	36	8	8	0		11				13				
								Ē												
							1	Ė	214 -											
																6				
								9												
			213 1	SS	10	100	50 / 100mm				50 100 mm	B ○10				]				
A12,07%		END OF BOREHOLE	94							1					1					
	od E&IS, a Divis	on of Wood	∑ No reesta	anding (	groundv	water me	easured	in oper	n boreho	ole on comple	tion o drilling		Cave	e in de	oth a ter re	emoval o aug	ers <u>79 m</u>	1		
50 \	Vogell Road Uni	s 3 & 4											o-cradinić:		The state of the s					
Car	nmond Hill Onta nada No. (905) 415-3	AND DESCRIPTION OF THE PROPERTY OF THE PROPERT	Borehole details a qualified Geote	chnical E	ngineer.	Also, bo	rehole inf	ormatic	on should	be read in con									Scale 1	1 53
ww	No (905) 415-2 w woodplc com	.002	commissioned ar	nd the ac	company	ying'Expl	anation o	f Boreh	ole Log'.			To a	M						ige 1	

R	ECORD	OF BORE	HOLE N	<b>o</b>	BH	<u>B1</u>									wood.
Pro	ject Number						Drilling	Location	Arterial A2	E:606238 N:48		Logged by MS			
Project Client City of Brampton							Drilling	Method	150 mm Sol	lid Stem Auger		Compiled by PR			
Pro	Project Name Arterial Roads within Highway		427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mount	ed Drill			Reviewed by SM	
Pro	Area (Area 47) Project Location Arterial A2, Brampton, Ontario							Date S	Started	Jan 10, 2020	Date Com	pleted Jai	n 10, 20	20 Revision No 0, 8/14/20	
LITHOLOGY PROFILE					IL SA	MPLII	NG			FIELD	TESTING	LAB TES		Z, - 5	
							(9)			Penetra	tion esting	Soil Vapour R  ▲ COV (LEL)	TOV (LEL)	O	COMMENTS &
0		DESCRIPTION		9	nber	(%	(%) QC	•	E	TOTAL PROPERTY OF THE PARTY OF	PPT • DCPT. Nilcon Vane*	△ COV (ppm) □	TOV (ppm)	RUMEN A	GRAIN SIZE
Sgy P				e ype	e Nu	ery (	'N' / ROD (	E)	EVATION	M O Vane*  △ Intact  ▲ Remould	♦ Intact ♦ Remould	100 200 3 W <sub>P</sub> W	00 400 W <sub>L</sub>	SUME	DISTRIBUTION (%)
Lithology Plo	Condetta Consum d S	Surface Florentians 244 Fee		Sample	Sample Number	Recovery (%)	S B	DEPTH (m)	ELEV.		ear Strength (kPa) 60 80	Plastic 20 40 6	Liquid 80 80	NS NS P	GR SA SI CL
×××	at	out 140 mm ASPHAL	T 211 4	0,	0,	-	0,	_	-	20 40		20 40 0			
▩		Gravelly Sand FILL some ines	01				9		\$5 50000000						32 56 (12) Located at the intersection o
▩		moist	240.7	SS	1	100	27		211 -	0		o	ļ		Coleraine Drive and Highway 50
▓		brown/dark grey Silty Clay FILL	210 7 0 8			16	- 8			1			1		
▓	some sand t	race to some gravel tr	ace organics	SS	2	100	12	_ 1							
$\overset{\infty}{\approx}$			210 0	1000		110000			210 -						
	1	END OF BOREHOLE	15						210 -						
										1					
										1 1					
										1 1					
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										1					
										1					
										1					
			1 ****	75							5 3	1 1		- E	

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	ECORD OF I	BOREHOLI	E No	<b>o</b> .	BH	<b>B2</b>										W	00	d
Project Number TP115086								Drilling Location Arterial A2							ogged by	MS		
							Drilling	Method	150 mm Sc	olid Stem A	Co	Compiled by						
Project Name Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Project Location Arterial A2, Brampton, Ontario							Drilling	Drilling Machine Track Mounted Drill					Re	eviewed by	SM			
Pro	ject Location Arteria	al A2, Brampton, O	ntario						Date S	Started	Jan 23, 2020	Date Date	Completed Ja	n 23, 2020	D Re	evision No	0, 8/	14/20
	LITHOLOG	Y PROFILE	7	SO	IL SA	MPLII	NG			FIELD	TESTING		TESTING					
Lithology Plo	DESC	CRIPTION		Sample ype	Sample Number	Recovery (%)	SP 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane*  Δ Intact  ▲ Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> </ul> near Strength (kPa)	△ COV (LE 2  △ COV (pp 100 2  W <sub>P</sub> Plastic	apour Reading L) TOV (LEL) 4 6 8 m) 0 TOV (ppm) 00 300 400  W W Liquid 40 60 80	NS RUMEN A ON NS ALLA ON	<b>C</b> GR	GRAIN SI DISTRIBUT (%)	ZE	CL
2000	about 300	mm TOPSOIL	209 9				8	-	210 -									
<b>***</b>	Silty (rewo	orown Clay FILL	0 3 209 5 0 7	SS	1	75	7		711513. 3	0		3(						
	SILTY CLAY / trace san	CLAYEY SILT TILL d trace gravel sti to hard		SS	2	100	17	-1	209 -	O		<sup>IS O</sup> 13						
				SS	3	100	22	2		0		<sup>0</sup> 13						
	cobble	es/boulders	-	SS	4	100	45		208 -		0	<sup>13</sup> 13						
	SILTY SAN some gra ver	Drown D / SANDY SILT evel trace clay y dense wet	207 2 - 3 0 -	SS	5	75	65	3	<b>207</b> –		0	o 0 <sub>11</sub>			14	49	33	4
	trace san	wn/grey CLAYEY SILT TILL d trace gravel to very sti	37	SS	6	83	34	- 4 - 4	206 -	0		°11						
		grey	205 2	SS	7	100	27	- 5		0		<sup>8</sup> °11						
	END OF	BOREHOLE	50															

 $\frac{\nabla}{2}$  Groundwater encountered on completion o drilling on  $\underline{1/23/2020}$  at a depth o  $\underline{3.7 \text{ m}}$ 

R	ECORD	OF BOREHOLE N	B3									W	ood.		
Pro	ject Number	TP115086						Drilling	Location	Arterial A2		Logged by	MS		
Project Client City of Brampton  Project Name Arterial Roads within Highway 4								Drilling Method		150 mm So	lid Stem Auge	Compiled by	PR		
Project Name Arterial Roads within Highway 4 Area (Area 47) Project Location Arterial A2, Brampton, Ontario				ndustri	al Seco	ondary	Plan	Drilling	Machine	Track Mount	ted Drill			Reviewed by	SM
Project Location Arterial A2, Brampton, Ontario								Date S	Started	Jan 23, 2020	Date Con	npleted Jar	23, 2020	Revision No	0, 8/14/20
LITHOLOGY PROFILE				SOIL SAMPLING				FIELD	TESTING	LAB TE		PG - 1			
PERCENTAGE						(%		-	The second secon	tion esting	Soil Vapour  COV (LEL)	TOV (LEL)	S	COMMEN &	ITS
Q	DESCRIPTION		уре	Sample Number	(%	'N' / RQD (%)	•	E) N	O SPT   M O Vane*	PPT DCPT Nilcon Vane*	2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400		RUMEN A	GRAIN SI DISTRIBUT	
Lithology Plo			Je y	ole Nu	Recovery (%)	N./	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact Remould	W <sub>p</sub> W	W <sub>L</sub>	ALLA	(%)	ION
Lithol	Geodetic Ground S	Surface Elevation: 211.8 m	Sample	Samp	Reco	8	DEP"	ELEN	* Undrained Sh 20 40	ear Strength (kPa) 60 80	Plastic	Liquid 60 80	SN	GR SA	SI CL
***	a	Surface Elevation: 211.8 m   bout 200 mm TOPSOIL			-										
	tra	Silty Clay FILL ce gravel trace organics	SS	1	58	5			0		30				
<b>※</b>		(reworked soil) 211 1 brown 0 7						211 -							
	SILTY trace sand	CLAY / CLAYEY SILT TILL d trace gravel cobbles/boulders	SS	2	100	21	_ _ 1	211	0			1			
		very sti to hard	li de contra	-	100						12	ļj			
						- 1		8				ļļ			
			SS	3	100	28		210 -	0		0 0 12	.ii			
							_ 2	1				1			
		brownish grey													
	Š.														
		208 8	SS	4	100	46		209 -	1	)	12				
KZZZ.		END OF BOREHOLE 3 0					_ 3		1						

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

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R	ECORD	OF BOREHOL	E No	<b>o</b> .	BH	<b>B4</b>								WC	od.	
Project Number TP115086								Drilling Location		Arterial A2		Logged by	MS	_		
Pro	Project Client City of Brampton  Project Name Arterial Roads within Highway 4							Drilling Method		150 mm Solid	d Stem Augers	Compiled by	PR	_		
Pro			427 In	dustri	al Seco	ondary P	lan [	Drilling	Machine	Track Mounted	d Drill		Reviewed by	SM	_	
Pro	Area (Area 47) Project Location Arterial A2, Brampton, Ontario								Date S	Started	Jan 23, 2020	Date Completed J	an 23, 2020	Revision No	0, 8/14/20	_
	LITHOLOGY PROFILE		SOIL SAMPLING						FIELD	TESTING	LAB TESTING	24 1			$\dashv$	
												Soil Vapour Reading COV (LEL) TOV (LEL)	8	COMMEN	TS	-
_		DESCRIPTION		0	nber		(%) Q		E	N. S. C.	PPT ● DCPT △	2 4 6 8 COV (ppm)  TOV (ppm	4 N	GRAIN SI	ZE	
gy Pk		DEGORAL HON		е уре	Nun e	ery (%	'N' / RQD	E	OIL	M O Vane*  △ Intact  ▲ Remould	Nilcon Vane*  ♦ Intact  Remould	100 200 300 400 W <sub>P</sub> W W <sub>L</sub>	RUMEN A	DISTRIBUT (%)	ION	
Lithology Plo				Sample	Sample Number	Recovery (%)	8	DEPTH	ELEVATION	* Undrained She	ear Strength (kPa)	Plastic Liquid	(O) (O)		SI CL	
	Geodetic Ground S	bout 200 mm TOPSOIL	211 5	O	o	œ	0)		ш	20 40	60 80	20 40 60 80		SIL SIL	oi oc	٦
		dark brown Silty Clay FILL	02	SS	1	83	5		8	0			8			
₩	tra	ce gravel trace organics (reworked soil)	211 1	-			<u> </u>		211 -							
	SILTY	CLAY / CLAYEY SILT TILL	200	SS	2	100	13		211 -	0						
	t	race sand trace gravel sti to very sti		200 000 000	pr. 1000	estate de la		- 1								
				0.0		455										
			200.0	SS	3	100	24		210 -	0						
K/X		END OF BOREHOLE	18						37				1			
										1 1						
	d Fole - Dida	G00-100-0-10000000000000000000000000000		76			<del></del>				- 12°	- 3 5 155	See to			$\dashv$

 $\stackrel{\nabla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

R	ECORD	OF BOREHOLE N	0.	ВН	<u>B5</u>									W	ood.
Pro	ject Number	TP115086						Drilling	Location	Arterial A2				Logged by	MS
Pro	ject Client	City of Brampton						Drilling	Method	150 mm So	lid Stem A	ugers		Compiled by	PR
Pro	ject Name	Arterial Roads within Highway Area (Area 47)	427 In	dustri	al Seco	ndary	Plan	Drilling	Machine	Track Mount	ted Drill		5	Reviewed by	SM
Pro	ject Location	Arterial A2, Brampton, Ontario						Date	Started	Jan 23, 2020	Date (	Completed Jai	23, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING		TESTING apour Reading	_		
Q.		DESCRIPTION	уре	mper	(%	OD (%)	•	(m) Ni		tion esting PPT • DCPT Nilcon Vane*	▲ COV (LE	L) TOV (LEL) 6 8 m) TOV (ppm) 00 300 400	RUMEN A ON	GRAIN SI	ZE
Lithology Plo	Condette Constant	refere Floreston 244.2 m	Sample y	Sample Number	Recovery (%)	SP 'N' / ROD	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact ♦ Remould ear Strength (kPa)	W <sub>p</sub> Plastic 20 4	W W <sub>L</sub>	NS RUMI NS ALLA	DISTRIBUT (%)	SI CL
1222	Geodetic Ground S	out 300 mm TOPSOIL	0)	0,		0,	-	100	20 40	80 80		0 60 80			
<b>***</b>	٦	211 0   0 3	SS	1	83	6		211 -	0		□ 0 <sub>17</sub>				
	SILTY trace sand	brown  CLAY / CLAYEY SILT TILL  I trace gravel cobbles/boulders  sti to hard	SS	2	100	10	1	210 -	0		<sup>0</sup> 14				
			SS	3	100	18	- 2		0		<sup>0</sup> 13				
			SS	4	100	35		209 -	0		<sup>a 0</sup> 13				
		grey					- 3	208 —							
			SS	5	100	28		200	0		°11				
			SS	6	100	20	- <b>4</b>	207 -	0		°11				
		206 2 END OF BOREHOLE 5 0	SS	7	100	17	- 5		o		a 0 <sub>14</sub>				

 $\frac{\nabla}{\partial x}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

wood.
Logged by MM
Compiled by PR
Reviewed by SM
, 2020 Revision No 0, 8/14/20
COMMENTS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

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R	ECORD	OF BOREHOLE	No.	BH	B7 /	BH	S5								W	00	od.
Pro	oject Number	TP115086						Drillin	g Location	C	ulvert at A	rterial A2 E-V	V E:60563	3 N:4852520	Logged by	MS	
Pro	oject Client	City of Brampton						Drillin	g Method	1	50 mm So	olid Stem Aug	jers		Compiled b	y PR	
Pro	oject Name	Arterial Roads within Highwa	ay 427 Ir	ndustri	ial Sec	ondary	Plan	Drillin	g Machine	Tr	ack Moun	ted Drill	200,000 000,000	CONTRACTOR STATE	Reviewed	y SM	
Pro	ject Location	Arterial A2, Brampton, Ontar	io					Date	Started	Fe	eb 26, 2020	Date Co	mpleted F	Feb 26, 2020	Revision N	0, 8	/14/20
	LITH	OLOGY PROFILE	SC	OIL S/	AMPLI	NG			FIEL	D TE	STING		ESTING	344 5.			
				Tes		(%)		•	The same of the sa	etration	esting	▲ COV (LEL)	ur Reading ■ TOV (LEL 6 8		COMM &		
90		DESCRIPTION	уре	nmper	(%)	SQD (	2	(m) NC	M O Van		DCPT ilcon Vane*		□ TOV (ppr 300 400	n) RN N	GRAIN DISTRIB		i
Lithology Plo				Sample Number	Recovery (%)	'N' / ROD	DEPTH (m)	ELEVATION	△ Intact ▲ Remou	ıld ♦	Intact Remould	W <sub>P</sub> V		RUMEN A	(%		
Litho	Geodetic Ground S	urface Elevation: 209.3 m	Sample	Sam	Reco	8	DEP	ELE			strength (kPa) 50 80	Plastic 20 40	Liquid 60 80	SS	GR SA	SI	CL
<b>***</b>		dark brown 0		1	100	6	Ē										
₩	trace to	by Clay / Clayey Silt FILL some gravel trace organics	81,620.0		100	0	E	209 -	0			40	)				
▓		brown to grey 0					Ē										
	trace sand	CLAY / CLAYEY SILT TILL to sandy trace to some gravel cobbles/boulders	SS	2	100	8	1		0			e o <sub>25</sub>					
		sti to hard					Ė	208 -				25		100			
							E							153			
			SS	3	100	27	Ē		0	den.	[ <del> </del>	12		100			
			-			1	_ 2				J.,			3			
		grey					ŧ	207 -	ļ								
		0,	SS	4	100	50	E			0		°13		- 40			
							_ 3										
					400	-00	Ē	206									
			SS	5	100	69	Ė	206 -	:		0	11					
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			SS	6	83	58	- 4				)	°12			4 43	50	3
		Sand & Silt			J. C. S. C.		Ė	205 -	i i		ļj	12		200			
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			SS	8	100	62 / 150mm	E	203 -		6	2 0 150 mm	s o 13					
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			SS	9	100	66	- 8				0	o <sub>24</sub>					
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				pro-	12.012	120	Ė'	200 -									
		199	SS	10	100	39	-			0		°23					
ZXX	1	END OF BOREHOLE 9					f -										
	od E&IS, a Divisi nada Limited	ion of Wood 💆 Ground	dwater er	counter	red on o	ompletic	n o dr	illing on	2/26/2020 a	at a dep	oth o <u>58 m</u>	☐ Cave in	depth a ter r	removal o aug	ers <u>91 m</u>		
50	Vogell Road Unit	ts 3 & 4		9.12	-10 LV381CD	ancortes (100)	eters (a (a (a))			nontrol et é		0.050.00.000.000.000					
Car	hmond Hill Ontar nada	Borehole detail a qualified Geo	technical i	Engineer	. Also, bo	rehole in	formati	on should				esent and require otechnical report				Scale	1 53
ww	No (905) 415-2 w woodplc com	commissioned	and the ad	ccompan	ying'Exp	lanation o	of Borel	nole Log'.			30	- Topolt		-			1 of 2

Scale 1 53 Page 1 of 2

	ECORD OF BOREHOLE N	О.									wood.
	rect Number TP115086  TP115086  TP115086  TP115086		7.0	Project	Name	Arteria	I Roa	ds within Highway 427 Ind	lustrial Secondary Plan A	rea (Are	a 47)
rio	LITHOLOGY PROFILE		NI SA	MPLI	NG			FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION	Sample ype	Sample Number	Recovery (%)	SP 'N' RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration esting  O SPT	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)  2 4 6 8  △ COV (ppm) □ TOV (ppm) 100 200 300 400  W <sub>P</sub> W W <sub>L</sub> ■ □ Plastic Liquid 20 40 60 80	NS RUMEN A ON NS ALLA ON	COMMENTS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Sand 00-06 m Bentonite 06-55 m Sand Filter 55-91 m Screen 61		0		9			2	3		

R	ECORD OF BOREHOLE N	0.	BH	B8								WC	ood.
Pro	ject Number TP115086						Drilling	g Location	Arterial A2	E:605564 N:4852529		Logged by	MS
Pro	ject Client City of Brampton						Drilling	Method	150 mm So	lid Stem Augers		_ Compiled by	PR
Pro	ject Name Arterial Roads within Highway	427 In	ndustri	al Seco	ndary	Plan	Drilling	g Machine	Track Mount	ted Drill		Reviewed by	SM
Pro	Area (Area 47) ject Location Arterial A2, Brampton, Ontario	)					Date \$	Started	Feb 20, 2020	Date Completed Fe	b 20, 2020	Revision No	0, 8/14/20
	LITHOLOGY PROFILE	SC	OIL SA	MPLI	NG			FIELD.	TESTING	LAB TESTING	8 1		
									tion esting	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)	8	COMMEN	TS
٥	DESCRIPTION	Ф	nber	9	(%) QC	1074200	E	15.00 S S S S S S S S S S S S S S S S S S	PPT • DCPT	2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400	RUMEN A	GRAIN SI	
gy Pk	DESCRIPTION	е уре	e Nur	ery (9	'N' / RQD	E)	ATIO	M O Vane*  △ Intact  ▲ Remould	Nilcon Vane*  ♦ Intact  Remould	100 200 300 400 W <sub>P</sub> W W <sub>L</sub>	CLLA	DISTRIBUT (%)	ION
Lithology Plo	Condition Comment State on Floridation 244.4 and	Sample	Sample Number	Recovery (%)	S ds	DEPTH (m)	ELEVATION		ear Strength (kPa)	Plastic Liquid 20 40 60 80	(O (O		SI CL
100	Geodetic Ground Surface Elevation: 211.1 m about 100 mm TOPSOIL 211.0		0,	-	0)	-	211 -	20 40	00 00	20 40 80 80			
	dark brown Silty Clay FILL trace gravel trace organics	SS	1	100	9			0			1		
***	(reworked soil) 210 5 brown 0 6					-							
	SILTY CLAY / CLAYEY SILT TILL trace sand trace gravel	SS	2	100	22	_ 1		0		•			
	very sti to hard					ļ	210 -	iii.					
		SS	3	44	36	Ē		0					
DX.	END OF BOREHOLE 17					-1							
								1 1					
								1					
$\vdash$								9 9	H 3	9 9 8 58			

 $\stackrel{\textstyle \nabla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD	OF BOREHOLI	E No	. ]	ВН	B9										W	ood.
Pro	ject Number	TP115086							Drilling	Location	Arterial A	2 E:6054	61 N:4	1852548		Logged by	MS
Pro	ject Client	City of Brampton							Drilling	Method	150 mm	Solid Ste	m Auge	ers		Compiled by	PR
Pro	ject Name	Arterial Roads within Hig Area (Area 47)	hway 4	27 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Track Mo	unted Dri	II			Reviewed by	SM
Pro	ject Location		ntario						Date :	Started	Feb 20, 20	<b>)20</b> D	ate Cor	mpleted Fel	20, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	2	SO	IL SA	MPLI	NG			FIELD	TESTING			STING r Reading			
							(%)		E	100000	ation esting	▲ CO	V (LEL)	TOV (LEL)	NO NO	COMMEN &	NACO-CC
Old.		DESCRIPTION		ype	nmbe	(%)	'N' / ROD	ê		M O Vane	Nilcon Van	A CO	V (ppm) 200	TOV (ppm) 300 400	RUMEN A	GRAIN SI DISTRIBUT	
Lithology Plo				Sample	Sample Number	Recovery (%)		DEPTH (m)	ELEVATION	△ Intact ▲ Remould		3 mm	0	W <sub>L</sub>	ALL	(%)	
Lith	Geodetic Ground S	Surface Elevation: 212.5 m	040.0	Sam	Sam	Rec	85	DEP	H H	* Undrained S 20 4	hear Strength (kF 0 60 80	(a) Plas 20		Liquid 60 80	S S S	GR SA	SI CL
	· · ·	dark brown Silty Clay FILL	2123	SS	1	100	15			0			36				
	tra	ce gravel trace organics	211 8	(M) (M)		215058	100000		212 -	1			36	.ii			
	SILTY	brown CLAY / CLAYEY SILT TILL	07	- 4				-					-				
	trace s	and and sandy trace gravel cobbles/boulders		SS	2	100	13	_ 1		0		<b>9</b> 0 <sub>1</sub>	9				
		very sti to hard	-					Ē	211 -								
									211					121111111111111111111111111111111111111			
				SS	3	100	34	- - 2		0		1	8				
		*******									- Pot		( )	1-1-			
		grey		SS	4	100	68	Ē	210 -		0	B 0					
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				SS	5	100	48	Ē	209 -		0	B 0					
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				SS	7	100	49			:	0	B 0	i				
		END OF BOREHOLE	207 4 5 0					- 5	33			13					
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abla}{=}$  Groundwater encountered on completion o drilling on <u>2/20/2020</u> at a depth o <u>4.3 m</u>

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD	OF BOREHOL	E No	0.	BH	B10														W	00	od.
Pro	ject Number	TP115086							Drilling	Locati	ion	Arte	rial A2	E:605	365 N	1:485	2580		1	Logged by	MS	
Pro	ject Client	City of Brampton							Drilling	Metho	od	150	mm So	lid Ste	m Au	igers			(	Compiled by	PF	<u> </u>
Pro	ject Name	Arterial Roads within H	ighway	427 In	dustri	al Seco	ndary	Plan	Drilling	Machi	ine	Trac	k Mount	ted Dri	ill				1	Reviewed by	SN	1
Pro	ject Location	Area (Area 47) Arterial A2, Brampton,	Ontario						Date S	Started		Feb	20, 2020	<u> </u>	ate C	ompl	eted Fe	b 20, 20	20	Revision No	0,	8/14/20
	LITH	OLOGY PROFILE		SO	IL SA	MPLI	NG			FIE	ELD 1	TEST	ING		AB T			4G - 5				
							(%)		_		enetrat		CONTROL OF THE PARTY OF THE PAR	▲ CC	Soil Vap V (LEL)	) =	TOV (LEL)	S		COMME &	NTS	
0		DESCRIPTION		9	mber	(%	OD (3	_	E	11.500100400000			DCPT on Vane*	△ CC	V (ppm	) 🗆	TOV (ppm)	RUMEN A		<b>GRAIN S</b>		
Sgy P				e ype	e Nu	ery (	'N' / ROD (	E	EVATION	M O \ △ Inta ▲ Rer	ect	♦ I	ntact Remould	100 W	1	W 300	400 W <sub>L</sub>	LLA		DISTRIBU (%)	ПОІ	V
Lithology Plo	Condetta Consul S	turface Florenteen, 242 7 m		Sample	Sample Number	Recovery (%)	8	DEPTH (m)	ELEV.	1000000	ned She	ar Stren	ngth (kPa) 80	Pla 20	stic 40	60	Liquid 80	NS NS P	GR	SA	SI	CL
~~~	a	bout 150 mm TOPSOIL	2126	0,	0,		0,	_							-							
<b>※</b>	tra	dark brown Silty Clay FILL ce gravel trace organics	02	SS	1	79	8	-		0				<b>a</b> ;								
<b>※</b>		(reworked soil) brown/brownish grey	212 1					Ē	040													
		CLAY / CLAYEY SILT TILL race sand trace gravel	200360	SS	2	100	18	-	212 -	o												
		very sti to hard						- 1														
				SS	3	100	54	Ė				0										
X		END OF BOREHOLE	211 0				-	-			111111											
		END OF BOTTLINGE	31.5							1				1								
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 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www woodplc com

Pro Pro	oject Number oject Client oject Name oject Location  LITH	OF BOREHOL  TP115086  City of Brampton  Arterial Roads within Hi Area (Area 47) Arterial A2, Brampton, CO  OLOGY PROFILE  DESCRIPTION	ighway Ontario	427 In	dustri		ondary	РЕРТН (m)	Drilling	FIELD Penetra ○ SPT □ M ○ Vane* △ Intact ▲ Remould	Arterial A2  150 mm So  Track Mount  Feb 20, 2020  TESTING  tion esting  PPT ● DCPT  Nilcon Vane*  ◇ Intact  ◆ Remould  aar Strength (kPa)  60 80	blid Stem Au ted Drill  Date C  LAB T Soil Vap  COV (LEL)  2 4  COV (ppm 100 200		NS ALLA ON NS ALLA ON	C	ogged by ompiled by eviewed by evision No  COMMEN & GRAIN S DISTRIBUT (%)	MS PR SM 0,8/1	
	tra	dark brown/brown Sitty Clay FILL ce gravel trace organics (reworked soil) brown	212 2 211 6 0 7	SS	1	100	16		212	0		°25						
		CLAY / CLAYEY SILT TILL sand to sandy trace gravel very sti to hard	100000	SS	2	100	25	1	211 -	0		<sup>9</sup> <sup>0</sup> 13						
				SS	3	100	43	- - - - 2	210 —	C		<b>13</b>			2	24	49	25
		brownish grey  END OF BOREHOLE	209 3	SS	4	100	56	- - - - - - - 3	210		0 1	9 °13	The second secon					

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50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD	OF BOREHOL	LE No	<b>o</b> .	BH	B12													W	00	d.
Pro	ject Number	TP115086							Drilling	Location	n	Arteria	al A2	E:60519	2 N:48	852676			Logged by	MS	
Pro	ject Client	City of Brampton							Drilling	Method	d	150 m	m Sol	lid Stem	Auge	rs			Compiled by	PR	
Pro	ject Name	Arterial Roads within H Area (Area 47)	lighway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machin	ne	Track	Mount	ed Drill					Reviewed by	SM	
Pro	ject Location	Arterial A2, Brampton,	Ontario						Date 9	Started		Feb 20	, 2020	Dat	e Com	pleted Fe	eb 20, 20	20	Revision No	0, 8/	14/20
	LITH	OLOGY PROFILE	3	SO	IL SA	MPLII	NG			FIE	LD 1	ESTI	NG			STING	Î				
							(%)		_	Contract of the Contract of th		on estir	A TOTAL STREET	▲ COV	LEL)	Reading TOV (LEL)			COMMEN &	ITS	
Q		DESCRIPTION		ype	Sample Number	(%	OD (°	•	E) N	O SPT		Nilcon	The second of	2 △ COV 100		6 8 □ TOV (ppm) 300 400	RUMEN A		<b>GRAIN S</b>		
Lithology Plo					ole Nu	Recovery (%)	'N' / ROD (	(m) HJ	ELEVATION	△ Intac ▲ Rem	t	♦ Inta	ct	W <sub>P</sub>	w	W <sub>L</sub>	RUME		DISTRIBU (%)	HON	
Lithol	Geodetic Ground S	surface Elevation: 214.3 m		Sample	Samp	Reco	8	DEPTH	ELEV	* Undraine 20	ed She		h (kPa) 80	Plastic 20		Liquid 60 80	SNS	GR	SA	SI	CL
<b>**</b>	al	dark brown	214 1 0 2				8	2	214 -					•	į						
燚	tra	Silty Clay FILL ce gravel trace organics	2000	SS	1	83	17		214	0				g) :		:	1				
X	<b>\</b>	greyish brown CLAY / CLAYEY SILT TILL	213 6 																		
	SILTY	race sand trace gravel		SS	2	100	24	_ _ 1		0						ļ <u>.</u>					
		very sti to hard							213 -			w.j.	ļ		a fina	ļ					
			2126	SS	3	100	69					0									
XX		END OF BOREHOLE	17					8									1				
										Ē											
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50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

RI	ECORD	OF BOREHOLE N	о.	ВН	B13									W	ood	
Pro	ject Number	TP115086						Drilling	Location	Arterial A2	E:605111 N:4852740		Lo	gged by	MS	_
Proj	ject Client	City of Brampton						Drilling	Method	150 mm So	lid Stem Augers		Co	ompiled by	PR	_
Pro	ject Name	Arterial Roads within Highway Area (Area 47)	427 In	dustri	al Seco	ndary	Plan	Drilling	Machine	Track Mount	ted Drill		Re	eviewed by	SM	_
Pro	ject Location	Arterial A2, Brampton, Ontario						Date	Started	Feb 20, 2020	Date Completed	Feb 20, 202	20 Re	evision No	0, 8/14/20	<u>_</u>
	LITH	OLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING	302, 5				┪
						(%		-		tion esting	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LI  2 4 6 8			COMMEN &	TS	
٥		DESCRIPTION	уре	mber	(%	'N' / RQD (%)		E N	O SPT   M O Vane*	PPT DCPT Nilcon Vane*	△ COV (ppm) □ TOV (p	RUMEN A		<b>GRAIN SI</b>		
A KBC			le y	e Nu	ery (	Z	E H	ATIO	△ Intact ▲ Remould	♦ Intact ♦ Remould	W <sub>P</sub> W W <sub>L</sub>	- SUME	D	OISTRIBUT (%)	ION	
Lithology Plo	Geodetic Ground S	Surface Elevation: 215.7 m	Sample	Sample Number	Recovery (%)	8	DEPTH (m)	ELEVATION	* Undrained Sh 20 40	ear Strength (kPa) 60 80	Plastic Liquid 20 40 60 80	SNS	GR	SA	SI CL	L
1.00	a	dark brown/brown					-									
	tra	Silty Clay FILL ce gravel trace organics	SS	1	75	8	Ė		0		o 32	0.00				
		(reworked soil) 215 0 brown 0 7					-	215 -				-4.				
	SILTY trace sand	CLAY / CLAYEY SILT TILL	00			00	_ 1									
		d trace gravel cobbles/boulders hard to very sti	SS	2	54	36	_	8.	0		17					
							F	85								
			SS	3	100	44		214 -								
			55	3	100	44	- - 2				0 14	22.00				
							E					.*				
			SS	4	100	64	Ē			0 1		111				
					100	•		213 -			° 013					
							- 3									
			SS	5	100	39	-		0		<sup>0</sup> 013	3.24				
			65 Table	20.00	CHOOLS	10000	Ē				13	000				
		<u></u>	- /				ŧ	212 -								
		grey	SS	6	100	19	_ 4	8	0		a o <sub>13</sub>					
											13	231				
						- 8	-					373				
		210 7	SS	7	100	21		211 -	0		0 12	12.70				
VXX		END OF BOREHOLE 5 0					- 5		1			-				
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 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	RECORD OF BOREHOLE No. BH B14  roject Number TP115086													WC	od
Pro	ject Number	TP115086							Drilling	Location	Arterial A2			Logged by	MS
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Sol	id Stem Augers		Compiled by	PR
Pro	ject Name	Arterial Roads within H	ighway	427 In	dustri	al Seco	ndary l	Plan	Drilling	Machine	Track Mount	ed Drill		Reviewed by	SM
Pro	ject Location	Arterial A2, Brampton, G	Ontario						Date S	Started	Jan 24, 2020	Date Completed Ja	n 24, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	ï	SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING			
											tion esting	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)	8	COMMEN	TS
		DESCRIPTION		0	nber		(%) Q		E	17 (18 (18 (18 (18 (18 (18 (18 (18 (18 (18	PPT • DCPT	2 4 6 8 △ COV (ppm) □ TOV (ppm)	N N	GRAIN SI	ZE
ay Pk		DESCRIPTION		ype	Nun	%) (ve	N'/ ROD	E	Į.	M O Vane*  △ Intact  ▲ Remould	♦ Intact	100 200 300 400 W <sub>P</sub> W W <sub>L</sub>	RUMEN A	DISTRIBUT (%)	ION
Lithology Plo				Sample	Sample Number	Recovery (%)	S. OS	DEPTH (m)	ELEVATION	* Undrained Sho	ear Strength (kPa)	Plastic Liquid	(O) (O)		SI CL
20	Geodetic Ground S ab	out 200 mm TOPSOIL	216 9	O	Ø	Œ	o)	-	ш -	20 40	60 80	20 40 60 80		OK OA	oi or
<b>***</b>		drak brown / brown Silty Clay FILL	02	SS	1	100	7			0		g			
<b>※</b>	trac	ce gravel trace organics (reworked soil)	216 5 0 6												
	SILTY	brown CLAY / CLAYEY SILT TILL	- 50	SS	2	100	25			0					
	tr	race sand trace gravel very sti to hard			10.000			<del>-</del> 1	216 -						
				Page 1941	-	25,000									
			1000	SS	3	100	56				0	· · · · · · · · · · · · · · · · · · ·			
900		END OF BOREHOLE	215 2 1 8				2				-1-1-				
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Ma	d Eale a Didal										18 18				

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www woodplc com

R	ECORD	OF BOREHOL	E N	0.	ВН	B15						W	ood.			
Pro	oject Number TP115086									g Location	Arterial A2				Logged by	MS
Pro	ject Client	City of Brampton					Drillin	g Method	150 mm So	lid Stem Aug	ers		Compiled by	PR		
Pro	ject Name	Arterial Roads within H Area (Area 47)	ighway	427 In	dustri	al Seco	ondary	Plan	Drillin	g Machine	Track Mount	ted Drill			Reviewed by	SM
Pro	ject Location	Arterial A2, Brampton, (	Ontario						Date	Started	Jan 24, 2020	Date Co	mpleted Jar	24, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	20	SC	IL SA	MPLI	NG			FIELD	TESTING		STING	4 1		
					TEX		(%		-	The second secon	tion esting	Soil Vapor  COV (LEL)  2  4	ur Reading ■ TOV (LEL) 6 8	S	COMME &	NTS
Q		DESCRIPTION		уре	Sample Number	(%	'N' / RQD (%)	•	E) N	O SPT   M O Vane*	PPT DCPT Nilcon Vane*	△ COV (ppm)	□ TOV (ppm) 300 400	RUMEN A	GRAIN S	
ogy P				e y	le Nu	/ery (	N.'N	DEPTH (m)	ATIO	△ Intact ▲ Remould	♦ Intact ♦ Remould	W <sub>P</sub> W	A DOMESTIC OF THE PARTY OF THE	ALLA	DISTRIBU	IIION
Lithology Plo	Geodetic Ground	Surface Elevation: 217.3 m		Sample	Samp	Recovery (%)	8	DEPT	ELEVATION	* Undrained Sh 20 40	ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	SSS	GR SA	SI CL
200	a	bout 150 mm TOPSOIL dark brown / brown	217 2													
		Silty Clay FILL trace gravel	26236	SS	1	100	6		217 -	0		28				
		(reworked soil)	216 8 0 6													
	SILTY	brown CLAY / CLAYEY SILT TILL race sand trace gravel		50000000				_ 1								
		hard		SS	2	100	32	Ė .		0		<sup>0</sup> 10				
									216 -							
						100		Ē								
				SS	3	100	35	_ _ 2		0:		14	1			
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								Ē	215 -							
				SS	4	100	52				0	° 13				
		END OF BOREHOLE	214 3 3 0					- 3	1	1 1						
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10000000	4 F010 - Di-4-	UEDO MICAULINITED		76	_						F. 10		Fn (2#5)	20		

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50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

N	RECORD OF BOREHOLE No. BH B16																		W	00	d.
Proj	ect Number	TP115086							Drilling	Locati	ion	Arter	ial A2					L	ogged by	MS	
Proj	ect Client	City of Brampton							Drilling	Metho	od	150 r	nm Sol	lid Stem	Auge	rs		0	Compiled by	PR	
Proj	ect Name	Arterial Roads within Area (Area 47)	Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machi	ine	Track	Mount	ed Drill				F	Reviewed by	SM	
Proj	ect Location	Arterial A2, Brampton,	, Ontario						Date S	Started		Jan 2	4, 2020	Dat	e Com	pleted Ja	n 24, 202	0 F	Revision No	0, 8/1	4/20
	LITH	OLOGY PROFILE	2.	SO	IL SA	MPLI	NG			FIE	ELD 1	ESTI	NG			STING	2, 1				
					124		(%)		-	Contract Con		ion est	Charles of the same of	▲ COV (	LEL)	Reading TOV (LEL) 6 8	8		COMMEN &	ITS	
စ္		DESCRIPTION		уре	Sample Number	(%)	(c)	6	(m) No	O SPT			DCPT	2 △ COV ( 100		TOV (ppm)	RUMEN A		GRAIN S	ZE	
Lithology Plo					ole Nu	Recovery (%)	'N' / ROD (	TH (m)	ELEVATION	△ Inta ▲ Rer	ct	♦ Int	act emould	W <sub>P</sub>	W	W <sub>L</sub>	ALLA		(%)	IION	
Lift	Geodetic Ground S	surface Elevation: 217.9 m		Sample	Samp	Reco	8	НТӨЭО	e.e.	* Undrai 20	ned She 40	ar Streng 60	th (kPa) 80	Plastic 20		Liquid 60 80	SS	GR	SA	SI	CL
<b>***</b>	al	drak brown / brown	217 8 0 2																		
▩		Silty Clay FILL trace gravel	217 4	SS	1	100	8			0		x to jac	cegoroug	)			1				
		(reworked soil) brown	0.6					24 3		1					1						
	SILTY	race sand trace gravel		SS	2	100	21	_ _ 1	217 -	0				1	- <del> </del>						
		very sti to hard				4	- 3				and,				.ļ	ļļ					
				SS	3	100	56					0									
		END OF BOREHOLE	216 1				9		2				3		-						
		END OF BOREHOLE	18							:											
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50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

## RECORD OF BOREHOLE No. BH B17 Project Number TP115086 **Drilling Location** Arterial A2 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Track Mounted Drill Reviewed by SM Area (Area 47) Arterial A2, Brampton, Ontario 0, 8/14/20 Jan 24, 2020 Date Completed Jan 24, 2020 Revision No Project Location **Date Started** LITHOLOGY PROFILE **SOIL SAMPLING FIELD TESTING LAB TESTING** COMMENTS o Penetration esting ▲ COV (LEL) ■ TOV (LEL) RUMEN A E O SPT PPT DCP **GRAIN SIZE** Numbe ROD DESCRIPTION y pe M O Vane\* Nilcon Vane\* △ Intact ◇ Intact ▲ Remould ◆ Remould Recovery (%) Lithology Plo **ELEVATION** E DISTRIBUTION ż Wp w (%) Sample Sample \* Undrained Shear Strength (kPa) 20 40 60 80 Liquid 80 Plastic 20 SNS GR SA CL SI etic Ground Surface Elevation: 218.5 m about 150 mm TOPSOIL 218 3 dark brown / brown SS 100 8 0 Silty Clay FILL (reworked soil) 218 217 9 SILTY CLAY / CLAYEY SILT TILL trace sand to sandy trace gravel cobbles/boulders SS 2 100 21 0 016 very sti to hard 217 SS 3 100 30 0 27 2 216 SS 100 42 0 °15 °13 SS 100 50 0 215 grey SS 6 100 39 0 014 214 7 SS 100 29 0 013 END OF BOREHOLE

Wood E&IS, a Division of Wood Canada Limited

 $\frac{\nabla}{\partial x}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www woodplc com

R	ECORD OF BOREHOLE No. BH B18													WC	ood.
Pro	ect Number TP115086							Drilling	g Location	Arterial A2			Logged by	MS	
Pro	ject Client	City of Brampton	1						Drilling	Method	150 mm So	lid Stem Augers		Compiled by	PR
Pro	ject Name	Arterial Roads w	ithin Highway	427 In	dustri	al Seco	ondary	Plan	Drilling	g Machine	Track Mount	ted Drill		Reviewed by	SM
Pro	ject Location	Area (Area 47) Arterial A2, Bram	npton, Ontario						Date	Started	Jan 24, 2020	Date Completed Ja	n 24, 2020	_ Revision No	0, 8/14/20
	LITH	OLOGY PROFIL	.E	SC	OIL SA	MPLI	NG			FIELD	TESTING	LAB TESTING	2) 1		
							(%)			The second secon	ation esting	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)	8	COMMEN &	TS
0		DESCRIPTION		9	nber	(%	OD (a)		E	1,500,000,000,000	PPT • DCPT	2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400	RUMEN A	<b>GRAIN SI</b>	ZE
gy PI				е уре	e Nu	ery (	N'/ ROD	E	ATIO	M O Vane*  △ Intact  ▲ Remould	♦ Intact	100 200 300 400 W <sub>P</sub> W W <sub>L</sub>	LLA	DISTRIBUT (%)	ION
Lithology Plo	0-1-0-1			Sample	Sample Number	Recovery (%)	8	DEPTH (m)	ELEVATION	* Undrained Sh	ear Strength (kPa) 60 80	Plastic Liquid 20 40 60 80	(O (O		SI CL
200	Geodetic Ground 8	bout 150 mm TOPSO	IL 219 1	0)	0,	-	0)		3.9	20 40		20 40 60 80			
₩		drak brown / brown Silty Clay FILL	02	SS	1	100	8	E	219 -	0					
<b>#</b>		trace gravel (reworked soil)	218 6 0 6					ŧ							
	SILTY	brown CLAY / CLAYEY SIL	T TILL s/boulders	SS	2	100	20	Ε,		0					
	u ace sell	very sti to hard		p=400,410				- 1	218 -						
						400	46	Ė	210						
			047.4	SS	3	100	43	E			)				
XX		END OF BOREHOLE	217 4												
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	W.			Щ.	μ.,	_	$\vdash$				FC 107		<u> </u>		

 $\stackrel{\textstyle \nabla}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

RE	CORD	OF BOREHOL	E N	o.	ВН	B19									W	ood.
Proj	ect Number	TP115086							Drilling	g Location	Arterial A2				Logged by	MS
Proj	ect Client	City of Brampton					Drilling	g Method	150 mm Sol	lid Stem Auge	ers		Compiled by	PR		
Proj	ect Name	Arterial Roads within Hi	es (15) (86)		dustria	al Seco	ondary	Plan	Drilling	g Machine	Track Mount	ed Drill	2000001 85 862	Control of the Control	Reviewed by	SM
Proj	ect Location	Arterial A2, Brampton, C	Ontario						Date	Started	Jan 24, 2020	Date Cor	mpleted Jar	24, 2020	Revision No	0, 8/14/20
- 4	LITH	OLOGY PROFILE	2	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TE Soil Vapour		_		
					12		(%)		(E)	The second secon	tion esting	▲ COV (LEL)	TOV (LEL)	NO	COMMEN &	and the co
Old Dio		DESCRIPTION		уре	Sample Number	(%)	'N' / RQD (%)	(F		M O Vane*	Nilcon Vane*	Δ COV (ppm) 100 200	TOV (ppm) 300 400	RUMEN A	GRAIN S DISTRIBU	
Lithology Plo				Sample	N eldı	Recovery (%)	, v	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact ♦ Remould	W <sub>P</sub> W	W <sub>L</sub>	ALL	(%)	1117111
	Geodetic Ground	Surface Elevation: 219.5 m		Sam	San	Rec	ક્ર	DEP	E.E.	* Undrained She 20 40	ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	SSS	GR SA	SI CL
	a	dark brown/brown	2193	SS	1	100	7					17				
₩	,	Silty Clay FILL trace gravel (reworked soil)	218 9	67,750	80	512051	N		219 -			17				
	CII TV	brown CLAY / CLAYEY SILT TILL	0.6	- 4			- 9									
	SILI	race sand trace gravel very sti to hard		SS	2	100	29	_ 1		0		15				
		80000#x888 80000885959						_								
			ŀ						218 -							
				SS	3	83	37	-		0		16				
				-			- 3	_ 2					4			
		greyish brown							217 -							
				SS	4	100	40					14	4			
			216 5			863.84	10000	- - 3	- 8	1 1		14				
		END OF BOREHOLE	30													

 $\stackrel{\underline{\nabla}}{=}$  No reestanding groundwater measured in open borehole on completion o drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD	OF BOREHOL	E N	0.	BH	B20								WC	ood.
Pro	Project Number TP115086								Drilling	Location	Arterial A2			Logged by	MS
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Soli	lid Stem Augers		Compiled by	PR
Pro	ject Name	Arterial Roads within H	ighway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Track Mounte	ed Drill		Reviewed by	SM
Pro	ject Location	Area (Area 47) Arterial A2, Brampton,	Ontario						Date \$	Started	Jan 24, 2020	Date Completed Jan	24, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	1	SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING Soil Vapour Reading	_ [		
Lithology Plo		DESCRIPTION urface Elevation: 219.9 m		Sample ype	Sample Number	Recovery (%)	SP 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane* △ Intact ▲ Remould	Nilcon Vane*		NS RUMEN A ON NS ALLA ON	GRAIN SIZ DISTRIBUT (%)	ZE
	ab	drak grey / brown	2198				1	-			1				
₩		Silty Clay FILL trace gravel		SS	1	75	9	-	3.	0		g)(			
	CII TV	(reworked soil) brown	219 3 0 6												
	SILIT	cLAY / CLAYEY SILT TILL ace sand trace gravel very sti to hard		SS	2	100	26	_ 1	219 -	0					
				- 4	-			= =	Z						
			1-10000000	SS	3	100	56	Ē	8.		0				
		END OF BOREHOLE	218 1 1 8	-			1	3							
										1					
ıl										1 2 2	20 (0)				

 $\frac{\nabla}{2}$  Groundwater encountered on completion o drilling on  $\underline{1/24/2020}$  at a depth o  $\underline{12 \text{ m}}$ 

R	ECORD	OF BOREHOL	E N	0.	BH	B21							W	ood.		
Pro	ject Number	TP115086							Drilling	g Location	Arterial A2				_ Logged by	MS
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Sol	lid Stem Au	igers		_ Compiled by	PR
Pro	ject Name	Arterial Roads within H Area (Area 47)	ighway	427 In	dustria	al Seco	ndary	Plan	Drilling	g Machine	Track Mount	ed Drill	E 155,741 H5 Dat	0.0000000000000000000000000000000000000	Reviewed by	SM
Pro	ject Location	Arterial A2, Brampton,	Ontario						Date S	Started	Jan 24, 2020	Date 0	Completed Ja	n 24, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE	2	SO	IL SA	MPLI	NG			FIELD	TESTING		TESTING oour Reading	_		
					_		(%)		<b>E</b>		tion esting		) TOV (LEL)	NO NO	COMMEN &	ITS
이		DESCRIPTION		ype	Sample Number	(%)	'N' / RQD (%)	(F		M O Vane*	Nilcon Vane*	△ COV (ppm 100 20	1) □ TOV (ppm) 0 300 400	RUMEN A	GRAIN S	
Lithology Plo				Sample	ple N	Recovery (%)	N. /	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact Remould	W <sub>P</sub>	W WL	ALLA	(%)	
Litho	Geodetic Ground S	ourface Elevation: 220.8 m		Sam	Sam	Rec	<del>S</del>	DEP	B.E	* Undrained Sh 20 40	ear Strength (kPa) 60 80	Plastic 20 40	Liquid 60 80	SS	GR SA	SI CL
<b>***</b>	dark	grey / dark brown / brown	2206	SS	1	100	12	Ē								
▓	tra	Silty Clay FILL ce gravel trace organics		33	10	100	12	E				14		] ]		
▓		(reworked soil)						Ē	220 -					1		
▓				SS	2	100	9	_ 1		0		o <sub>22</sub>				
▓				XOUN		10.50		-	8.			22				
▓				- 0				Ē	33							
▓				SS	3	100	9	Ē	219 -	0			39			
			2186					- 2								
		brown CLAY / CLAYEY SILT TILL	22					Ē								
	tı	race sand trace gravel sti to hard		SS	4	100	13	Ε,	7	0		017				
			-					- - 3	218 -							
								- 3		1 1			<u>.</u>	1		
				SS	5	100	27	-		0		16		1		
				- 4				Ė	217 -					1		
		grey		70000	1750	200	1000	_ 4	217							
				SS	6	100	22	-	8	0		°17				
								Ė								
			La Propinsion	SS	7	100	30	Ē	216 -	0		20				
00		END OF BOREHOLE	2158	-				- 5	20							
	od E&IS, a Divisi						mulatic			124/020 at a	depth o 27 m	De Cove			ore 43 m	

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

RI	ECORD OF BOREHOLE No. BH B22														W	ood.
Pro	ject Number	TP115086							Drilling	Location	Arterial A2	E:604484 N:4853360		Lo	gged by	MS
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Sol	lid Stem Augers		Co	ompiled by	PR
Pro	ject Name	Arterial Roads within Hig Area (Area 47)	ghway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Truck Mount	ted Drill		Re	eviewed by	SM
Pro	ject Location	Arterial A2, Brampton, O	ntario						Date S	Started	Jan 23, 2020	Date Completed	an 23, 202	0 Re	evision No	0, 8/14/20
	LITH	OLOGY PROFILE	ì	SO	IL SA	MPLII	NG			FIELD	TESTING	LAB TESTING	34 %			
							(%)		-		A CONTRACTOR OF THE PARTY OF TH	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL 2 4 6 8			COMMEN &	ITS
Q		DESCRIPTION		ype	Sample Number	(%	OD (	•	E) N	O SPT   M O Vane*	PPT • DCPT Nilcon Vane*	△ COV (ppm) □ TOV (ppr 100 200 300 400	RUMEN A	_	GRAIN SI	ZE
Lithology Plo					ole Nu	Recovery (%)	N'/ ROD	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact Remould	W <sub>P</sub> W W <sub>L</sub>	ALLA M		(%)	ION
Litho	Geodetic Ground S	urface Elevation: 220.5 m		Sample	Sam	Reco	8	DEP"	EE	* Undrained She 20 40	ear Strength (kPa) 60 80	Plastic Liquid 20 40 60 80	SS	GR	SA	SI CL
***	ab	out 200 mm ASPHALT Gravelly Sand FILL	2203				3		82					33	58	(9)
▩		some ines					- 8		220 -				(8)	00	30	(0)
▩		brown/dark grey	219 9 0 6	SS	1	75	9			0			4.			
₩		Silty Clay FILL trace gravel	ŀ			10	- 3	_ _ 1					A			
畿				SS	2	100	18	_		0		•	58			
₩		END OF BOREHOLE	219 0						219 -							
			, ,													
										1 1						

 $\stackrel{\textstyle \nabla}{=}$  No  $\,$  reestanding groundwater measured in open borehole on completion o  $\,$  drilling

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

## RECORD OF BOREHOLE No. BH S6 Project Number TP115086 **Drilling Location** Culvert at Arterial A2 E-W E:605620 N:4852529 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Track Mounted Drill Reviewed by SM Area (Area 47) Arterial A2, Brampton, Ontario 0, 8/14/20 Feb 26, 2020 Date Completed Feb 26, 2020 Revision No Project Location **Date Started** LITHOLOGY PROFILE **SOIL SAMPLING FIELD TESTING LAB TESTING** COMMENTS 8 Penetration esting ▲ COV (LEL) ■ TOV (LEL) RUMEN A E O SPT PPT DCP **GRAIN SIZE** Numbe COV (ppm) 100 200 □ TOV (ppm) 300 400 N'/ ROD DESCRIPTION Recovery (%) M O Vane\* Nilcon Vane △ Intact ◇ Intact ▲ Remould ◆ Remould <u>y</u> Lithology Plo **ELEVATION** E DISTRIBUTION W<sub>P</sub> w (%) Sample \* Undrained Shear Strength (kPa) 20 40 60 80 Liquid 80 Plastic 20 SNS GR SA CL SI etic Ground Surface Elevation: 209.0 m about 100 mm TOPSOIL 208 9 dark brown Silty Clay / Clayey Silt FILL some sand trace to some gravel trace organics SS 100 4 047 brown to grey SILTY CLAY / CLAYEY SILT TILL trace to some sand trace gravel cobbles/boulders SS 2 100 5 208 0 °28 irm to hard SS 3 100 10 0 019 2 207 SS 100 35 0 °15 206 grey SS 100 57 0 °15 205 SS 6 100 62 0 09 108 012 7 SS 100 108 5 204 $\bar{\Delta}$ 69 150 mm 6 203 100 69 / 016 SS 8 7 202 SS 100 83 0 20 201 200 023 SS 10 100 43 0 1993 **END OF BOREHOLE** Wood E&IS, a Division of Wood ☐ Groundwater encountered on completion o drilling on 2/26/2020 at a depth o 5.5 m ■ Cave in depth a ter removal o augers 6 1 m 50 Vogell Road Units 3 & 4

50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www woodplc com

	ECORD OF BOREF ject Number TP115086	IOLE N	0.	ВН	S1/	ВН	A2		g Location	Culvert at C	oleraine Drive E:604	481 N·4854343		od.
*******	ject Client City of Brampton							110000000	g Method	20000 10000	olid Stem Augers	101 11.1001010	Compiled by	PR
	ject Name Arterial Roads wit	hin Highway	427 In	dustri	al Seco	ondary	Plan			Track Moun			Reviewed by	SM
599 7	Area (Area 47) ject Location Brampton, Ontario					Jinuary .		552 L25	Started	Jan 20, 2020	E SERVE NEED DEVELOP.	Jan 20, 2020	Revision No	0, 8/14/20
	LITHOLOGY PROFILE		SC	OIL SA	MPLI	NG			FIELD	TESTING	LAB TESTING			
Lithology Plo	DESCRIPTION  Geodetic Ground Surface Elevation: 222.8 m about 200 mm ASPHAL		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □ M O Vane  Δ Intact ▲ Remould	♦ Intact ♦ Remould near Strength (kPa)	Soll Vapour Reading  ▲ COV (LEL) ■ TOV (  2 4 6 8  △ COV (ppm) □ TOV (  100 200 300 40  W <sub>P</sub> W W  Plastic Liqui  20 40 60 80	STRUMENTAT	GRAIN SI DISTRIBUT (%)	ZE
***	brown	222 6					Ē		- 1					
	Sand and Gravel FILL trace to some silt moist dark grey/brown Silty Clay / Clayey Silt FIL	03	SS	1	100	7		222 -	0		a o 24			
	trace gravel trace organic	os .	SS	2	100	5	- 1 - -		0		¤ ° <sub>23</sub>			
		10000	SS	3	100	8	2	221 -	0		9 °31			
	brown SILTY CLAY / CLAYEY SILT trace to some sand trace gr cobbles/boulders very sti to hard	220 6 2 2 TILL avel	SS	4	100	30		220 -	0		в о <sub>16</sub>			
			SS	5	83	53	3			0	G ₽16 <b>Φ</b>	1	18	48 33
	grey		SS	6	100	28	- - - 4 -	219 -	0		<sup>0</sup> 21			
			SS	7	100	71	- - - - 5	218 -		0	a o <sub>13</sub>			
						MARIN SAGAZ MA	- - - - - - -	217 -						
			SS	8	100	33		216 -	0		o 22			
						1000	- - 7 -							
			SS	9	100	86 / 280mm	- 8	215 -		86 280	is O olmm 13			
						Section Section Section	9	☑ = 214 -						
		Parameters .	SS	10	80	50 /		8		50		[: # : ]		
CACAC	END OF BOREHOLE	9 4		.,		100mm				50 100 mm	a o <sub>17</sub>			
Can	d E&IS, a Division of Wood ada Limited	∑ Groundw	vater en	counter	ed on co	ompletio	no dr	illing on	1/20/2020 at	a depth o 82 m	Cave in depth a to	er removal o augers	91m	

	ECORD OF BOREHOLE N	О.						ds within Highway 427 Inc	dustrial Secondary Plan	(A		od.
	ect Number TP115086 ect Location Brampton, Ontario		3.0	rioject	Ivanie	Atterio	ai Roa	us within nighway 427 life	dustrial Secondary Flam	uea (Ale	<del></del>	
	LITHOLOGY PROFILE	SC	OIL SA	MPLI	NG			FIELD TESTING	LAB TESTING			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DЕРТН (m)	ELEVATION (m)	Penetration esting  O SPT	Soil Vepour Reading  ▲ COV (LEL) ■ TOV (LEL)  2 4 6 8  △ COV (ppm) □ TOV (ppm)  100 200 300 400  W <sub>P</sub> W W <sub>L</sub> ■ □  Plastic Liquid  20 40 60 80	INSTRUMENTATION INSTALLATION	GRAIN SIZ DISTRIBUTI (%)	ZE
_	50 mm dia monitoring well with lushmount protective casing installed (depth below ground	0,	0,		0,	_						
	Concrete 00-03 m Sand 03-06 m Bentonite 06-55 m Sand Filter 55-61 m Screen 61-91 m											

		OF BOREH	HOLE N	0.	ВН	<u>S2</u>										ood.
	ject Number								15050000	Location				6 N:4854343	_ Logged by	MS
	ject Client	City of Brampton		407.1				<b>.</b>		Method	150 mm So		Augers		_ Compiled by	PR
	eject Name	Arterial Roads with Area (Area 47) Brampton, Ontario		427 In	dustri	al Seco	ondary	Plan	SE 120	Machine Started	Jan 20, 2020	9000	Completed •	Jan 20, 2020	Reviewed by Revision No	SM 0, 8/14/20
	LITH	OLOGY PROFIL	E	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB	TESTING			
Lithology Plo		DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetra ○ SPT □  M ○ Vane* △ Intact ▲ Remould	ntion esting PPT   DCPT  Nilcon Vane*  Intact Remould	△ COV (LE 2 △ COV (pp 100 2 W <sub>p</sub>	apour Reading EL) ■ TOV (LEI 4 6 8 om) □ TOV (ppr 00 300 400  W WL	RUMENTAT	COMMEN & GRAIN S DISTRIBU (%)	IZE
===	Geodetic Ground S	out 200 mm ASPHAL	T	San	San	Rec	&	DEF	Я	* Undrained Sh 20 40	ear Strength (kPa) 60 80	Plastic 20	Liquid 40 60 80	NST	GR SA	SI CL
		brown Sand and Gravel FILL trace to some silt moist	222 3	SS	1	100	8		222	0		s <sup>0</sup> 24				
	Silt tra	dark grey/brown ty Clay / Clayey Silt Fli ce gravel trace organia	LL cs	SS	2	42	8	_ _ 1		0		□ °26				
		brown		SS	3	75	7		221 -	0		o <sub>26</sub>		10		
		brown CLAY / CLAYEY SILT						- 2 -	220 —							
		very sti to hard	30130123	SS	4	100	29	- 3		0		°13				
				SS	5	46	42		219	C	)	<sup>3</sup> 012				
		grey		SS	6	100	28	- - 4 - -	218 —	0		o <sub>21</sub>				
				SS	7	100	19	5		Ó		o 16		***		
									217					e e e		
								- - 6								
				SS	8	100	35		216 -	О.		021				
								- 7 - - -	215							
				SS	9	100	36	8 2	•	0		<sup>3</sup> 0 <sub>11</sub>		• 13		
									214 -							
			52-52-53-53-53-53	ce	10	100	50 /	- 9 -			5 <u>0</u>		ļ <u>ģ</u> ģ	20		
202		END OF BOREHOLE	213 1 9 4	SS	10	100	100mm				100 mm	10				
	od E&IS, a Divis ada Limited	on of Wood	∑ No reest	anding (	groundy	vater me	easured	in open	boreho	le on complet	ion o drilling	■ Cav	e in depth a ter	removal o auge	ers <u>79 m</u>	
Rich Can el	ogell Road Uni mond Hill Onta lada No (905) 415-2 v woodplc com	io L4B 3K6		chnical E	ngineer.	Also, bo	rehole in	formatio	n should		ntial conditions pre unction with the geo					Scale 1 53

Page 1 of 1

## RECORD OF BOREHOLE No. BH S3 Project Number TP115086 Culvert at Highway 50 E:606278 N:4852633 **Drilling Location** Logged by **Project Client Drilling Method** 150 mm Solid Stem Augers Compiled by City of Brampton Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Track Mounted Drill Reviewed by SM Area (Area 47) Date Completed Jan 10, 2020 Revision No 0, 8/14/20 Project Location Brampton, Ontario **Date Started** Jan 10, 2020 LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING LAB TESTING** COMMENTS RUMENTATION Penetration esting ▲ COV (LEL) ■ TOV (LEL) E O SPT PPT DCP **GRAIN SIZE** Numbe COV (ppm) 100 200 □ TOV (ppm) 300 400 ROD DESCRIPTION Recovery (%) M O Vane\* Nilcon Vane △ Intact ◇ Intact ▲ Remould ◆ Remould Sample Type ithology Plo **ELEVATION** E DISTRIBUTION ż Wp w W (%) Sample \* Undrained Shear Strength (kPa) 20 40 60 80 Liquid 80 Plastic 20 NST NST GR SA CL SI tic Ground Surface Elevation: 210.7 m dark grey/brown Sand and Gravel FILL SS 100 30 0 210 dark grey/brownish grey Silty Clay / Clayey Silt FILL trace to some sand some gravel trace organics SS 2 16 0 75 °7<sub>13</sub> 209 SS 3 83 10 0 °22 2 SS 100 10 0 °20 208 brown/grey SILTY CLAY / CLAYEY SILT TILL trace sand to sandy trace gravel cobbles/boulders SS 100 15 °15 sti to hard 207 SS 6 100 88 0 10 33 46 18 206 90/ SS 7 100 250mr 205 010 SS 100 8 44 204 7 ⊻ SILTY SAND / SANDY SILT TILL trace clay trace gravel 87 280 203 87 / 9 100 SS 35 56 280m 202 50 150 mm 50/ 017 SS 100 150mr 201 2 END OF BOREHOLE Wood E&IS, a Division of Wood ☑ Groundwater encountered on completion o drilling on 1/10/2020 at a depth o 7 0 m. 50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying Explanation of Borehole Log'. Canada Scale 1 53 el No (905) 415-2632 www.woodplc.com

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RI	ECORD	OF BOREH	IOLE N	ο.	вн	S4									Wo	ood.
Proj	ject Number	TP115086							Drilling	g Location	Culvert at H	ighway 50	E:606254 N:48	352631	Logged by	MS
Pro	ject Client	City of Brampton							Drilling	g Method	150 mm So	lid Stem Au	igers		_ Compiled by	PR
Pro	ject Name	Arterial Roads wit	hin Highway	427 In	dustri	al Seco	ndary	Plan	Drilling	g Machine	Track Mount	ted Drill			Reviewed by	SM
Pro	ject Location	Brampton, Ontario	•						Date	Started	Jan 10, 2020	Date C	Completed Jar	10, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFILE		SC	IL SA	MPLI	NG			FIELD	TESTING		TESTING our Reading	_		
Lithology Plo	Geodetic Ground S	DESCRIPTION Surface Elevation: 210.6 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT   M O Vane*      Intact  Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> <li>ear Strength (kPa)</li> </ul>	△ COV (LEL 2 4 △ COV (ppm 100 200	TOV (LEL) 6 8 1) TOV (ppm) 300 400  W WL Liquid	NSTRUMENTATION NSTALLATION	COMMEN & GRAIN SI DISTRIBUT (%)	ZE
	,	Sand and Gravel FILL trace to some silt moist		SS	1	42	45		210 –	(	)	**************************************				
	Sil	dark brown/black ty Clay / Clayey Silt Fil race to some gravel tra	209 3 1 2	SS	2	83	11	1		0		°5 °22				
	some sand t	race to some gravel tra	ice organics	SS	3	75	9	- 2	209 -	0		°29				
		brick pieces		SS	4	100	9	,	208 -	0		°25				
			206 8	SS	5	67	11	3	207 –	0		<sup>0</sup> 29				
	SILTY	brown CLAY / CLAYEY SILT to some sand trace gracobbles/boulders hard	TILL avel	ss	6	100	59	- - 4 -			0 1	°11				
				SS	7	100	101	5	206 -		101	<b>9</b> 0 <sub>9</sub>				
		grey							205 -							
				SS	8	100	46	- 6 - - - - -	204 -	(	0	10 10				
							2	- 7 - 7								
				SS	9	100	45	8	<u>⊽</u> 203 – =		)	O 14				
								- - - - - 9	202 -							
	1		201 1 9 4 200 8	SS	10	100	35		201 -	0		o 16				
Woo	d E&IS, a Divis ada Limited	ion of Wood	9 8	ater en	counter	ed on co	mpletic	no dr	illing on	1/10/2020 at a	depth o 76 m			d. 63		

	ECORD OF BOREHOLE N	wood.									
	ect Number TP115086 ect Location Brampton, Ontario		70	Project	Name	Arteria	I Road	ds within Highway 427 Indu	istrial Secondary Plan A	rea (Area	<u>a 47)</u>
	LITHOLOGY PROFILE	SC	OIL SA	MPLI	NG			FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT PPT • DCPT	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)  2 4 6 8  △ COV (ppm) □ TOV (ppm) 100 200 300 400  W <sub>P</sub> W W <sub>L</sub> ■ Plastic 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
<u></u>	SILTY SAND / SANDY SILT TILL  trace clay trace gravel dense moist  END OF BOREHOLE  50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Sand 00-06 m Bentonite 06-58 m Sand Filter 58-61 m Screen 61-91 m		0	α	6			20 40 60 30	40 60 80	4	

R	ECORD	OF BOREHOL	E No.	BH	<b>S5</b>	BH	B7							W	00	d.
Pro	ject Number	TP115086						Drillin	g Location	Culvert at A	vrterial A2 E-V	V E:605633	N:4852520	Logged by	MS	
	oject Client	City of Brampton							g Method		olid Stem Aug	jers		Compiled by	PR	
	oject Name	Arterial Roads within H Area (Area 47)	lighway 427	ndustr	ial Sec	ondary	Plan	50E 100		Track Moun	e seed to	1010 D182		Reviewed by	SF 0308	erress.
Pro	ject Location	Brampton, Ontario						Date	Started	Feb 26, 202	0 Date Co	mpleted Fe	eb 26, 2020	Revision No	0, 8/	14/20
	LITH	OLOGY PROFILE	S	OIL S	AMPLI	NG			FIELD	TESTING		ESTING ur Reading	7	COMME	NTC	
				-		(%)		Œ	The same of the sa	ration esting	▲ COV (LEL)	TOV (LEL)	NSTRUMENTATION NSTALLATION	&		
Plo		DESCRIPTION	, ybe	Sample Number	(%)	SPT 'N' / RQD	Ê		M O Vane △ Intact	e* Nilcon Vane*  ♦ Intact	△ COV (ppm) 100 200	TOV (ppm) 300 400	ATIO	GRAIN S DISTRIBU	TION	
Lithology Plo			Sample Type	nple h	Recovery (%)	N.	DEPTH (m)	ELEVATION	▲ Remould	f Remould  Shear Strength (kPa)	W <sub>P</sub> W Plastic	•	STALL	(%)		
=	Geodetic Ground S	out 150 mm TOPSOIL	209 2	S	Re	8	B	d		to 60 80	20 40	Liquid 60 80	ZZ	GR SA	SI	CL
	Silt	dark brown y Clay / Clayey Silt FILL some gravel trace organics	0 2 SS	1	100	6		209 -	0		40					
	SILTY	brown to grey CLAY / CLAYEY SILT TILL	07				Ė									
	trace sand	to sandy trace to some grav cobbles/boulders sti to hard	vel ss	2	100	8	-1	208 -	0		°25					
							E									
			SS	3	100	27	_ 2		0		<sup>0</sup> 12					
							Ē	207 -								
		grey	SS	4	100	50	Ē		<u> </u>	0	°13					
							- 3									
							Ē	000								
			SS	5	100	69	Ė	206 -		0	°11					
							}									
		Sand & Silt	SS	6	83	58	- 4		<b>.</b>	0	°12			4 43	50	3
			-			64 /	E	205 -		64						
			SS	7	100	64 / 150mm	-			64 150 mm	<sup>0</sup> 10					
						3	- 5 -									
							Ē	204 -		ļļļ						
							Ē;	<u> </u>								
						62 /	<del>-</del> 6			62						
			SS	8	100	150mm	ŧ	203 -		62 150 mm	13					
							Ē									
							7									
							Ē	202 -	ļ							
							Ē		1							
			SS	9	100	66	- 8			0	°24		F. ⊟ 1.			
							Ė	201 -	] <u>-</u>							
							Ē		] 							
							- - 9									
								200 -	<u>-</u>							
			SS	10	100	39	Ē		-	9	23					
25/2		END OF BOREHOLE	199 6 9 8										24			
	od E&IS, a Divisi nada Limited	on of Wood	Groundwater e	ncounte	ered on o	ompletic	on o dr	illing on	2/26/2020 at	a depth o <u>58 m</u>	n Cave in	depth a ter re	moval o auge	ers <u>91 m</u>		
50 \	Vogell Road Unit	s 3 & 4												1		
Car	nada No (905) 415-2	Boreho a qualif		Enginee	r. Also, bo	rehole in	formati	on should	be read in cor	tential conditions pr njunction with the ge			sistance from			1 53
www	w woodplc com	33.1111					N. C. CO.							F	Page 1	1 of 2

										-			
RECORD OF BOREHOLE No. BH S5 / BH B7													
Pro	ect Number TP115086		F	Project	Name	Arterial Roa	ds within Highway 427 Inc	dustrial Secondary Plan A	rea (Area	a 47)			
Proj	ect Location Brampton, Ontario												
	LITHOLOGY PROFILE	SC	IL SA	MPLI	NG		FIELD TESTING	LAB TESTING					
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	(m) TION (m)	Penetration esting  ○ SPT □ PPT ● DCPT  M O Vane* Nilcon Vane*  △ Intact ◇ Intact	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)  2 4 6 8  △ COV (ppm) □ TOV (ppm) 100 200 300 400  W <sub>P</sub> W W <sub>L</sub>	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
itholog		ample	ample	ecove	N. 1d	DEPTH (m)	▲ Remould ◆ Remould  * Undrained Shear Strength (kPa) 20 40 60 80	Plastic Liquid	NSTRI	GR SA SI CL			
_	50 mm dia monitoring well with lushmount protective casing installed (depth below ground	· O	o)	Œ	- os		20 40 60 80	20 40 60 80	==	3. 3. 3.			
	sur ace)												
	Sand 00-06 m Bentonite 06-55 m Sand Filter 55-91 m Screen 61-91 m												
		1	1	1	1	I		W W W W					

## RECORD OF BOREHOLE No. BH S6 Project Number TP115086 **Drilling Location** Culvert at Arterial A2 E-W E:605620 N:4852529 Logged by **Project Client** City of Brampton **Drilling Method** 150 mm Solid Stem Augers Compiled by Arterial Roads within Highway 427 Industrial Secondary Plan Drilling Machine **Project Name** Track Mounted Drill Reviewed by SM Area (Area 47) 0, 8/14/20 Feb 26, 2020 Date Completed Feb 26, 2020 Revision No Project Location Brampton, Ontario **Date Started** LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING LAB TESTING** COMMENTS RUMENTATION Penetration esting ▲ COV (LEL) ■ TOV (LEL) E O SPT PPT DCP **GRAIN SIZE** Sample Numbe COV (ppm) 100 200 □ TOV (ppm) 300 400 'N' / ROD DESCRIPTION Recovery (%) M O Vane\* Nilcon Vane △ Intact ◇ Intact ▲ Remould ◆ Remould Lithology Plo Sample Type **ELEVATION** E DISTRIBUTION W<sub>P</sub> w (%) \* Undrained Shear Strength (kPa) 20 40 60 80 Liquid 80 Plastic 20 NST NST GR SA CL SI etic Ground Surface Elevation: 209.0 m about 100 mm TOPSOIL 208 9 dark brown Silty Clay / Clayey Silt FILL some sand trace to some gravel trace organics SS 100 4 047 brown to grey SILTY CLAY / CLAYEY SILT TILL trace to some sand trace gravel cobbles/boulders SS 2 100 5 208 0 °28 irm to hard SS 3 100 10 0 019 2 207 SS 100 35 0 °15 206 grey SS 100 57 0 °15 205 SS 6 100 62 0 09 108 012 7 SS 100 108 5 204 $\bar{\Delta}$ 69 150 mm 6 203 100 69 / 016 SS 8 7 202 SS 9 100 83 0 20 201 200 023 SS 10 100 43 0 1993 **END OF BOREHOLE** Wood E&IS, a Division of Wood ☐ Groundwater encountered on completion o drilling on 2/26/2020 at a depth o 5.5 m Cave in depth a ter removal o augers 61 m 50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

R	ECORD OF	BOREHO	LE No	0.	BH	S7 /	BH	C2	7				wood.
Pro	ject Number TP11	15086							Drilling	Location	Culvert at Co N:4853816	untryside Drive E:604850	Logged by MS
Pro	ject Client City	of Brampton							Drilling	Method	150 mm Sol	id Stem Augers	Compiled by PR
Pro		rial Roads within (Area 47)	Highway	427 In	dustri	al Seco	ondary	Plan	Drilling	Machine	Track Mounted Drill		Reviewed by SM
Pro	ject Location Bran	npton, Ontario							Date S	Started	Mar 26, 2020	Date Completed Mar 26, 20	20 Revision No 0, 8/14/20
	LITHOLOG	GY PROFILE	8	SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING	
Lithology Plo	DES	CRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane* △ Intact ▲ Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> </ul> ear Strength (kPa)	Soll Vapour Reading	GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
****	about 13	0 mm ASPHALT brown	217 6 0 1					-					
		nd Gravel FILL to some silt moist	216 9	SS	1	83	17		217	O			
	dark br Silty Clay some sand trace to	own / dark grey / Clayey Silt FILL some gravel trace o	09 rganics	SS	2	100	11	- 1 - - -		0			
			215 6	SS	3	100	13	2	216 -	0			
	trace to som	brown / CLAYEY SILT TILL e sand trace gravel eles/boulders hard	22	SS	4	21	40	- 3	<u></u> 215 −	0			
				SS	5	100	59				0		
			-	SS	6	50	62 / 150mm	- 4 4	214 -		62 150 mm		
				SS	7	100	55 / 150mm		213		55 150 mm		
												6 6	
		grey						_ 6	212 -				
				SS	8	25	67	- - - - 7	211 -		0		
				SS	9	100	44	- 8	210 -	C	)		
									209 —				
			0.000	SS	10	67	50	- 9 - - -			0		
BA	END O	F BOREHOLE	208 0 9 8	4				-					
Woo	od E&IS, a Division of N	Wood ∑	Groundw	ater en	counter	ed on co	mpletio	n o dr	illing on	3/26/2020 at a	depth o 27 m	9 9 5 NAX 1	

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RECORD OF BOREHOLE No. BH S7 / BH C27  Project Number TP115086  Project Name Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)													
	ect Location Brampton, Ontario		7.0	,		7				iun	61		
	LITHOLOGY PROFILE	SC	OIL SA	MPLI	NG			FIELD TESTING					
Lithology Plot	DESCRIPTION	Sample Type Sample Number Recovery (%)		Recovery (%)	SPT 'N' / RQD (%)		ELEVATION (m)	Penetration esting  ○ SPT	Soil Vepour Reading  ▲ COV (LEL) ■ TOV (LEL)  2 4 6 8  △ COV (ppm) □ TOV (ppm)  100 200 300 400  W <sub>P</sub> W W <sub>L</sub> ■ □  Plastic Liquid  20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
_	50 mm dia monitoring well with lushmount protective casing installed (depth below ground												
The state of the s	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Sand 00-06 m  Bentonite 06-55 m  Sand Filter 55-61 m  Screen 61-91 m		0					3					

RECORD OF BOREHOLE No. BH S8 WOOD.															
Pro	ject Number	TP115086							Drilling	Location	Culvert at C N:4853824	countryside Drive E:604	854	Logged by	MS
Pro	ject Client	City of Brampton	<u> </u>						Drilling	Method	150 mm Sc	olid Stem Augers		Compiled by	PR
Pro	ject Name	Arterial Roads wi	ithin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Track Moun	ted Drill		Reviewed by	SM
Pro	ject Location	Brampton, Ontari	io						Date	Started	Mar 26, 202	Date Completed	Mar 26, 2020	Revision No	0, 8/14/20
	LITH	OLOGY PROFIL	.E	SOIL SAMPLING						FIELD	TESTING	LAB TESTING	34.		
							(%)		_	The second secon	ration esting	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEI	) NO	COMMEN &	TS
Q		DESCRIPTION		8	mber	(%	op (e		E N	M O Vane	* Nilcon Vane*	△ COV (ppm) □ TOV (ppr	RUMENTATION TALLATION	<b>GRAIN SI</b>	
agy P				le Typ	e Nu	rery (	Z / Z	E)	ATIO	△ Intact ▲ Remould	♦ Intact	W <sub>P</sub> W W <sub>L</sub>	L LA	DISTRIBUT (%)	ION
Lithology Plo	Geodetic Ground S	Surface Elevation: 219.5 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD	DEPTH (m)	ELEVATION		Shear Strength (kPa) 0 60 80	Plastic Liquid 20 40 60 80	00 00	GR SA	SI CL
****	at	brown	LT 2194 01												
₩	,	Sand and Gravel FILL trace to some silt											30		
₩		moist		SS	1	42	15	Ē	219 -	0					
₩		dark brown	218 6					_ 1	20				4.		
₩	some sand t	ty Clay / Clayey Silt Frace to some gravel to	ILL race organics	SS	2	92	6	Ė .	3	0		Liiii			
₩								-	218 -	i					
				SS	^	00		Ė	210						
₩			Falker, said	SS	3	83	6	_ _ 2		0			10.0		
<b>#</b>		brown	$\frac{2173}{22}$					Ē					263		
	SILTY	to some sand trace g	T TILL ravel	SS	4	100	56		Z 217 -		0		* *		
		cobbles/boulders hard	3	33	-	100	30	Ē					43		
								- 3					39		
				SS	5	33	45	-	8		0				
					N.T.			-	216 -						
							72/	ŧ	8		72				
				SS	6	100	150mm	- 4	8		72 150 mm				
									100				250		
				SS	7	100	50 /	-	215 -		50				
	trace	e to some shale ragm	ents	33	- %	100	80mm	F			50 80 mm				
								_ 5 _							
								-		1					
									214 -						
								- - 6							
		grey						Ė					40		
		gicy		SS	8	100	60	-	213 -		· · · O · · · · ·	•	2.		
						1		Ē		ļģ			23		
								_ _ 7							
								Ē	1	ļ., į.,,,					
									212 -						
				100000	20	7000000	1		3				322		
				SS	9	100	31	- 8	3	0			30		
								Ē		1					
								Ė	211 -				- 1		
													343		
								- 9			ļļ				
				SS	10	100	50			i 	0	<b>.</b>			
		END OF BOREHOLE	209 9 9 7						210 -				_		
		LID OF BUKEHULE	97							į					
Woo	d E&IS, a Divis	ion of Wood	∇ Convento	nter en			malatia		Illino on	3/26/2020 at	a double a 2.4 m	-	Sect. Sec		

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	RECORD OF BOREHOLE No. BH S8  Project Number TP115086 Project Name Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)												
	pject Number TP115086  pject Location Brampton, Ontario		- F	Project	Name	Arterial Ro	ads within Highway 427 Inc	dustrial Secondary Plan A	rea (Are	a 47)			
110	LITHOLOGY PROFILE	90	MI CA	MPLI	NG		FIELD TESTING	LAB TESTING					
Lithology Plot			Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	Penetration esting  ○ SPT □ PPT ● DCPT	Soil Vapour Reading  ▲ COV (LEL) ■ TOV (LEL)	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Litho	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Sand 00-06 m Bentonite 06-58 m Sand Filter 58-61 m Screen 61-91 m	Sample Type	Same Same Same Same Same Same Same Same	Red	TPR		• Undrained Shear Strength (kPa) 20 40 60 80	Plastic Liquid 20 40 60 80	TSNI TSNI	GR SA SI CL			

	ect Number	OF BOREHOLE N			Drilling	g Location		ountryside	Drive E:60408	80	Logged by	od.			
Proje	ect Client	City of Brampton						Drilling	N:4852848 ing Method 150 mm Solid Stem Augers				Compiled by	PR	
Proje	ect Name	Arterial Roads within Highway	427 In	dustria	al Seco	ondary	Plan	Drilling	g Machine	Track Mount	ted Drill			Reviewed by	SM
Proje	ect Location	Area (Area 47) Brampton, Ontario						Date	Started	Mar 18, 2020	Date (	Completed Ma	r 18, 2020	Revision No	0, 8/14/20
- 88	LITH	OLOGY PROFILE	SOIL SAMPLING					9	FIELD	TESTING		TESTING	2, 1		
Lithology Plo	Geodetic Ground S	DESCRIPTION  Surface Elevation: 214.4 m  pout 150 mm ASPHALT 214.3	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane* △ Intact ▲ Remould	<ul> <li>♦ Intact</li> <li>♦ Remould</li> <li>ear Strength (kPa)</li> </ul>	△ COV (LE	m)	NSTRUMENTATION NSTALLATION	GRAIN SI DISTRIBUT (%)	ZE
<b>***</b>		grey 2142					E								
	Sill	trace to some silt moist dark brown ty Clay / Clayey Silt FILL	SS	1	100	9		214 -	0		19				
	trace to s	ome sand trace to some gravel	SS	2	83	8	- 1 - - -	213 -	0		°23				
		212 6 brown to grey 1 8 CLAY / CLAYEY SILT TILL	SS	3	100	7	2		0		°19 °15				
	trace to se	ome sand trace to some gravel cobbles/boulders irm to hard	SS	4	100	53		212 -		0 1	°18				
							- - 3								
		grey	SS	5	100	19	-	211 -	0		o <sub>14</sub>				
			- 33	8	0	50 / 30mm	_ <b>4</b>			30 mm			ha	ard augering	
			SS	7	100	50 / 80mm		210 -		50 80 mm	a 0 <sub>9</sub>				
							_ _ 5								
								209 -							
			SS	8	100	50 / 100mm	- - 6			50 100 mm	°11				
								208 -							
							- <b>7</b>								
								207 -		65					
			SS	9	100	65 / 150mm	8			65 150 mm	<sup>0</sup> 14				
								206 -							
							9								
	1	205 0 END OF BOREHOLE 9 4	SS	10	100	65 / 150mm	Ē_	205 -		65 150 mm	15				
	d E&IS, a Divis	ion of Wood	anding	groundv	vater me	easured	in ope	n boreho	ole on complet	ion o drilling			di te		

227100	ECORD ject Number	OF BOREHOLE NO	0.	ВН	S10			Drilling	Location	Culvert at Co	ountryside Drive E:60408	12	Logged by	od.
142000	ject Client	City of Brampton							Method	N:4852848			Compiled by	PR
		dunikan den de de de Martine	407 1-	44.			Diam			150 mm Solid Stem Augers Track Mounted Drill				\$1 <u></u>
552	ject Name ject Location	Arterial Roads within Highway Area (Area 47) Brampton, Ontario	427 III	iaustria	ai Seco	ondary	Plan	59A 130	Started	Mar 18, 2020	SARTON POWER SOUNDS SESSENSE	r 18, 2020	Revision No	SM 0, 8/14/20
	LITH	OLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING	4 1		
Lithology Plo		DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane* Δ Intact ▲ Remould  * Undrained She	tion esting  PPT   DCPT  Nilcon Vane*  Intact Remould ear Strength (kPa) 60 80	Soll Vapour Reading  COV (LEL)	NSTALLATION  STALLATION	COMMEN & GRAIN SI DISTRIBUT (%)	ZE
~~~	Geodetic Ground S	out 150 mm ASPHALT 213.6	Ø	()	œ	S	_	ш	20 40	60 80	20 40 60 80		in on	GI CE
		brown Sand and Gravel FILL trace to some silt moist brown ty Clay / Clayey Silt FILL	SS	1	100	7		213 -	0		a O <sub>16</sub>			
		trace to some gravel	SS	2	100	9	- 1 - -		0		22 °22			
	SILTY trace to so	brown to grey  CLAY/CLAYEY SILT TILL  me sand trace to some gravel  cobbles/boulders  very sti to hard	SS	3	83	19	- - - 2	212	0		<sup>9</sup> 0 <sub>18</sub>			
			SS	4	75	25	- - - - - - - -	211 -	0		<sup>9</sup> °15			
		grey	SS	5	100	15	, 		0		1 0 <sub>12</sub>			
			SS	6	100	64 / 150mm	- - 4 -	210 -		64 150 mm	908			
			SS	7	100	53 / 150mm	- - - - - 5	209 -		53 150 mm	<sup>9</sup> 016			
							- - - - - - 6	208 –		62				
			SS	8	100	62 / 150mm		207 -		150 mm	9 <sup>0</sup> 19			
							- <b>7</b>	207						
			SS	9	100	75 / 150mm	- - - - - 8	206 -		75 150 mm	<sup>1</sup> °12			
						200000	- <u>\</u>	205 —						
						- 1	- 9							
		END OF BOREHOLE 9 4	SS	10	100	50 / 100mm			5	0 100 mm	1 o <sub>13</sub>			

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 $\stackrel{\textstyle 
abla}{=}$  Groundwater encountered on completion o drilling on  $\underline{3/18/2020}$  at a depth o  $\underline{82\,m}$ 

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RI	RECORD OF BOREHOLE No. BH S10													
	ect Number TP115086		- 1	Project	Name	Arteria	l Roa	ds within Highway 427 Ind	ustrial Secondary Plan A	rea (Are	ea 47)			
Pro	ect Location Brampton, Ontario							I sisi a tratilia I						
	LITHOLOGY PROFILE	SOIL SAMPLING					FIELD TESTING Penetration esting	Soil Vapour Reading  COV (LEL) TOV (LEL)	NOI	COMMENTS				
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	DEPTH (m) ELEVATION (m)	E	E O	E O	O SPT □ PPT ● DCPT.  M O Vane* Nilcon Vane* △ Intact ← Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	2 4 6 8  △ COV (ppm) □ TOV (ppm) 100 200 300 400  W <sub>p</sub> W W <sub>s</sub> Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	& GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
. 1 . 1	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)													
	Sand 00-06 m Bentonite 06-55 m Sand Filter 55-91 m Screen 61-91 m													

Proje	ect Number	TP115086													000	•
- 5 D	(CONTROL 10)	11 110000							Drilling	g Location		ountryside Drive E:6038	19	Logged by	MS	•
Proie	ect Client	City of Brampton							Drilling	Method	N:4852560 150 mm So	lid Stem Augers		Compiled by	PR	
	ect Name	Arterial Roads wi	thin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	g Machine	Track Mount	ted Drill		Reviewed by	SM	_
Proje	ect Location	Brampton, Ontari	io						Date \$	Started	Mar 24, 2020	Date Completed Ma	r 24, 2020	Revision No	0, 8/14/2	0
- 4	LITH	OLOGY PROFIL	E	SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING Soil Vapour Reading				_
Lithology Plo		DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / ROD (%)	TH (m)	ELEVATION (m)	The second secon	♦ Intact	Soli Vapour reading  A COV (LEL) ■ TOV (LEL)  2 4 6 8  Δ COV (ppm) □ TOV (ppm)  100 200 300 400  W <sub>p</sub> W W <sub>c</sub>	NSTRUMENTATION NSTALLATION	GRAIN SI DISTRIBUT (%)	ZE	
Litho	Seodetic Ground S	urface Elevation: 213.2 m	_	Sam	Sam	Reco	TGS	DEPTH	B.B.	* Undrained SI 20 40	hear Strength (kPa) 0 60 80	Plastic Liquid 20 40 60 80	TSN TSN	GR SA	SI (	CL
***		brown	<u>213 0</u> 0 2	ų.			3		213 -							
	Silt	fand and Gravel FILL trace to some silt moist dark grey/brown y Clay / Clayey Silt Fi	212 6 0.6	SS	1	100	9			0		•				
	trace to	some gravel trace or	ganics	SS	2	83	7	-1 -	212 -	0						
			211 0	SS	3	100	16	- 2 <sub>\(\sigma\)</sub>	<u>7</u> 211 –	0						
	SIL	brown to grey TY SAND / SANDY SI trace gravel dense moist to wet	22	SS	4	100	46		211 -		0 1	9				
		moist to wet		SS	-	92	39	3	210 -							
				33	5	83	39									
		grey		SS	6	83	44	- 4 - -	209 -		0 .	<b>L</b>				
				SS	7	333	35	- - - - 5	8	0		9				
									208 -							
							000	- - 6	207 -							
				SS	8	88	35			0						
							5000	_ <b>7</b>	206 -							
	2	trace shale ragments		SS	_	100	55 /		!		55					
				55	9	100	150mm	- 8 -	205 -		150 mm					
		brown to grey CLAY / CLAYEY SILT to sandy trace to sor cobbles/boulders					SEA SHOWN YOUR									
		hard	204 0	SS	0	00	50 / 80mm	- 9	204		50					
		END OF BOREHOLE	92				SUMM				80 mm					
	E&IS, a Divisi	on of Wood	∑ Groundw	ater or	counter	ed on on	mpletic	n o ddii	ling on	3/24/2020 at a	a depth o 21 m	☐ Cave in depth a ter ren	noval o succe	s 76m		_
50 Vo Richn Cana el N	da Limited ogell Road Unit nond Hill Ontar	s 3 & 4 io L4B 3K6	Borehole details	as prese	nted, do	not const	titute a th	orough u	understa n should	nding of all pote	ential conditions pre	esent and require interpretative assetechnical report for which it was			Scale 1	

Project Number  Project Client  Project Name Project Location  TP115086  City of Brampton  Arterial Roads withi Area (Area 47) Brampton, Ontario	n Highway	427 In	dustria	al Seco	ondary Plan	_ Drillir	ng Location ng Method ng Machine Started	Culvert at Cou N:4852567 150 mm Solid Track Mounted Mar 24, 2020		9	Logged by Compiled by Reviewed by Revision No	MS PR SM 0, 8/14/20
LITHOLOGY PROFILE  DESCRIPTION		-		MPLI	(%) Qt	ON (m)	Penetra O SPT   M O Vane*	PPT ● DCPT  Nilcon Vane*	LAB TESTING  Soil Vapour Reading COV (LEL) ■ TOV (LEL)  2 4 6 8  COV (ppm) □ TOV (ppm) 100 200 300 400	FRUMENTATION FALLATION	COMMEN & GRAIN SI DISTRIBUT	ZE
DESCRIPTION  DESCRIPTION  Geodetic Ground Surface Elevation: 213.5 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RG	ELEVATION	△ Intact ▲ Remould  * Undrained Sh 20 40	onear Strength (kPa)	W <sub>P</sub> W W <sub>L</sub> Plastic Liquid  20 40 60 80	NSTRUN NSTALL	(%)	SI CL
about 140 mm ASPHALT brown Sand and Gravel FILL trace to some silt moist darkgrey/ brown Silty Clay / Clayey Silt FILL trace to some gravel trace organ	212 9 0 6	SS	1	100	12	213	0					
uace o some graver nace organ	liks	SS	2	67	6	212						
	211 3	SS	3	83	7 -2		0					
brown to grey SILTY SAND / SANDY SILT trace gravel compact to very dense moist to wet	22	SS	4	75	20	211						
grey		SS	5	83	36	210						
		SS	6	100	91 - 4			0				
		SS	7	100	104	209		104				
	207 7				50/	208		50				
END OF BOREHOLE Auger re usal at 5 8 m depth 50 mm dia monitoring well with lust protective casing installed (depth belo sur ace)  Sand 00-06 m Bentonite 06-21 m Sand Filter 21-58 m Screen 27-58 m	5 8 nmount	33		100	30mm			30 mm				

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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying Explanation of Borehole Log'.

R	ECORD	OF BORE	HOLE N	0.	вн	S13								W	00	d.
Pro	ject Number	TP115086							Drilling	g Location	Culvert at C	larkway Drive E:604621	N:4852286	Logged by	MM	
Pro	ject Client	City of Brampton							Drilling	Method	150 mm Sc	olid Stem Augers		Compiled by	PR	
Pro	ject Name	Arterial Roads wit	thin Highway	427 In	dustri	al Seco	ondary	Plan	Drilling	g Machine	Track Moun	ted Drill		Reviewed by	SM	
Pro	ject Location	Brampton, Ontari	0						Date	Started	Feb 25, 2020	Date Completed Fe	b 25, 2020	Revision No	0, 8/1	4/20
	LITH	OLOGY PROFIL	E	SO	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING	4 1			
					Tiga		(%		=	1000	ation esting	Soil Vapour Reading  COV (LEL) TOV (LEL)  2 4 6 8	NOIL	COMME &	NTS	
બુ		DESCRIPTION		)be	nmper	(%)	SQD (	e e	(m) NC	M O Vane		△ COV (ppm) □ TOV (ppm) 100 200 300 400	TION	GRAIN S DISTRIBU		
Lithology Plo				Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION	△ Intact ▲ Remould		W <sub>P</sub> W W <sub>L</sub>	NSTRUMENTATION NSTALLATION	(%)		
Litho	Geodetic Ground S	urface Elevation: 210.2 m		Sam	Sam	Rec	SPT	DEP	E.E	* Undrained Si 20 4	hear Strength (kPa) 0 60 80	Plastic Liquid 20 40 60 80	ISN G	GR SA	SI	CL
***	·	brown brown Sand and Gravel FILL		SS	1	100	62	Ē	210 -		0	BO 4				
₩		trace to some silt moist	1					ŧ		]						
₩																
₩	Cile	greyish brown ty Clay / Clayey Silt FI	209 2	SS	2	63	8	- 1	209 -	0		<sup>80</sup> 6				
₩	trace to some	e sand trace to some organics	gravel trace					Ē.	2000							
₩								ŧ •	2							
₩				SS	3	100	15	_ 2	8	0		<sup>13</sup> 014				
₩									208 -							
₩				SS	4	100	9	Ē	1	0						
₩				55	-	100	3					^ ° <del>1</del> 2				
₩								- 3								
₩				SS	5	100	7	Ē	207 –	0		a · o15				
₩								Ē	3							
₩			150000					E_4								
$\widetilde{\mathcal{Z}}$	SILTY	grey CLAY / CLAYEY SILT	206 1 4 1					Ė,	206 -							
	trace	to some sand trace great very sti	ravel					ŧ.	Ē							
				SS	6	100	27	Ē	- 8					3 16	50	31
				00	U	100	21	- 5				12		3 10	30	31
								Ė	205 -							
			204 6 5 6					Ē								
		grey TY SAND / SANDY SI gravel cobbles/bould	LT					- - 6								
		loose to very dense moist to wet		00	7	400	20	Ė	204 -							
	2			SS	7	133	22			0		19				
								E	8							
	8							7								
							Į į	Ē	203 –							
								Ē								
				SS	8	100	9	- - - 8		0		a 0 <sub>.18</sub>				
	50							Ē	202 -							
	8							E								
							55 /	- 9			55					
		END OF BOREHOLE	200 9 9 3	SS	9	100	130mm		201 -		130 mm	8 O <sub>14</sub> : : :				
Was	od E&IS, a Divisi	ion of Wood	∇ -	70							18 18					
Can	ada Limited	NAME AND ADDRESS OF A STATE OF A		ater end	counter	red on co	mpletio	n o dr	illing on	2/25/2020 at	adeptho 43 m	Cave in depth a ter rer	noval o augen	s <u>15 m</u>		
	ogell Road Unit Mond Hill Ontar Ada		Borehole details	as prese	nted, do	not cons	titute a th	norough	understa	nding of all pot	ential conditions pro	esent and require interpretative ass	sistance from		•	. =-
el	No (905) 415-2 woodplc com	2632	a qualified Geotec commissioned ar	chnical E	ngineer	Also, bo	rehole in	formati	on should	be read in con	unction with the ge	otechnical report for which it was			Scale 1	

Page 1 of 2

											_		
R	ECORD OF BOREHOLE N	0.	BH	S13							wood.		
	ject Number TP115086		- F	Project	Name	Arteri	al Roa	ds within Highway 427 Ind	dustrial Secondary Plan A	STING Reading I TOV (LEL) 9 9 10 TOV (ppm) 300 400 Liquid 60 80 SI SI CL  COMMENTS 8 GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
Pro	ject Location Brampton, Ontario			MOLU				FIFE D TEATING	LAD TECTING				
Lithology Plot	LITHOLOGY PROFILE  DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DЕРТН (m)	ELEVATION (m)	Penetration esting  ○ SPT	△ COV (ppm) □ TOV (ppm) 100 200 300 400  W <sub>p</sub> W W <sub>L</sub> Plastic Liquid	INSTRUMENTATION INSTALLATION	& GRAIN SIZE DISTRIBUTION (%)		
	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)  Sand 00-06 m Bentonite 06-40 m Sand Filter 40-76 m Screen 46-76 m												

R	ECORD	OF BORE	HOLE N	o.	BH S	S14									W	00	d. I
Pro	ject Number	TP115086							Drilling	g Location	Culvert at C	larkway Dri	ve E:604618	N:4852293	Logged by	ММ	
Pro	ject Client	City of Brampton	I .						Drilling	Method	150 mm Sc	olid Stem Au	igers		Compiled by	PR	
Pro	ject Name	Arterial Roads w	ithin Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	g Machine	Track Moun	ted Drill			Reviewed by	SM	
Pro	ject Location	Area (Area 47) Brampton, Ontar	io						Date	Started	Feb 25, 202	0 Date C	Completed Fel	25, 2020	Revision No	0, 8/1	4/20
	LITH	OLOGY PROFIL	E	SO	IL SA	MPLII	NG			FIEL	D TESTING	LAB	TESTING	4 1			
									255		etration esting	Soil Vap	oour Reading	O	COMMEN	ITS	
•		DESCRIPTION		0	nber	(9	%) QC	100/100	E	O SPT	□ PPT ● DCPT	2 4 △ COV (ppm	6 8 n) □ TOV (ppm) 0 300 400	ION	GRAIN S		
gy Pk		DEGORAL HOR		е Тур	e Nun	ery (%	r/RC	(m)	EVATION	M O Va △ Intact ▲ Remo	♦ Intact	100 200 W <sub>P</sub>	0 300 400 W W	LLAT	DISTRIBUT (%)	TION	
Lithology Plo				Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	E-EV		d Shear Strength (kPa) 40 60 80	Plastic 20 40	Liquid	NSTRUMENTATION NSTALLATION	R SA	SI	CL
_ 	a a	pout 90 mm ASPHAL	T 209 9							20		20 40	80 80				
▓	:	grey sand and Gravel FILL trace to some silt	2701	SS	1	100	67	E			0	4					
₩		moist					1000				4						
₩									209 -	ļ							
₩			208 7	SS	2	63	30	-		C	)	0 <sub>4</sub>					
₩	Silt trace to so	brown to grey y Clay / Clayey Silt F ome sand trace to so	12 ILL me gravel	- (1	- 4							°11					
₩			o gravo.	00	•	00											
₩				SS	3	92	14	_ _ 2	208 -	0		15					
₩									8.								
₩				SS	4	63	6		3.	0							
₩				-	- 8	275				· · · · ·		<sup>0</sup> 14					
₩					-		- (	- 3	207 -								
₩				SS	5	100	10			0		o 0 <sub>12</sub>					
₩				53866		S. Markin						12					
₩									200								
▓		grev	205 9					- 4 <u>5</u>	206 -								
	SILTY	grey CLAY / CLAYEY SIL' to some sand trace g	T TILL						-								
		so t to sti	ŀ				9										
				SS	6	83	3	_ 	205 -	þ		16					
			-						8								
								B	8								
							1	_ _ 6	204 -								
				SS	7	133	13			0							
			-	ethicae	120	SHACE	ASSESSED OF				Tilli	22					
							1				1 1 1		The state of the s				
			202 8				8	<del>- 7</del>	203 -								
		grey TY SAND / SANDY S					8	B			4						
	trace	to some clay trace g dense to very dense moist to wet	ravei			-											
		motor to mot		SS	8	67	31	- - - 8	202 -		)	021			51	47	2
								- 0	W. Carrier								
								Ė		} :							
								_ _ 9	201 -								
41	N .	END OF BODEHO!	200 7	SS	9	100	60 / 150mm				60 150 mm	13					
		END OF BOREHOLE	93														
										1							
Woo	od E&IS, a Divisi	on of Wood	☑ Groundw	ator cr	counter	od on so	moletic	0.0 44	lling on	alaelanan	at a depth o 41 m	<u>                                     </u>	B S\$1				
Can	ada Limited ogell Road Unit	10000000000000000000000000000000000000	= Gloundw	atol elic	Journere	ou on co	wheno	an an	mig on	Z Z JI Z U Z U	αια υσρυίο <u>4 1 Π</u>						
Rich	mond Hill Ontar	o L4B 3K6									potential conditions pr			Istance from		Cools	. F2
el	No (905) 415-2 woodplc com	632	a qualified Geotec commissioned an	nnical E	ompany	Also, bor	enole inf ination o	ormation f Boreh	on should ole Log'.	pe read in o	conjunction with the ge	otecnnical repo	rt for which it was		500.00	Scale 1	

		OF BOREH	IOLE N	0.	ВН	S15						hadron partition and an arrange	N. 4050555		od.
	ject Number	City of Brampton							1000000000	g Location	B00000 10 00000	arkway Drive E:604169	N:4852729	525 00 0000	MS
	ject Client	Arterial Roads with	hin Hinburg	407 In	d. otol	al Can		Dian		g Method		lid Stem Augers		_ Compiled by	PR
252	ject Name ject Location	Area (Area 47) Brampton, Ontario		427 III	austri	ai Seco	ondary	Pian	- 120 LC	Started	Track Mount Feb 24, 2020	CONTROL BOOK STREET WESTERN	b 24 2020	_ Reviewed by	SM 0. 9/14/20
FIC	jeci Location	Brampton, Ontario							Date	Started	Feb 24, 2020	Date Completed Fe	D 24, 2020	_ Revision No	0, 8/14/20
	LITH	OLOGY PROFILE		SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING Soil Vapour Reading	7	COMMEN	ITE
Lithology Plo	Geodetic Ground S	DESCRIPTION  Surface Elevation: 212.7 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □ M O Vane' △ Intact ▲ Remould	♦ Intact ♦ Remould hear Strength (kPa)	▲ COV (LEL) ■ TOV (LEL) 2 4 6 8  Δ COV (ppm) 100 200 300 400  W <sub>p</sub> W W <sub>s</sub> Plastic Liquid 20 40 60 80	NSTRUMENTATION NSTALLATION	COMMEN & GRAIN SI DISTRIBUT (%)	ZE
***	<b>\</b> _	grey	212_6_					-		1					
	,	Sand and Gravel FILL trace to some silt moist	211.8	SS	1	79	37		212 -	0		o <sub>3</sub>			
	Silf trace to s	brown ty Clay / Clayey Silt FIL ome sand trace to som	L e gravel	SS	2	42	14	- 1 - -		0		ı o			
			040.5	SS	3	100	8	2	211 -	0		20			
	SILTY	grey CLAY / CLAYEY SILT	210 5 2 2 TILL	-				Ė							
	trace	sand to sandy trace gra cobbles/boulders very sti to hard	avel	SS	4	185	25		210 -	] - -		20			
				SS	5	100	68 / 180mm	- 3 - -			68 180 mm	<sup>3</sup> 016			
									209 -						
				SS	6	46	20	- <b>4</b>		0		<sup>9</sup> °11			
				SS	7	100	67 / 250mm	- 5	208 -		67 250 mm	a c <b>918</b>		6 31	46 17
								- - - 6	207 -						
				SS	8	100	92 / 250mm				92 25	0 mm18			
								- - 7	206 -						
				SS	9	89	94		205 -		O	1 0 22			
								<b>- 8</b>				22			
								- - - - - 9	204 -						
				SS	10	100	59/	ŧ		1	59				
		END OF BOREHOLE	203 2 9 4	975EB	1000	0.000	150mm	-	-		59 150 mm	a O <sub>19</sub>			
	od E&IS, a Divisi ada Limited		∑ No reest	anding	groundv	water me	easured	in ope	n boreh	ole on comple	tion o drilling	Cave in depth a ter re	moval o augen	s <u>94 m</u>	

R	ECORD OF BOREHOLE N	0.	BH S	<u>S16</u>							wood.
Pro	ect Number TP115086						Drilling	Location	Culvert at Cl	larkway Drive E:604158 N:4852745	
Pro	ect Client City of Brampton						Drilling	Method	150 mm So	lid Stem Augers	Compiled by PR
Pro	ect Name Arterial Roads within Highway	427 In	dustria	al Seco	ndary	Plan	Drilling	Machine	Track Mount	ted Drill	Reviewed by SM
Pro	Area (Area 47) ect Location Brampton, Ontario						Date	Started	Feb 24, 2020	Date Completed Feb 24, 2020	Revision No <u>0, 8/14/20</u>
	LITHOLOGY PROFILE	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING Soil Vapour Reading	COMMENTS
Lithology Plo	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □  M O Vane* Δ Intact ▲ Remould * Undrained She	tion esting  PPT	△ COV (LEL) ■ TOV (LEL) □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □	& GRAIN SIZE DISTRIBUTION (%)
****	Geodetic Ground Surface Elevation: 213.0 m about 90 mm ASPHALT 213.0	Ø	o	œ	Ø	-	ш .	20 40	60 80	20 40 60 80 ZZ G	N ON SI CE
	grey Sand and Gravel FILL trace to some silt moist	SS	1	100	32			О		a <sup>o</sup> 11	
	dark grey 0 9 Silty Clay / Clayey Silt FILL trace to some sand trace to some gravel	SS	2	83	14	- 1 -	212	0		o 12	
		SS	3	100	8	2	211 -	0		24	
	SILTY CLAY / CLAYEY SILT TILL trace to some sand trace gravel cobbles/boulders very sti to hard	SS	4	100	22	- - - - - - 3		0		a o <sub>16</sub>	
		SS	5	100	37		210 -	0		a 0 <sub>(4</sub>	
		SS	6	100	29	<b>-4</b>	209 -	0		a o <sub>12</sub>	
	grey	SS	7	100	62	- - - 5	208 -		0 •	a 0 <sub>9</sub>	
		SS	8	100	50 / 100mm	_ _ _ 6	207 —	5	0 100 mm	a o <sub>12</sub>	
					o trobust trobusts sta	- - - - 7	206 -				
		SS	9	100	70 / 150mm				70 150 mm	a °8	
					roumm	8	205 -		150 mm	8	
					States System and	9	204 -				
	200.0	SS	10	100	71				0	a 0 16	
XX	END OF BOREHOLE 98					-					
Woo	d E&IS, a Division of Wood   ✓ No. recet							8 8	- 15		

Wood E&IS, a Division of Wood Canada Limited

No reestanding groundwater measured in open borehole on completion o drilling

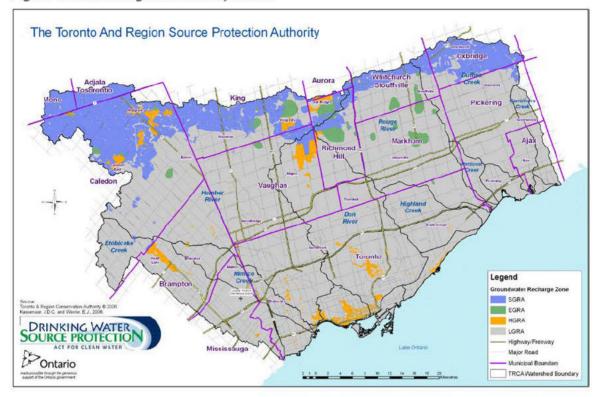
50 Vogell Road Units 3 & 4 Richmond Hill Ontario L4B 3K6 Canada el No (905) 415-2632 www.woodplc.com

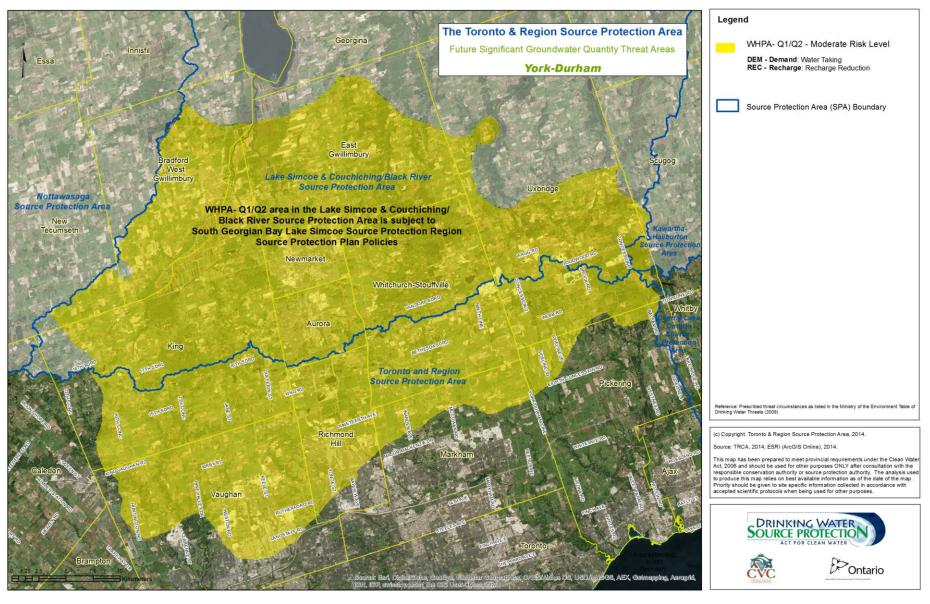
Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying Explanation of Borehole Log'.

R	ECORD OF BOREHOLE N	О.	вн	S16							wood.
	ect Number TP115086		-	Project	Name	Arteria	l Roa	ds within Highway 427 Indi	ustrial Secondary Plan A	rea (Are	ea 47)
Pro	ect Location Brampton, Ontario							I sis a reason I	I AD TEOTINO		
	LITHOLOGY PROFILE	SC	JIL SA	MPLI		1		FIELD TESTING Penetration esting	Soil Vapour Reading  COV (LEL) TOV (LEL)	NOI	COMMENTS
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	O SPT □ PPT ● DCPT  M O Vane* Nilcon Vane* △ Intact ◆ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	2 4 6 8  △ COV (ppm) □ TOV (ppm) 100 200 300 400  W <sub>p</sub> W W <sub>s</sub> Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	& GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
	50 mm dia monitoring well with lushmount protective casing installed (depth below ground sur ace)										
	Sand 00-06 m Bentonite 06-55 m Sand Filter 55-91 m Screen 61-91 m										

B	Bu Bl. B.	n	Ground Surface Elevation	End of Borehole Elevation	OW 5 -1 / 1		Proposed Road Surface	GW Depth from Propose
Borehole Log ID	BH Plan Station	Road Profile Station	(m)	(m)	GW Depth (m)	GW Level Elev. (m)	Elevation (m)	Road Surface (m)
oleraine Drive				**************************************			T:	
A1	0+000	12+270	215.5	210.5	(DRY)	( <del>-</del>	215.6	> 5.1
A2	0+000	12+270	215.4	213.5	(DRY)		215.6	> 2.1
A3	0+150	12+120	216.1	213.3	2.7	213.4	216.5	3.1
A5	0+300	11+970	216.3	215.0	(DRY)	-	217.4	> 2.4
A7	0+450	11+820	218.2	216.6	(DRY)	E=1	218.4	> 1.8
A8	0+450	11+820	217.9	216.1	(DRY)	22°	218.4	> 2.3
A9	0+600	11+670	219.1	214.1	(DRY)	-	219.3	>5.2
A10	0+600	11+670	219.0	217.2	(DRY)	(-)	219.3	> 2.1
A11	0+750	11+520	219.9	216.8	(DRY)	123	220.2	> 3.4
A13	0+900	11+370	220.0	217.3	2.4	217.6	221.2	3.6
A15	1+050	11+220	221.5	220.0	(DRY)	-	222.1	> 2.1
A17	1+200	11+070	222.5	217.5	(DRY)	151	223.0	> 5.5
A18	1+200	11+070	222.9	221.1	(DRY)	(#3)	223.0	> 1.9
A19	1+350	10+920	222.6	219.6	(DRY)	121	224.0	> 4.4
A20	1+350	10+920	222.4	221.2	(DRY)	1 <del></del> 0	224.0	> 2.8
A21	1+500	10+770	223.2	221.9	(DRY)	(=)	224.1	> 2.2
A23	1+650	10+620	222.8	213.4	8.2	214.6	223.3	8.7
A25	1+800	10+470	225.0	220.0	(DRY)	(=)	224.7	> 4.7
A26	1+800	10+470	224.4	222.6	(DRY)	(=1	224.7	> 2.1
A27	1+950	10+320	226.8	223.8	(DRY)	1-1	226.7	> 2.9
A28	1+950	10+320	226.8	225.6	(DRY)	-	226.7	> 1.1
A29	2+100	10+170	228.6	227.1	(DRY)	(2)	228.7	> 1.6
A30	2+100	10+170	228.7	226.9	(DRY)	(=)	228.7	> 1.8
A31	2+250	10+020	230.7	225.7	(DRY)	(=1	230.7	>5.1
rterial A2	2.200	20.020	250.7	223.1	(5)	+	250	
B2	0+100	13+210	210.2	205.2	3.7	206.5	210.4	3.9
B3	0+200	13+110	211.8	208.8	(DRY)	25515	210.9	> 2.1
B4	0+300	13+010	211.7	209.9	(DRY)	-	211.4	> 1.5
B5	0+400	12+910	211.3	206.2	(DRY)	129	212.0	> 5.8
B6	0+500	12+810	210.9	208.8	(DRY)		212.5	> 3.7
B7	0+600	12+710	209.3	199.6	5.8	203.5	213.0	9.5
S6	0+637	12+673	209.0	199.3	5.5	203.5	213.2	9.7
B8	0+700	12+610	211.1	209.4	(DRY)	-	213.5	> 4.1
B9	0+800	12+510	212.5	207.4	4.3	208.2	214.1	5.9
B10	0+900	12+410	212.7	211.0	(DRY)	-	214.6	> 3.6
B11	1+000	12+310	212.7	209.3	(DRY)	100	215.1	> 5.8
B12	1+100	12+310	214.3	212.6	(DRY)	127	215.6	> 3.0
B13	1+200	12+110	215.7	210.7	(DRY)	-	216.2	> 5.5
B14	1+300	12+110	217.1	215.2	(DRY)	-	216.7	> 1.5
B15	1+400	11+910	217.1	215.2	(DRY)	- FE	217.2	> 2.9
B16	1+500	11+810	217.9	214.3	(DRY)	_	217.7	> 1.6
B17	1+600	11+710	217.9	213.4	(DRY)	SR2	217.7	> 1.6
	20,000,000,000		1.0 1.00.000		PURE LINET	949 -		71 × 500.00
B18	1+700	11+610	219.2	217.4	(DRY)	<b>2</b>	218.8	> 1.4
B19 B20	1+800	11+510	219.5	216.5	(DRY)	210.6	219.3	> 2.8
670	1+900	11+410	219.8	218.1	1.2	218.6	219.8	1.2
B21	2+015	11+295	220.8	215.8	2.7	218.1	220.4	2.3

Figure C 10: Recharge Area Classification





Map 3.4: York-Durham – Future Significant Groundwater Quantity Threat Areas

# Appendix B: Supporting Calculations



#### Runoff Generated from the 90th Percentile Rainfall Event (27mm)

Cubaatahmant	Total Area (ha)	Pervious	Area (ha)	lmp	pervious Area (h	a)	27 mm Runoff	Volume (m³)
Subcatchment	Total Area (ha)	Proposed	Existing	Proposed	Existing	Net	Total Imp Area	Net Increase
Arerial A2								
A1	2.08	0.43	2.08	1.64	0.00	1.64	443.8	443.8
A2	1.80	0.40	1.76	1.41	0.04	1.36	379.4	367.6
А3	1.83	0.40	1.76	1.44	0.07	1.36	387.9	367.8
A4	2.07	0.43	2.05	1.64	0.01	1.62	442.4	438.7
A5	2.09	0.42	2.02	1.67	0.07	1.60	451.4	431.5
A6	2.04	0.51	2.04	1.53	0.00	1.53	412.0	412.0
A7	5.31	1.09	5.31	4.22	0.00	4.22	1139.7	1139.7
Coleraine Drive								
CR1	2.94	0.88	2.16	2.07	0.78	1.29	558.2	348.0
CR2	1.66	0.43	1.33	1.23	0.33	0.90	331.4	243.1
CR3	1.15	0.33	0.95	0.82	0.20	0.62	221.4	167.1
CR4	2.39	1.08	1.96	1.31	0.44	0.88	354.2	236.6
CR5	1.39	0.34	1.19	1.05	0.20	0.85	282.9	228.2

### **Pre-Development Water Balance Volume Calculations - Arterial A2**

Notes: Ratios of runoff, evapotranspiration, and infiltration as per Table 3.1 of MOE SWMPDM 2003

	Drainage Area Table (ha)													
Land Cover	Soil Group	Subcatchment A1	Subcatchment A2	Subcatchment A3	Subcatchment A4	Subcatchment A5	Subcatchment A6	Subcatchment A7						
Land Cover	Jon Group	Contributing Area (ha)												
	Α	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
Pervious Area	В	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
Pervious Area	С	2.08	1.76	1.76	2.05	2.02	2.04	5.31						
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
Impervious Area	N/A	0.00	0.04	0.07	0.01	0.07	0.00	0.00						
•	Totals	2.08	1.80	1.83	2.07	2.09	2.04	5.31						

	Soil Group Weighting (per Table 3.1 of SWMPDM 2003)													
Soil Group	Runoff	Infiltration	Evapotranspiration	Precipitation										
Α	149	276	515	940										
В	187	228	525	940										
С	222	182	536	940										
D	270	145	525	940										
Α	16%	29%	55%	100%										
В	20%	24%	56%	100%										
С	24%	19%	57%	100%										
D	29%	15%	56%	100%										

Annual Soil Infiltration (mm)						
Year Range	Average Annual Precipitation (mm)	Soil A Infiltration (mm)	Soil B Infiltration (mm)	Soil C Infiltration (mm)	Soil D Infiltration (mm)	
1995 - 2019	797.6	234.19	193.46	154.43	123.03	

	Annual Subcatchment Infiltration (m <sup>3</sup> )							
Subcatchment #:	Subcatchment A1	Subcatchment A2	Subcatchment A3	Subcatchment A4	Subcatchment A5	Subcatchment A6	Subcatchment A7	
Volume:	3204.83	2718.85	2717.30	3170.09	3120.51	3144.91	8200.09	

Daily Subcatchment Infiltration (m <sup>3</sup> )							
Subcatchment #:	Subcatchment A1	Subcatchment A2	Subcatchment A3	Subcatchment A4	Subcatchment A5	Subcatchment A6	Subcatchment A7
Volume:	8.78	7.45	7.44	8.69	8.55	8.62	22.47

## **Pre-Development Water Balance Volume Calculations - Coleraine Drive**

Notes: Ratios of runoff, evapotranspiration, and infiltration as per Table 3.1 of MOE SWMPDM 2003

	Drainage Area Table (ha)								
Land Cover	Soil Group	Subcatchment CR1	Subcatchment CR2	Subcatchment CR3	Subcatchment CR4	Subcatchment CR5			
Land Cover	30ii Group	Contributing Area (ha)							
	Α	0.00	0.00	0.00	0.00	0.00			
Pervious Area	В	0.00	0.00	0.00	0.00	0.00			
Pervious Area	С	2.16	1.33	0.95	1.96	1.19			
	D	0.00	0.00	0.00	0.00	0.00			
Impervious Area	N/A	0.78	0.33	0.20	0.44	0.20			
	Totals	2.94	1.66	1.15	2.39	1.39			

	Soil Group Weighting (per Table 3.1 of SWMPDM 2003)								
Soil Group	Soil Group Runoff Infiltration Evapotranspiration Precipitation								
Α	149	276	515	940					
В	187	228	525	940					
С	222	182	536	940					
D	270	145	525	940					
Α	16%	29%	55%	100%					
В	20%	24%	56%	100%					
С	24%	19%	57%	100%					
D	29%	15%	56%	100%					

Annual Soil Infiltration (mm)							
Year Range	Average Annual Precipitation (mm)	Soil A Infiltration (mm)	Soil B Infiltration (mm)	Soil C Infiltration (mm)	Soil D Infiltration (mm)		
1995 - 2019	797.6	234.19	193.46	154.43	123.03		

Annual Subcatchment Infiltration (m <sup>3</sup> )							
Subcatchment #:	Subcatchment CR1	Subcatchment CR2	Subcatchment CR3	Subcatchment CR4	Subcatchment CR5		
Volume:	3342.58	2054.81	1467.68	3023.07	1830.27		

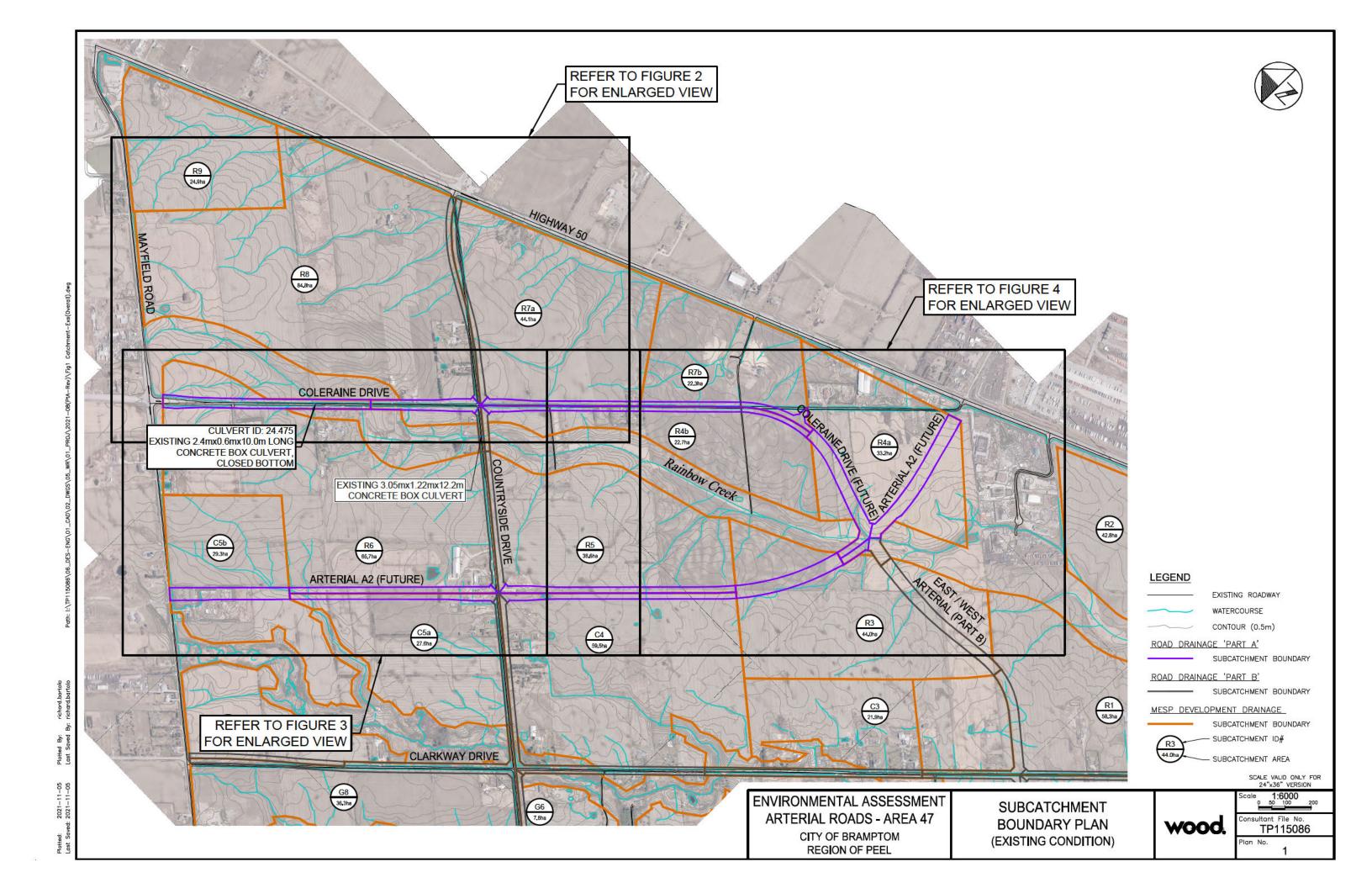
Daily Subcatchment Infiltration (m <sup>3</sup> )							
Subcatchment #:	Subcatchment CR1	Subcatchment CR2	Subcatchment CR3	Subcatchment CR4	Subcatchment CR5		
Volume:	9.16	5.63	4.02	8.28	5.01		

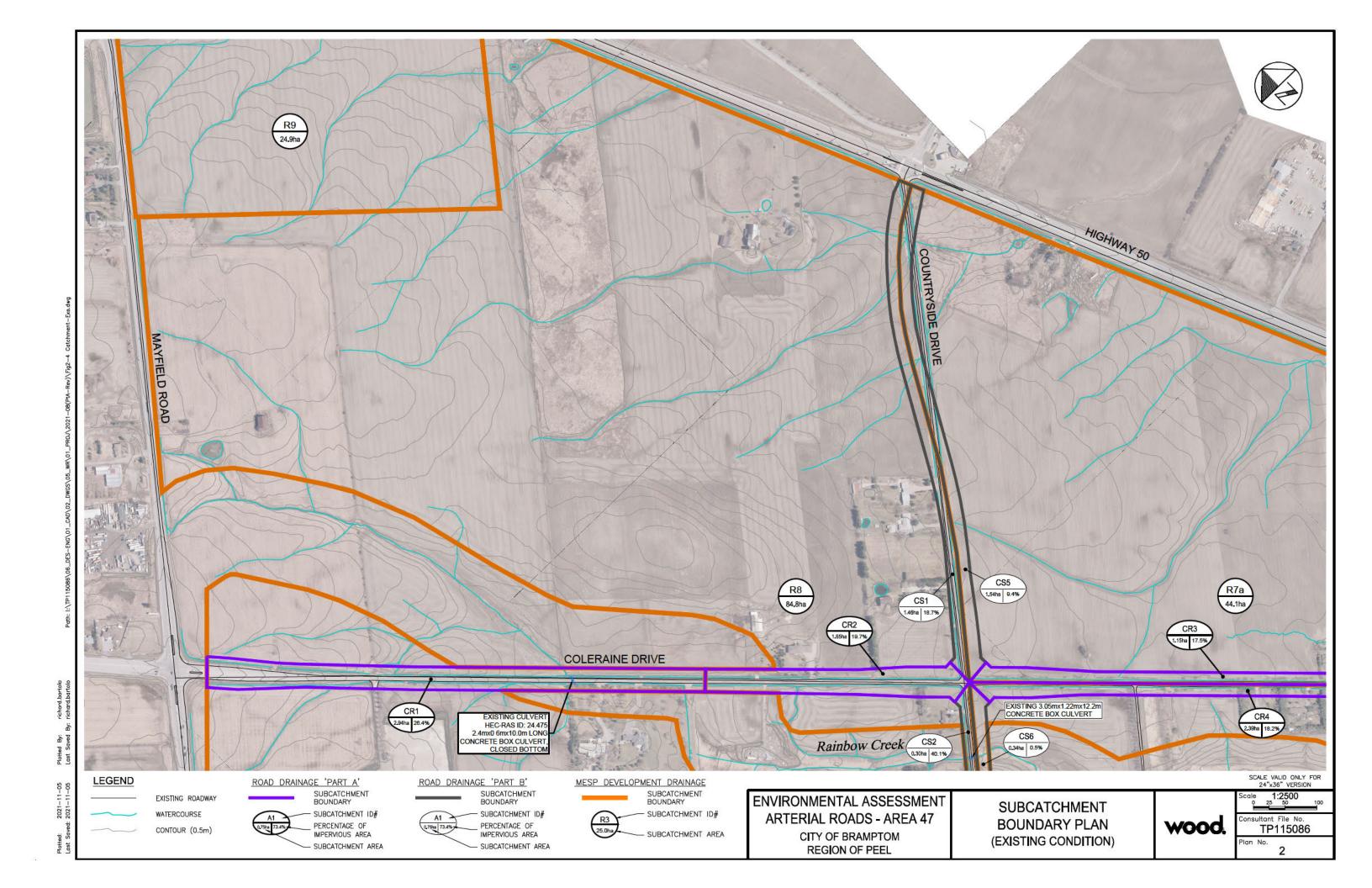
#### Runoff Generated from a 5mm Rainfall Event

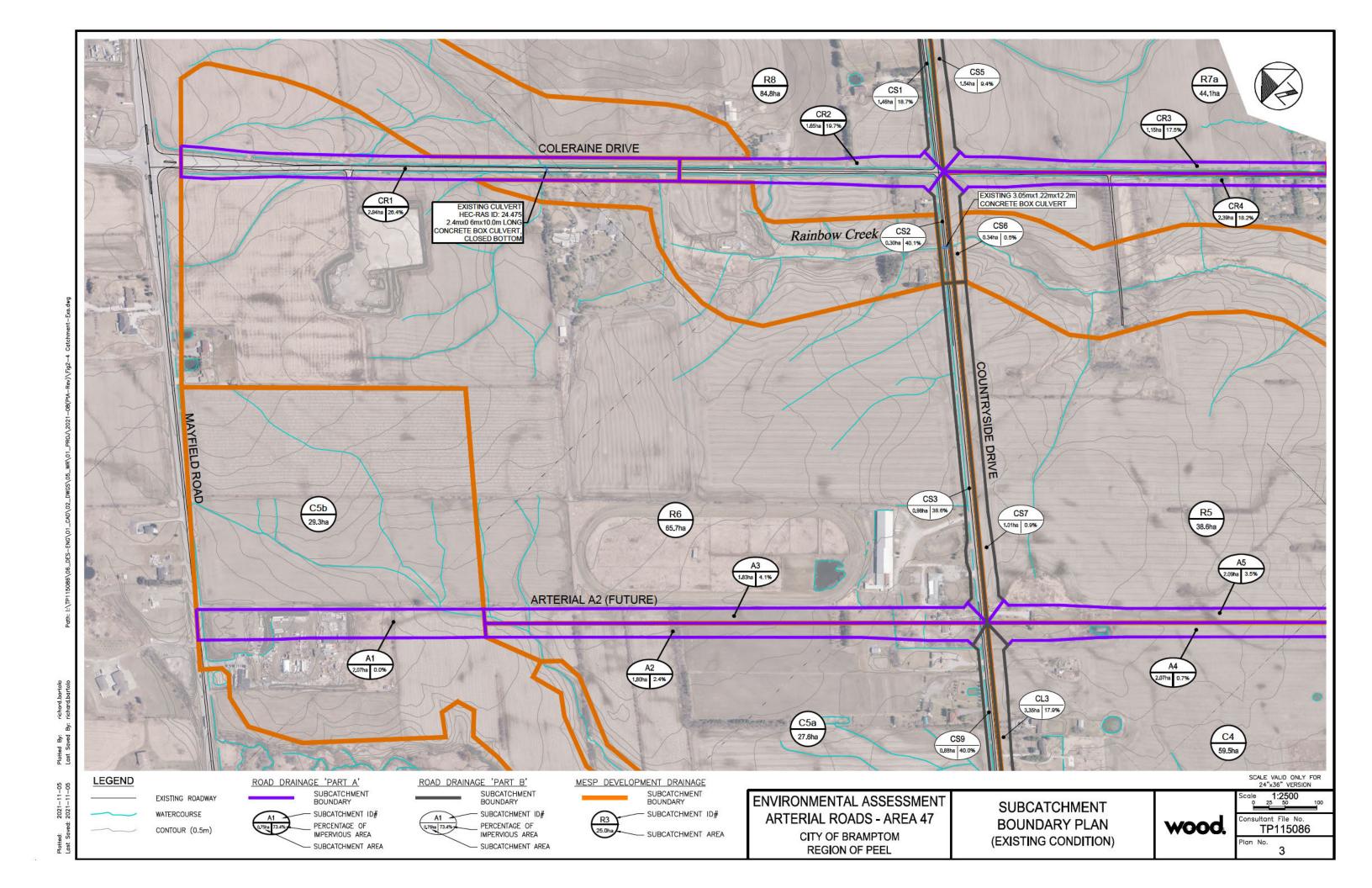
Subcatchment	Impervious Area (ha)	5 mm Runoff Volume (m³)						
Arerial A2								
A1	1.64	82						
A2	1.41	70						
А3	1.44	72						
A4	1.64	82						
A5	1.67	84						
A6	1.53	76						
A7	4.22	211						
Coleraine Drive								
CR1	2.07	103						
CR2	1.23	61						
CR3	0.82	41						
CR4	1.31	66						
CR5	1.05	52						

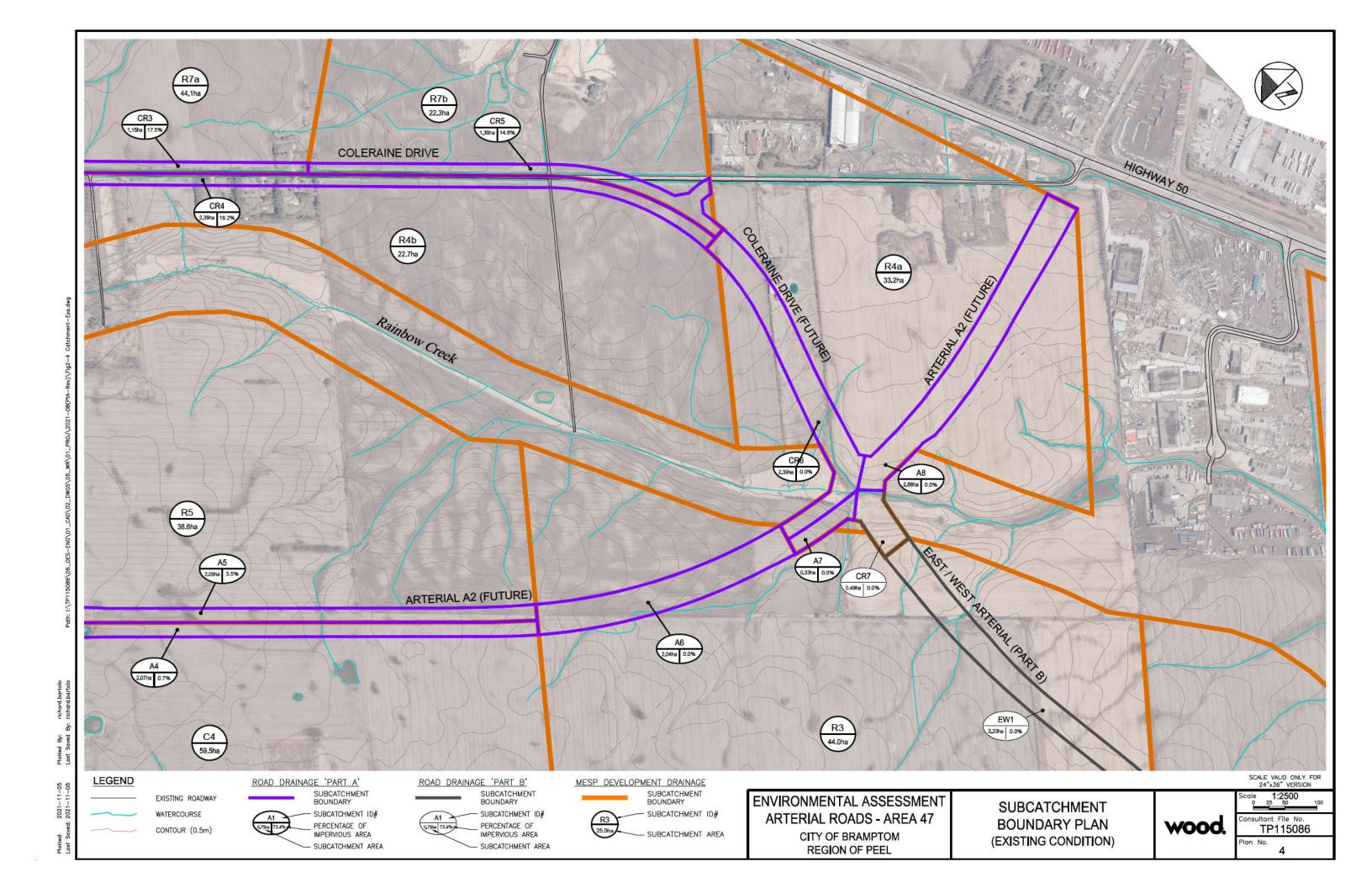
## Appendix C: Plans

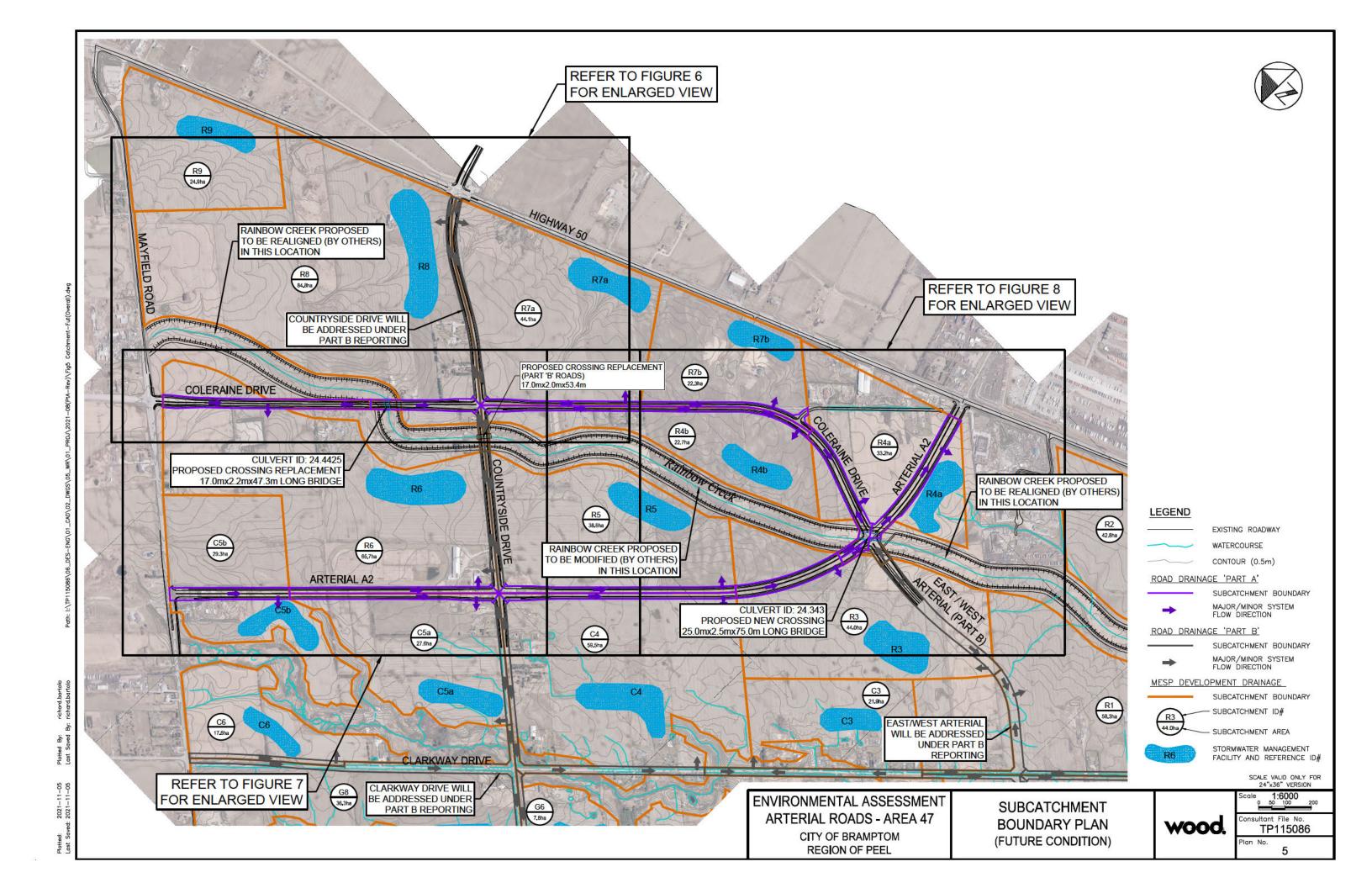


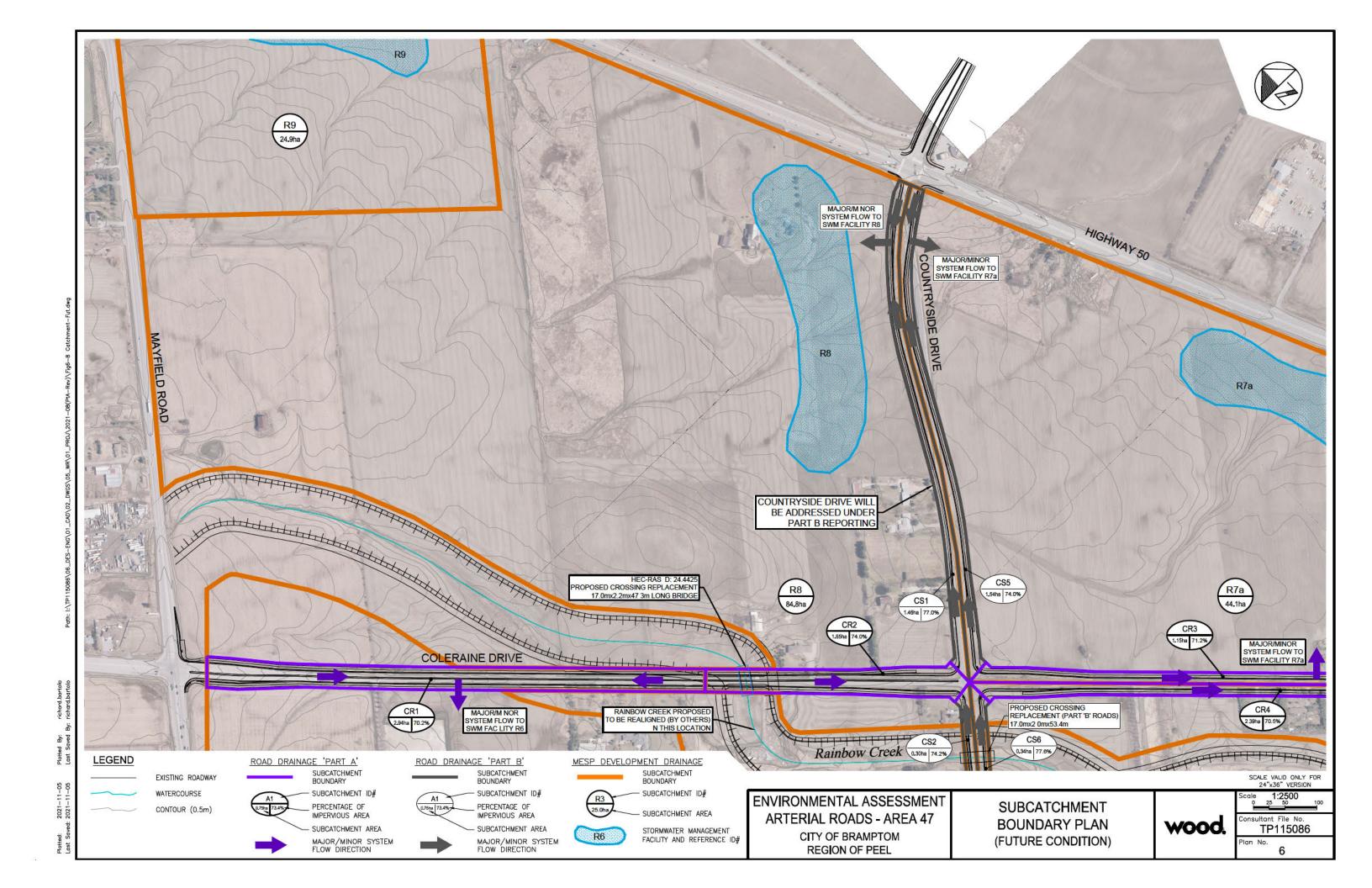


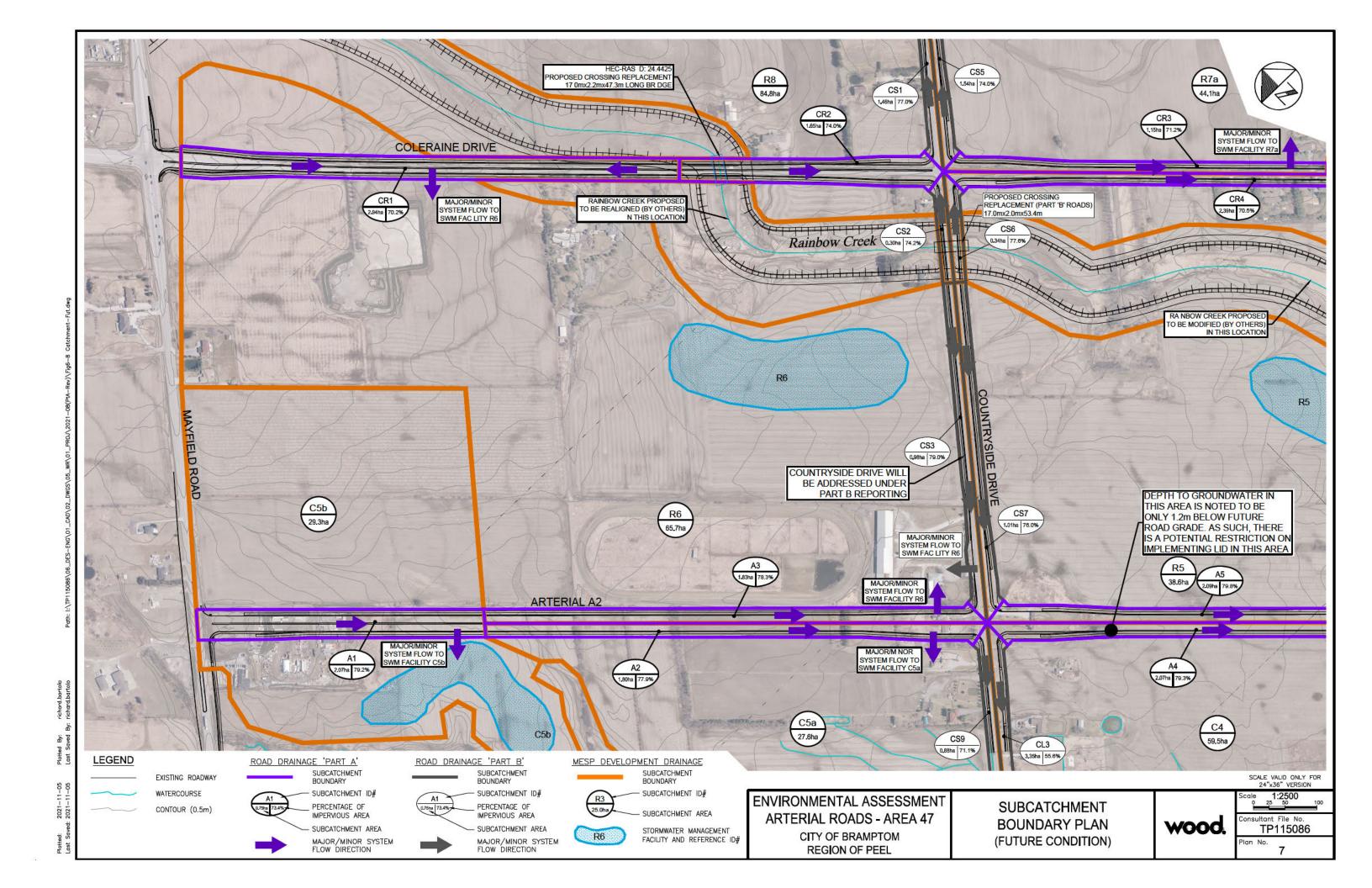


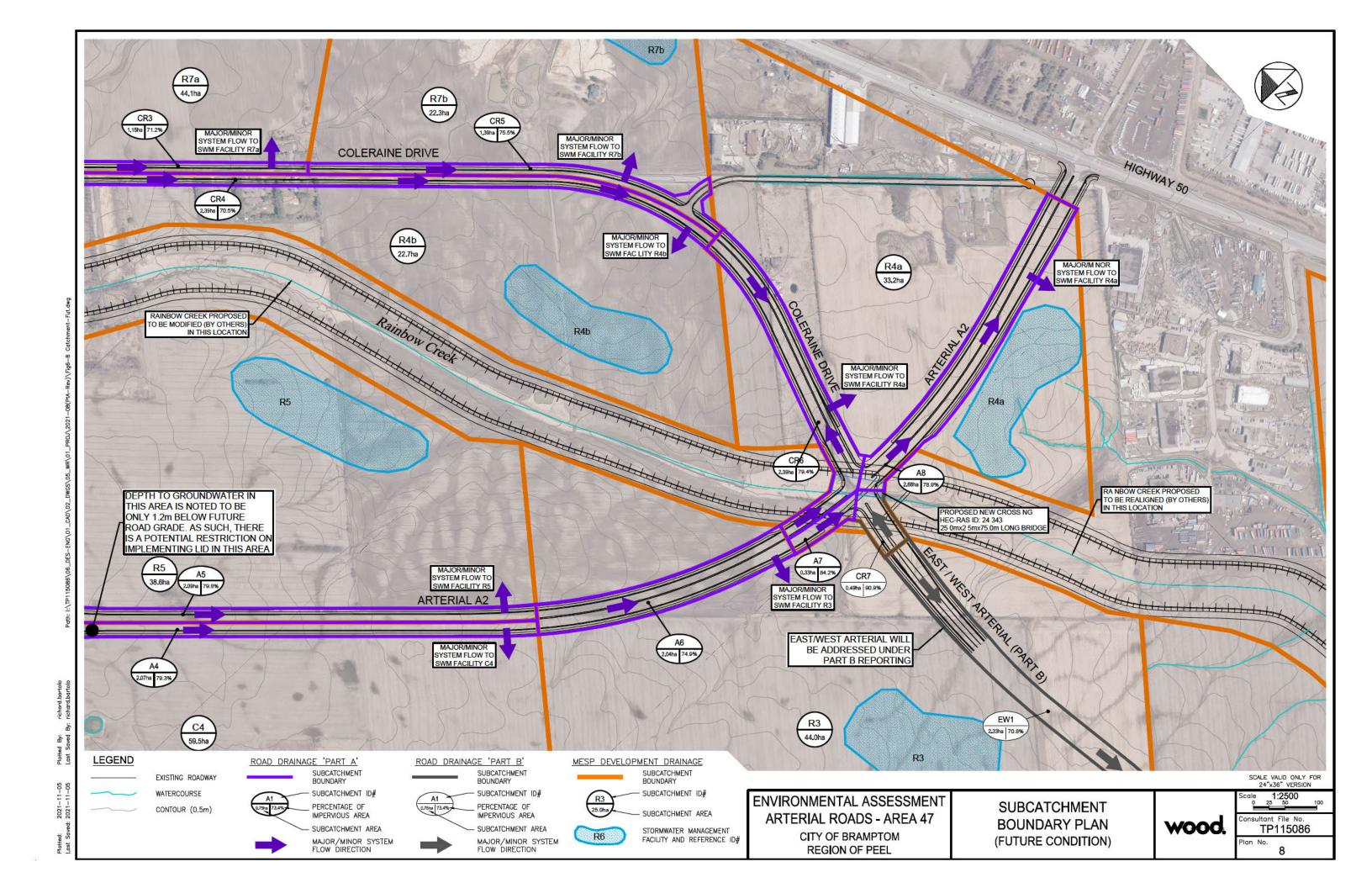












# Appendix D: Correspondence





Development Services, Public Works 10 Peel Centre Drive, Suite A, 6<sup>th</sup> Floor Brampton, Ontario L6T 4B9

Dear Mr

As you know, the Region of Peel has requested the developers fronting Coleraine Drive from Countryside Drive to future Arterial Road A2 provide land for a stormwater management pond to accommodate storm run off from the realigned Coleraine Drive

The developer group, including a sidentified on the attached figure all subject to a final design.

If you have any questions or require any further Information, please do not hesitate to contact the undersigned.

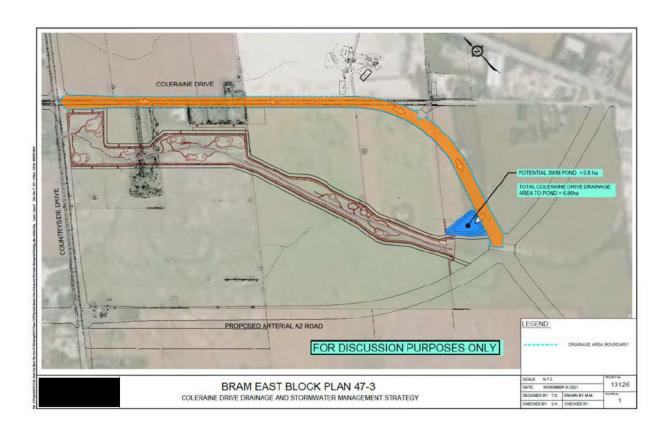
Yours truly,



Cd Cd

Figure 1

Proposed Location of Coleraine SWM Pond and Drainage Area Boundary



# Appendix E: Coleraine Drive Drainage Planning – Alternatives Assessment

#### **Coleraine Drive Drainage Planning**

Two alternative stormwater management options have been considered for the Coleraine Drive R.O.W., namely:

1. **Alternative #1** - Redirecting R.O.W. drainage from Subcatchments CR4, CR5, CR6, CS6 and A7, away from SWMFs R7b and R4b, to SWMF R4a.

A high-level review of this alternative has been completed based on the following:

- a) Determine Technical Feasibility of Alternative Drainage Plan: confirmation of sufficient elevation to support a gravity conveyance system to SWMF R4a.
- b) Preliminary Storm Sewer Design for Alternate Drainage Plan: preparation of a preliminary storm sewer design and layout for the noted drainage scenario.
- c) Hydrologic Modelling: development of a hydrologic model to simulate the 100-year stormwater runoff in support of the assessment of the feasibility of redirection of runoff to SWMF R4a.
- d) Costing: development of a high-level cost of the preliminary storm sewer design and alternate storage framework for the noted drainage concept.

Each of these component tasks is documented in the following sections.

2. **Alternative #2** - Redirecting R.O.W. drainage to a new SWM facility to be located (under discussion) in the north-west quadrant of the intersection of Coleraine Drive and Arterial A2 as illustrated in Figure E-1.

The multi-lateral discussions have not reached conclusion, regarding SWM facility location, at the time of writing of this report. As such, this scenario should be further evaluated during detailed design and the R.O.W. drainage, per the catchments divide provided in this SWM report (ref Appendix C), be the responsibility of the adjacent landowners to accommodate.



Figure E-1 Approximate Location of Possible Future SWM Facility

(background image source Google Earth Pro<sup>TM</sup>)

#### Assessment of Drainage Alternative #1

#### Determine Technical Feasibility of Alternative Drainage Plan

A key element of the feasibility of the Alternative Drainage Plan is confirmation of sufficient elevation to support a gravity conveyance system. The following information is considered relevant to this determination:

- The proposed road profile of Arterial A2, adjacent to the MESP proposed stormwater management facility (SWMF) R4a, has an elevation of 210.84 m.
- The proposed channel invert of Rainbow Creek adjacent to the expected discharge point of the SWMF R4a outlet headwall ranges from 206.99 m to 207.22 m.
- Based on this, the vertical drop between the proposed road profile elevation and the proposed Rainbow Creek channel invert ranges from 3.62 m to 3.85 m.

It is noted that a minimum vertical drop of 3.0 m would typically be necessary to implement a SWMF in this configuration. Therefore, based on the information presented above there appears to be sufficient vertical drop between the proposed roadway and the receiving Rainbow Creek to allow SWMF R4a to be implemented.

A high-level review to determine if the proposed siting of SWMF R4a would be suitable to accommodate the roadway drainage from the arterial roadways has been completed. Based on the assessment completed as part of Task 2 and 3, it is concluded that the siting of SWMF R4a would be suitable to allow for major and minor system conveyance of the arterial roadway drainage into SWMF R4a.

Lastly, a high-level review has been completed of the estimated storage volume capacity to determine if the proposed SWMF R4a would have sufficient storage capacity to accept drainage from the arterial roadways. It is noted that, under ideal circumstances, the proposed grading of SWMF R4a would have been made available to this assessment to calculate an accurate storage volume capacity, however it is understood that the proposed grading is not available at this time. As such, the available information has been used in order to draw a reasonable conclusion. Based on the footprint of the proposed SWMF R4a as presented on the attached Figures, the surface area of SWMF R4a is noted to be approximately 24,700 m². Assuming an active storage depth of 2.0 m, and 5H:1V side sloping, the storage volume of SWMF R4a would be approximately 42,000 m³. In comparison to the 100-year runoff volumes presented under Task 3 below, it would appear that SWMF R4a could be designed with sufficient storage volume capacity to accommodate the arterial roadway drainage.

#### Preliminary Storm Sewer Design

Preliminary storm sewer designs and layouts have been developed for two drainage scenarios, namely:

- a) Subcatchments CR4, CR5, CR6, CR7, and A7 directed to adjacent ponds as originally planned; and,
- b) Subcatchments CR4, CR5, CR6, CR7, and A7 directed to SWMF R4a.

As Coleraine Drive is a Region owned R.O.W., the sizing and layout were completed using the Region of Peel IDF data (which is marginally higher than the City's design IDF rainfall). Storm sewers were sized to convey the 1 in 10-year storm event based on City of Brampton Intensity-Duration-Frequency (IDF) curves. The storm sewer design sheet is provided in Appendix B. As indicated on the storm sewer design sheet, the storm sewer sizes required to convey the 10-year peak flows under this drainage scenario range in size from 250 mm to 1050 mm.



For scenario b), it is noted that the proposed Coleraine Drive profile has been re-graded to eliminate the originally proposed low point north of the Coleraine Drive/Arterial A2 intersection. The intention of removing this low point is to eliminate the need to capture the 100-year peak flow within Coleraine Drive and subsequently upsize the proposed storm sewer to provide sufficient conveyance capacity to convey the 100-year peak flow to SWMF R4a. Upsizing the storm sewers would result in additional costs.

Lastly, major system conveyance capacity calculations have ben made to ensure that the major system peak flows generated by the arterial roadways can be conveyed overland within the R.O.W., while adhering to the applicable Region of Peel Major System Design criteria. The Region of Peel Major System Design criteria requires one lane of traffic in each direction to be free from flooding during the 100-year event. It is noted that the major system peak flows are peak flows greater than the minor system storm event (i.e., 10-year storm event) up to the 100-year storm event. Following the assessment of the major system conveyance capacity calculations, it was determined that some of the major systems conveying drainage to SWMF R4b and SWMF R4a along Coleraine Drive provide insufficient major system conveyance capacity. As such, the respective storm sewers have been upsized to accommodate additional conveyance capacity so that the overland flows within these major systems can adhere to the Region of Peel Major System Design criteria.

#### Hydrologic Modelling

A hydrologic model using Visual Otthymo has been developed to simulate the 100-year runoff volumes from the roadway subcatchments draining to the MESP proposed SWMFs R7b, R4b and R4a, as well the drainage condition in which these drainage areas are re-directed to SWMF R4a. In accordance with the TRCA SWM Criteria (TRCA, 2012), the 6-hour and 12-hour AES design storms have been simulated to generate the hyetographs for each roadway subcatchment. The results of the modelling are presented in Tables E-1 and E-2 below:

MESP/ Wood **Drainage Area** 100-year Runoff Depth 100-year Runoff Volume **Receiver Pond** Subcatchment ID (ha) (mm) (m<sup>3</sup>)R4b CR, CR4 2.73 68.00 1,856 R7b CR5 1.39 76.35 1,061 R4a CR6, CR7, A7, A8 5.80 78.11 4,530 Total 7.448 R4b CR, CR4 2.73 68.00 1,856 R7b CR5 1.39 76.35 1,061 CR6, CR7, A7, A8 5.80 R4a 78.11 4,530 Total 7,448

Table E-1 MESP Proposed Drainage Plan

Table E-2 Drainage Areas Re-directed to SWMF R4a

MESP/Receiver Pond	Wood Subcatchment ID	_	100-year Runoff Depth (mm)	100-year Runoff Volume (m³)
R4a	CS6, CR4, CR5, CR6, CR7, A7, A8	9.93	74.93	7,441

\$2,962,440

As indicated in Tables D-1 and D-2, the total volume between the two drainage scenarios is comparable, with an overall difference of only 7 m<sup>3</sup>. The notable difference between the two scenarios is that for the scenario where drainage areas are re-directed to SWMF R4a, the full volume (i.e., 7,441 m<sup>3</sup>) would have to be accommodated within SWMF R4a, whereas under the MESP Proposed Drainage Plan scenario, only 4,530 m<sup>3</sup> would have to be accommodated within SWMF R4a. This constitutes a difference of 2,911 m<sup>3</sup>.

#### **High-Level Costing**

Using the information presented under Task 1b above, high-level costing of the preliminary storm sewer designs has been estimated, summarized below:

#### Scenario 1

		Total	¢2 278 785
•	Drainage to SWM Pond R7b:	_	\$288,662
•	Drainage to SWM Pond R4b:		\$997,2 <b>14</b>
•	Drainage to SWM Pond R4a:		\$992,909

#### Scenario 2

Combined Drainage to SWM Pond R4a:

Detailed costing sheets for both scenarios are provided in Appendix B.

Using the information presented under Task 1c above, high-level costing of the 100-year runoff volumes generated under the two drainage scenarios has been developed. Costing has been developed using Wood's available pool of construction pricing. Tables E-3 and E-4 below present the high-level costing for the two drainage scenarios.

Table E-3 MESP Proposed Drainage Plan

MESP Pond	Wood Subcatchment ID	Drainage Area (ha)	100-year Runoff Volume (m³)	Unitary Storage Cost (\$/m³)	Cost (\$)
R4b	CS6, CR4	2.73	1,856	\$ 123	\$ 228,228
R7b	CR5	1.39	1,061	\$ 123	\$ 130,503
R4a	CR6, CR7, A7, A8	5.80	4,530	\$ 123	\$ 557,190
		Total	7,448		\$ 915,981

Table E-4 Drainage Areas Re-directed to SWMF R4a

MESP Pond	Wood Subcatchment ID	Drainage Area (ha)	100-year Runoff Volume (m³)	Unitary Storage Cost (\$/m³)	Cost (\$)
R4a	CS6, CR4, CR5, CR6, CR7, A7, A8	9.93	7,441	\$ 123	\$ 915,243

#### 3.8.1.2 Assessment of Drainage Alternative #2

As already noted, multi-lateral discussions have not reached conclusion at the time of writing of this report, and as such quantitative evaluation of this alternative has not been completed. It is directed that detailed evaluation of this alternative be completed as a component of detailed design. However, given that



Alternative #1 is considered viable, as demonstrated by the assessment outlined in Section 3.8.1, it is presupposed that Alternative #2 will also be found to be viable.

