Early Works Groundwater Protection and Well Monitoring Plan – County Road 4

Highway 400 – Highway 404 Link (Bradford Bypass) County Road 4 Early Works (GWP 2008-21-00)

60636190

March 2022

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AECOM: 2015-04-13

Quality Information

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Revision History

Rev #	Revision Date	Revised By:	Revision Description
0	December 23, 2021	Brian Holden	Draft Report
1	January 6, 2021	Brian Holden	Revised Draft Report
2	January 21, 2021	Brian Holden	Final Report
3	March 11, 2022	Brian Holden	Revised Second Draft Report
4	March 16, 2022	Brian Holden	Revised Final Report

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1. Introduction

The Ontario Ministry of Transportation (MTO) has retained AECOM Canada Ltd. (AECOM) to undertake the Early Works study for the grade separated bridge crossing at County Road 4 for the future Bradford Bypass (Highway 400 – Highway 404 Link) Project, in accordance with the provisions of the Ontario Regulation (O. Reg.) 697/21. The Project limits of construction work is located along County Road 4 from 8th Line to 9th Line intersections within in the Town of Bradford West Gwillimbury and Simcoe County. The Study Area map is presented in **Figure 1**. This study will advance as an early works project for the Bradford Bypass. The new bridge will be designed to include the widening of County Road 4 approved by Simcoe County.

This *Groundwater Protection and Well Monitoring Plan* was prepared for MTO in support of the County Road 4 Early Works Project (the Project) for the purpose of determining possible impacted local water wells, environmental features that are within the active dewatering zone and recommending appropriate monitoring and/or mitigation measures, as required. This plan also details the water well survey program that should be initiated before, during and after County Road 4 reconstruction. This plan was prepared in accordance with the requirements of O. Reg. 697/21, Section 8.

1.1 Data Review

The following background information and reports was reviewed as part of this report:

- Hydrogeological Investigation Report – Bradford Bypass – Country Road 4. Highway 400 to Highway 404 Link (Bradford Bypass) Country Road 4 Early Works (GWP 2008-21-00) by AECOM Canada Ltd, 2021;
- Door To Door Water Well Report – Bradford Bypass – Country Road 4. Highway 400 to Highway 404 Link (Bradford Bypass) Country Road 4 Early Works (GWP 2008-21-00) by AECOM Canada Ltd, 2021;
- Ontario Geological Survey (OGS); and
- MECP Water Well Information System (WWIS) Records and PTTW/EASR database.

1.2 Study Area

The County Road 4 Early Works span a distance of approximately 1.3 km between 8th Line to 9th Line in the Town of Bradford West Gwillimbury and Simcoe County. The Study Area includes the lands within a 500 m buffer on either side of the proposed route Right-of-Way (ROW) as shown in **Figure 1**.

2. Groundwater Protection Plan

Groundwater protection in the context of the County Road 4 Early Works reconstruction program is considered to include issues related to groundwater interference (changes in groundwater levels) and potential effects on groundwater quality.

The groundwater protection plan and well monitoring program is structured to provide an overview of groundwater protection plan issues, and discuss specific monitoring requirements, permit requirements and contingency planning including mitigation measures to be carried out during the detail design and construction phases of the project.

2.1 Groundwater Interference Overview

AECOM's review of the County Road 4 Early Works plans included the potential for groundwater interference is limited to those areas where the deeper road alignment (trenches, ditches and bridge support structures) cuts in the range for 1 m to 12 m locally will extend below the existing groundwater table. The potential effects are anticipated to be limited and shallow surficial deposits consisting of silt and silty clay may be encountered within the glacial lacustrine with silt sand seams that may result in drainage into the excavation and associated potential lowering of the surrounding shallow groundwater levels. Groundwater interference is considered to result when water levels in the adjacent residential domestic water wells located within the shallow groundwater table are lowered to a point that adversely affects the residential water supply.

In the case of this Project, potential well interference will most likely be limited to shallow drilled or dug wells completed at similar depths to the respective excavation and dewatering depths. These water supply wells could potentially experience lowering of the water levels where they tap into permeable shallow surficial soils that are under active dewatering. The potential radius of influence (ROI) from the County Road 4 Early Works would likely be limited to a radius of approximately 39 to 40 m.

Deep wells completed in the deeper surficial soils (15 m or deeper) which represent the majority of drilled domestic water wells within 500 m of the Study Area should not experience any significant interference from dewatering related to the Project. However, if it is determined during the detail design stage that such a potential exists, measures to address this issue should be considered.

Based on a review of nearby domestic water wells (**Figures 2**) indicates that within the Study Area, there are potentially 1–3 domestic water wells within the dewatering area that could be affected.

2.2 Groundwater Quality Overview

There are two primary effects where the County Road 4 Early Works construction can affect groundwater quality. The first includes potential spills during construction and the second are the long-term effects associated with the operation of the road. Groundwater quality issues can potentially affect down-gradient shallow domestic water wells or surrounding wetland environments.

2.2.1 Construction Effects and Proposed Mitigation Measures

The issue surrounding spills during the construction phase will be primarily limited to petroleum products from machinery (fuels and lubricants). The use of the best management practices for handling of hydrocarbons according to the Ministry of Environment, Conservation and Parks Standards and the Technical Standards and Safety Authority (TSSA) of the Ministry of Government Services will reduce the potential of environmental adverse effects associated with petroleum product handling and spill remediation. Spillage of petroleum products must be immediately remediated according to these standards such that groundwater quality is not impacted.

2.2.2 Operational Effects and Proposed Mitigation

Longer-term effects of the roadway operation on groundwater quality are typically associated with spillage associated with accidents that must be directly remediated, and the long-term use of road salt. Road salt dissolves in highway runoff that can then infiltrate into the underlying groundwater system from the roadside ditching. Where the ditching is constructed in low permeability glacial till soils, the potential influence is considered to be small. However, where the directly underlying soils are permeable (sand, sand and gravel), the influences of salty infiltration may be more pronounced. This susceptibility is reflected by the Aquifer Vulnerability Index (AVI) designation for the construction areas of the roadway underpass for the proposed Bradford Bypass as shown in **Figure 3**. The effect of road salt can result in the direct increase of shallow groundwater salinity, or in the case of deeper wells an increase in water hardness over time.

Based on AECOM's understanding of the regional hydrogeology, the potential effect of road salt runoff from the highway on the shallow groundwater system and shallow surficial materials is considered high. These areas of high aquifer vulnerability could potentially be impacted by saline runoff. As such, clay or impermeable liners are expected to be used within the sides of the excavated areas requiring dewatering to limit seepage.

2.2.3 Site Mitigation Measures

In addition to the mitigation measures listed above, the following mitigation measures should be considered during the detail design phase of the project, and implemented where appropriate:

- Tilling of soils in non-vegetated areas prior to restoration to re-establish infiltration along access roads, storage areas, or other well traveled areas where soil compaction has occurred in areas that previously permitted infiltration.
- Backfilling of excavations that intercept existing groundwater flow with porous granular material to maintain existing groundwater linkage particularly within wetland areas.
- Well abandonment will be carried out in compliance with O. Reg. 903.

3. Dewatering Discharge

Dewatering effluent shall be directed to the local Town sanitary or storm sewer. Any discharge of water would be subject to the terms and conditions of all required permits obtained by the Contractor based on the actual conditions encountered during construction. Sewer discharge requires by-law authorization from the Town. Due to the close proximity of the construction to agricultural drains, it is suggested that the discharge be directed away from the drains to reduce overland flow and promote infiltration.

If the groundwater pumped for dewatering purposes is to be directed to the natural environment, it is required that water quality testing for Provincial Water Quality Objectives (PWQO) be completed prior to dewatering. Given the geological material encountered, it is suggested that the dewatering contractor be prepared to potentially deal with treatment for suspended solids prior to discharge to the sanitary sewer. Given the Highly Vulnerable Aquifer (HVA) status near the proposed underpass, discharge to the natural environment is unlikely to be an option during dewatering.

The results of the baseline water quality sampling completed within the Study Area indicates that dewatering effluent may not fulfill the water quality requirements under the Town of Bradford West Gwillimbury's Sewer Use Bylaw 2013-68 for Storm Sewer Discharge without pre-treatment for the exceeded parameters identified by AECOM sampling in 2021 (AECOM, 2021A). It will be the responsibility of the dewatering contractor to ensure that any discharge to the local Region sewer system occurs in full compliance with the Town's Sewer Use By-Law (By-Law 2013-68). The Contractor shall ensure that all control measures implemented, and all materials collected or trapped by those measures are recovered and properly disposed of when they are no longer engaging in the activity or discharge to the sanitary sewer. Expected treatment options for the dewatering discharge potentially include sedimentation tanks and filtration.

The results described are representative of the condition at the sampled monitoring well at the time of sampling and do not necessarily reflect conditions that will be present at the time of construction. Confirmation of local groundwater levels and groundwater quality shall be completed by the Contractor prior to the outset of project construction activities.

Prior to discharging any dewatering effluent, the Contractor will be required to ensure that all necessary discharge permits have been secured and that the water taking plan, discharge plan, a water treatment process and sampling plan has been designed and implemented in accordance with the terms and conditions of such permits and the contract documents.

4. Groundwater Monitoring

The following proposed groundwater monitoring program includes groundwater level monitoring and groundwater quality monitoring to establish the pre-construction baseline conditions and any potential changes in these conditions are a result of construction dewatering.

Golder Associates Ltd. (Golder) has installed monitoring wells during the completed geotechnical investigation. Monitoring is suggested to be completed within these monitoring wells if they are not destroyed by construction activities. Selected residential monitoring wells will also be part of this program.

4.1 Residential Well Survey

As shown is **Figure 3**, there are 1-4 domestic water wells that are within the proposed dewatering zone and should be visited prior to construction beginning to determine if the well is still used for the residence. AECOM completed a Door to Door Water Well Survey in 2021 (AECOM, 2021B) that contacted all MECP domestic water well owners within 500 m of the Study Area. In addition to the wells show in **Figure 3,** it is required that the residential wells visited by AECOM in 2021 are included as part of the residential monitoring well program:

[redacted]

These residential properties are outside the dewatering ROI but given homeowner interest and existing condition review of the domestic wells, these wells could act as outlying monitoring wells to confirm there are not connections that may develop during short-term dewatering operations. The frequency of groundwater level and groundwater quality monitoring will be the same as the monitoring wells listed in Section 4.2 and 4.3. Prior to the initiation of the monitoring and sampling of the residential properties listed above, AECOM will contact local public health (Simcoe Muskoka Public Health) to allow for involvement as requested/required.

4.2 Groundwater Level Monitoring

Additional monitoring wells have installed as part of the project by Golder, these wells are shown in **Figure 1**. Should the location of any existing monitoring wells be in conflict with the location(s) of Project construction or damaged as a result of Project construction activities, it is required that an MECP licenced water well contractor be retained by the Contractor to decommission those locations in accordance with Ontario Regulation 903 (Wells), as amended. It is further required that replacement well(s) be installed by a licenced environmental drilling contractor to replace any decommissioned monitoring wells and/or piezometers.

The monitoring wells monitored during this AECOM's 2021 field program (AECOM, 2021A) are considered as part of the proposed monitoring program. These monitoring wells are CR4-03, CR4-11, CV1-01 and CV1-04. The proposed frequency of groundwater level measurement within the existing monitoring well network is as noted in **Table 1**. Each monitoring well will have groundwater level data loggers installed in spring 2022 with monthly water level monitoring and downloads commencing after the data loggers have been installed

The monitoring of surface water is not included as part of the monitoring program described herein. However, the monitoring of surface water should be considered prior to, during and post construction should any dewatering discharge to a local surface water feature be required for any reason.

Table 1: Groundwater Level Monitoring Program Details

	Dewatering Period	Measurement Frequency
Pre-Construction	One Month Prior	Weekly
During Construction	1st Week	Daily
	2nd Week to End of 1st Month	Weekly
	End of 1st Month to Program Completion	Bi-Weekly
Post-Construction	Monthly monitoring will be obtained for six months after construction has completed or until baseline conditions are obtained.	

Where the monitoring completed above identifies a significant amount of water level drawdown (i.e., in excess of 0.3 m at a monitored location more than 40 m [R_o] away from the dewatering area), immediate action should be taken by the Contractor to assess and potentially modify their dewatering approach / methodology, and/or rate / duration of pumping, so as to limit the dewatering R_o and alleviate the observed groundwater level impact. It is recommended that dataloggers be installed in each residential water well and monitoring well and left for the duration of the dewatering period listed in **Table 1**.

Monthly hydrographs will be provided to the MTO, MECP, and Simcoe Muskoka Public Health showing the changes to the local groundwater levels as a result of the proposed construction.

4.3 Confirmatory Sampling Program

It is required that the Contractor pursue permission for sanitary sewer discharge from the Town of Bradford West Gwillimbury. The following sections have been prepared outlining proposed requirements for the discharge of dewatering effluent that should be modified, if required, based on the discharge permit obtained.

4.3.1 Water Quality / Treatment Standards

Dewatering effluent is proposed to meet the following Water Quality Standards prior to discharging into the municipal storm and/or sanitary sewer systems:

- Town of Bradford West Gwillimbury's Sewer Use Bylaw (Bylaw 2013-68)

Sodium sampling results will be provided to local Public Health Agencies (Simcoe Muskoka Public Health) as received. Adequate pre-treatment shall be provided by the Contractor at each dewatering location to achieve compliance with prior to any off-Site discharge occurring. Establishing treatment methodology (settling tank) is the responsibility of the Contractor and may be further informed by the raw (pumped) water quality and confirmatory sampling results obtained by the Contractor.

4.3.2 Proposed Confirmatory Sampling Program

Pre-assessment sampling of the water that is planned to be discharged is to be completed by the Contractor and submitted to an accredited environmental analytical laboratory for quality testing against applicable parameter concentration limits (e.g., Regional Sewer Use By-laws). The intent of this sampling is to confirm both the background (raw) and Contractor's treated water quality prior to the commencement of any dewatering discharge activities.

Regular sampling and testing of the discharge by the Contractor will be required during construction to verify that the effluent quality continues to comply with region's sewer use by-law limits and permits, as applicable. The frequency of confirmatory sample collection is summarized in **Table 2**.

Table 2: Confirmatory Sampling Frequency*

Dewatering Period	Sampling Frequency
One Month Prior to Program Commencement	Monthly
1st Week	Twice
2nd Week to End of 1st Month	Weekly
End of 1st Month to Program Completion	Monthly

*Notes: *To be modified as appropriate based on the discharge permit received.*

A visual inspection must be completed by the Contractor along with the collection of in-field turbidity and temperature measurements (both untreated and treated effluent discharge streams) on a daily basis during periods of active discharge for the duration of the dewatering system(s) operation. A visual inspection of the HVA area and surface water features within the proposed construction area are also required.

In the event that a sample is determined to be 'unacceptable' based on the applicable water quality standards, field turbidity and/or temperature monitoring activities, additional effluent samples must be obtained by the Contractor immediately upon receipt of the initial laboratory results for verification purposes. In the event of "unacceptable" results, the local Public Health agencies (Simcoe Muskoka Public Health) will be notified immediately.

Where the verification sampling is confirmed, immediate action should be taken by the Contractor to assess and potentially modify their dewatering approach / methodology, rate / duration of pumping, and/or provide additional / alternative pre-treatment prior resuming any further discharge. Prior to resuming any effluent discharge, a confirmatory sample should be obtained by the Contractor confirming adherence with the applicable water quality standards.

Where the verification sampling is determined to be anomalous, the confirmatory sampling program is expected to resume at the staged sampling frequency outlined in **Table 2**.

5. Permitting Requirements

Where construction dewatering volumes between 50,000 and 400,000 L/day are expected, filing of the project on MECP's EASR system is required in accordance with Ontario Regulation 63/16 (as amended). Where expected construction dewatering volumes exceed 400,000 L/day, a PTTW (Category 3) will be required from MECP in accordance with Section 34 of the Ontario Water Resources Act (RSO, 1990). Based on the dewatering estimates provided by AECOM (AECOM 2021A), an EASR is required to provide dry working conditions within in the excavations even as the maximum total dewatering for the excavation is 394,896 L per day. It is assumed that the construction will occur in stages and dewatering volumes will stay well within the limits of an EASR.

5.1 Water-Taking Volumes

A daily record of the timing, total volumes, and average rate of water-taking at each excavation location shall be maintained by the Contractor on a daily basis during completion of the Project. The flow meter(s) shall be calibrated prior to use and installed / operated in accordance with manufacturer specifications.

6. Contingency Measures

6.1 Spill Response Plan

Contingency plans are to be in place to address groundwater protection associated with the Country Road construction. The uncontrolled release of dewatering effluent is considered a spill along with any construction chemical release and must be managed using the Contractor's Spill Prevention and Response Plan.

If the effluent is released to the natural environment and causes a significant impact[1] on the surrounding waters, this shall be reported to the MECP Local District office in Barrie, ON, MECP Spills Action Centre, and the Town of Bradford West Gwillimbury. If the effluent results in a significant impact or a disturbance to aquatic habitat (i.e. debris/tools/equipment falling into a watercourse, sediment spill, deleterious substance spill, etc.), it must also be managed in accordance with mitigation measures listed in the Contractor sediment and erosion control plan.

If the effluent is released to the Town of Bradford West Gwillimbury's municipal sewer system (sanitary or storm), there may be a requirement to report the release to the Town, subject to the terms of the Discharge Permit. Additional reporting may be required based on the quality and quantity of the spilled effluent and the affected receptors.

6.2 Well Interference Complaint

In the event that, a well interference complaint is received, the following procedure shall be implemented in a timely manner:

- Upon receipt of a well complaint, either via phone call to the Project, or in person to a staff member in the field, all information is to be collected.
- The MTO, MECP and Simcoe Muskoka Public Health will be notified immediately. If this is during normal business hours, the MECP local district office (Barrie: 1-800-890-8511) will be contacted and the Spills Action Centre (1-800-268-6060) after hours. MTO and Simcoe Muskoka Public Health will be emailed.
- A well complaint investigation will be conducted as per the MECP policies and a qualifies expert (P.Geo. or P. Eng) will undertake and/or oversee the following:
    1. Collect a water well sample at the complainant's water well, prior to any treatment systems ("raw"), after allowing the distribution system to flow for approximately 5 minutes and submit the water sample to a qualified laboratory for an analysis of the general chemistry suite of water quality parameters, including E.Coli, Total Coliforms, Total Dissolved Solids, Metals, Turbidity, Chloride, Sodium and pH;
    2. Compare the results of the analysis of the water sample to any pre-construction water sampling analysis (if available) for the residential well;
    3. Investigate and provide a professional opinion regarding the claimed impact to the well or well water.
    4. Provide a detailed written opinion as to whether the water sampling analysis results demonstrate that the construction or dewatering activities may have caused an adverse effect on the well's water supply.

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1. Significance of impact to be evaluated by biologist identified as the Suitably Qualified Consultant for the Project.

- If the well issue is confirmed to be a result of the Project's activities, the MTO will provide a letter to the property owner explaining the outcome of the well investigation and detail the recommended mitigation measures (including lowering / replacement of pump inlet, well rehab, new well installed or local watermain connection if available) to remediate the issue. A temporary drinking water supply will be provided and connected to the resident if the Project activities are found to be responsible, at the cost of the MTO until remediation measures have resolved the issue.
- Of the well issue is found not be a result of the Project's activities, MTO will provide a letter to the property owner explaining the outcome of the well investigation and the rationale for the decision.
- Notification and a copy of any lab results, letters or communication records will be provided at each step of the above process to the MTO, MECP and Simcoe Muskoka Public Health.

7. Closure

This groundwater protection and well monitoring plan was completed for the intended purpose of characterizing and assessing possible impacts to local water wells and groundwater dependant environmental features, and to recommend appropriate discharge, mitigation and monitoring measures, as required.

The results of AECOM's Hydrogeological Investigation were relied upon by AECOM in the completion of this plan. AECOM has assumed that all information provided was factual and accurate. Judgement has been used by AECOM in the interpretation of the field information provided. However, it is recognized that subsurface physical and chemical characteristics may vary between or beyond borehole locations given the variability observed in local geological and hydrogeological conditions. If variability in geologic and/or hydrogeologic conditions, in comparison to the information presented in this report, is observed at the time of construction, AECOM should be contacted to review the conditions present and assess the potential implications.

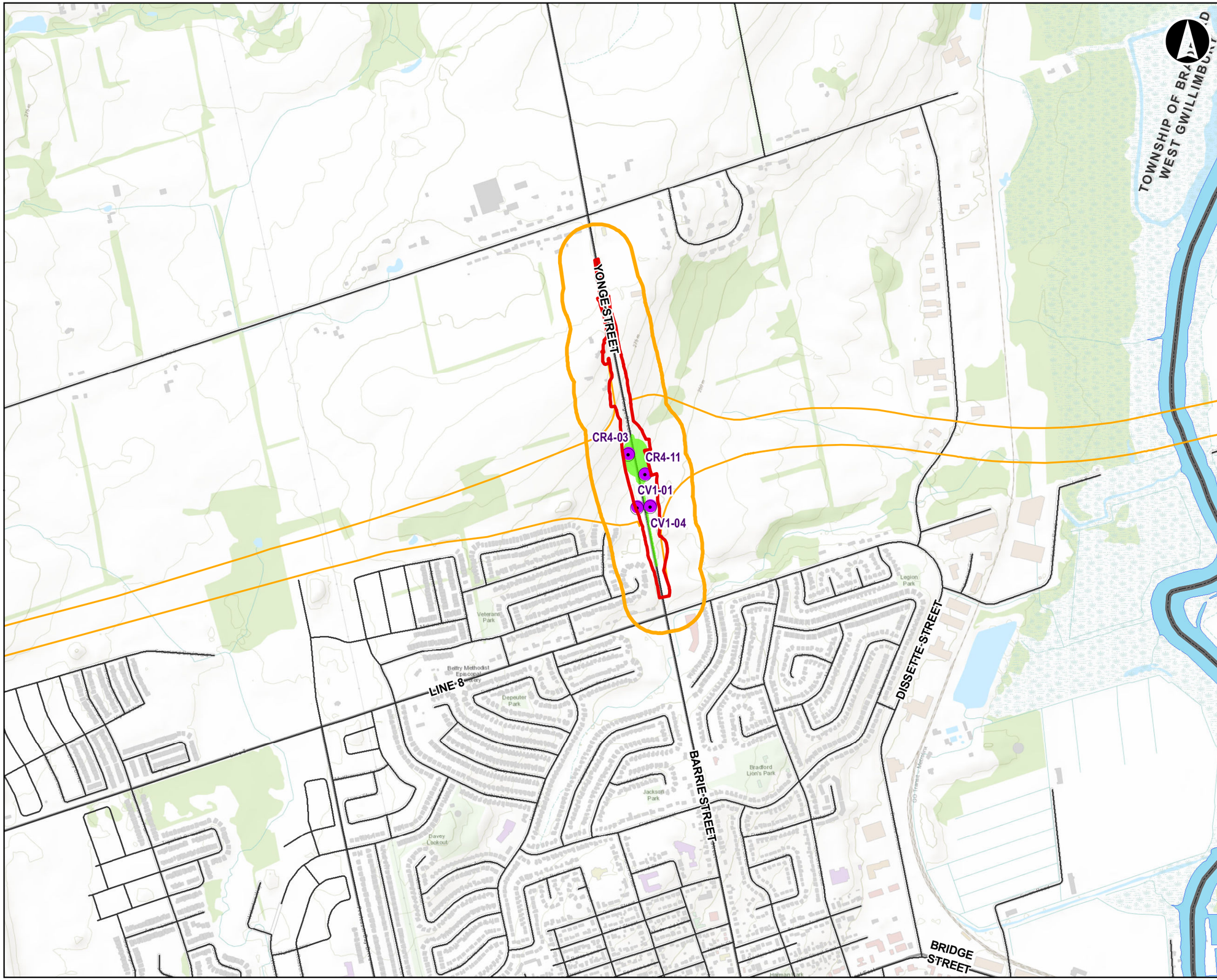
8. References

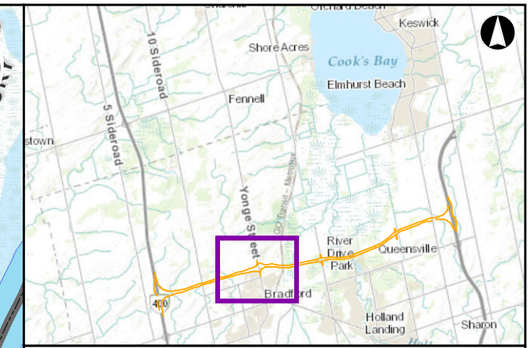
AECOM Canada Ltd., 2021A:
Hydrogeological Investigation Report – Bradford Bypass – Country Road 4. Highway 400 o Highway 404 Link (Bradford Bypass) Country Road 4 Early Works (GWP 2008-21-00).

AECOM Canada Ltd., 2021B:
Door To Door Water Well Report – Bradford Bypass – Country Road 4. Highway 400 o Highway 404 Link (Bradford Bypass) Country Road 4 Early Works (GWP 2008-21-00).

Ontario Ministry of the Environment and Climate Change (MECP), 2018:
Water Well Information System (WWIS).

Figures





Legend

- Highway 400 - Highway 404 Link (Bradford Bypass) Right of Way
- County Road 4 Limits of Work
- Foundation BH Locations

Roads

- Provincial Highway
- Other
- Municipality Boundary
- Waterbody
- Radius of Influence

0 145 290 580 870
Meters

Highway 400 - Highway 404 Link (Bradford Bypass)

County Road 4 Monitoring Well Locations

January 2022	1:12,500 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: Imagery Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,
	V: Study Area	
AECOM		**Figure 1**

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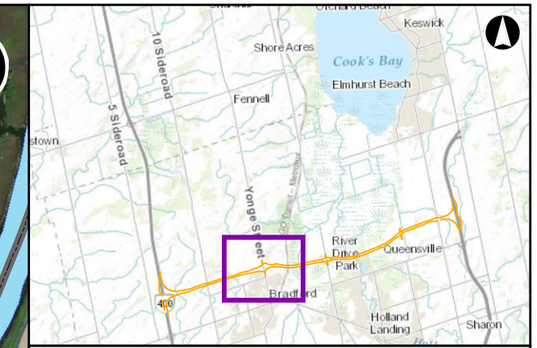

Legend

- Study Area Boundary
- County Road 4 Limits of Work
- Highway 400 - Highway 404 Link (Bradford Bypass) Right of Way
- Municipality Boundary
- Watercourses
- Waterbody
- Radius of Influence

Roads

- Provincial Highway
- Other

MECP Water Wells

- Domestic
- Industrial
- Not Used
- Test Hole
- Unknown

0 145 290 580 870
Meters

Highway 400 - Highway 404 Link (Bradford Bypass)

MECP Water Well Records in Dewatering Area

January 2022	1:12,500 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS
	V: Study Area	
AECOM		**Figure 2**

Map location: K:\Laptop\CACS\Project\Projects\60617618 Bdrd Bypass\600-CAD_GIS\620-929 (GIS-Graphics)\Design\01_Reports\Groundwater\CR4 Update\MXD\BBP-CR4_GW_BuiltFeatures_20220104.mxd
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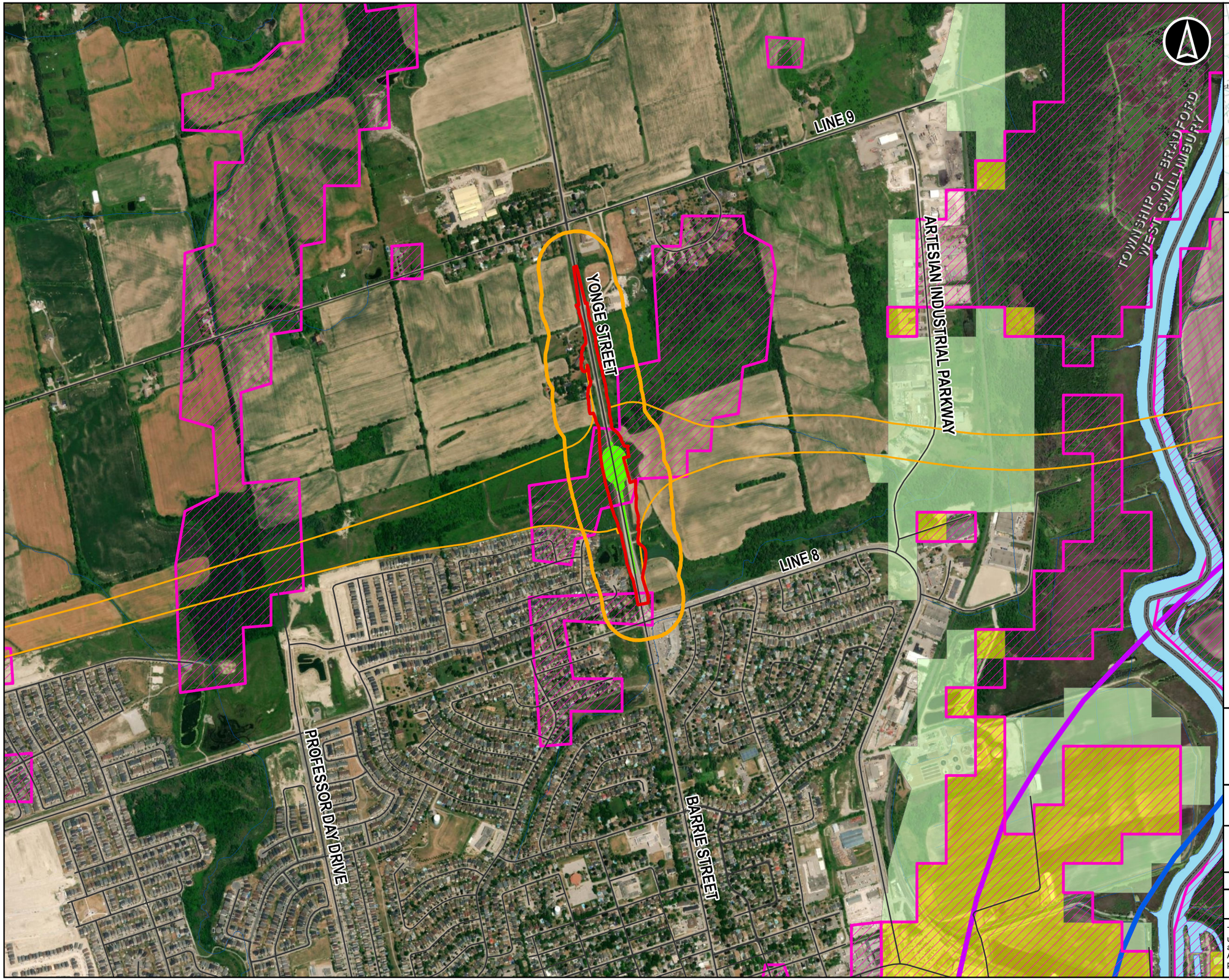

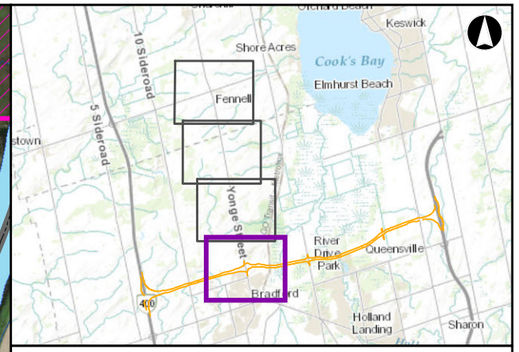

Legend

- Study Area Boundary
- County Road 4 Limits of Work
- Highway 400 - Highway 404 Link (Bradford Bypass) Right of Way

Roads

- Provincial Highway
- Other
- Municipality Boundary
- Waterbody
- Watercourses
- Radius of Influence (ROI)
- Highly Vulnerable Aquifer

Wellhead Protection Areas

- WHPA-C1
- WHPA-D

SGRA Vulnerability Level

- High
- Low

0 145 290 580 870
Meters

Highway 400 - Highway 404 Link (Bradford Bypass)

Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas

January 2022	1:12,500 * when printed 11"x17"	Datum: NAD 1983 UTM Zone 17N Source: Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS
	V: Study Area	
AECOM		**Figure 3**

Map location: K:\Projects\CA\CA4\CA4TOT\Data\Projects\60607161 Bradford Bypass\60-CAD_GIS\20-929 (GIS-Graphics)\Design\01_Reports\Groundwater\CR4 Update\MXD-BBP-CR4_GW_HVA_SGWR_20220104.mxd
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