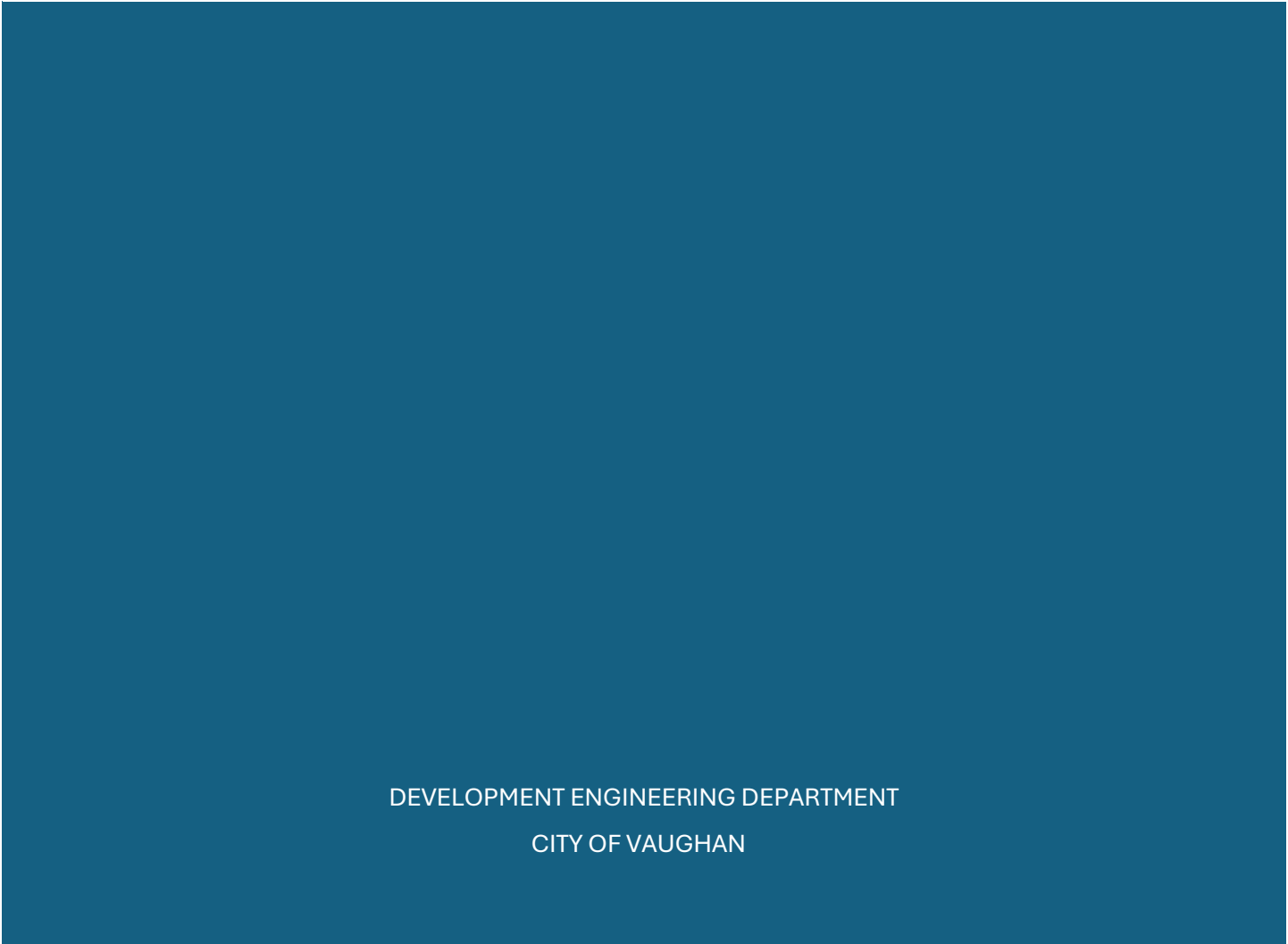




# HYDROGEOLOGICAL ASSESSMENT GUIDELINE - DEVELOPMENT APPLICATIONS



DEVELOPMENT ENGINEERING DEPARTMENT  
CITY OF VAUGHAN

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## 1. Introduction

This guidance document has been developed by the Development Engineering (DE) Department of the City of Vaughan (the City) to provide information and direction to developers and their consultants relating to hydrogeological assessment requirements for conventional development applications. It is intended as a resource to improve efficiencies, reduce approval timelines, and outline the City's position on potential development-related hydrogeological impacts to the public, local infrastructure and the natural environment.

The guidance provided is based on a review of standard practices for development-related hydrogeological assessments in Ontario and is not intended to be prescriptive or replace professional judgment. While this document may serve as a framework for undertaking hydrogeological assessments, pre-consultation with the City and other relevant governing agencies is strongly recommended to determine the specific scope of any hydrogeological submission.

It should be noted that this guidance document is not a legally binding instrument. The City, in conjunction with other governing authorities, may choose to change the scope of analyses within its jurisdiction as required.

## 2. Hydrogeological Assessment Content and Requirements

Hydrogeological assessments should be provided in a technical report format for review by the City's DE Department. The following sections outline the minimum submission requirements.

### 2.1. Qualifications

Hydrogeological assessment reports shall be prepared, signed, and stamped by a qualified person licensed to practice professional geoscience in Ontario.

A person meets the qualifications to be a qualified person for the purposes of subsection 2.1 if,

- the person holds a certificate of registration under the *Professional Geoscientists Act, 2000* and is a practicing member, temporary member or limited member, in good standing, of the Association of Professional Geoscientists of Ontario; or
- the person holds a license, limited license or temporary license under the *Professional Engineers Act*.

## 2.2. Existing Conditions

The existing site condition information listed in the following sections should be included in the hydrogeological assessment report.

### 2.2.1 Introduction, Background, Site Location & Description

The following introductory, background, and site location information should be included:

- Report author, title, company name and qualifications;
- Applicant and Owner of the subject property;
- Township/municipality, address, size of Property and area to be developed;
- Overview of the study area including a description of the planning context and relevant policies;
- Brief description of the proposed development including size, purpose, and all proposed subsurface work;
- Present land use of the subject Property and its adjacent properties; and
- Location and context map showing the following:
  - Major/minor roads;
  - Groundwater sensitive areas; and
  - Surface water bodies.

### 2.2.2 Physiography

A description of the physiography of the study area should be presented to provide relevant information on the landscape, and type of geologic landforms present. A regional map should be provided showing the location of the site within the broader physiographic context of the area.

### 2.2.3 Geology and Soils

The description of the site geology should include regional and site-specific subsurface conditions. Local features such as bedrock valleys and glacial landforms should be noted when known and relevant. An overview of the regional stratigraphy including formation thicknesses and unit names, is required. This description should also include representative soil samples, analysed in a Canadian Association for Laboratory Accreditation (CALA) certified laboratory, to determine grain size distribution and material percolation rates. A minimum of two cross-sections should be provided to support observations on geology, stratigraphy and groundwater flow patterns. Borehole logs and monitoring wells should be shown on cross-section drawings with an interpretation of observed geologic units and the groundwater flow regime.

## 2.2.4 Boreholes

Subsurface investigations comprised of boreholes are required to determine geologic site conditions. Boreholes should be installed at strategic locations that reflect the proposed development, planned infiltration measures, and sensitive groundwater dependent features. Boreholes should extend past the maximum depth of excavation (e.g. footings, elevator shafts, foundation drainage, etc.) to characterize the underlying geologic conditions that could impact excavation stability. For sites with physical or engineering-related constraints, site-specific pre-consultation with City staff may be necessary to determine the number and depth of boreholes. The City retains the right to request additional borehole data, as necessary, to ensure safe excavation design.

Each borehole record should show the date of completion, ground elevation in metres above sea level (masl), soil observations, and any additional data collected. Borehole locations should be provided on a figure, and borehole records shall be provided in an Appendix to the report.

## 2.2.5 Monitoring Wells

Monitoring wells are required to assess seasonal variability in water levels, aquifer characteristics, hydraulic gradients, groundwater flow direction, and hydraulic connection to surface water features. The number and location of groundwater monitoring wells required to establish hydrogeological conditions will vary depending on site geology, location, and complexity of the proposed development. Monitoring well placement and screen depth should be determined in a holistic manner, factoring in all relevant geologic constraints and proposed engineering design features.

For developments requiring excavations that intersect the water table, a select number of monitoring wells should be screened at the maximum depth of excavation. Additional wells should be screened in the underlying hydrostratigraphic unit to investigate potential confined aquifers or pressurized groundwater conditions at depth that could impact excavation stability and building design. For sites with geologic or engineering-related constraints, site-specific pre-consultation with City staff may be necessary to determine the number and depth of monitoring wells.

Monitoring wells should be measured as necessary to determine stabilized water levels and seasonal influences on groundwater elevations. A long-term groundwater monitoring program may be required in circumstances where infiltration measures are proposed or when characterizing the hydroperiod of groundwater dependent natural features. It should be noted that groundwater levels measured immediately after drilling or prior to well development are not representative of the stabilized water levels and will not be accepted for engineering design purposes.

A geodetic survey should be conducted to establish reference elevations for each monitoring well and used to provide consistent elevations of soil contacts and groundwater levels. Monitoring well locations should be provided on a figure, and all well construction details should be provided in an Appendix to the report.

### 2.2.6 Private Well Surveys

Private well data from domestic wells within 500 m of the site should be used to characterize groundwater conditions. A door-to-door well survey within a 500 m radius of the site should be completed to determine well location, construction details and water levels where possible. In addition, the Ministry of the Environment, Conservation and Parks (MECP) water well data within 500 m of the site should be obtained to supplement and confirm the data collected through the door-to-door survey. All relevant and supporting private well data should be provided in an Appendix to the report.

### 2.2.7 Hydrogeology

The hydraulic conductivity (K) of each geologic unit observed should be characterized. The proponent should utilize data from single well response tests completed on site monitoring wells. Both horizontal and vertical K test data should be provided.

To characterize the groundwater conditions at the site, both groundwater levels and flow patterns should be discussed with all collected site data presented. This should include:

- Identification and description of observed hydrostratigraphic units;
- A description of groundwater levels and seasonal fluctuations;
- Inferred direction of groundwater flow; and
- Areas of groundwater discharge or recharge, if applicable.

A description of both shallow and deep groundwater flow regimes should be provided along with contour figures outlining flow directions. Flow system characteristics including horizontal and vertical gradients between hydrogeological units must be included. Field work should be carried out to assess the potential impacts of the proposed development on groundwater dependent features, local infrastructure and nearby groundwater users.

### 2.2.8 Surface Water Features

A description of the study area should include all surface water features on or adjacent to the site. Areas of groundwater discharge should be noted where observed. A figure should be provided displaying all relevant surface water features on or adjacent to the site.

### 2.2.9 Source Water Protection

A description of applicable source water protection policies should be provided. The description should include a characterization of source water vulnerable areas on the site and any mitigative measures taken to conform with the applicable policies. For further information please reference [“Approved Source Protection Plan, Credit Valley – Toronto and Region – Central Lake Ontario \(CTC\) Source Protection Authority, Amendment \(Version 6.0\), March 6, 2024.”](#)

### 2.2.10 Water Quality

A description of groundwater and, where applicable, surface water quality should be provided to establish a baseline condition to assess potential development-related impacts. The consultant should request or acquire water quality data and comment on anticipated impacts from the development to both ground and surface water quality in the area. Where impacts are anticipated, the consultant should suggest ways to mitigate these impacts.

If dewatering discharge is directed to City infrastructure, unfiltered groundwater quality samples should be collected and compared to the parameters outlined in the City’s [“Sewer Use By-law 025-2024,”](#) or its successor bylaw.

## 2.3 Impact Assessment

Development can result in negative impacts to the local groundwater system including reduction in infiltration, reduced baseflow, raised or lowered groundwater levels, changes in flow direction, and creation of preferential flow paths. Impacts may be cumulative in areas where intensive development is planned. Where applicable, the proponent must provide an assessment of potential impacts. The scope of the impact assessment will vary depending on site location, policy requirements, and scale of the proposed development.

### 2.3.1 Dewatering

Where excavations extend below the groundwater table, short term (construction) and long-term (permanent) dewatering may be required.

Dewatering estimates of the peak daily discharge volume for both short-term and long-term dewatering are required. Professional judgement should be used in determining the specific equations, models, or inputs used in dewatering estimates to ensure all observed site conditions are appropriately accounted for. As a conservative measure, discharge estimates should incorporate an appropriate safety factor and use the “worst case” (e.g. seasonally high groundwater level, highest K value, etc.) input parameters to evaluate maximum potential discharge. An estimation of incident precipitation entering

the open excavation from a 25-millimetre storm event should be included in the short-term discharge estimate. The use of engineering measures (e.g. waterproofing, caisson walls, soldier piles and lagging, etc.) to reduce or eliminate dewatering needs are encouraged and should be accounted for in discharge estimates. Calculations will be provided in full, outlining all assumptions, equations, and inputs used to estimate short- and long-term discharge.

An estimate of the zone of influence of dewatering should also be provided. If negative impacts to the natural environment, nearby structures, local infrastructure or the public are identified, the applicant will provide the following:

- Evaluation of the extent of the negative impact;
- Details of the existing state of all areas of concern within the affected zone; and
- A mitigation and monitoring plan to address impacts as necessary.

If a mitigation and monitoring plan is recommended, a post-development report that confirms the affected areas have been returned to their pre-development conditions is required.

#### 2.3.1.1 MECP Water Taking Permits

Where a Permit to Take Water (PTTW) or Environmental Activity and Sector Registry (EASR) is required from the MECP, the proponent should provide the City with all supporting information. This should include permitted and actual planned water taking details as well as any special conditions of the permit, where applicable.

#### 2.3.1.2 City of Vaughan Dewatering Discharge Approval

When dewatering discharge is directed to the municipal sewer system, a discharge approval is required from the City's DE Department.

The City issues two separate discharge approvals:

- **Temporary Approval:** short term (construction) dewatering of excavations that intersect the groundwater table; and
- **Permanent Approval:** long term (permanent) dewatering of building foundations that intersect the groundwater table.

In general, the City does not support directing dewatering discharge to the sanitary sewer system – discharge is to be directed to the storm sewer system. Discharge directed to municipal infrastructure is required to meet the water quality standards outlined in "[Sewer Use By-law 025-2024](#)," with appropriate on-site treatment measures in place prior to discharge, if necessary. The City will only approve discharge volumes



that the municipal infrastructure can reasonably accept. In circumstances where sewer capacity is limited, alternative disposal methods may be required.

### 2.3.2 Water Balance Assessment

A water balance assessment is required to estimate the pre- and post-development infiltration rates for most development applications, as outlined in **Table 1** below.

**Table 1. Legislative Authority for Water Balance Assessments in the City of Vaughan**

| Legislative Authority                                 | Applicability                                                                                                                                                     | Requirements                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Oak Ridges Moraine Conservation Plan</b>           | Major Developments in the Oak Ridges Moraine                                                                                                                      | Site Water Balance: Best efforts to maintain all pre-development water balance parameters.                                                                                                                                                                                           |
| <b>Conservation Authorities Act</b>                   | Major Developments                                                                                                                                                | Feature Based Water Balance: maintain pre-development hydroperiod of the feature (e.g. woodland, wetland, watercourse).                                                                                                                                                              |
| <b>York Region Official Plan Policy 3.3.7</b>         | Development outside of the Oak Ridges Moraine Plan, outside of the Wellhead Protection Area (WHPA) - Q2 and within a Significant Groundwater Recharge Area (SGRA) | Maintain pre-development infiltration rates to the fullest extent possible.                                                                                                                                                                                                          |
| <b>CTC Source Protection Plan – REC - 1 Policy</b>    | Major developments within WHPA-Q2                                                                                                                                 | Site Water Balance: maintain total annual pre-development infiltration rates.                                                                                                                                                                                                        |
| <b>City of Vaughan Official Plan Policy 2.7.4.20</b>  | Any Development                                                                                                                                                   | Preserve or remediate natural variation in water balance, groundwater direction, infiltration quantities, surface water quality and groundwater quality.                                                                                                                             |
| <b>City of Vaughan Official Plan Policy 2.16.1.9</b>  | Development in SGRA                                                                                                                                               | Define site-specific water balance criteria in the Master Environment and Servicing Plan using a local, pre-development water balance model to maintain ecological functions through appropriate proportion of infiltration and evaporation/reuse measures for stormwater management |
| <b>City of Vaughan Official Plan Policy 2.16.1.10</b> | Development in Sensitive Hydrogeologic Areas                                                                                                                      | Maintain or enhance (where practical) significant groundwater infiltration functions at the predevelopment levels, particularly in those areas identified as sensitive hydrogeologic areas.                                                                                          |

The intent of the water balance assessment is to provide an estimate of the pre-development infiltration rates and to then determine how this rate will be affected in the post-development condition. Calculations should estimate the amount of infiltration necessary to maintain pre-development conditions, or meet predetermined infiltration targets, if required. For further information regarding the technical requirements of water balance assessments please reference [“Guidance: Water Balance Assessments, CTC Source Protection Authority, October 2019.”](#)

Detailed information on proposed mitigation measures should be provided to account for the loss of infiltration. These details should include the location of the proposed mitigation measures, volume of water to be infiltrated, design infiltration rate, and condition of the soils to support water being infiltrated. For design requirements and best practices regarding the construction of infiltration facilities please reference [“Stormwater Management Criteria, Appendix C, Water Balance and Recharge, TRCA, August 2012.”](#)

### 2.3.3 Groundwater Levels

Where the existing groundwater levels are shown to support surface water features and where the proposed development will require dewatering or alterations to infiltration volumes, an impact assessment of the groundwater levels and dependent features must be included. Feature-based impact assessments and their specific requirements should be completed in consultation with the Toronto and Region Conservation Authority (TRCA). For further information please reference [“Hydrogeological Assessment Submissions, Conservation Authority Guidelines for Development Applications, Conservation Ontario, June 2013.”](#)

### 2.3.4 Private Wells

Where required by the City, a detailed impact assessment should be prepared that identifies local private wells that may be influenced by development and outline a monitoring program to be undertaken before, during, and after construction of the development, as follows:

- A baseline well monitoring report shall be submitted to the City prior to the pre-servicing or registration of the Plan (whichever occurs first) and shall include, at minimum, the following tests:
  - Bacteriological Analysis — total coliform and E-coli counts;
  - Chemical Analysis — Nitrate Test; and
  - Water level measurement below existing grade.

- If the test results are not within the Ontario Drinking Water Standards, notifications must be sent to relevant homeowners, the Region of York Community and Health Services Department and the City within twenty-four (24) hours of obtaining the test results. Monitoring should continue as follows:
  - Well monitoring shall continue during construction and an interim report shall be submitted to the City for records purposes; and
  - Well monitoring shall continue for one year after the completion of construction and a summary report shall be submitted to the City prior to Completion Approval.

If impacts are observed, a temporary water supply shall be provided to the affected residents upon notice by the City. If the quantity and quality of water in the existing wells is not restored to their original condition within a month after first identification of the issue, a qualified person will be engaged to evaluate the wells and recommend solutions including, but not limited to, well deepening or a permanent water service connection from the municipal watermain system.

### 2.3.5 Monitoring Programs

A long-term groundwater monitoring program may be required prior to development to further assess existing conditions or gather data in support of impact assessments. When an impact assessment indicates that development related groundwater issues may arise, the developer may be required to initiate a secondary monitoring program throughout the construction and post-construction phases. Impact-related monitoring programs should be designed to compare groundwater levels and water quality from the pre- to post-development conditions. The scope of the monitoring program will vary depending on site location, policy requirements, and scale of the proposed development. Impact-related monitoring programs should be developed in consultation with the City and all other relevant government agencies and stakeholders.

### 2.3.6 Contingency Plans

If determined during pre-consultation or technical review that significant impacts could be anticipated from the proposed development, a contingency plan may be required. This may include situations where large scale or long-term dewatering is required, infiltration rates are significantly reduced, or where water quality may be impacted. The contingency plan must include trigger levels and mitigation measures to address potential impacts. Contingency plans can be requested to address short- and long-term impacts depending on the duration and complexity of the development and the potential for impacts. If a contingency plan is implemented, a post-construction monitoring report is required to confirm that the affected areas have been returned to their pre-

development condition. Contingency plans should be developed in consultation with the City and all other relevant government agencies and stakeholders.

## 2.4 Summary and Recommendations

Hydrogeological assessments will summarize the key findings, conclusions and provide recommendations to minimize potential impacts to the public, local infrastructure, and the natural environment.

## 2.5 Figures

The hydrogeological assessment must include appropriately scaled and oriented figures, sufficient to describe the subject property in its hydrogeological context. At minimum, the following figures should be provided:

- Borehole/Monitoring Well Locations;
- Geology and Surficial Soils;
- Groundwater Contours;
- Hydrogeological Cross Sections;
- Infiltration Testing Locations;
- Location and Context Map;
- Location of Surface Water/Groundwater Interaction;
- MECP Water Well Records within a 500 m Radius;
- Physiography;
- Recharge and Discharge Areas; and
- Source Water Protection - Vulnerable Areas.

## 2.6 References

References should be listed as applicable.

## 2.7 Appendices

At minimum, the following information should be included with the report as Appendices:

- Borehole Logs;
- Dewatering Calculations;
- Grain Size Analysis Results;
- Groundwater Monitoring Results;
- In-situ Hydraulic Conductivity and Infiltration Testing Results;
- Laboratory Groundwater Quality Results;
- Water Balance Calculations; and
- Well Records.

### 3. References

*“Approved Source Protection Plan, CTC Source Protection Authority, Amendment (Version 6.0), March 6, 2024.”*

*“City of Vaughan Official Plan 2010, City of Vaughan, May 29, 2020.”*

*“Clean Water Act, 2006.”*

*“Construction Dewatering and Groundwater Control, New Methods and Applications, Powers et al., 1992.”*

*“Environmental Protection Act, R.S.O., 1990, c.E.19.”*

*“Groundwater Lowering in Construction, A Practical Guide to Dewatering, Cashman and Preene, 2012.”*

*“Guidance: Water Balance Assessments, CTC Source Protection Region, October 2019.”*

*“Hydrogeological Assessment Submissions, Conservation Authority Guidelines for Development Applications, Conservation Ontario, June 2013.”*

*“Oak Ridges Moraine Conservation Act, 2001, S.O. 2001, c. 31.”*

*“Ontario Professional Geoscience Act, 2000.”*

*“Ontario Water Resources Act, R.S.O., 1990, c. O.40.”*

*“Sewer Use By-law 025-2024, City of Vaughan.”*

*“Stormwater Management Criteria, Appendix C, Water Balance and Recharge, TRCA, August 2012.”*

*“2022 York Region Official Plan, York Region, June 2023.”*