Hydrogeological Studies & Best Management Practices for Groundwater Protection Guidelines

Regional Official Plan Guidelines

Halton REGION

Halton Region Official Plan Guidelines

The **Regional Official Plan (ROP)** is Halton's guiding document for land use planning. It contains policies that guide decisions related to, among other things, managing growth and its effects on Halton's social, economic and natural environment.

The **ROP Guidelines** are a set of documents that clarify, inform, and aid in the implementation of the Plan's policies.

"This Plan calls for the preparation of certain guidelines or protocols to provide more detailed directions in the implementation of its *policies*."

Halton Region Official Plan – Section 192
as adopted by Regional Council, December 16, 2009

The Guidelines have been prepared in accordance with Section 192 of the ROP. They provide direction and outline approaches that can be used to satisfy the relevant policies of the Plan. They do not introduce additional policy requirements, and, in the event of a conflict between the Guidelines and the Regional Official Plan, the Plan shall prevail.

The Guidelines may be updated from time to time as required through a report to Regional Council.

For more information, visit **halton.ca/ROP** or **halton.ca/ROPguidelines** ,or call 311.

Guidelines for Hydrogeological Studies & Best Management Practices for Groundwater Protection

The **Guidelines for Hydrogeological Studies & Best Management Practices for Groundwater Protection** ensure that the environment and public health are protected by requiring that development proposing individual on-site water and sewage services only proceeds at a density and scale that will not result in the degradation of ground and surface water resources.

Purpose

The purpose of these Guidelines is to:

- **clarify when hydrogeological studies are required** by the Regional Official Plan;
- **outline the criteria** used to ensure the availability of an adequate and safe supply of potable water, and, suitable soil conditions for on-site sewage disposal; and,
- **establish the procedures** for processing and evaluating development applications and their associated hydrogeological studies.

Application & Use

When development is proposed with individual on-site water and sewage services, the Regional Official Plan requires certain criteria to be met and demonstrated through hydrogeological studies. These Guidelines outline these criteria and should be used as a resource in this way by a variety of users, including:

- **Regional, Local and external agency staff:** when reviewing applications for developments proposing on-site water and sewage services;
- the **development industry:** for clarity on the requirements of hydrogeological studies and the associated approvals process; and
- the **public:** to understand how the protection of Halton's groundwater resources is studied and assessed through the development process.

Supporting Documents

In addition to the policy direction provided by the Regional Official Plan, the following documents should be considered alongside these Guidelines, as appropriate:

- *Ontario Water Resources Act, 1990*; *Safe Drinking Water Act, 2002*; *Clean Water Act, 2006*
- Ontario Building Code
- Ministry of the Environment – "Technical Guidelines for On-site Sewage Systems: Water Quality Impact Risk Assessment (Procedure D-5-4)"; "Technical Guideline for Private Wells: Water Supply Assessment (Procedure D-5-5)";
- Halton ROP Guidelines – Protocol for Protocol for Reviewing Development Applications with Respect to Contaminated or Potentially Contaminated Sites; and,
- Local Official Plan & Zoning By-law.

Version

Version 1.0 | This version of the Guidelines was brought before the Inter-Municipal Liaison Committee on June, 18 2014 through Report No. IMLC01-14. It replaces all previous guidelines pertaining to private water and wastewater services outside of Halton's Urban Area.

Table of Contents

1.0 Guidelines for Hydrogeological Studies and Standards for Private Services

1.1 Purpose and Introduction

The Guidelines for Hydrogeological Studies and Best Management Practices for Groundwater Protection define the minimum information requirements to be included in hydrogeological reports in support of proposed developments with individual on-site water and sewage services. Other agencies, including the local municipalities, Conservation Authorities or the Niagara Escarpment Commission may have additional requirements for studies of this nature. Such development could impact the ground and surface water quality and quantity within Halton Region.

The required information will establish that:

- an adequate and safe supply of *potable water* is available for the proposed development;
- soil conditions are suitable for on-site sewage disposal;
- on-site sewage disposal systems will not impair use of the ground and surface water quality and quantity as well as other natural-heritage areas; and that
- site-specific recommendations (including minimum lot sizes) are clearly followed to protect ground and surface water quality and quantity.

These Guidelines provide information to proponents who are seeking approval to develop land with individual on-site water service (private wells) and/or individual on-site sewage service (*private sewage disposal systems*). Such approvals are typically associated with plans of *subdivision* (residential, commercial and industrial), condominium applications, official plan and zoning by-law amendments, severance applications and any other forms of development plans. If appropriate, information collected during this process may be used to calculate minimum lot sizes within the development. This document also contains high-level information pertaining to open and closed loop geothermal systems.

For the purposes of approving development on individual on-site water and sewage services, the provincial Ministry of the Environment (MOE) has delegated the responsibility for dealing with such matters to the Regional Municipality of Halton (Halton Region) through the Halton Regional *Health Department*.

The information contained in this document is largely derived in consultation with the MOE, specifically from the MOE documents titled, "Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment (Procedure D-5-4)" and "Technical Guideline for Private Wells: Water Supply Assessment (Procedure D-5-5)." Other legislation, such as the *Ontario Water Resources Act (OWRA),* the *Safe Drinking Water Act (SDWA),* the *Clean Water Act (CWA)* as well as Provincial documents such as the Ontario Building Code (OBC), are also referenced. For the most part, the information is generic in nature and is not intended to provide detailed methodologies for site-specific studies. Such studies may need to be developed by the proponents and/or their consultants, for individual development applications as determined in consultation with the Regional *Health Department* on a case by case basis.

By following the procedures presented in this document, proponents, together with Halton Regional staff, will be able to confirm the individual on-site water and sewage servicing potential of proposed properties. Individual on-site water and sewage servicing capability is a prerequisite to any development outside of the urban area. Assuming the proposed development is permitted in principal, other land use planning concerns, (including studies mandated by Regional and Local official plans, zoning, and impacts on agriculture), should be considered after individual site servicing capability is confirmed. The other planning matters should be integrated with servicing after the site servicing capability has been determined.

The Regional Municipality of Halton has been delegated by the Ontario Minister of Municipal Affairs and Housing as the approval authority for Official Plans and the following land development applications: subdivisions, condominiums, land severances and part lot control exemptions. Halton Region evaluates and approves these various plans and development applications to ensure consistency with Provincial policies, the Halton Region Official Plan and associated policies and guidelines. Plans and applications for development with individual on-site water and sewage services may only be approved where Provincial and municipal policy and regulatory requirements have been successfully satisfied. In situations where municipal water and municipal sewage services are not available, the Halton Region Official Plan requires that all developments be self-sustaining on individual on-site water service and individual on-site sewage service. **Neither public nor private communal water and/or sewage servicing is permitted in support of any development application in designated private servicing areas.**

Please consult Halton Region's Urban Servicing Guidelines for service requirements where municipal water and sewage servicing is available.

2.0 Requirements for Preliminary (Stage 1) and Final (Stage 2) Hydrogeological Investigations

2.1 General Information Regarding Preliminary (Stage 1) and Final (Stage 2) Hydrogeological Investigations

This document contains Halton Region's requirements for hydrogeological studies for development based on private water and sewage systems. Other agencies (including the local municipalities, Conservation Authorities and the Niagara Escarpment Commission) may have additional requirements for studies of this nature.

In developing these Guidelines, consideration has been given to the previously utilized MOE Guidelines and policies. All applications for development on *private services* will be assessed in accordance with the requirements of this part of the Guidelines.

Two-stage hydrogeological studies are required by Halton Region in support of privately-serviced lands. The purpose of these studies is to ensure that all provincial legislation, standards, objectives and other components of operational guidelines are met. The studies are described briefly below.

A **Preliminary Hydrogeological Investigation (Stage 1)** to determine that:

a) adequate supplies of potable and/or treatable groundwater are readily obtainable throughout the development lands;
b) anticipated groundwater withdrawals are perennially sustainable from on-site wells without adverse impact on natural heritage features and without disruption of groundwater takings from neighbouring wells;
c) quality impacts of the generated sewage effluent are within acceptable limits at the property limits; and,
d) neighbouring downgradient wells, streams and wetlands are protected from sewage effluent.

A Preliminary Hydrogeological Investigation (Stage 1) will determine if the site can accommodate individual on-site water and sewage services and is necessary for Draft Approval of *subdivision* plans.

A **Final Hydrogeological Investigation (Stage 2)** to determine that:

a) adequate, potable and/or treatable groundwater is obtainable on any remaining lots of the proposed development (except for developments and severances of two residential lots or fewer); and,
b) adjacent neighbouring wells are not adversely impacted as demonstrated by the test pumping; and,
c) the hydrogeologic findings and interpretations presented in the Stage 1 Preliminary Hydrogeological Investigation are valid.

A Final Hydrogeological Investigation (Stage 2) is necessary prior to the Registration of *subdivision* plans.

2.2 Preliminary Hydrogeological Investigation (Stage 1) Requirements

Prior to Draft Plan Approval of a *Subdivision* Plan, Severance Approval, or an Official Plan Amendment, Halton Region requires that a Preliminary Hydrogeological Investigation be undertaken. The results must demonstrate that the proposed development lands can adequately accommodate the individual on-site

servicing and such services will not have adverse effects on groundwater and surface-water sources within 250 meters of the proposed development (or greater, if the hydrogeologist determines that the expected area of influence is greater than 250 meters).

A Preliminary Hydrogeological Investigation (Stage 1) must include (but is not limited to) the following:

1) Physical Setting

a) Provide regional and local maps which show site location and orientation with Lot and Concession Numbers. Use maps of the scale that best describe the site and local features from available Ontario Base Mapping.

b) Describe and map local servicing, site physiography, surface topography, surface drainage conditions, environmental features, wetlands, watercourses, and flood plains within at least 500 metres of the site boundary.

c) Identify present and previous on-site and adjacent land uses, and determine potential contamination sources (such as spill or refuse sites) that may necessitate a formal environmental site assessment.

2) Water Supply

a) Describe the Regional hydrogeologic setting.

b) Plot and locate test well(s) and observation wells and show on 1:10,000 scale maps.

c) Tabulate local well information (log, depth, static level, pumping water level, pump setting, rated pumping capacity and screenzone).

d) Prepare at least two hydrogeologic cross sections extending through the development lands and identify the proposed aquifer system(s) intended for water supply.

e) Estimate the on-site recharge and comment on the potential of aquifer mining.

f) Assess the susceptibility of the proposed *water-supply aquifer* to surface-derived contamination.

g) List the well construction particulars for each on-site test well, including:

i. Detailed diagram showing casing length and wall thickness, screen slot size, length and diameter, top-of casing elevation.
ii. MOE well log and number (including GPS co-ordinates).
iii. Water level data for adjacent monitoring and test wells.

h) Provide pumping-test particulars for each on-site test well, including:

i. Graphical plot of the prolonged aquifer test (with each well pumped for at least six hours).
ii. Analysis of the pumping test results (by Jacob or Theis method). The analysis should discuss and identify the short-duration and sustained (perennial) capabilities of the on-site test wells and aquifers.

i) Discuss the water quality obtained at each on-site test well in regard to the groundwater potability and treatment requirements.

j) Evaluate the observed water-level responses in private wells within 250 meters (or greater, if the hydrogeologist determines that the expected area of influence is greater than 250 meters) and determine the possibility of future water-supply disruptions following completion of the proposed development.

k) Provide advice on possible mitigation measures where water level interference occurred in any off-site well during on-site testing.

3) Sewage Disposal

a) Plot locations of test pits / boreholes and water-table quality monitors, areas of shallow saturation, and delineate distribution of major surficial soil types (excepting topsoil and/or upper 0.5 metre native soil veneer).

b) Provide graphical plots of grain-size results of representative soil samples.

c) Identify major soil types (below the upper topsoil / veneer) influencing the infiltration of precipitation (groundwater recharge) beneath the development lands.

4) Quality Impact Assessment

a) Prepare potentiometric maps for the shallow groundwater system and for the *water-supply aquifer*, showing the lateral groundwater gradients and direction of groundwater movement beneath the site and downgradient of the property limits.

b) Determine the appropriate *groundwater recharge rate* through the surficial sediments, recognizing the areal distribution (estimated *groundwater recharge rates* of the predominant soils types are listed in Appendix 2 of these Guidelines).

c) Calculate the allowable development density for the proposed residential, commercial, industrial and/or land severance application, following the Region-approved direct dilution procedure.

d) Estimate the nitrate-nitrogen impact on downgradient groundwater and surface water sources, following the Region-approved dilution procedure.

The above noted information is used to:

- Interpret the hydrogeological conditions beneath the property;
- Calculate the quantity of groundwater available to supply wells on the property;
- Determine the prevailing groundwater quality on-site and possibly in nearby private wells and/or groundwater monitors;
- Calculate the nitrate-nitrogen loadings from subsurface sewage effluent disposal;
- Assess the suitability of the soil conditions and identify limiting factors (bedrock, water-table proximity) on the property for sewage effluent disposal for purpose of sewage system design;
- Calculate the potential impact on the shallow and/or deep groundwater system with respect to quantity resulting from the proposed development;

- Determine the extent to which predicted groundwater impacts from the development will affect existing on-site and off-site groundwater sources and natural features such as surface water, wetlands and natural-heritage areas; and
- Establish the number of *self-sustaining lots* that are supportable on the development property.

2.3 Final Hydrogeological Investigation (Stage 2) Requirements

As a condition of a Draft Plan Approval, or an Official Plan / Zoning By-Law Amendment Approval (except developments and severances of two residential lots or fewer), Halton Region requires that a Final Hydrogeological Investigation be carried out to establish the feasibility of a well that yields adequate supplies of potable and/or treatable groundwater on each lot within the development. The study will also confirm that the proposed development will not have adverse quality and quantity impacts to the existing groundwater and/or surface-water sources adjacent to the proposed development. In some instances, Halton Region may require the Final Hydrogeological Investigation prior to Draft Plan Approval, dependent on the results of the Preliminary Hydrogeological Investigation.

A Final Hydrogeological Investigation (Stage 2) must include (but is not limited to) the following:

1. Map all boreholes drilled and wells installed on each lot for the purpose of providing a potable water supply. Attach well schematics and final well records containing the MOE reference number and GPS co-ordinates.

2. Summarize the pumping-test and water-quality results for each of the private water-supply wells and confirm that adequate supplies of potable water exist on each lot of the proposed development.

3. List the on-site monitoring results and advise on the significance of the observed water-level responses.

4. Where significant interference is anticipated or observed, provide a mitigative plan acceptable to Halton Region.

5. Review the assembled nitrate-nitrogen level for the individual wells and confirm the development density determined in the previous Preliminary Hydrogeological Investigation.

6. Obtain water-level elevations of on-site test wells to confirm the potentiometric surface, the groundwater flow and the prevailing groundwater flux within the water-supply aquifer established in the previous Preliminary Hydrogeological Investigation.

7. Verify that adequate direct groundwater recharge and/or underflow is available within the subject property so that downgradient groundwater sources will not experience adverse quality impacts as deduced in the Preliminary Hydrogeological Investigation.

8. Include an off-site well monitoring program acceptable to Halton Region if storm water and/or sewer servicing construction extends more than five metres below existing grade and/or if extensive surface grading is proposed on the development property. Monitoring shall include periodic water-level measurements and water-quality sampling of neighbouring wells within 200 metres from the property boundary, prior to and during construction and continuing for a period at least three months following completion of the on-site activities. Within three months following completion of the monitoring program, a technical report of the monitoring results shall be provided to the Regional Health Department for peer review at cost to the applicant.

The above noted information is used to:

- Establish that each lot is *self-sustaining* and can support a perennial *adequate private well*.
- Determine the off-site water quantity impact and develop Regionally-accepted mitigation procedures between the applicant and the potentially affected persons.
- Corroborate the initial interpretation of groundwater flux and movement beneath the site and verify that existing down gradient groundwater and surface-water sources and natural heritage features will not experience future adverse water quantity and quality impacts resulting from the proposed development.
- Confirm the lot / development density determined by the Preliminary Hydrogeological Investigation.

2.4 Hydrogeological Studies for Developments Comprising Two Lots or Less

For developments and severances of two or fewer residential lots, the hydrogeological studies will be limited to the installation / testing of a single well and a sampled soil testhole on one of the development lots or on the severed lot, and the completion of a Preliminary Hydrogeological Investigation (Stage 1) Report to the satisfaction of Halton Region.

As a condition of severance approval, an *adequate private well* shall be drilled / tested on the remaining lot (if not previously undertaken).

2.5 Technical Reports

The results and findings of the Preliminary Hydrogeological Investigation and the Final Hydrogeological Investigation must be submitted in report form, with supporting documentation, for review by the Regional *Health Department* and the local Conservation Authority. The applicant will be required to pay the costs associated with peer reviewing the Preliminary Hydrogeological Investigation (Stage 1) Report, and if needed, the Final Hydrogeological Investigation (Stage 2) Report as well as all associated meeting requests.

3.0 Private Water Supplies

3.1 General Information Regarding the Assessment of Private Water Supplies

These Guidelines describe the position of Halton Region regarding the assessment of water supplies for developments on private wells. The Guidelines are based on past experience with developments utilizing private wells within Halton Region, and reflect the need to ensure that future owners of lots or homes have a high probability of being able to obtain adequate quantities of potable and/or treatable water for domestic consumption over both the short and long term.

These Guidelines apply to development proposals for residential developments involving individual private well water supplies and open loop geothermal systems. The Development Agreement between the applicant and Halton Region shall be used to bind development to the recommendations of the supporting hydrogeology studies including warning clauses and any on-going monitoring requirements.

These Guidelines also pertain to condominiums, severances, industrial, commercial and institutional developments where groundwater is used for human consumption and the taking does not exceed 50,000 Litres in any day. Halton Region should be contacted for information on the applicability of these Guidelines to other types of privately-serviced developments.

Development proposals which require an on-site source of *potable water* will require a complete hydrogeological assessment to determine the availability and sustainability of adequate groundwater supplies from a private well on each lot with respect to quantity and quality; and the potential for adverse interference between on-site wells, and with existing off-site wells, existing or proposed *private sewage disposal systems*, natural heritage features and other uses (such as streamflow and wetland maintenance).

3.2 Assessment of Private Wells

Within all privately serviced lands, well construction and abandonment requirements shall comply with Ontario Regulation 903 made under the *Ontario Water Resources Act*, R.S.O.1990 (OWRA), as amended from time to time. Local geology should be reviewed with Regional staff. The appropriate Source Water Protection Plan (or Assessment Report, if no Source Water Protection Plan is available), mandated by the *Clean Water Act* should also be consulted to ensure that private servicing will not result in the establishment of transport pathways.

Committee of Adjustment decisions to approve individual privately serviced residential severances are contingent upon compliance with the Regional *Health Department* requirements that:

- An *adequate private well* shall be constructed on any proposed severed / retained lot in regard to both **quantity and quality**; and,
- Each severed / retained lot shall be *self-sustaining*, as defined in this document.

Wells shall be drilled on each proposed lot unless on-site testing demonstrated that underlying aquifers are unable to support a drilled well, in which case bored wells may be considered (as long as they are providing the water supply described in Section 3.3 and conforming with Ontario Regulation 903 made under the OWRA).

The Regional *Health Department* will advise the appropriate Local Municipal Building Department as to whether a particular well meets the private well water standards contained in this document and whether the owner / applicant will be required to install a water storage tank to meet the peak-period water demand and to install appropriate treatment facilities to provide *potable water* supplies.

3.3 Water Supply and Quality Requirements

The Regional *Health Department* shall determine if a private well servicing a residential, commercial, industrial or institutional development provides adequate and *potable water*. The following criteria are used to make this assessment.

3.3.1 Water Quantity

The adequacy of a water supply well on each lot with respect to quantity shall be based on a result of the sustainable-yield pumping test conducted during the Preliminary Hydrogeological Investigation (Stage 1) and the Final Hydrogeological Investigation (Stage 2).

A well with a sustainable yield greater than 18.8 L/min is considered to be adequate for normal domestic needs with conventional pressure-system storage.

A well with a sustainable yield between 4.5 L/min and 18.8 L/min may be approved provided that the system storage has sufficient capacity to meet the estimated peak-period demand.

A well with a sustainable yield less than 4.5 L/min is considered to be an inadequate water-supply source.

Further information and rationale is provided in section 3.4.1.2 of this guideline.

3.3.2 Water Quality

A water supply well is considered to be adequate with respect to quality where the water:

a) Naturally contains concentrations; or,

b) Can be reasonably treated to concentrations below the Ontario Drinking Water Quality Standards (ODWQS) and the Ontario Drinking Water Quality Objectives and Operational Guidelines (ODWQOOG) documented in Ontario Regulation 169/03 made under the *Safe Drinking Water Act,* 2002 (SDWA) as amended from time to time, for those parameters listed in Appendix 1.

A water supply is considered inadequate with respect to quality where:

a) A health related parameter of the listed ODWQS is exceeded or is projected to be exceeded; or,

b) An aesthetic parameter of the listed ODWQOOG is exceeded and is not considered reasonably treatable by the MOE and the Region by means of a private water treatment system; or,

c) A health hazard is anticipated due to a nearby off-site and/or on-site source of pollution.

3.4 General Procedures for Assessing Private Water Supplies for Preliminary Hydrogeological Investigations (Stage 1)

A Preliminary Hydrogeological Investigation (Stage 1) will be required by Halton Region prior to recommendation of Draft Approval for Plans of *Subdivision*, Institutions, Condominiums and Severance Applications, and may be required prior to approval of Official Plan Amendments that would permit development on *private services*. The study must be performed and a report submitted to Halton Region at or immediately after the circulation of the proposed Official Plan / Zoning Amendment, Severance Application, or Draft Plan of *Subdivision* or Development. The report must address concerns relative to the following:

- Proposed development must be supplied with water from private wells for domestic consumption that is of acceptable quality and of adequate quantity.
- Appropriate well construction techniques need to be followed in order to minimize the possibility of well water quality degradation.
- Development must not result in adverse water quantity interference conflicts between users in the proposed development and water-supply wells on lands within 200 metres from the property boundary.
- Proximity to and influence on designated *Hydrogeologically Sensitive Areas* and *Wellhead Protection Areas* (including those defined in Sourcewater Protection Plans and Assessment Reports) and the potential quantity / quality impacts on nearby natural heritage areas arising from the proposed development need to be assessed and addressed.

With respect to quality, each private well must provide water that is safe and aesthetically suitable for human consumption. The suitability of the water for human consumption is determined by comparing the results of the analysis of groundwater samples from test wells with the applicable ODWQOOG for aesthetic parameters and ODWQS for health-related parameters (listed in Appendix 1).

With respect to quantity, each test well must provide sufficient water for normal domestic purposes. This will be determined mainly from the individual pumping tests on the test wells as described in Section 3.4.1.1 of these Guidelines.

Approval for all developments on *private services* in the rural areas will depend on the completeness and accuracy of the Preliminary Hydrogeological Investigation (Stage 1). If it is found to be incomplete or provides unsupported interpretations, Halton Region will advise the proponent by letter of any outstanding issues. Such advice and recommendations must not be construed as Conditions of Approval but rather as suggestions for those cases where the proponent wishes to continue to pursue approval. Halton Region may not undertake its review until such time that a report satisfying the requirements of these Guidelines has been submitted.

During the Preliminary Hydrogeological Investigation (Stage 1), the site assessment to establish groundwater availability and quality must be undertaken as follows:

1) The minimum number of test wells to be pumped and sampled will be:

    - Three test wells for sites up to 15 hectares in area;
    - Four test wells for more than 15 and up to 25 hectares;
    - Five test wells for more than 25 and up to 40 hectares; and,
    - For more than 40 hectares, one additional test well for each additional 20 hectares or portion thereof.

2) The area distribution of test wells must be such that hydrogeological conditions are adequately represented across the site. More than the minimum number of test wells referred to in section 1) above may be required, depending on the area configuration and hydrogeological complexity of the site.

3) Consideration must be given to past or present land uses. Existing improperly decommissioned wells are to be identified since such installations may qualitatively impact on the underlying groundwater sources. Moreover, any unaddressed contaminant spills on or adjacent to the site which may affect water quantity or quality should be identified and evaluated for the potential impact on groundwater quality. The test wells are to be located in an area which would permit a definitive assessment of these impacts. The Preliminary Hydrogeological Investigation (Stage 1) shall include

recommendations for proper decommissioning of on-site abandoned wells, and test wells which are not intended for subsequent water supply utilization or monitoring, in accordance with Ontario Regulation 903.

Wells that are to be retained for monitoring should be assessed by a certified well technician for compliance with Ontario Regulation 903.

Note: For more information on contaminated or potentially contaminated sites, please refer to Halton Region's Protocol for Reviewing Development Applications with Respect to Contaminated or Potentially Contaminated Sites.

4) Test wells must be completed in a manner and at locations as to permit the prediction of the quantity and quality of groundwater throughout the development property. Accordingly, the construction of these wells must be typical of the future wells in the development, and must comply with MOE and Halton Region requirements as well as any additional specifications recommended by the consultant. Consideration should be given to having at least one of the test wells drilled to below the intended target aquifer to determine the presence of deeper aquifer zones. This information may be useful in identifying the preferred aquifer capable of ensuring the water supply longevity.

Existing water supply wells located on-site or in the immediate proximity of the site may be used as test wells, provided they fulfil conditions 1) to 4) above, and are fully incorporated into the well water quantity and quality testing and monitoring programs described in the sections below. The use of existing wells and of the data obtained from them must be justified in the report as being technically appropriate; however, there must be at least one acceptable test well, new or existing, located on-site. Such existing wells which are used in the yield assessment must have a MOE-filed water well record that has been accurately and fully completed by the licensed drilling contractor. The integrity of the well and its record are essential to ensure that comparison is being made on the basis of reliable information, and that wells being established on the development site will not be compromised. Existing wells should be assessed and certified by a qualified well technician prior to testing or monitoring.

If the consultant and licensed well contractor properly locates and constructs the test wells, or if there are pre-existing wells on the property which meet the requirements of section 4) above, the developer may use them later as water supply wells. These wells must, however, yield potable and/or reasonably treatable water and meet the construction requirements indicated in the approved study recommendations, which are implemented by provisions in the Development Agreement between the municipality and the proponent. If any such wells are not to be maintained for future use, they must be properly abandoned as required by Ontario Regulation 903 made under the OWRA. Abandonment must be recommended in the Preliminary Hydrogeological Investigation Report (Stage 1) and must be implemented by the Development Agreement. To ensure that the recommendations of the report are properly implemented, the Report should include recommendations for supervision of well construction by a qualified consultant at the time the well is being constructed by the licensed well contractor.

3.4.1 Procedures for Assessing Water Quantity

Each of the test wells constructed during the Preliminary Hydrogeological Investigation (Stage 1) must be subjected to a pumping test for at least six continuous hours. The test may be done sequentially on the individual wells, or several wells could be pumped simultaneously, utilizing nearby unpumped wells as observation wells. If feasible, consideration should be given to additionally pumping a test well at the total *subdivision* water demand rate in order to clearly demonstrate the capacity of the target aquifer to supply the anticipated demands.

3.4.1.1 Pump Test Procedure

During the Preliminary Hydrogeological Investigation (Stage 1), the following pumping test procedure is required at each test well site:

- A house-to-house survey shall be undertaken to locate accessible private water supply wells within 200 metres from the boundary of the proposed development. Permission to access private wells for monitoring shall be at the discretion of the property owner. Should the well be inaccessible or should the owner not provide permission for monitoring, the consultant shall document such circumstances in the hydrogeological report.

- Following construction, the test wells must be developed to provide water with a turbidity level less than 10 Nephelometric Turbidity Units (NTU) prior to the pumping test in order to subsequently establish the prevailing turbidity levels in the aquifer. At conclusion of the pumping test, the well shall deliver water having a turbidity content less than five NTU or shall be additionally developed to attain such turbidity. Should E. Coli bacteria and/or Total Coliform bacteria be detected and persist in the water, additional development shall be undertaken until the turbidity is one NTU or less.

- The test rate for the Preliminary Hydrogeological Investigation (Stage 1) shall be at least the minimum rate discussed in the following subsection 3.4.1.2: Calculation of Test Rate and Well Yield.

- The pumping test must begin with a static water level and must be performed at a stable rate (±five percent) for a minimum period of six hours (longer where supplementary storage is necessary) of "continuous" pumping (no stoppages): water levels must be monitored in test wells, adjacent surface-water features and any *accessible wells* within 200 metres at an appropriate frequency. Water must be discharged downgradient and at an appropriate distance from the test well to ensure that artificial recharge does not occur and in a manner that does not cause any surface erosion or adverse impact to natural features.

- Following the pumping test, water level recovery must be regularly monitored in the test well until 95 percent recovery occurs or for 24 hours, whichever is less. Where incomplete recovery occurs, the issue of the long-term safe yield (sustainable yield) of the aquifer **must** be addressed in the Preliminary Hydrogeological Investigation Report (Stage 1).

- Should a drawdown exceeding 10% of available drawdown be recorded in an off-site private well during the above testing, the consultant shall undertake the well assessment and yield testing of that well (if permitted by the well owner) to further assess water quantity issues at the affected residence or facility.

- If water-supply disruptions / depletion are observed / predicted, the consultant shall document the proposed mitigative commitments between the affected person or agency and the developer in the Preliminary Hydrogeological Investigation Report (Stage 1).

- If the water taking during the test is anticipated to exceed 50,000 L/day, a temporary Permit To Take Water will be required from the MOE prior to conducting the test. Sufficient information and time should be given to MOE staff for evaluation and issuance of the Permit. Consideration must be given to where the pumped water is to be discharged, in order to avoid artificial recharge of the pumped aquifer and any other adverse environmental impacts to adjacent wetlands and watercourses.

- The analysis of the pumping test data should be performed using the Jacob or Theis method, and the results should be discussed in the Preliminary Hydrogeological Investigation Report (Stage 1).

3.4.1.2 Calculation of Test Rate and Well Yield

The minimum pumping test rate and well yield required for a particular development must be calculated as outlined below.

The per-person daily water demand shall be 450 Litres as indicated in the MOE publication "Water Wells and Groundwater Supplies in Ontario". Peak demand occurs for a period of 120 minutes each day. This is equivalent to a peak demand rate of 3.75 L/min for each person. The basic minimum pumping test rate is this rate multiplied by the "likely number of persons per well" which, for a single family residence, shall be the number of bedrooms plus one. Unless it is otherwise established to the satisfaction of Halton Region, a minimum of four bedrooms shall be used in the calculation to calculate the daily and peak demands. The total test withdrawal shall amount to at least 4,500 Litres (or twice the daily water demand) to demonstrate the availability of adequate water supplies for a single family residence with four bedrooms.

The only instance where a rate lower than the above calculated rate may be used is where preliminary results indicate that this test rate cannot be sustained in the long term, and consideration is given to systems which would compensate for low well yields. In this case, the test rate may be decreased to a rate not less than 4.5 L/min, but the pumping duration must be proportionately increased such that the total volume of water pumped equals the volume that would have been pumped if the test had been conducted at the above calculated minimum rate for a continuous six-hour period (for example, the pumping duration would have to be extended to about 16 hours, should the test rate be 4.5 L/min in the well tested during the Preliminary Hydrogeological Investigation (Stage 1)).

When a low-yield well is subsequently utilized as a water supply source, the well must be equipped with a storage system (such as a cistern) sized to provide the calculated peak-demand volume during a 120 minute period by means of the combined effective well pumping rate and the useable system storage. The effective rate shall be interpreted to be the deduced yield that is available from the well, utilizing not more than two-thirds of the available drawdown after 120 minutes of pumping (as determined during the well test).

Regardless of whether systems are required to compensate for low yields, new water supply wells will be required to perennially sustain repeated pumping at the calculated rate during a peak-demand period of 120 minutes at 24-hour intervals.

Where a well can provide water at the calculated test rate, it is not acceptable to conduct a pumping test at a lower rate and subsequently recommend the use of a storage system to compensate for low well yield simply in order to limit the migration of poorer quality water into the well.

3.4.2 Procedures for Assessing Water Quality

The consultant must obtain and analyze sufficient raw-water quality samples during the pumping test on each test well to determine the physical, chemical and bacteriological quality of the water. At least two samples must be collected after one hour and during the last hour of the test. The consultant may wish to periodically obtain additional samples during the pumping period, since the consultant must address water quality changes over time and demonstrate that the water quality data are representative of the long-term quality.

Prior to any sampling for bacteriological water quality, there must be no chlorine residual in the groundwater. The consultant shall conduct chlorine residual tests at the well head using a field chlorine kit and shall certify that **zero** chlorine residual was obtained and the time that bacteriological samples were obtained.

Where there are wells in nearby established developments, information is to be obtained from residents, where possible, and other sources regarding water quality problems. If on-site sewage systems are used in the existing development(s) and are also to be used in the proposed development, well water samples from the existing development should be obtained and analyzed. The consultant should use this information to predict the impact of the proposed on-site sewage systems on water quality within the proposed development.

Water quality may vary between aquifers or with depth in the same aquifer. The consultant should recommend appropriate well construction and must comment on the potential for cross-contamination between aquifers.

Shallow and/or unconfined aquifers are susceptible to contamination from sources located at or near the ground surface. If wells are to be constructed within such aquifers, and especially where individual on-site sewage systems are also proposed, the consultant must recommend measures which will reduce the risk of contamination, particularly in *Hydrogeologically Sensitive Areas* and/or *Wellhead Protection Areas*.

The minimum set of parameters for which the analyses must be performed is listed in Appendix 1. Analysis procedures must provide results below the applicable ODWQS and ODWQOOG for the sampled parameters. Other parameters, such as heavy metals, pesticides, tannins, sulphide, phenols, and fluoride, may be required by Halton Region. The consultant must also determine whether conditions specific to the site or its surrounding area require the inclusion of these additional parameters. Complete documentation of sampling times, any on-site analytical methods, and all analytical results must also be included in the report.

If methane or other potentially hazardous gases are encountered during the water supply assessment, the consultant will recommend appropriate risk management measures and include this information in the Preliminary Hydrogeological Investigation Report (Stage 1).

Note: Where health-related drinking-water standards or treatment limits for aesthetic drinking-water objectives have been exceeded, the areas which the relevant test wells represent may have to be excluded from the proposed development site. In this case a justification for the selection of the revised boundary of the site is required by Halton Region.

3.4.2.1 Treatment Systems

For some aesthetic parameters, the drinking-water objectives may be exceeded provided that concentrations are below the treatment limits noted in Table 3, Appendix 1. The Appendix lists these parameters, the limits for treatment and some comments on treatment methods. In cases where raw water sodium levels exceed 20 mg/L, warning clauses shall be registered on title. In addition, if water softening is utilized to reduce hardness, a warning shall be registered on the title with a recommendation that a separate tap, which by-passes the softener, be installed to supply unsoftened drinking water.

The treatment systems mentioned in Table 3 of Appendix 1, are suggested for treatment of single-parameter exceedances. When treatment for more than one parameter is required, the systems suggested may not be appropriate due to treatment process interferences. The consultant must supply recommendations regarding the type of treatment required to continuously provide *potable water* supplies.

3.4.3 Well Construction

Construction specifications for water supply wells constructed within the proposed development must be addressed by the consultant in the Preliminary Hydrogeological Investigation Report (Stage 1). Minimally, the construction of both the test wells and future water supply wells must comply with Ontario Regulation 903 made under the OWRA, and with municipal requirements – where applicable. Any drilled well completed in

the overburden shall be equipped with a commercially manufactured screen sized to prevent the entrance of materials following development of the well.

When on-site sewage systems are proposed, or when they already exist on adjacent property, protection of the wells from contamination by effluent must be addressed by the consultant.

When shallow and/or unconfined aquifers are to be used, the consultant must recommend construction specifications and well locations to address the issue of the susceptibility of such aquifers to contamination from sources at or near the ground surface.

Well locations must be selected in order to minimize the impacts on the location of leaching beds on adjoining lots and meet the requirements of the Ontario Building Code's setback criteria.

The consulting hydrogeologist should work with the planner or site engineer in producing the development plan. Well and sewage systems may then be incorporated at an early stage into the site design, thereby optimizing site resources for water supply and sewage treatment. Storm water management should also be taken into consideration when siting a well and a sewage system on the individual lot.

Water quality may vary between aquifers or with depth in the same aquifer. The consultant shall recommend appropriate well siting and construction, methods and requirements, and must comment on the potential for cross-contamination between aquifers in the Preliminary Hydrogeological Investigation Report (Stage 1).

The proponent's consultant may wish to recommend additional site-specific construction criteria and/or supervision of well construction by qualified staff. In studies in which the consultant's initial findings show that water quality or quantity standards cannot be met without special well construction specifications, the initial data which led to these conclusions must be included in the report. The structure of the test wells on which the final quantity and quality data are based must meet these specifications and the wells must be tested according to the procedures stipulated in these Guidelines, in order for the data to be deemed representative.

Consistent with Ontario Regulation 903 made under the OWRA, contractors and residents must ensure that the finished grade of the ground surface allows the casing to protrude the required height to prevent ponding at the well head. When flowing well conditions occur, the requirements of Ontario Regulation 903 made under the OWRA must be met to prevent uncontrolled groundwater discharge. The consultant must address the above issues in the Preliminary Hydrogeological Investigation Report (Stage 1) and make the appropriate recommendations to secure the wellhead conditions.

Note: The MOE requires the proper abandonment of any unused previously existing wells and/or test wells so that groundwater contamination is prevented.

3.4.4 Adjacent Lands and Water Uses

Land uses within a minimum of 500 metres of the site must be described in the Preliminary Hydrogeological Investigation Report (Stage 1). Where wells exist on or adjacent to the site, a survey of well owners, static and pumping levels and sampling and analysis of representative well water, should be conducted and reported by the consultant. Accessible off-site wells and surface-water features within 200 metres from any development well shall be monitored during the on-site pumping tests. The potential for an adverse impact to or by the development must be addressed, when there have been, are, or may in the foreseeable future significant potential sources of groundwater contamination, or potential causes of quantity interference with groundwater or surface resources or well water supplies within a minimum of 500 metres from the site boundary. The Preliminary Hydrogeological Investigation Report (Stage 1) should direct the Final Hydrogeological Investigation Report (Stage 2) to address these issues. In addition, prior consultation with

the local Conservation Authority should be considered by the proponent to determine their monitoring requirements if natural heritage features are situated near the development.

3.4.5 Other Considerations

Shallow wells and unconfined aquifers are susceptible to seasonal water-level fluctuations. In this regard, the consultant must comment on the magnitude of such fluctuations and the effect on well yields and may need to perform additional investigations to determine the possibility of future well water quantity problems during the Preliminary Hydrogeological Investigation (Stage 1).

All heat-pump systems must be designed and constructed in accordance with current standards and regulations. For closed loop vertical geothermal systems, design and installation is regulated by O.Reg. 98/12 under the *Environmental Protection Act*. Holes drilled for the purposes of open loop heat-pump systems are considered wells and are subject to Ontario Regulation 903 made under the OWRA. These systems may also require a Permit To Take Water and/or Sewage Works Approval, which are both governed by the OWRA. If an open loop heat-pump system is considered, the consultant must detail the potential impact on water quality of the return water from the open system to the aquifer of origin in the Preliminary Hydrogeological Investigation (Stage 1). The consultant is strongly encouraged to inform the Region if a closed loop heat-pump system is considered. All heat-pump systems that involve drilling holes in the ground have the potential to contaminate groundwater by creating transport pathways for chemicals and pathogens. Because of this, heat-pump systems may be subject to future regulations or policies under the *Clean Water Act, 2006.*

If treatment systems that require additional amounts of water for their operations are to be used, those amounts must be added to the required well yield and peak-demand supply. Typical treatment systems requiring "additional water" include water softeners, iron filtration units and reverse osmosis units.

In the Preliminary Hydrogeological Investigation (Stage 1), the Consultant must determine, in situations where the proposed development is located within *Hydrogeologically Sensitive Areas* and/or the *Wellhead Protection Areas*, (including those defined in Sourcewater Protection Plans and Assessment Reports) that adequate separation occurs between the water well and sewage system to assure protection of groundwater quality on the individual well and that the development's sewage loading does not adversely impact the long-term groundwater quality obtained from the municipal-well sources.

3.5 General Procedures for Assessing Private Water Supplies for Final Hydrogeological Investigations (Stage 2)

The well construction, test pumping and quality sampling procedures at all remaining development lots are similar to those described in the Preliminary Hydrogeological Investigation (Stage 1), with the following modifications / exceptions:

1) The well shall be continuously pumped for a minimum period of three hours if drawdown stabilization is observed during this test interval or otherwise the test shall be continued for a minimum duration of six hours. Water levels must be monitored in the nearest on-site wells and accessible off-site wells and in the surface-water features within a distance of 200 metres from the pumped well.

2) The well shall be developed to obtain a turbidity level not greater than 10 NTU prior to test pumping, but shall deliver not more than five NTU at conclusion of test pumping or otherwise development shall continue until such turbidity is attained. Should the water contain in excess of zero Colony Forming Units (CFU)/100 mL of Total Coliform bacteria and/or E. Coli bacteria during repeated sampling, the well shall be additionally developed to provide one NTU or less turbidity.

3) Water quality testing of the individual wells shall be undertaken on one sample collected near the termination of the pumping test and shall at least include:

    - E. Coli and Total Coliform bacteriological determinations (on samples determined to have zero chlorine residual)
    - Iron, Manganese, Sodium
    - Nitrate-nitrogen, Chloride, Sulphate
    - Dissolved Organic Carbon
    - Turbidity, Colour
    - Hardness, Alkalinity

4) Based on the observed drawdowns and recoveries in the pumped wells, the monitored private wells and the pump test analysis, the consultant shall confirm that adequate supplies of potable and treatable groundwater will be continuously available within the *subdivision*, without adversely affecting the adjoining private properties and/or natural heritage features and functions.

3.6 Additional Information Regarding Heat-Pump Systems, Water Storage Facilities and Water Quality Assessment

It should be noted that Halton Region will not recommend approval for Official Plan Amendments, Draft Plans of *Subdivision* or Condominium, Severances or other Development Plans, unless Halton Region is satisfied with the Preliminary Hydrogeological Investigation Report (Stage 1). Where groundwater of adequate quality and quantity is demonstrated to be available to service the proposed development, Halton Region will require, as a condition of Final Approval, that the Development Agreement between Halton Region and the developer, include the recommendations of the Preliminary Hydrogeological Investigation Report (Stage 1).

If groundwater open loop heat-pump systems are being considered for use in the proposed development, an assessment must be included in the Preliminary Hydrogeological Investigation (Stage 1) to ensure that *potable water* supplies will not be adversely impacted within and adjacent to the development. The consultant is strongly encouraged to inform the Region if a closed loop heat-pump system is considered. If the issue of groundwater heat pumps is not fully addressed, Halton Region will request that a condition be placed in the Development Agreement indicating that the use of groundwater heat pumps has not been approved as part of the development.

The utilization of water-storage facilities (such as cisterns) that compensate for low well yields between 4.5 and 18.8 L/min is acceptable, as discussed in these Guidelines. If the Region agrees to compensatory water systems, notification will be given through the Development Agreement between Halton Region and the proponent.

With respect to raw water quality, the following criteria will apply in the assessment of water quality conditions for private wells:

- Where health (ODWQS) and aesthetic (ODWQOOG) criteria (listed in Table 1, Table 2 and Table 3 of Appendix 1) are met, Halton Region will comment favourably on approval of the Official Plan Amendment or on Draft Approval of the Severance, *Subdivision* or Condominium Plan.

- Where health-related ODWQS criteria (Table 1 and Table 2 of Appendix 1) are not met, (with exception of the 20 mg/L warning level for sodium), Halton Region will recommend against approval of the specific individual well within the proposed development.

- Where health-related ODWQS criteria are met but aesthetic ODWQOOG objectives are exceeded in a private well, private water treatment systems may be considered to reduce aesthetic parameter concentrations to a level below the desirable limit, and thereby meet the ODWQOOG requirements. The concentrations considered treatable by Halton Region for common aesthetic parameters and possible treatment systems are provided in Table 3 of Appendix 1.

- If Halton Region agrees to the use of private water treatment systems, notification will be given through the Development Agreement between Halton Region and the proponents. The local municipality also shares responsibility of ensuring that the terms of the Development Agreement are carried out in regard to the installation, operation and maintenance of suitable treatment facilities.

- Where an aesthetic parameter exceeds the concentrations considered treatable, Halton Region will recommend against approval of the well as a *potable water* source.

Where the total dissolved solids exceed 6000 mg/L, chloride exceeds 500 mg/L and/or sulphate exceeds 500 mg/L, the groundwater shall be defined as being mineralized and abandonment of the well shall be undertaken as required by Ontario Regulation 903 made under the OWRA.

4.0 *Private Sewage Disposal Systems*

4.1 General Information Regarding the Assessment of *Private Sewage Disposal Systems*

The purpose of these Guidelines is to protect surface water and groundwater quality, the environment and public health by ensuring that development utilizing *private sewage disposal systems* proceeds at a density and distribution that will not result in, or cause quality degradation of groundwater and surface water in exceedance of acceptable limits. Compliance with acceptable limits shall be demonstrated through predictions of the deduced nitrate-nitrogen impact on the groundwater at the development boundary and at existing downgradient residences and environmental features within 500 metres from the development boundary.

Where a *private sewage disposal system* services a commercial, industrial, condominium, institutional lot or a residential lot with a calculated OBC sewage-system design flow that exceeds 3000 L/day, and/or, a location adjacent to a sensitive environmental feature according to the local Conservation Authority, tertiary treatment (for Biochemical Oxygen Demand and suspended solid removal) shall be undertaken at the *private sewage disposal system* to the quality standards described in the OBC, as amended from time to time.

These Guidelines have been assembled with the recognition that each proposed development site has finite resources available to treat sewage, and that the resources are highly variable within the development site. Evaluation of the quality impact during the Preliminary Hydrogeological Investigation (Stage 1) should allow an overview indication of the supportable development density before substantial study costs are incurred by the proponent.

These Guidelines apply to proposals for residential, severance, recreational, institutional, commercial and industrial developments which use *private sewage disposal systems* having design sewage flows of less than 10,000 Litres/day, and being subject to approval under the OBC.

These Guidelines do not apply to large-volume subsurface sewage disposal systems having design flows greater than 10,000 Litres/day, being subject to MOE approval, or the assessment of impacts between existing isolated individual residential systems or interference between individual systems on existing neighbouring lots within a hamlet or *subdivision*.

Halton Region will require that a hydrogeological report is conducted for a *private sewage disposal system* having a design flow exceeding 10,000 Litres/day to determine the downgradient off-site nitrate-nitrogen increase and to establish the extent of nitrate-nitrogen removal treatment needed to maintain 2.5 mg/L nitrate-nitrogen at the property boundary by the system requiring a MOE Certificate of Approval. The continuous treatment requirement shall be reported to the MOE by the proponent and shall be incorporated into the Region's Development Approval conditions.

Although the Regional *Health Department* (as well as other approval authorities) may support a proposal involving *private sewage disposal systems*, it does not assume responsibility for failure of the systems(s), for correcting the damage to adjacent properties, or for the construction of new sewage systems. This is the sole responsibility of the proponent / owner of the system.

4.2 Evaluation of *Private Sewage Disposal Systems*

This section refers to conventional septic tank and tile bed systems, defined in the OBC, as the standard for development evaluation. Halton Region does not support new developments based on other types of *private sewage disposal systems*. Once lots are created and registered, the approval of new and replacement *private*

sewage disposal system installations is administered by the local municipality as part of the building permit process.

All land areas designated as *private sewage disposal system* envelopes to be used for the installation of *private sewage disposal systems* must meet the minimum clearance requirements pursuant to the OBC.

New development approvals on *private sewage disposal systems* require a minimum area on each lot, capable of accommodating the installation of a conventional tile bed system.

The tile field(s) must be adequately separated from all property boundaries, water-supply wells and surface-water sources to meet the minimum requirements of the OBC or such greater clearance distance as Halton Region, Drinking Water Source Protection Committee, local Conservation Authorities and Municipalities may determine, based on, but not limited to, such factors as topography, drainage, water table or soil conditions and placement of services.

The tile field(s) must be situated outside of all natural heritage and natural hazard constraints and associated buffers.

Development applications which propose to utilize *private sewage disposal systems* will be required to include a terrain analysis and hydrogeological assessment during the Preliminary Hydrogeological Investigation (Stage 1) to determine:

a) The suitability of the site conditions for private sewage disposal systems (having a design sewage flow less than 10,000 L/day) conforming with the OBC; and,

b) The potential on-site and off-site quality impacts on the groundwater systems and nearby surface water features.

Note: All proposed development on *private services* will be reviewed on the basis of being capable of supporting the installation of a conventional septic tank and tile bed system, maintaining an area of vacant and suitable land for this system.

4.3 Procedures for Assessing *Private Sewage Disposal Systems* for Preliminary Hydrogeological Investigations (Stage 1)

An assessment of shallow on-site soil conditions; depth to saturation and/or water table; depth to bedrock; drainage and terrain conditions must be undertaken prior to Draft Approval, Severance Approval or an Official Plan / Zoning Amendment to determine:

a) The hydraulic characteristics of the surficial soils for subsurface sewage effluent disposal; and,

b) The infiltration capacity of the surficial soils and the ambient shallow-saturation nitrate-nitrogen content for evaluation of the supportable development density.

Based on the field results, the consultant must make recommendations regarding the optimum location and orientation of leaching beds. In general, the attenuative capabilities of a site can be optimized by maximizing separation distances between *private sewage disposal systems*, the on-site private wells, and downgradient wells and property boundaries.

The Regional *Health Department* will review the soil investigation results to determine the quality impact of the proposed development. The hydrogeological information required for the Preliminary Hydrogeological

Investigation (Stage 1) in assessing the *private sewage disposal system* design and systems shall include the following components:

1) The installation of test pits and/or boreholes extending to at least three metres or to bedrock refusal, equally distributed at approximately one excavation / borehole per two hectares of the development property. A minimum of four test pits and/or boreholes shall be installed for any proposed development.

2) The detailed geologic logging of the test pits / boreholes including soil texture, density, colour and moisture content, and the grain-size analysis of at least four representative soil samples collected at a depth of one metre, and one additional sample per five hectares or portion thereof above 10 hectares of the development property.

The collection of water samples for background determinations from at least two water-table quality monitors equally distributed throughout the development lands and one additional monitor per five hectares or portion thereof above 10 hectares. These monitors may be included as part of the testing described under 1) above. Should shallow-depth saturation occur below the overburden-bedrock contact, water samples collected from the on-site test wells may be considered to represent the background quality conditions.

5.0 Minimum Lot Sizing and Quality Impact

5.1 General Information Regarding Minimum Lot Sizing

Minimum lot sizing referred to in this section deals with lot sizes needed to support private servicing. Larger lots than those necessary for private servicing may be required for other, non-servicing related reasons such as Official Plan or Zoning By-law requirements. These Guidelines apply to the creation, expansion and/or alteration of boundaries of privately serviced lots.

The term "*self-sustaining lot*" referred in these Guidelines, means a lot having sufficient area to accommodate the dwelling, an *adequate private well* and a conventional *private sewage disposal system* envelope; while maintaining compliance with the OBC and Ontario Regulation 903 made under the OWRA; and receiving sufficient direct groundwater recharge to dilute the calculated nitrate-nitrogen loading from the existing or proposed *private sewage disposal system* to 10 mg/L or less at the property limits. It should be noted that this 10 mg/L limit includes the sum of nitrate and ammonia nitrogen (because ammonia oxidizes to nitrate). Some existing lots may not conform to these Guidelines and development may be restricted or denied if the lot is conveyed without a structure or if a substantial amount of time lapses prior to a detached residence being erected on the lot.

5.1.1 Minimum Lot Sizing for Residential Developments and Severances

Within the designated Hamlets where overall development studies were completed prior to June 1996, the site-specific hydrogeological studies outlined in these Guidelines shall be carried out to the satisfaction of Halton Region to determine if the severed / retained lots are *self-sustaining* and/or to assess the appropriate residential-lot density for the proposed development.

All individual residential severances within and outside of the designated Hamlets shall meet the minimum lot size recommendations of the Preliminary Hydrogeological Investigation (Stage 1) carried out to the satisfaction of Halton Region to ensure that severed lot and the retained lot are self-sustaining, as supported by the site-specific study.

All rural residential lots within plans of *subdivision* (comprising three or more lots) shall meet the minimum lot size recommendations of the site-specific Preliminary (Stage 1) and Final (Stage 2) Hydrogeological Investigations carried out to the satisfaction of Halton Region.

5.1.2 Minimum Lot Sizing for Industrial, Commercial, Condominium and Institutional Developments

For Industrial and Commercial Plans of *Subdivision*, Condominium, Institutional Applications and Individual Severances for non-residential uses, applicants should contact the Regional *Health Department* to determine the specific needs for a hydrogeological study prior to the commencement of the initial site-specific investigation.

5.1.3 Conditions of Approval for All Development Types

As a condition of approval for all rural estate plans of *subdivision*, to be serviced by individual *private services*, the owner / applicant will be required to establish an *adequate private well* and to demonstrate acceptable quality impact in a manner required by the Regional *Health Department*, on each draft approved lot prior to Final Approval. In the case that an *adequate private well* cannot be established on any draft approved lot or unacceptable quality impact should be deduced, the said lot shall not be registered as a separate building lot, but will be either merged with an abutting lot or the *subdivision* will be redesigned to the satisfaction of Halton Region.

Proponents for Industrial and Commercial Plans of *Subdivision*, Condominiums and Institutions may, as a condition of Draft Approval, be required to enter into an agreement with Halton Region pertaining to operation of private wells and sewage disposal systems and their relationship to site-specific constraints or uses which may affect future operation. The Agreement will be registered on title to ensure the terms will apply to successive owners.

5.2 Procedures for Assessing Quality Impact for Preliminary Hydrogeological Investigations (Stage 1)

This section contains general procedures to assessing both on-site and off-site groundwater and surface water quality for residential, industrial, commercial, institutional and condominium developments.

5.2.1 General Information about Assessing Water Quality

Every proposed development involving *private sewage disposal systems* requires an assessment of the impact of sewage effluent on water quality. The purpose of the assessment is to ensure that the deduced effluent discharge from the *private sewage disposal systems* in a development will have a minimal effect on the groundwater beneath the property and on present or potential uses at the adjacent surface-water features and groundwater sources. For the purposes of these Guidelines, the Provincial ODWQS of 10 mg/L of nitrate-nitrogen (including nitrate and ammonia nitrogen) is used as an indicator of the maximum allowable groundwater impact at the property limits. These Guidelines set out the principal considerations which should be included in a quality-impact assessment acceptable to Halton Region.

For the purpose of these Guidelines, the only exception to the use of groundwater for anything other than a drinking water supply shall be a reasonable use which has a water quality requirement more stringent than defined by the ODWQS and ODWQOOG listed in Ontario Regulation 169/03 made under the SDWA.

Groundwater impact predictions shall be calculated for the proposed development downgradient property boundary and for the area extending 500 metres from the downgradient boundary of the development.

The potential impact of the on-site discharge of sewage effluent on surface water must be evaluated in a manner acceptable to the local Conservation Authority where a permanent receiving surface-water or natural-heritage feature occurs at the downgradient property boundary. This work must be done by qualified individuals and must address the potential impact from chemicals which may be of concern listed in the MOE Guideline B-1-1 Water Management – Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment.

5.2.2 Procedures for Assessing On-site Water Quality for Residential Developments

In the Preliminary Hydrogeological Investigation (Stage 1), Halton Region requires the following considerations and assumptions to be used in assessing the combined nitrate-nitrogen impact of *private sewage disposal systems* at and down gradient of the development boundary:

1) **Nitrate-Nitrogen Source:**
   In most cases total nitrogen (all species) converted to nitrate-nitrogen is considered as the critical contaminant. For the purposes of predicting the potential for groundwater impact, a nitrate-nitrogen content of at least 40 mg/L in the sewage effluent shall normally be used in the impact assessment.

   A residential dwelling with up to four bedrooms shall be considered to generate a minimum of 1000 L/day of sewage (resulting in a nitrate-nitrogen loading of 40 grams/day). For each additional

bedroom in a residence, the sewage generation shall increase by 250 L/day (or an additional loading of 10 grams/day nitrate-nitrogen).

Note: Nitrate-nitrogen removal treatment may not be considered to decrease the interpreted nitrate-nitrogen loading, as the provision for such treatment is not included in the OBC standards.

2) Nitrate-Nitrogen Dilution:

In assessing the nitrate-nitrogen impact, only the on-site precipitation reaching the water table (groundwater recharge) will be accepted by Halton Region as a quantifiable dilution source.

Mixing of the sewage discharge with groundwater flowing beneath the site (underflow) will not be allowed in the dilution calculations as the current and future activities cannot be ascertained on the upgradient lands. The stringent Halton Region requirement that the dilution availability shall only comprise the on-site groundwater recharge was established in consultation with the MOE when *subdivision*-approval responsibilities were transferred to Halton Region and subsequently adopted by Regional Council.

The *groundwater recharge rates* acceptable to Halton Region are listed in Appendix 2 for the predominant soils. The soil samples that are analyzed in accordance with Section 4.3 of these Guidelines shall be classified according to the MIT System for comparison with the *groundwater recharge rates* listed in Appendix 2 of these Guidelines. The representative recharge rate for the property shall be the geometric mean of the rates determined for the individual soil samples collected throughout the property.

Estimates of the on-site recharge shall consider the post-development impermeable areas (including roof tops and paved areas). Where precipitation is directed to a subsurface stormwater system, the rainfall occurring on roof tops, driveways and access roads shall be deducted from the potential on-site infiltration in evaluating the development quality impact. Where roof top discharge to adjacent land and where access roads discharge to open ditching, the precipitation occurring on the *impervious areas* may be partially utilized in the dilution calculations.

Consideration is required in regard to the ambient nitrate-nitrogen detected in either the shallow-saturation zone and/or the underlying aquifer intended as the development groundwater source. Where the ambient nitrate-nitrogen has a geometric mean greater than two mg/L within the on-site wells (due to antecedent on-site and upgradient land-use activities), the consultant should provide a detailed interpretation regarding the source and possibility that the nitrate-nitrogen content may be decreased by the changing land use. If attributed to adjacent off-site uses, the observed nitrate-nitrogen content should be factored into the dilution calculations when determining the permissible residential density. Any individual well having a nitrate-nitrogen content exceeding nine mg/L shall be abandoned as a dependable groundwater source and any individual well having a nitrate-nitrogen content exceeding five mg/L shall be equipped with reverse-osmosis treatment equipment for the drinking water portion of the water supply.

Residential lot-area variations are recognized due to the development design / configuration, however the minimum individual-lot area should be at least three-quarters (0.75) of that for a *self-sustaining lot* area to maintain the on-site quality conditions. This standard only applies to residential *subdivisions* – not severances.

3) **Dilution Calculation:**
Appendix 3 and Appendix 4 of these Guidelines exemplify on-site nitrate-nitrogen impact evaluations for a privately-serviced residential *subdivision* and for an individual residential severance, based on the principal Region considerations.

5.2.3 Procedures for Assessing On-site Water Quality for Industrial, Commercial, Institutional and Condominium Developments

These Guidelines only apply to "dry" developments in which individual lots have an average design flow of less than 10,000 L/day/lot, as otherwise the development would be subject to MOE approval. In addition, the sewage must only consist of human wastes. No industrial or commercial cooling or process wastewater may be considered for discharge to the sewage disposal system.

The sewage flow from industrial and/or commercial individual *private sewage disposal systems* may vary greatly depending on the type and intensity of use. Although specific uses for each lot or block may not be known at the planning review stage, it is necessary to determine the allowable nitrate-nitrogen loading from each individual *private sewage disposal system* without exceeding the 10 mg/L nitrate and ammonia nitrogen limit at the property boundary. In the Preliminary Hydrogeological Investigation (Stage 1), the following procedure is followed in establishing maximum allowable effluent flow for each lot:

1) **Nitrate-Nitrogen Dilution:**
The groundwater recharge shall only comprise the on-site infiltrating precipitation and shall be determined for the predominant surficial soils from the table of *groundwater recharge rates* listed in Appendix 2 of these Guidelines.

   Estimates of the groundwater recharge must factor in the post-development impermeable areas (including roof tops and paved areas), which are considered to have no infiltration capability.

   The effective recharge area may be enhanced by the installation of an open-space subsurface infiltration bed or trench (if technically feasible) that is recharged by clean roof runoff. The recharge rate through the infiltration system may be substantially larger than that of the predominant native soil in recognition of the increased recharge potential.

   Note: Nitrate-nitrogen removal treatment system(s) shall not be considered by the Region in evaluating the permissible sewage flow, as such treatment is not specified in the OBC for systems with a design capacity less than 10,000 L/day.

2) **Maximum Allowable Flow:**
The maximum allowable flow for each lot or the entire industrial, commercial, institutional or condominium development can be calculated by dividing the deduced recharge availability by a factor of four.

3) **Maximum Number of Users:**
The maximum number of persons that can be supported on each lot and/or the development will be determined from the sewage design flow for the intended building use, listed in the OBC (Table 8.2.1.3.B). Restrictions regarding the allowable number of users will normally be incorporated as recommendations in the Preliminary Hydrogeological Investigation (Stage 1), and the recommendations shall be implemented by provisions in the Development Agreement between the proponent and Halton Region.

Appendix 5 of these Guidelines exemplifies an on-site nitrate-nitrogen impact evaluation for a privately-serviced Industrial / Commercial development, based on the principal Halton Region considerations.

5.2.4 Procedures for Assessing Off-site Water Quality for Residential, Industrial, Commercial, Institutional and Condominium Developments

In the Preliminary Hydrogeological Investigation Report (Stage 1) for residential, industrial, commercial, institutional and condominium developments, Halton Region requires an evaluation of the potential nitrate-nitrogen impact that may occur within the existing privately-serviced areas situated within 500 metres downgradient from the proposed development boundary.

1) **Contaminant Source:**
   In evaluating the downgradient nitrate-nitrogen increase, the sewage flow shall be that calculated to be supportable on-site (Section 5.2.2 or Section 5.2.3) on the proposed Residential, Industrial / Commercial, Condominium or Institutional development.

2) **Nitrate-Nitrogen Dilution:**
   In assessing the off-site nitrate-nitrogen impact, the upgradient and downgradient recharge occurring within groundwater flow channel that frames the development may be utilized to evaluate the nitrate-nitrogen impact in the existing downgradient groundwater sources. All proposed sewage sources within the flow channel containing the sewage plume and extending 500 metres upgradient and 500 metres downgradient from the development shall be included in the mass-balance appraisal. The upgradient recharge contribution may be deduced by assessment of the recharge rate for the predominant soils in the defined catchment area and/or the prevailing lateral gradient and water-transmitting capacity of the developed aquifer, as appropriate. Ambient nitrate-nitrogen and impermeable surfaces may be disregarded in the off-site impact calculation.

   If the calculated amount of nitrate-nitrogen exceeds eight mg/L downgradient of the development, additional studies will be required during the Final Hydrogeological Investigation (Stage 2) to demonstrate acceptable impact within the downgradient groundwater sources. Where an acceptable nitrate-nitrogen impact is deduced downgradient of the development, the excess groundwater recharge underflow may not be utilized in determining the proposed development density.

Appendix 6 of these Guidelines provides a simplified mass-balance calculation of the off-site nitrate-nitrogen impact to assist in the interpretation of Halton Region requirements.

5.3 Assessing Quality Impact for Final Hydrogeological Investigations (Stage 2)

The Final Hydrogeological Investigation (Stage 2) must confirm the ability of the site to treat sewage within acceptable on-site and off-site impacts as identified in these Guidelines. All data from the Preliminary Hydrogeological Investigation Report (Stage 1) are to be included in the Final Hydrogeological Investigation Report (Stage 2).

5.4 Additional Information Regarding Quality Impact Approvals

For development applications (Official Plan / Zoning Amendments, Severances and Plans of *Subdivision*, Institutions or Condominiums serviced with *private sewage disposal systems*), the quality assessment must be completed in accordance with these Guidelines to demonstrate that acceptable nitrate-nitrogen levels will occur within the development and downgradient of the development, and the quality impacts on surface water will be within tolerable limits as determined by the local Conservation Authority. Shoreline development proposals will be reviewed on a case-by-case basis but shall comprise *self-sustaining lots* as defined in these Guidelines.

The groundwater impact assessment must be approved by Halton Region prior to Draft Approval of Severances, Plans of *Subdivision*, Institutions and Condominiums, and prior to approval of most Official Plan / Zoning By-Law Amendments. If the calculated amount of nitrate-nitrogen and ammonia nitrogen exceeds 10 mg/L at the downgradient property boundary, Halton Region will not accept the development application.

For industrial and/or commercial development applications involving *private sewage disposal systems*, Halton Region will require that a municipal by-law be enacted for the subject lands restricting the industrial and/or commercial uses to *dry industrial / commercial uses*.

6.0 Appendices

Appendix 1 Groundwater Quality Parameter Tables

Published documents have been the main source of information regarding the water quality appearing in the tables below. Additional parameters may be required by Halton Region. Also, when new water quality limits are formally instituted by the relevant authority, these Guidelines will be updated and an effort will be made to distribute the new requirements to interested parties. However, **it is the responsibility of the consultant to apply those criteria which are appropriate at the time the study is performed or reported,** through review of the current and Ontario Drinking Water Quality Objectives, Operational Guidelines and Standards documented in Ontario Regulation 169/03, made under the *Safe Drinking Water Act*, 2002.

Table 1: Health-related Bacteriological Parameters

PARAMETER	ONTARIO DRINKING WATER QUALITY STANDARD[1]	COMMENTS
Escherichia Coli	0	Indicators of contamination
Total Coliform	0	Indicator of possible or potential contamination

[1]These are expressed as CFU per 100 mL of sample. Every bacteriological sample must be submitted for analyses for all the above and lab reports must be accompanied by a report of the chlorine residual as measured at the time of sampling.

Exceedances must be explained and any re-sampling must be fully documented with respect to chlorine residual, rates and duration of pumping and completeness of well development.

While the stated Ontario Drinking Water Quality Standard is zero CFU/100 mL of sample, it is recognized that the objective has been set as an indicator of inadequate disinfection within the distribution systems associated with water works. For the purposes of the assessment described by these Guidelines, Total Coliform of less than 5 CFU/100 mL or less, and zero CFU/100 mL E. Coli counts shall be considered as indicative of acceptable water quality. The chlorine residual must be zero before any bacteriological sample can be taken from a sampled well.

Table 2: Health-related Chemical Parameters

PARAMETER	ONTARIO DRINKING WATER QUALITY STANDARD[2]	COMMENTS
Nitrate	10.0 mg/L (as N)	Contamination indicator; exceedance may be dangerous to infants and others.
Nitrite	1.0 mg/L (as N)	Contamination indicator
Nitrate plus Nitrite	10.0 mg/L (as N)	Contamination indicator
Other Parameters	See [3] Below	

[2]The concentrations listed in Table 2 are the Maximum Acceptable Concentrations under the Ontario Drinking Water Quality Standards.
[3]The proponent or consultant shall add parameters where deemed necessary by current / previous on-site and adjacent land-use activities.

Table 3: Common Aesthetic, Analytical and Indicator Parameters

Parameter	General Comments	Ontario Drinking Water Quality Measure[4]	Maximum Concentration Considered Reasonably Treatable	Comments on Treatment
Alkalinity	Useful analytical parameter	-	-	-
Chloride	Associated with salt problems	250 mg/L	250mg/L	Not considered Reasonably Treatable above 250 mg/L
Colour	Associated with certain metals and organic substances	5 TCU	10 TCU	Carbon filter treatment systems[5]
Conductivity	Useful analytical parameter	-	-	-
Dissolved Organic Carbon (DOC)	Taste, odour, colour, turbidity precursor for harmful contaminants after chlorination	5.0 mg/L (as C)	10.0 mg/L	Carbon filter treatment system
Hardness	Taste, encrustation and reaction with soap	500 mg/L (as $CaCO_3$)	-	Water softener[6]
Iron	May cause staining of plumbing fixtures and laundry	0.3 mg/L (as Fe)	Up to 5.0 mg/L	Water softeners or manganese greensand filters
			5.0 to 10.0 mg/L	Oxidation with filtration through proprietary filter media or chlorination followed by sand or multimedia filtration
Manganese	May cause staining of plumbing fixtures and laundry	0.05 mg/L (as Mn)	1.0 mg/L	Water softeners or greensand filters
pH	Associated with corrosion or encrustation or contamination by other substances	6.5-8.5	-	-
Sodium	Taste	200 mg/L (as Na)	200 mg/L	Not considered Reasonably treatable above 200 mg/L[7]
Sulphate	Laxative	500 mg/L (as SO_4)	500 mg/L	Not considered Reasonably Treatable above 500 mg/L
TDS (Total Dissolved Solids)	Corrosion or encrustation of metal fixtures or appliances; taste; must be measured independently of conductivity and turbidity	500 mg/L	-	Requires written rationale that corrosion, encrustation or taste problems will not occur
Turbidity	See [8] Below	5 NTU	10 NTU	Requires written rationale that recommended treatment economically provides low-turbidity water
Other Parameters	See [9] Below			

[4]Except for hardness, the drinking water quality limits in Table 3 of these Guidelines are Aesthetic Objectives under the Ontario Drinking Water Quality Objectives and Operational Guidelines.

[5]Higher, iron-related colour may be removed by greensand treatment; however, the nature of the constituents causing excessive colour must be determined to evaluate the appropriate treatment.

[6]Generally, water with a hardness value of more than 300 mg/L is considered "very hard". The Ontario Ministry of the Environment publication entitled "Ontario Drinking Water Quality Objectives and Operational Guidelines", states that waters with hardness "in excess of 500 mg/L are unacceptable for most domestic purposes".

[7]Sodium also has a health-related 'warning level' of 20 mg/L, above which the Medical Officer of Health shall be notified in order to alert local physicians for referral to patients having sodium-restricted diets. Since water softening results in elevated sodium levels, a separate tap that supplies unsoftened water, should be installed for drinking purposes.

[8]The consultant must determine that if turbidity is present in the raw water at termination of post-construction development and testing, particular care must be taken during testing to ensure that the bacteria standards of Table 1 are met. The aesthetic concentration of five NTU is acceptable where the sampled well contains zero CFU/100 mL E. Coli bacteria and less than five CFU/100 mL Total Coliform bacteria and the well does not require continuous disinfection. Where the well has a repeatedly detectable bacteriological content and requires continuous disinfection to maintain potable-water quality, the well supply shall be developed and/or treated to have a turbidity of one NTU or less prior to disinfection within the system.

[9]The proponent or consultant shall add parameters where deemed necessary by current / previous, on-site and adjacent land-use activities.

Appendix 2 Groundwater Recharge Rates

Within Halton Region, the sewage-system impact assessment only allows the consideration of on-site groundwater recharge for dilution purposes. In these Guidelines, the portion of infiltrating precipitation that reaches the underlying water table is considered groundwater recharge.

The available groundwater recharge is determined by reference to the following table, which was previously assembled by MOE Regional staff from the results of previous MOE water resource and drainage basin studies.

The listed rates are consistent with the rates previously utilized by the Ministry of the Environment Central Region when that agency was responsible for the technical review of privately serviced developments; and with the typical rates presented in "Ministry of the Environment Hydrogeological Technical Information Requirements for Land Development Applications, April 1995".

The representative *groundwater recharge rate* for the development parcel shall be the geometric mean of the individual *groundwater recharge rates* determined by grain-size evaluation of the predominant soil samples.

Predominant Soil Texture	Groundwater Recharge Rate (mm/year)
Coarse Sand /Gravel	250
Fine to Medium Sand	200
Silty Sand	175
Sandy Silt	150
Silt	125
Clayey Silt	100
Clay	75

Appendix 3 Example of On-site Impact Calculation for Privately Serviced Residential Subdivision

Evaluation Criteria / Site Information:

Number of Proposed Four Bedroom Dwellings (P):	15
Subdivision Area (A):	20 ha
Infiltration Rate (I):	0.15 m/year
Nitrate-Nitrogen Loading/Dwelling (N):	40 gm/day
Impervious Surface (S):	0.1

Calculations

1. Calculation of the On-site Recharge (R)
   = (A) * (1-S) * (I)

   = 74.0 m^3/day

2. Calculation of Nitrate-Nitrogen Loading (L)
   = (N) * (P)

   = 600 gm/day

3. Resultant Nitrate-Nitrogen Increase
   = (L ÷ R)

   = 8.1 gm/m^3

   = (8.1 mg/L)

Appendix 4 Example of On-site Impact Calculation for Privately Serviced Residential Severance (Two or Fewer Lots)

Evaluation Criteria / Site Information:

Number of Bedrooms in Residence:	5 bedrooms
Sewage Volume per Bedroom	250 L/day
Infiltration Rate (I):	0.15 m/year
Sewage Nitrate-Nitrogen (C):	40 mg/L
Drinking Water Standard (O):	10 mg/L
Maximum allowable sewage discharge according to the OBC:	10,000 L/d

Calculations

1. Sewage Effluent Volume (V)
   = (5) * (250)

   = 1.25 m^3/day

2. Calculated Nitrate-Nitrogen Loading (L)
   = (V) * (C)

   = 50 gm/day

3. Minimum Lot Area (A)
   = (L) * (365) ÷ (O) ÷ (I) ÷ (10,000)

   = (50) * (365) ÷ (10) ÷ (0.15) ÷ (10,000)

   = 1.21 hectares

Note: The retained lot shall also have an equivalent or larger area to meet the nitrate-nitrogen dilution requirements.

Appendix 5 Example of On-site Impact Calculation for Privately Serviced Commercial / Industrial Subdivision

Evaluation Criteria / Site Information:

Property Area (A):	30 ha
Infiltration Rate (I):	0.15 m/yr
Sewage Nitrate-Nitrogen (C):	40 mg/L
Drinking Water Standard (O):	10 mg/L
OBC Design Flow (F):	0.12 m^3/day/person
Impervious Surface (S):	0.25

Calculations

1. Calculation of the On-site Recharge (R)
   = (A) * (1-S) * (I)

   = 92.5 m^3/day

2. Required Dilution Ratio (D)
   = (O) ÷ (C)

   = 0.25

3. Permissible Sewage Effluent Loading (E)
   = (R) * (D)

   = 23.1 m^3/day

4. Estimated Nitrate-Nitrogen Loading / Occupant (F)
   = 0.12 m^3/day

5. Allowable Maximum Number of employees for entire proposed 30 ha development
   = (E) ÷ (F)

   = 193

Appendix 6 Example of Off-site Impact Calculation for Privately Serviced Residential Subdivision

Evaluation Criteria / Site Information:

Proposed Number of Lots (P):	15
Number of existing Upgradient and Downgradient Residences within Flow Channel (E):	32
Nitrate-Nitrogen Loading / Dwelling (N):	40 gm/day
Flow Channel Area from upgradient divide to 500 m below development (A):	60 ha
Predominant Soil Distribution within flow channel:	70% sandy silt till, 30% sand
Maximum allowable sewage discharge according to the OBC:	10,000 L/d
Infiltration Rates:	See Appendix 2

Calculations

1. Calculation of Flow Channel Recharge (R)
   = (A) * (I)

   = [(60) (0.7) (0.15) + (60) (0.3) (0.20)] * (10,000) ÷ 365

   = 270 m^3/day

2. Calculation of Nitrate-Nitrogen Loading (L)
   = (N) * (E+P)

   = 1880 gm/day

3. Resultant Nitrate-Nitrogen 500 m downgradient of Proposed Development
   = (L) ÷ (R)

   = 6.96 gm/m^3

   = 6.96 mg/L

Appendix 7 Glossary of Terms

Accessible Well	A water-supply well in which the water level may be measured by wetted tape or electric depth gauge. Access into the well for water-level monitoring shall require the permission of the well owner.
Adequate Private Well	A drilled well that has been constructed in conformance with Ontario Regulation 903 and has been tested to i) provide a withdrawal of at least 4.5 L/min and at least 2250 L/day, which are reproducible at 24-hour intervals on a perennial basis; and ii) meet the Ontario Drinking Water Standards and Objectives with reasonable treatment.
Adverse Quality Impact	An increase in the off-site concentration of a chemical or bacteriological parameter above the Ontario Drinking Water Quality Objective, Operational Guideline or Standard, deduced to occur from the sewage loading of a proposed development.
Combined Impact	Refers to the blended quality impact of all the individual on-site systems on the development site. The impact effluent discharge on groundwater is not assessed on a plume-by-plume basis.
Dry Industrial / Commercial Uses	Those uses in which only the disposal of human waste generated by the employees is permitted to the *private sewage disposal system*. No liquid industrial waste, wash water, cooling water or process water may be discharged to the system.
Health Department	The Medical Officer of Health and Public Health Inspection staff of the Regional Health Department mandated under prevailing legislation.
Groundwater Recharge Rate	The portion of the annual infiltrating precipitation that is deduced to reach and provide recharge to the underlying water table.
Hydrogeologically Sensitive Area	An area delineated in the Regional Municipality of Halton report titled 'Halton Aquifer Management Plan, Phase 1 Report: Background Hydrogeology, February 1995', in which additional studies may be required by the Region in support of proposed privately serviced developments.
Impervious Area	The portion of a lot that is covered by roof or roadway and drains to an on-site subsurface stormwater system.
Potable Water	Water that meets the MOE Ontario Drinking Water Quality Standards and Objectives for the chemical and bacteriological parameters listed in Appendix 1, or that contains aesthetic parameters exceeding the Objectives at concentrations considered to be reasonably treatable.

Private Services	*Private sewage disposal system* and private well water situated on the individual lot proposed for residential / industrial / commercial / institutional development.
Private Sewage Disposal System	An approved on-site septic tank and tile bed system regulated by the OBC.
Self Sustaining Lot	An individual lot on which i) an *adequate private well* may be constructed; ii) a waste disposal system conforming with the OBC may be completed; and iii) sufficient direct groundwater recharge occurs to dilute the on-site nitrate-nitrogen loading (including nitrate and ammonia nitrogen) to less than 10 mg/L at the property limits.
Subdivision	A development comprising two or more Residential or Commercial and/or Industrial Lots.
Significant Interference	A water level lowering in an off-site well that prevents the previously established withdrawals of groundwater supplies due to pumping of an individual well or several wells within the development.
Water-Supply Aquifer	An overburden or bedrock system which is or which may be used as a sustainable source of domestic water supplies.
Wellhead Protection Area	An area located hydraulically up gradient of existing municipal wells, within which quantitative and/or qualitative impacts may be caused by future development.

Appendix 8 Reference Document Listing

Conducting Hydrogeological Studies Regarding Development on Private Services:
Health Protection and Promotion Act, R.S.O. 1990, as amended from time to time

Safe Drinking Water Act, 2002, (SDWA), as amended from time to time

Ontario Regulation 903, made under the *Ontario Water Resources Act*, R.S.O. 1990, (OWRA) as amended from time to time

2006 Ontario Building Code, Ontario Regulation 350/06, under the *Ontario Building Code Act, 1992*, (OBC) as amended from time to time

Official Plan of the Region of Halton, 2006

Memorandum of Understanding with the Ministry of the Environment (May 1996)

MOE Guideline B-1-1: Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy (July, 1994)

Ontario Ministry of the Environment Water Resources Groundwater Publications – Water Wells and Groundwater Supplies:
Water Wells & Groundwater Supplies in Ontario (Booklet).

Water Well Records for Ontario, Regional Municipalities of Halton and Peel, Bulletin 4-21.

Water Wells in Ontario: Important facts about water well construction (Brochure)

Water Wells in Ontario: Installation of Well Pumps (Brochure)

Water Wells and Groundwater Supplies: The Protection of Water Quality in Bored and Dug Wells (Information Sheet)

Water Wells and Groundwater Supplies: The Protection of Water Quality in Drilled Wells (Information Sheet)

Water Wells and Groundwater Supplies: Recommended Methods of Plugging Abandoned Water Wells (Information Sheet)

Related Reports:
The Hydrogeology of the IFYGL Forty Mile and Oakville Creeks Study Areas, MOE Water Resources Publication 5b.

Hydrogeology and Groundwater Model of the Blue Springs Creek IHD Representative Drainage Basin, MOE Water Resources Publication 10.

Geology and Water Resources of the East and Middle Oakville Creeks IHD Representative Drainage Basis, MOE Water Resources Publication 12.

Guelph-Amabel Aquifer, Hamilton to Orangeville, Major Aquifers in Ontario MOE Map Series 78-3.

Halton Aquifer Management Plan, Phase 1 Report – Background Hydrogeology, February 1995, Regional Municipality of Halton.

Halton Aquifer Management Plan, Phase 2 Report – Municipal Wellhead Protection Technical Study, April 1997, Regional Municipality of Halton.