CITY OF OTTAWA

HYDROGEOLOGICAL AND TERRAIN ANALYSIS GUIDELINES

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1.0 INTRODUCTION

In the mid-1990's the review and acceptance of hydrogeological and terrain analysis reports, which were produced in support of planning applications for privately serviced development, was transferred from what was then Ontario's Ministry of the Environment and Energy (MOEE) to individual development approval authorities – typically, upper tier and single tier municipalities, such as the City of Ottawa (City).

Immediately prior to and in anticipation of the transfer of this technical review role, the MOEE produced what are currently referred to as Ontario's environmental land use planning guides. These have been traditionally referred to as the D-series Guidelines.

Ontario's environmental land use planning guides have been applied within the City since the amalgamation of the eleven municipalities within the former Regional Municipality of Ottawa-Carleton in 2000. It is understood that the Ministry of the Environment, Conservation and Parks (MECP) will be updating their guides. The timing for these updates, however, has not been established.

The provincial guides are now more than twenty years old. They reference now-inapplicable provincial regulations, agencies, policies and in some instances, outdated professional standards. The City of Ottawa understands that these issues have created unnecessary uncertainty within the local consulting industry and by professional staff at the City.

It was therefore in the best interest of the public and the City that local Hydrogeological and Terrain Analysis Guidelines be established to address the current local planning environment and define current professional standards, while upholding fundamental aspects of the existing provincial guides.

Another motivation for the development of local Hydrogeological and Terrain Analysis Guidelines is that in the past it was difficult for development stakeholders to determine the requirements for hydrogeological investigations for various types of development applications under the Ontario Planning Act. This guideline therefore presents the submission requirements for a full range of development applications.

1.1 Document Structure

The first sections of these guidelines are based on Ontario's Procedures D-5-4 and D-5-5. Section 3 reproduces verbatim these procedures (in bold italics), with additional clarifying annotations for the Ottawa context. Many of these annotations mirror the wording or the principles of the MOEE Hydrogeological Technical Information Requirements for Land Development Applications (April 1995), amended to refer to the current regulatory framework. Other annotations clarify professional standards. For ease of reference, subsections 3.1 and 3.2 follow the numbering in the MECP Procedures D-5-4 and D-5-5 respectively.

A Terrain Analysis subsection forms part of Section 3. This subsection fills a gap that was left when the review and approval functions were transferred to the municipality. Prior to the transfer, the MECP, through local Health Units, required that lot development plans be prepared, based on the distinct terrain units within a development. This subsection explains how the analysis is to demonstrate that private sewage systems can be accommodated in each terrain unit and is expected to be aligned with and inform the three-step assessment process in Section 5.2 of Procedure D-5-4.

The Terrain Analysis subsection also formalizes the requirement for a private services plan. Although the precise location of each component (e.g., buildings, wells, in-ground sewage systems, etc.) may be refined at the building permit stage, the private services plan will give direction on relative layout and will help minimize interference risks and maximize access to wells and sewage systems.

Following Section 3, the guidelines present study requirements for development applications other than subdivisions. Throughout these sections, reference is made to relevant items in Section 3, considering the scope of the studies to be undertaken. The intent of these sections is to clarify the scope of studies in order to achieve a consistent approach for each type of application.

Two additional sections have been included in the guidelines to facilitate reporting: A section on reporting protocols that shows what elements should be included in all reports and a section on checklists to help consultants assemble reports. The intent of these two sections, along with the recommendation to undertake detailed pre-consultation, is to help reduce iterations in the review process.

1.2 Overall Submission Goals

One of the intents of these guidelines is to help reduce or eliminate the need for multiple submissions and reviews of hydrogeological documents provided in support of development proposals. A Hydrogeological and Terrain Analysis report should be initiated through a technical pre-consultation process, led by the proponent's hydrogeological and planning consultants. Although technical pre-consultation is not specifically mandated, it is often invaluable. In some specific circumstances, as described in these guidelines, pre-consultation should be considered effectively mandatory.

Following the successful completion of a field work plan, Hydrogeological and Terrain Analysis reports should be sufficiently detailed to enable recommendation for approval of the proposed development plan. Reporting and digital data submission requirements are discussed Sections 11.

1.3 Pre-consultation, Background Review and Work Planning

1.3.1 Pre-consultation

Prior to engaging in any field work, the City strongly recommends that the consultant holds technical pre-consultation with the reviewing hydrogeologist. This is in addition to the mandatory planning pre-consultation that is required by the City. To ensure that the technical pre-consultation is as useful as possible, the developer's consultant should have completed a desktop review of the hydrogeological background for the site and be prepared to discuss their field work plan. Pre-consultation is a useful tool for both the consultant and the reviewing hydrogeologist to manage expectations and to streamline the process by focusing on key issues.

An informed technical pre-consultation process is an important step in the conceptualization and planning of a Hydrogeological and Terrain Analysis project. A successful pre-consultation process should incorporate a thorough review of relevant background information and general work planning. Technical pre-consultation will clarify the overall scope of the work that will be required to support a full review.

If completed as recommended in these guidelines, pre-consultation should allow a developer to know, at the inception of a project, rather than following application submission, about the general duration and breadth, barring unforeseeable

circumstances, of the required study and about any related constraints on private servicing that may influence the lot fabric, density, viability and approvability.

It is expected that technical pre-consultation will take place in all cases for subdivisions. For other types of applications, pre-consultation is also highly recommended. The need for a formal meeting can be assessed by the consultant. In areas of known issues, or where the consultant is not familiar with the area, pre-consultation must take place. The scope of the pre-consultation can be scaled down for smaller scale developments (e.g. severances, coach houses, etc.), where an exchange of email may be enough.

In addition to pre-consultation, ongoing and open communication between the consultant and the reviewer is strongly encouraged. When unexpected issues are encountered as part of the field work, this should be discussed with the reviewer. For subdivisions, the reviewer will usually be the hydrogeologist at the Conservation Authority. For other types of applications, the planner at the City should be contacted so that the appropriate technical staff can be involved.

1.3.2 Background Review

The scoping of a hydrogeological work plan should be site specific, reference the best available existing regional and local hydrogeological information, and indicate where integration with other studies will occur (e.g. Geotechnical, Environmental Site Assessments, etc.). Consideration should be given to adjacent features such as wetlands, watercourses, bedrock outcrops, and other local constraints.

To explain site specific considerations, the following background information should be referenced and provided, as applicable: the City's Historical Land Use Inventory (HLUI); hydrogeological information database (the City can provide this information in areas where it is available); the Ontario Geological Survey's geological mapping (e.g. surficial, bedrock, karst, drift thickness, ARIP 191, etc.); Ambient Groundwater Geochemistry data for Southern Ontario; evaluation of local information from the Ministry of the Environment, Conservation and Parks (MECP), such as Water Well Information System (WWIS), Permit To Take Water (PTTW) database, Environmental Compliance Approval (ECA) database, Environmental Activity and Sector Registry (EASR) database; desktop air photography review of current and historical adjacent land uses; zoning considerations; local studies (such as the City's groundwater characterizations studies); City screening tools (e.g. thin soils, groundwater quality, etc.).

1.3.3 Work Planning

To ensure that technical pre-consultation is as useful as possible, the developer's hydrogeologist should submit an initial workplan with supporting background information for review, following which a meeting can be scheduled.

In a work plan, the hydrogeological work should be clearly scoped, not only in accordance with the contents of these guidelines, but also in accordance with the Official Plan, Subwatershed Study, Secondary Plan, and Community Design Plan policies related to hydrogeology or to development constraints that may influence well and/or septic system design or locations (e.g. natural hazards and features); as well as the provisions of the zoning designation and/or the provisions of existing development agreements (such as for phased development).

The work plan is not a full planning report. Rather, it is a brief summary of the technical work that will be done in order to address the requirements of these guidelines and any other technical document that might affect the site specific scope of work.

Based on the background review described above and on the requirements of these guidelines, the scoping of site specific hydrogeological work should also describe the intended test and observation well locations and construction specifications; the requirements for (field and lab) analyses of water chemistry parameters; the intended test pit, borehole and auger hole locations and construction specifications; aquifer test considerations (duration, test rates, etc.); the anticipated terrain mapping tools (LiDAR, land surveys, etc.); water budget (e.g. Thornthwaite-Mather) and any other relevant component of the study.

If this recommended process is followed, much of the introductory sections of the Hydrogeological and Terrain Analysis report will have been prepared as a result.

For all unexpected and potentially problematic site-specific testing results, additional detailed consultation is also highly recommended. This can occur informally, as circumstances arise.

1.4 DEVIATIONS

If the consultant wishes to apply methods which differ from the guidelines provided in this document, or if these guidelines do not cover a subject of concern to a specific site, or if the designer proposes to use techniques not covered in this document, then the onus shall be upon the consultant to justify a proposed work plan to the satisfaction of the City. The details of the deviation shall be the subject of a section of the report. All deviations require technical pre-consultation with the City, and approval from the Director, Infrastructure Services.

1.5 APPROVAL AUTHORITY

For privately serviced subdivisions, the City and its Conservation Authority Partners have a Memorandum of Agreement for the review of Hydrogeological and Terrain Analysis reports. For other types of development applications, the City may use internal expertise or retain outside agencies or peer review consultants. These agencies and consultants will provide recommendations; however, the City retains the approval authority in all cases.

2.0 DEFINITIONS [sources are shown in brackets, where applicable]

Aquifer: *A geologic formation that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses* [USGS]. (See definition of "*supply aquifer*".)

Combined Impact: *This refers to the blended impact of all the individual on-site systems on the development site. The impact of the system's effluent discharge on groundwater is not assessed on a plume by plume basis* [MECP D-5-4].

Development: *Means the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act* [PPS].

Development Boundary: This refers to the boundary as set out in the planning application. For the purpose of nitrate dilution calculations, the applicable boundary is the downgradient property line.

Director: *Either the Director under Part VIII of the Environmental Protection Act or the Regional Director of the MOEE* [MECP D-5-4]. For the purpose of these guidelines, wherever the MECP guidelines refer to "Director", "Ministry", "Ministry of the Environment", "MOEE", "Regional staff", "Regional Office", or "Regional Director", it shall signify the City of Ottawa. Decisions on planning applications will be made through the lines of authority already in place at the City, typically with the advice of a hydrogeologist.

Dry Industrial/Commercial Uses: *Those uses in which only the disposal of the domestic waste of employees is permitted and treated. No industrial liquid wastes, wash or cooling water or process wastes are permitted* [MECP D-5-4].

Guidelines: Unless otherwise specified, "guidelines" signifies these Hydrogeological and Terrain Analysis Guidelines.

Health Parameter: This is a drinking water quality parameter with a Drinking Water Quality Standard, as defined in O.Reg. 169/03, under the Safe Drinking Water Act, or any other documentation from or recognized by the MECP or Ottawa Public Health.

Hydrogeologically Isolated: *Those areas characterized by strong upward hydraulic gradients; massive, unfractured clay deposits at or near ground surface; or other thick impervious layers of materials over water-bearing formations* [MECP D-5-4].

Hydrogeologist: In accordance with Professional Geoscientists Ontario (PGO), a hydrogeologist is a title that represents to the public that an individual is offering or providing professional geoscience services (see definition of "professional geoscience").

Individual On-site Sewage System: For sites generating 10,000 L/d or less, sewage systems are defined in the Ontario Building Code. Sites generating more than 10,000 L/d are subject to the Ontario Water Resources Act, administered by the MECP.

MECP: The Ministry of the Environment, Conservation and Parks. In portions of these guidelines, where wording is reproduced verbatim, the Ministry may also be referenced as MOE, MOEE or MOECC.

Professional Geoscience: Defined in the Professional Geoscientists Act, 2000, as follows; *An individual practises professional geoscience when he or she performs an activity that requires the knowledge, understanding and application of the principles of geoscience and that concerns the safeguarding of the welfare of the public or the safeguarding of life, health or property including the natural environment. An individual shall not practise professional geoscience unless he or she is a member of the Association* [PGO] *and practises in accordance with the terms, conditions and limitations imposed on his or her membership.* With the exception of: *An individual who is licensed as a professional engineer under the Professional Engineers Act and who is competent by virtue of training and experience, in accordance with the regulations made under that Act, to engage in practices that would also constitute the practice of professional geoscience* [S.O. 2000, c. 13].

Q20 Concept: This is a sustainable well yield concept, originally introduced by Farvolden, and described in the following document by Maathuis, H. and G. van der Kamp, 2006: *The Q20 Concept: Sustainable Well Yield and Sustainable Aquifer Yield. Saskatchewan Research Council Publication No. 10417-4E09*. Available at https://www.wsask.ca/

Receiving Aquifer (or Groundwater): This is the first aquifer encountered that will receive effluent from a sewage system. (See definitions of "aquifer" and "supply aquifer".) The receiving aquifer will be capable of accommodating a drinking water well meeting the requirements of the Wells Regulation.

Soil: *Means unconsolidated naturally occurring mineral particles and other naturally occurring material resulting from the natural breakdown of rock or organic matter by physical, chemical or biological processes that are smaller than 2 millimetres in size or that pass the US #10 sieve* [O.Reg. 153/04].

Supply Aquifers: *For the purposes of this guideline, a supply aquifer is defined as groundwater which is or which may be used to provide domestic water supply(ies). Designation of groundwater for other than domestic consumption is at the Director's discretion* [MECP D-5-5]. (See definition of "Director".)

Thin Soils: *Consists of soil equal to or less than 2 metres in depth beneath the soil surface, excluding any non-soil surface treatment such as asphalt, concrete or aggregate* [O.Reg. 153/04].

Trace Metals: Samples for metal testing must be filtered. Unless otherwise indicated, for the purpose of these guidelines the suite of trace metal parameters shall include the following, as a minimum: Aluminum (Al), Antimony (Sb), Arsenic (As), Barium (Ba), Beryllium (Be), Boron (B), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Copper (Cu), Lead (Pb), Molybdenum (Mo), Nickel (Ni), Selenium (Se), Silver (Ag), Strontium (Sr), Thallium (Tl), Uranium (U), Vanadium (V), Zinc (Zn). Other metals, such as Calcium, Iron, Magnesium, Manganese, Potassium, and Sodium are already included in the Subdivision Package suite of parameters.

Well Inspection Report: Development on private wells must be supported by a satisfactory well inspection report in conjunction with the building permit and inspection process. As a minimum, a hydrogeologist must certify that the inspection included observing the placement of the casing and, where present, the well screen, and the placement of the sealant into the annular space of the well and any other requirement set out by City guidelines and policies. The hydrogeologist will prepare the well inspection report certifying that the well meets the minimum well construction requirements in the Wells Regulation and any additional design recommendations in the Hydrogeological and Terrain Analysis report, and that the inspection outlined above has been conducted under his/her supervision. The well inspection report will be sealed by the professional hydrogeologist (P.Geo. or P.Eng.), and will also be signed by the well driller.

2.0 Definitions

3.0 SUBDIVISIONS

3.1 Procedure D-5-4 with Annotations—Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment

1.0 Statement of principles

This guideline describes the position and requirements of the Ministry of Environment and Energy (MOEE) regarding the assessment of the potential impact on groundwater caused by proposed developments on individual on-site sewage systems (sub-surface sewage systems). This guideline applies only to those areas of the Province which have not been designated under Notice 3/87 (attached) as subject to MOEE Guideline B-7, Incorporation of The Reasonable Use Concept into MOEE Groundwater Management Activities (formerly MOEE Policy 15-08). In areas so designated, the proposed development must comply with the requirements of MOEE Guideline B-7and its associated guidelines.

Development consists of every land use that is serviced by private individual sewage system effluent disposal including residential, commercial, industrial and institutional land uses. Seasonal and recreational properties are also included and should be considered in the same regard as properties which would have year-round occupation.

The Ministry of the Environment, Conservation and Parks (MECP) is no longer the authority reviewing hydrogeological studies supporting development, including studies outlined within this document. The City, one of its Conservation Partners or any other party designated by the City, is the reviewer for the purpose of these guidelines. The City is the approval authority in all cases.

The guideline reflects the Ministry's experience with development utilising individual on-site sewage systems, and emphasises the need to minimise the potential for adverse groundwater impacts resulting from their use.

This guideline is presented with the understanding that the use of individual on-site sewage systems has been justified by the municipality or the local planning authority. This justification includes an evaluation of alternative types of servicing. The Province encourages municipalities to plan for environmentally appropriate servicing infrastructures by undertaking comprehensive, large-scale assessment of groundwater and surface water resources (see the Provincial Policy Statement).

The purpose of this guideline is to protect the environment and public health by ensuring that development utilising individual onsite sewage systems proceeds at a density and scale which will not result in, or cause degradation of, groundwater resources in exceedance of acceptable limits. Compliance with acceptable limits shall be demonstrated through a prediction of the development's nitrate impact on the groundwater at the development boundary. The Guideline is intended to encourage the assessment of the potential for degradation on the basis of a technically based and technically defensible evaluation of the proposal.

See the definition of “development boundary” in Section 2 of this document.

2.0 Objectives

The objectives of this guideline are as follows:

To provide technical guidance to professionals involved in land development (in particular, hydrogeologists) in assessing the potential for unacceptable groundwater impacts resulting from the use of individual on-site sewage systems, through a three stage assessment process.

To ensure that proposals are submitted with the required technical support to allow the Director to either support the proposed development, designate the proposed development under Notice 3/87 (thus requiring an assessment in compliance with MOEE

Guideline B-7 and its associated guidelines), or to recommend against approval.

3.0 Application of the guideline

This guideline applies to the combined or total impact on groundwater of a development proposal of more than five units with individual on-site sewage systems, in areas which have not been designated under Notice 3/87 (attached). The Guideline applies to residential, commercial and industrial proposals which use individual on-site sewage disposal systems for the treatment of domestic waste. Application to development proposals involving five or fewer units shall be at the discretion of the Regional Director. Although MOEE does not normally review development proposals consisting of 5 or fewer lots, municipalities are encouraged to retain, on their behalf, professionals with demonstrated expertise in hydrogeology with emphasis on development on private services, to review studies prepared in accordance with this Guideline. Municipalities are also encouraged to implement the provisions of this guideline in their consideration of developments by consent or severance.

The City of Ottawa Hydrogeological and Terrain Analysis Guidelines provide direction for all types of planning applications (see the applicable sections in the guidelines).

This Guideline does not apply to the following:

1. ***Large Subsurface Sewage Disposal Systems as defined in Notice 3/87 (attached);***

Systems with average daily sewage flows of over 4,500 Litres per day were previously referred to as “Large Subsurface Disposal Systems”. However, since the transfer of responsibility for small sewage systems from the Environmental Protection Act to the Ontario Building Code, Policy B-7 now applies to systems with daily sewage flows of more than 10,000 L/d and require an Environmental Compliance Approval (ECA) from the MECP.

2. ***the assessment of impacts of existing isolated individual residential sewage systems or interference between individual home systems on existing neighbouring lots within a subdivision (see Note below);***

3. ***applications for approval of on-site systems which are replacements due to the failure (e.g., due to hydraulic load, age, etc.) of the original system.***

This guideline may not apply to non-standard individual on-site systems which are specifically designed to reduce nitrate loadings. It should be emphasised that MOEE encourages the development of new technologies for the treatment of domestic sewage waste. The Ministry will entertain proposals for development which incorporate new technologies. Contact your regional MOEE office for information on these types of systems.

It is not the practice of the City to approve developments where lot sizing is based on the use of nitrate reducing sewage systems. Sewage systems that reduce total nitrogen species (including nitrate), or other contaminants, may be proposed by the consultant for other reasons—other than lot sizing (e.g., as a mitigation measure where site sensitivity is marginal). Nitrate is a common indicator of contamination from sewage systems, but it is not the only parameter of concern. Systems that reduce nitrogen may not treat other contaminants.

Note: Where the use of individual on-site systems has resulted in unacceptable impairment of off-site water quality, the issue should be handled in accordance with MOEE Guideline B-9-1 (formerly Policy 15-10), Resolution of Groundwater Quality Interference Problems.

4.0 Designated areas under notice 3/87

Under Notice 3/87, the Director under Part VIII of the Environmental Protection Act or the MOEE Regional Director may designate a municipality or an area of a municipality as subject to MOEE Guideline B-7.

It is important to note that even though an applicant may meet the requirements of Section 5 of this Guideline, the Director reserves the right to require more detailed assessment or to designate any site or area of a municipality as subject to MOEE Guideline B-7 under Notice 3/87. The likelihood of this occurring is greater where:

conditions outlined in Section 5.1 are not met;

the development proposed has a higher density than previous development proposals in the municipality;

the scale of the proposal is such that an increased degree of assurance is appropriate; or

it is known that there are existing high levels of groundwater contamination by nitrate-nitrogen.

When these environments are encountered or these developments are proposed, the Director's support may be conditional upon the establishment of monitoring programs and financial assurances. Under these circumstances contact the local MOEE Regional Office for more information.

Although the Director may support a proposal involving individual on-site sewage systems and permit their installation, the Director does not assume responsibility for failure of the system(s), for correcting the damage to adjacent properties, or for the construction of new sewage systems. This is the responsibility of the proponent/owner of the system.

No area of the City has been specifically designated as subject to MECP Guideline B-7 for privately serviced development.

5.0 Groundwater impact assessment in non-designated areas

5.1 General Evaluation

The groundwater impact assessment will address the ability of the lands, identified by and restricted to the development proposal document, to treat sewage effluent to meet acceptable limits. This assessment, and the assessment described in the "Technical Guideline for Private Wells: Water Supply Assessment", should be completed and submitted together as one document. Approval Authorities (i.e. the Ministry of Municipal Affairs and/or designate) should only consider support for development applications involving individual on-site sewage systems where the proponent and/or the consultant has:

a. in conjunction with the municipality, defended the use of private services to the satisfaction of the MOEE Regional Director in accordance with the Provincial Comprehensive Set of Policy Statements, particularly, the Policy Statement and Implementation Guideline B7, Planning for Sewage and Water Services, and the Policy Statements and Implementation Guidelines B8 through B11, Growth and Settlement;

b. demonstrated to the local Health Unit (or to the MOEE, in those areas where MOEE administers the Part VIII Program) that the site complies with the requirements of Ontario Regulation 358 and related policies and guidelines;

The design and construction of private individual sewage systems, where daily flows are less than 10,000 litres per day, are reviewed and approved by the Ottawa Septic System Office (OSSO), in reference to relevant conditions of the development agreement and the private servicing plan.

c. determined the representative existing background nitrate nitrogen levels in the receiving groundwater. This determination will involve the collection of groundwater samples from various locations on and adjacent to the development site. The consultant must provide a clear rationale for the number of times the site is sampled, the period of time over which the sampling has been undertaken

(capturing seasonal variations), and the manner in which this information is used in the assessment. The consultant must discuss the existing background nitrate-nitrogen concentrations relative to nitrate sources, and the susceptibility of groundwater to contamination. The Ministry will normally not support development in areas where background nitrate-nitrogen concentrations exceed 10mg/L. Where nitrate concentrations between 0 and 10 mg/L are found, the MOEE may also decide not to support development if the proponent's consultant cannot provide a reasonable explanation for the existing levels of nitrate concentration in the groundwater. However, if it can be demonstrated that existing levels of nitrates are the result of historical agricultural practices on the site (for example farming, feedlot, etc.), the proponent may be able to argue that the nitrate levels will decline after development, and;

In the rationale for the investigation of existing nitrate levels, the hydrogeological consultant should use specific information about on-site and neighbouring historical land uses, terrain units, physiographic characteristics and site-specific groundwater flow directions.

Sampling depths must correspond to the definition of receiving aquifer and groundwater sampling and testing methods must correspond to the requirements of Section 3.2, Annotated: Procedure D-5-5, Private Wells: Water Supply Assessment. In addition, the full suite of nitrogen species is to be analysed (nitrate, nitrite, TKN, ammonia and organic nitrogen). Only water bearing formations that receive sewage and can reasonably be used as a drinking water aquifer need to be investigated.

The City will require additional groundwater sampling events for sites where total nitrogen species are found between 2.5 and 10 mg/L. In these cases, the hydrogeological consultant should demonstrate that levels are not rising or spreading over time. The temporal distribution of samples will be on a case-by-case basis and should be discussed with the reviewer. Other lines of evidence, such as historical photos and knowledge of the area, can be used to rationalize background nitrogen concentrations.

The City will not accept development where nitrogen levels in the receiving aquifer (i.e. capable of being utilized as a water supply) exceed 10 mg/L or where they are found to be increasing and may reach 10 mg/L in the future.

> ***d. demonstrated that the area is not obviously hydrogeologically sensitive (for example, karstic areas, areas of fractured bedrock exposed at surface, areas of thin soil cover, or areas of highly permeable soils).***
>
> ***It is not the intent of MOEE to promote the development of areas with high infiltration rates (for example, sandy overburden deposits). Due to lack of effective effluent treatment, proposed development on individual on-site systems should not be approved in soils which have high infiltration rates.***

There are some areas of the City where high levels of anthropogenic groundwater impacts have been identified, where the soils overlying bedrock aquifers are thin (less than 2 metres), where karst has been observed, and where coarse sand deposits are exposed at the ground surface. Therefore, some sites in the City may not be suitable for private sewage system effluent disposal because of the high likelihood of existing and future adverse impacts on water supply aquifers. The concern for these areas relates to the increased mobility and lack of attenuation of pathogens, nutrients, etc., through such highly permeable materials.

If development is contemplated in such areas, mandatory technical pre-consultation is to take place. Further, the consultant must be prepared to provide very strong rationalization, based on multiple lines of evidence and additional testing, of how development could proceed while safeguarding water supply aquifers. Additional requirements may be imposed for these sites. Lines of evidence can come from gradients (vert. & hor.), the absence of surface impact indicators, additional sampling of nearby wells, additional test pits to delineate areas of thin soils, additional grain-size distributions, etc. The additional work will be site specific and should be discussed with the reviewer. These sites may require mitigation measures, such as, but not limited to extended well casing depths, increased separation distances between wells and sewage systems, alternate sewage system designs.

5.2 Three-Step Assessment Process

Every proposed development involving individual on-site sewage systems requires an assessment of the groundwater impact potential. The purpose of the assessment is to ensure that the combined effluent discharges from all the individual on-site sewage systems in a development will have a minimal effect on the groundwater and the present or potential use of the adjacent property. For the purposes of this Guideline, the Ontario Drinking Water Objective (ODWO) of 10 mg/L of nitrate-nitrogen is used as an indicator of groundwater impact potential. This Guideline does not define a precise methodology for determining the expected level of impact; however, it does set out the major considerations which should be included in a defensible assessment of the impact potential.

The assessment involves a three step process. The need to advance to the next step depends on the conditions defined in the previous step. The process is dependent on first satisfying the general requirements defined in Sections 4.0 and 5.1.

The first step involves a definition of the proposed development's minimum lot size. If the minimum lot size is smaller than that defined in Section 5.4, the assessment must progress to the second step, which involves evaluating the relationship between the individual on-site sewage systems and the groundwater. Where it cannot be demonstrated that the systems are isolated from existing or potential groundwater supplies, it will be necessary to progress to the final step of the assessment, which involves a detailed examination of contaminant loading to the groundwater.

Where a report is found to be incomplete, draft or preliminary, or makes unsubstantiated claims, the MOEE will advise the proponent by letter with regard to the report's deficiencies. MOEE may not undertake a full review until such time that a complete report (i.e., one which satisfies the requirement of this Guideline) has been submitted.

For reporting requirements see Section 11.

5.3 Fundamental Considerations

a. For the purposes of this guideline, the only exceptions to the use of groundwater for anything other than a drinking water supply shall be:

i. For reasonable uses which involve water quality more stringent than defined by the Ontario Drinking Water Objectives (for example: providing base flow to a cold water trout stream), or

ii. At the Director's discretion.

b. Groundwater impact predictions shall be calculated for the development site property boundary.

c. The consultant must make recommendations regarding the optimum location and orientation of leaching beds. In general, the attenuative capabilities of a site can be optimised by maximising separation distances between individual on-site systems and downgradient wells and property boundaries.

The location and orientation of leaching beds can have an impact on hydraulic competition between beds. Siting considerations should be included with the hydrogeological report to minimize the potential for interference between leaching beds and between leaching beds and wells. Stormwater management should also be taken into consideration.

Wells must be separated from sources of contaminants, in accordance with the Wells Regulation and the Ontario Building Code. To determine sources of contaminants, the City will refer to the MECP Water Supply Wells – Requirements and Best Management Practices, and the Ontario Building Code.

See Section 3.3 for terrain unit map and private servicing plan requirements.

d. Where applicable, the impact of the on-site discharge of sewage effluent into surface water must be evaluated. This work must be done by qualified individuals and must

address potential impact from phosphorus and other parameters which may be of concern (see MOEE Guideline B-1-1, Water Management -Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy, and contact your local Regional Office). The concentration of phosphate used in assessing the potential impact of sewage effluent should normally be 15 mg/L.

The City's Official Plan has requirements for minimum setbacks from water bodies, such as streams. In addition to the minimum setbacks in the Official Plan, City planners may, in conjunction with natural systems staff, review consultant reports and recommendations and determine the required setbacks on a site-specific basis (the City's natural systems staff should be consulted where surface water impacts are anticipated). Setbacks will normally be identified at the mandated planning pre-consultation; however, additional setbacks may be identified at the technical pre-consultation. The point of measurement for the setback (for e.g. sewage distribution pipes, mantles, etc.) should also be discussed and identified at pre-consultation.

5.4 Step One: Lot Size Considerations

For developments where the lot size for each private residence within the development is one hectare or larger, the risk that the boundary limits imposed by these guidelines may be exceeded by individual systems is considered acceptable in most cases. Developments consisting of lots which average 1 hectare (with no lot being smaller than 0.8 ha), may not require a detailed hydrogeological assessment, provided that it can be demonstrated that the area is not hydrogeologically sensitive. In such circumstances, it is the responsibility of the proponent to obtain a professional analysis from a qualified consultant that the area is not hydrogeologically sensitive.

It is assumed that attenuative processes within a one hectare lot will be sufficient to reduce the nitrate-nitrogen to an acceptable concentration in groundwater below adjacent properties. It should be noted that sufficient attenuative processes may not be present

in hydrogeologically sensitive environments, or where there is little water surplus available.

5.5 Step Two: System Isolation Considerations

Where proposed lot sizes are less than one hectare, the proponent and/or the consultant is/are responsible for assessing the potential risk to groundwater. Developments will normally be considered as low risk where it can be demonstrated that sewage effluent is hydrogeologically isolated from existing or potential supply aquifer(s). In making this assessment, the proponent and/or the consultant must:

a. evaluate the most probable groundwater receiver for sewage effluent: its definition must be defended by hydrogeological data and information obtained through a test pit, auger hole and/or test drilling program; and

b. define the most probable lower hydraulic or physical boundary of the groundwater receiving the sewage effluent.

The consultant must clearly define those portions of the subsurface which will be affected by the effluent. Detailed predictions of the shape of individual contaminant plumes and a description of specific contaminant concentrations over space and time may not be required.

There are some areas in the City that may be deemed safer than others for private sewage system effluent disposal because of the high likelihood that a sufficiently thick aquitard overlies potential or existing water supply aquifers. Such sites may be found to be hydrogeological isolated. If development is contemplated in such areas, and a system isolation argument is being put forward, mandatory technical pre-consultation is to take place.

The City will usually consider approximately 10 metres of massive unfractured clay deposits, or other sufficiently low permeability materials (min. $K=10^{-5}$ cm/s), to be hydrogeologically isolating, provided these deposits extend laterally a sufficient distance from the development boundary and are essentially free of permeable lenses. The 10 m thickness of massive unfractured clay is used as a guide for the threshold where an

acceptable comfort level would have been reached without having to do additional work—i.e., beyond demonstrating the thickness and aquitard properties of the materials. The value of 10 m is taken from the MECP *"Guideline for Applying 15-08* [now B-7] *to Large Subsurface Disposal Systems"*, section 3.2.1.

Where the above criteria are not met, the consultant will be required to demonstrate system isolation using multiple lines of evidence, which may include upward vertical gradients (with lack of gradient reversal), the absence of surface impact indicators (groundwater parameters), additional sampling of nearby wells, logged boreholes, additional grain-size analyses, etc. The type of evidence may be site-specific and should be discussed with the reviewer.

> ***The potential for isolation must be assessed on a site specific basis and may involve assessments of geologic and/or hydraulic boundaries. Please note that this may require hydrogeologic assessment of lands up to 500 metres beyond the actual development boundary.***
>
> ***In some cases, it may be necessary to demonstrate isolation from sensitive surface water environments. Wherever there is a potential for surface water impact, the proponent should contact the MOEE Regional Surface Water staff.***
>
> ***When it has been demonstrated that the sewage effluent will not enter supply aquifers, the lot density of the proposed development may be dictated by factors such as the need for sewage system replacement areas (i.e., contingency area), and by the minimum distances between individual on-site beds and wells, as defined by Ontario Regulations 358 and 903.***

The Ontario Building Code and the Wells Regulation [R.R.O. 1990, Regulation 903 (Wells) as amended made under the Ontario Water Resources Act, R.S.O. 1990, c. O. 40] set the minimum requirements for well construction and separation distances—refer to Section 3.3 (Terrain Analysis) for additional requirements.

5.6 Step Three: Contaminant Attenuation Considerations

Where it cannot be demonstrated that the sewage effluent is hydrogeologically isolated from all existing or potential supply aquifers, a hydrogeologic study is required to assess the risk that the development's individual on-site systems will cause concentrations of nitrate-nitrogen in groundwater to exceed 10 mg/L at the downgradient property boundary. As described below, there are various methods by which this detailed risk assessment can be done.

5.6.1 Monitoring-Based Assessments

The Ministry recognises that groundwater, infiltrating precipitation and sewage effluent will not be completely mixed at the property boundary. It is also recognised that processes such as absorption, denitrification, filtration and biodegradation may attenuate contaminants as the effluent passes down through the unsaturated zone and moves into the saturated zone. Since these processes are extremely difficult to quantify with any accuracy, they are usually only considered as a safety factor. However, if the consultant can provide documentation to the satisfaction of MOEE regarding the presence and extent of these processes on-site, their impact on nitrate concentrations will be considered. As discussed below, there is a number of ways in which this can be done.

a. Existing Development

In some situations, there may be nearby on-site sewage system based development in a similar hydrogeological environment. If this development has been in place for a lengthy period of time, information on existing groundwater quality could be used to demonstrate the combined effect of all available attenuative processes. This empirical information may then be used to help predict the impact of the proposed development.

The onus is on the proponent and/or the consultant to demonstrate adequately that:

i. the existing and proposed developments are located in similar hydrogeological environments;

ii. sewage effluent (quantity and quality) from the existing and proposed developments are comparable;

iii. monitoring produces results which accurately represent water quality conditions beneath the existing development. The consultant must provide a clear rationale for the number of times the site is sampled, the period of time over which the sampling has been undertaken (capturing seasonal variations), and the rationale for the way in which this information is used in the assessment.

In general, monitoring of groundwater quality should be concentrated close to the existing individual on-site systems. Due to effluent plumes possibly forming discrete, elongated shapes, intensive monitoring may be required to ensure that monitoring wells located further from the individual on-site systems are measuring effluent concentrations within the effluent plume(s). Water supply wells are not meant to be used as monitoring wells.

Most of the City is underlain by a complex geology, with high uncertainties and where long periods of time are required in order to reach geochemical equilibrium following land development. This has been borne out in groundwater characterization studies performed by the City. For this reason, monitoring-based assessments will typically not be accepted.

b. Phased Development

In situations where there is no existing development, it may be possible to develop lands considered in the planning document in phases, beginning with the upgradient portion.

Information obtained from monitoring effluent discharged from individual on-site systems in the upgradient phase, and its impact on groundwater, can then be used to determine the extent to which the downgradient portion of the site can be developed. Before approving such a phased development, the Ministry must be satisfied by the Ministry of Municipal affairs (MMA) or the delegated planning approval authority, that adequate planning controls are in place to regulate development of the downgradient portion of the site.

The above phased development assessment is not the same as the servicing review study prior to the approval of future phases, as described in these guidelines.

5.6.2 Predictive Assessment - Residential Development

The Ministry requires the following considerations and assumptions to be used in assessing the combined impact of individual on-site sewage systems at the boundary of residential developments:

a. Contaminant 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 impacts, a nitrate loading of at least 40 grams/lot/day per residential dwelling unit shall normally be used. (This is based on expected actual flows of 1000 L/day and a minimum value of 40 mg/L nitrate-nitrogen in the discharge from a Class 4 or Class 6 system (see O.Reg. 358) treating domestic/household sewage.)

b. Contaminant Attenuation:

i. In assessing contaminant attenuation, only dilution will be accepted by the Ministry as a quantifiable attenuation mechanism for nitrate.

ii. Dilution models involve dilution with infiltrating precipitation. Mixing with groundwater flowing through the site will normally not be allowed because it is usually not possible to control up gradient land uses. Flow through will not be considered where sensitive hydrogeological conditions exist. However, where up-gradient lands have been fully developed for a considerable period of time, the quantity and quality of groundwater flow available to dilute the effluent entering the receiving groundwater may be considered.

iii. The amount of available moisture surplus should normally be obtained from Environment Canada. Where available, reliable, long-term, site specific information, obtained from detailed water balance and/or groundwater studies, can be used.

Post-development site-specific annual water/moisture surplus estimates are to be used, including the effect of stormwater features (ponds, Low Impact Development practices, etc.). These estimates are to be derived from monthly, weekly or daily water budget calculations for distinct surplus areas within the site (i.e., areas with similar soil and vegetation), in accordance with the recommended methodology in the MECP Stormwater Management Planning and Design Manual. The MECP methodology was first introduced as a practice in the 1995, *MOEE Hydrogeological Technical Information Requirements for Land Development Applications*, and this document should also be consulted.

Site specific water/moisture surplus estimates should be obtained from Environment Canada modelling services, unless otherwise agreed upon with the City. These estimates must clearly pertain to discrete areas on the site with distinct water holding capacities, as defined by Thornthwaite and Mather. All original model inputs and outputs should be appended to and discussed within the body of the Hydrogeological and Terrain Analysis report.

A current 30-year climate data period should be used and should be from the from the closest representative Environment Canada climate station, unless otherwise agreed upon with the City.

iv. Estimates of the amount of this surplus which infiltrates into the ground must be based on site specific factors such as soils, topography, surface geology, and impermeable areas (including roof tops and paved areas).

The City will only accept post-development site-specific infiltration estimates for distinct water/moisture surplus and topographic areas. To partition the estimated water/moisture surplus between infiltration (considered to be groundwater recharge) and surface runoff, distinct infiltration factors, should be obtained from Table 2 (below).

Infiltration factors are specific to areas with unique combinations of soil, vegetation and topographical character. To support infiltration factor choices, the City will accept the following mapping and assessment: terrain unit mapping, in accordance with these guidelines; post-development grading plan and slope assessment; post-development land cover mapping, including the identification and removal of impervious areas; and, when the distribution of these areas is complex, a map presenting the distribution of water holding capacities, water surplus, infiltration factor areas and the resulting values of groundwater recharge. The following areas should also be clearly mapped, as applicable: open areas that must remain undisturbed to ensure infiltration will be met; development constraints, in accordance with these guidelines; stormwater management features (ditches, ponds, infiltration facilities, etc.), where these will have an effect on the assessment of impact.

v. The volume of sewage effluent, if used as dilution water in mass balance calculations, should not exceed 1000L/day/lot.

vi. Mathematical (computer) models may be used to assess the impact potential. Although the selection of model software will be left to the proponent, the Ministry must be provided with information on the model's validation and how its limitations and assumptions affect the results. All model simulations must include appropriate sensitivity analyses.

It is the intent of MOEE to allow only those dilution models to be used which are reasonable and can be defended on a site specific basis. Where the Ministry has concerns regarding the predicted impact, the Regional Director may consider designating the development under Notice 3/87.

Table 2: Infiltration Factors	
Description of Area/Development Site	**Value of Infiltration Factor**
TOPOGRAPHY	
▪ Flat land, average slope not exceeding 0.6 m per km (0.06%)	0.30
▪ Rolling land, average slope of 2.8 m to 3.8 m per km (0.28-0.38%)	0.20
▪ Hilly land, average slope of 28 m to 47 m per km (2.8-4.7%)	0.10
SOIL	
▪ Tight impervious clay	0.10
▪ Medium combinations of clay and loam	0.20
▪ Open sandy loam	0.40

COVER	
▪ Cultivated lands ▪ Woodland	0.10 0.20

From: Page 4-62, MOEE Hydrogeological Technical Information Requirements for land Development Applications (April 1995)

If the dilution methodology is proposed in areas of thin soils, the approach and the factors should be discussed at pre-consultation.

5.6.3 Predictive Assessment - Industrial/Commercial Development

This Guideline only applies to developments which have an average daily flow of less than 4,500 L/day/lot. Developments with larger flows will be assessed according to MOEE Guideline B-7. In addition, the sewage assessed should consist of domestic wastes only. No industrial/ commercial cooling or process wastewater is to be considered.

The nitrate loading from industrial/commercial individual on-site systems can vary greatly depending on the type and intensity of use. Since specific uses for each lot or block are not known at the planning document review stage, it is necessary to determine how much nitrate can be discharged from each individual on-site system without exceeding the ODWO of 10 mg/L at the property boundary. The following procedure is then used to set maximum allowable effluent flows for each lot:

This section of the guidelines applies to developments which have an average daily flow of less than 10,000 L/day/lot. See Section 5.6.2 of the MECP Procedure D-5-4, including the annotations in these guidelines, for the more general methodology.

a. Available Infiltration:

i. The amount of available moisture surplus should normally be obtained from Environment Canada or the

conservation authorities. Where available, reliable, long-term, site specific information, obtained from detailed water balance and/or groundwater studies, can be used.

ii. Estimates of the amount of moisture surplus which infiltrates into the ground must be based on site specific factors such as soils, topography, surface geology, and impermeable areas (including roof tops and paved areas).

b. Maximum Allowable Flow:

The maximum allowable flow for each lot or block in the industrial/commercial development can be calculated by dividing the amount of available infiltration {from (a)} by a factor of three. This was derived by simplifying the equation (40 mg/L x Flow) / (Flow + Infiltration) = 10 mg/L - Background

c. Maximum Number of Users:

To determine the maximum number of users which can be supported by the calculated allowable flow, please refer to Appendices 9.3.1 and 9.3.2 of MOEE's "Manual of Policy, Procedures and Guidelines for On-Site Sewage Systems." Restrictions regarding the allowable number of users will normally be incorporated as recommendations in the consultant's assessment, and the recommendations shall be implemented by provisions in the development agreement between the proponent and the municipality.

5.7 Additional Research

The Ministry recognizes that the assumptions required for allowing a predicted level of 10 mg/L to be used as a boundary target criterion, for exempting lots of one hectare, or for using nitrate nitrogen as the critical contaminant etc., may not be technically supported in every case. The Ministry recognizes that as research continues, information and technologies may become available which warrant minor or substantial revisions to this guideline.

6.0 Implementation

MOEE staff will implement this guideline through comments and advice supplied to municipalities, the public, and the approval Authority on planning documents circulated under the Planning Act.

For development applications (official plan amendments, plans of subdivision or condominium) involving more than five lots with individual on-site sewage systems, the approval Authority must ensure that an impact assessment has been completed in accordance with this Guideline which demonstrates that the impacts on ground and surface water of the proposal will be within acceptable limits. Shoreline development proposals will be reviewed on a case-by-case basis. The groundwater impact assessment must be approved by MOEE prior to its recommendation that draft approval be granted for plans of subdivision and condominium, and prior to approval of most official plan amendments.

As part of MOEE's recommendation that draft approval be granted, MOEE will request a condition of final approval which specifies that the MOEE receive a copy of a fully-executed subdivision/condominium agreement or other suitable development agreement between the municipality and the developer. The agreement will require that the recommendations of the impact assessment report as approved by MOEE (or its agents) be implemented.

For industrial or commercial development applications involving individual on-site systems, the approval Authority should ensure that a municipal by-law is enacted for the subject lands restricting the industrial/commercial uses to "dry industrial/commercial uses".

7.0 Definitions

See Section 2 of these guidelines for a more complete list of definitions.

Combined Impact

This refers to the blended impact of all the individual on-site systems on the development site. The impact of the system's effluent discharge on groundwater is not assessed on a plume by plume basis.

Director

Either the Director under Part VIII of the Environmental Protection Act or the Regional Director of the MOEE.

Individual On-site Sewage System

An on-site Class 4 or Class 6 sewage system regulated by Ontario Regulation 358 under the Environmental Protection Act.

Supply Aquifers

For the purposes of this guideline, a supply aquifer is defined as groundwater which is or which may be used to provide domestic water supply(ies). Designation of groundwater for other than domestic consumption is at the Director's discretion (see Section 5.3).

Dry Industrial/Commercial Uses

Those uses in which only the disposal of the domestic waste of employees is permitted and treated. No industrial liquid wastes, wash or cooling water or process wastes are permitted.

Hydrogeologically Isolated

Those areas characterized by strong upward hydraulic gradients; massive, unfractured clay deposits at or near ground surface; or other thick impervious layers of materials over water-bearing formations.

8.0 Reference documents

Other documents that should be used in conjunction with this Guideline include:

- ***The Provincial Policy Statement, Ministry of Municipal Affairs & Housing;***
- ***"Technical Guideline For Water Supply Assessment For Private Wells: Water Supply Assessment", MOEE.***
- ***"Manual of Policy, Procedures and Guidelines for On-site Sewage Systems", MOEE.***
- ***"Class Environmental Assessment for Municipal Sewage and Water Projects", Municipal Engineers Association.***
- ***"Class Environmental Assessment Document: Expansion or Upgrading of an Existing Sewage or Water System", Ecologistics Limited and MOEE.***

Addendum

Notice 3/87

To: Directors, Part VII, Environmental Protection Act
Re: Protection of groundwater quality

Ministry of the Environment Policy No. 15-085 "Incorporation of the Reasonable Use Concept Into MOE Ground Water Management Activities" came into effect April 25, 1986. A copy of the Policy and the referenced document entitled "The Incorporation of the Reasonable Use Concept Into the Ground Water Management Activities of the Ministry of the Environment" - September 1986 are appended for your information.

This policy and its appended document establish the basis for determining the reasonable use of ground water on property adjacent to sources of contaminants, and addresses the levels of contaminate discharge considered acceptable by the Ministry. The document establishes procedures for the determination of what constitutes reasonable use of ground water.

It will be noted that the document and the policy are considered to apply to large subsurface sewage systems (i.e., systems regulated by O. Reg. 374/81, under Part VII Environmental Protection Act).

The fundamental principles contained in Policy 15-08 and its attached document are already embraced in the "Manual of Policy Procedures and Guidelines for Private Sewage Disposal Systems"(Chapter 8 and Chapter 14), and only formalize those concerns for the purpose of implementing the Ministry's overall water quality management program as defined in the MOE publication "Water Management-Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment".

As you are all aware there is no definition of a large subsurface sewage disposal system contained in either the Environmental Protection Act or O. Reg. 374/81. The Regulation does however contain a definition for a Class A system, and Chapter 14 of the

"Manual of Policy, Procedures and Guidelines for Private Sewage Systems" does provide guidance respecting large systems.

For the purposes of implementation of Ministry Policy 15-08, we have defined Large Subsurface Sewage Disposal System as a subsurface system that:

a. has an average daily flow greater than 4500 L/d;

(this value is now 10,000 L/d)

b. serves more than five private residences/dwelling units, with a communal subsurface sewage system; or

c. serves more than five private residences/dwelling units with adjacent individual sub-surface sewage systems and which will be located in a municipality or an area of a municipality designated by the Part VII Director, and/or the Regional Director of the Ministry of the Environment; or

d. serves any institution, industrial or commercial establishment;

but does not include a sub-surface sewage system that:

i. serves an institutional, industrial or commercial establishment with an average daily flow less than 4500 L/d (this value is now 10,000 L/d) whose waste water consists solely of sewage of domestic origin, which is human body waste, toilet or other bathroom waste, and liquid or water-borne culinary sink waste.

Clause c) above permits either the Part VII Director or the MOE Regional Director to designate a municipality or an area of a municipality as subject to Policy 15-08. In such designated areas, any subdivision of more than five private residences/dwelling units with adjacent individual sub-surface sewage systems will be subject to Policy 15-08. Prior to the designation of a municipality

or an area of a municipality under Clause c) the respective Directors or their staff should consult with each other in order to establish/clarify the reasons for the designation and to ensure there is no misunderstanding or confusion.

The purpose of this Notice is to provide all Part VII Directors with guidelines respecting the implementation of Ministry Policy15-08. The suggested implementation procedures are as follows:

a. ***In the "Manual of Policies, Procedures and Guidelines for Private Sewage Disposal Systems" it is recommended that applicants proposing large systems undertake to have a pre-consultation meeting with the Part VII Director in order to establish fundamental design criteria etc. for the proposed works. When such meetings are held, Policy 15-08 and its appended document should be brought to the attention of the applicant and the applicant should be requested to address the concerns of the policy and document. As a first step the applicant should confirm the applicability of the policy with the appropriate MOE Regional Office. The decision of the MOE Regional Office and any subsequent assessment of ground water contamination etc. should be included in the applicant's submission to the Part VII Director.***

b. ***Where the MOE Regional Office has determined that Policy 15-08applies to a specific application, the report and assessment proposed by the applicant's consultant should be submitted to the MOE Regional Office by the Part VII Director for review and comment back to the Part VII Director.***

c. ***When a Part VII Director receives an application for which no pre-consultation meeting has been held or the proponent has not been advised of Policy 15-08, it is recommended that the application be forwarded to the MOE Regional Director for a determination as to the applicability of the policy.***

Where the MOE Regional Office determines that the policy is applicable, the Part VII Director should so advise the applicant in order that the required assessment may be prepared. This assessment should be forwarded to the MOE Regional Office by the Part VII Director for review, comment and acceptance/rejection.

d. When an MOE Regional Office cannot support the assessment of the applicant's consultant regarding the impact of the proposed undertaking the applicant should be so advised by the Part VII Director. Should the applicant choose to appeal the decision MOE Regional staff will act as expert witnesses on behalf of the Part VII Director at the Environmental Appeal Board Hearing.

Should you have any questions respecting the preceding or the attached we would request that you contact either the Technical Support Manager of the MOE Regional Office or, Mr. Brian J. Cooper, On-Site Sewage Systems, (416) 323-4503.

The original Notice 3/87 document was signed by:

W.R. Balfour

Director

Environmental Approvals and Land Use Planning Branch

and
C.E. McIntyre Executive Director Approvals and Engineering

3.2 Procedure D-5-5 with Annotations—Private Wells: Water Supply Assessment

1.0 STATEMENT OF PRINCIPLES

This guideline describes the position of the Ministry of Environment and Energy (MOEE) regarding the assessment of water supplies for developments on individual private wells. The Guideline is based on MOEE experience with development utilizing individual wells, and reflects the need to ensure that future owners of lots or homes have a high probability of being able to obtain adequate quantities of potable water for domestic consumption over both the short and long term.

Development consists of every land use that is serviced by individual private wells including residential, commercial, industrial and institutional. Seasonal and recreational properties are included and are considered in the same regard as properties which would have year-round occupation. Not all the requirements in this section apply to every type of planning application; the applicable sections in these guidelines should be consulted for specific requirements for the type of planning application being reviewed.

The Ministry of the Environment, Conservation and Parks (MECP) is no longer the authority for hydrogeological studies supporting development, including studies required by this document. The City, one of its Conservation Partners or any other party designated by the City, is the reviewer for the purpose of these guidelines. The City is the approval authority in all cases.

This guideline is presented for use with the understanding that the use of individual private wells has been justified by the municipality or the local planning authority. This justification includes an evaluation of alternative types of servicing. The Province encourages municipalities to plan for environmentally appropriate servicing infrastructures by undertaking comprehensive, large-scale assessment of groundwater and surface water resources (see the Provincial Comprehensive Set of

Policy Statements, particularly Policy Statement B7, Planning for Sewage and Water Services, and the Implementation Guideline to Policy Statement B7).

The City has various groundwater management programs, whereby it performs studies of groundwater in and outside of villages. The documents produced through these programs should be considered by the consultant. The applicable documents will be identified at the time of technical pre-consultation.

MOEE Guideline B-1-1, "Water Management - Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy", is made under the authority of the Ontario Water Resources Act (OWRA). Guideline B-1-1 deals with the protection and enhancement of drinking water quality and describes the Provincial Water Quality Objectives (PWQOs) and the Ontario Drinking Water Objectives (ODWOs). The primary purpose of Guideline B-1-1 is to protect public health and encourage the provision of aesthetically pleasing water. Water intended for human consumption should not contain any disease-causing organisms or hazardous concentrations of toxic chemicals or radioactive substances. Aesthetic considerations also provide a basis for drinking water objectives since the water should be pleasant to drink.

In addition to the information in these guidelines, reference should be made to the most recent water quality regulations and guidelines, including Ontario Regulation 169/03 (Ontario Drinking Water Quality Standards) and MECP Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, and any other relevant guidance.

Although MOEE does not normally review development proposals consisting of five or fewer private residences, the Ministry recommends that supplies serving five or fewer private residences should use the ODWOs to ensure the quality of drinking water. This recommendation may apply to development by consent or at the official plan amendment stage in certain areas; contact the local MOEE Regional office for further information. The Ontario Water

Resources Act, RSO 1990, obliges the MOEE to comment on the quality of private water supplies which are part of development proposals submitted to the MOEE for review.

Ontario Regulation 903 establishes standards and regulations concerning well construction.

With respect to proposals involving individual on-site sewage systems (subsurface sewage systems), a separate guideline for the assessment of the impact of such systems on adjacent lands is available from the MOEE office in your Region. The title of the Guideline is Technical Guideline for Individual On-site Sewage Systems: Water Quality Impact Risk Assessment.

With respect to communal water supply systems to serve more than five private residences, a Certificate of Approval, and possibly a Permit to Take Water will be required. For communal sewage systems, a Certificate of Approval will be required. For more information on communal systems, please contact the MOEE office in your area.

2.0 OBJECTIVES

The objectives of this guideline are as follows:

to provide technical guidance to professionals involved in land development (in particular, hydrogeologists) in the assessment of groundwater quality and quantity;

to provide an interpretation of the application of MOEE policy to development of individual private well water supplies; and

to ensure that development proposals are submitted with the required technical support.

3.0 APPLICATION

The guideline applies to all development proposals for residential development involving individual well water supplies. Development agreements between the proponent and the municipality, or its equivalent in unorganized areas, shall be used to bind development to the recommendations of approved hydrogeology studies.

The guideline also applies to developments for which a plan of condominium is required and to industrial, commercial or institutional developments where water is used for human consumption. Please contact your regional MOEE office for information on the applicability of the guideline to a particular development of this type.

Additional information and requirements pertaining to specific types of applications are found in other sections of these guidelines. The targets for water quantity and quality must be in accordance with these guidelines; however, in cases where commercial and industrial sites cannot meet these guidelines, a meeting with the City can occur, so that options can be discussed—this is especially relevant where the use has been designated in the Official Plan and the zoning is already in place.

4.0 INFORMATION REQUIREMENTS

4.1 General

A hydrogeological study will be required by MOEE prior to recommendation of draft approval for plans of subdivision and condominium, and may be required prior to approval of official plan amendments which would permit development on private services. The study must be performed and a report submitted to the MOEE at the time of circulation of the proposed official plan amendment or plan of subdivision. The report must address concerns relative to the following:

- ***Future residents must be provided with water for domestic consumption that is of acceptable quality and of adequate quantity.***
- ***Appropriate well construction techniques must be followed in order to minimise the possibility of well water quality degradation.***
- ***There must be minimal adverse effects on well water in the development from sources of contamination on the site or on adjoining lands.***
- ***Developments must not result in water quantity interference conflicts between users in the development and users on the adjoining lands.***

Well construction must meet the requirements of the Wells Regulation and the site-specific recommendations of the Hydrogeological and Terrain Analysis report. Development on private wells must be supported by a satisfactory well inspection report (see definition). In the case of a Hydrogeological and Terrain Analysis report, the well inspection report can consist in a clear statement in the report that the test wells, including production wells, have been supervised by the hydrogeologist, or a qualified person who is under the supervision of the hydrogeologist who signed the report. It is understood that pre-existing domestic wells, when used to supplement the minimum requirements in these guidelines, may not have a well inspection report.

With respect to quality, each future domestic well must provide water that is safe and aesthetically suitable for human consumption. The suitability of the water for domestic use is determined by comparing the results of the analysis of ground water samples from test wells with the applicable ODWOs (see Section 4.4 and the Appendix).

Water quality testing must be performed on the raw (untreated) water. The minimum water quality parameters (bacteriological and chemical) to be tested are outlined in the applicable sections of these guidelines. The list of parameters to be tested may have to be expanded as the area and site-specific circumstances dictate—e.g., trace metals, volatile organic compounds (VOCs), petroleum hydrocarbons (PHCs), pesticides,

arsenic, uranium, radon, iodine, barium, selenium, methane, etc. The parameters to be tested should be informed by the Phase I (and Phase II, if it exists) Environmental Site Assessment (ESA), nearby sources of contaminants and the geological setting of the site. The need for additional parameters should be discussed at pre-consultation. For subdivisions, the additional parameters will always include trace metals (filtered) and VOCs, as a minimum (see sub-section 4.4.1 below).

Suitable water quality includes all health parameters that were tested. Treatment will not be accepted for raw water that exceeds any health-related drinking water standard.

Suitable water quality also includes aesthetic parameters. Treatment for some aesthetic parameters is acceptable; however, the City complies with the guidance of the MECP to not grant approval where the raw water from the well exceeds the Maximum Concentration Considered Reasonably Treatable for the parameters listed in Table 3 of Procedure D-5-5. These treatability limits are based on what is reasonable for a private homeowner, particularly when treating water for an entire house.

> ***With respect to quantity, each future domestic well must provide sufficient water for normal domestic purposes (see Section 4.3 "Well Water Quantity Testing"). This will be determined mainly on the basis of data from pumping tests in test wells.***
>
> ***After its initial review of a hydrogeological study report, the MOEE may advise the consultant and the proponent that additional information be supplied, or recommend that further work be done. The 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. Ultimately, it is the hydrogeology of the site itself which will determine whether a proposal is acceptable.***
>
> ***When a report is found to be incomplete, draft or preliminary, or makes unsubstantiated claims, the MOEE will advise the proponent of the report's deficiencies. The MOEE may not undertake a full review until such time that a complete report (i.e., one which satisfies the requirements of this Guideline) has been submitted.***

4.2 Test Well Requirements

Site assessment for water supplies from wells must be undertaken as follows:

i) The minimum number of test wells will be:

- ***3 for sites up to 15 hectares in area;***
- ***4 for more than 15 and up to 25 hectares;***
- ***5 for more than 25 and up to 40 hectares;***
- ***for more than 40 hectares, one additional test well for each additional 20 hectares or portion thereof.***

The above are minima, if the hydrogeology is well known, geological conditions are consistent in the area and where there are other supporting data from wells of similar construction and in the same groundwater resource, thus providing the required level of confidence. The consultant will have to provide clear justification for the number of test wells. Prior to constructing any test well, technical pre-consultation with the City, or its Conservation Partners (where applicable), is strongly encouraged.

Where development by severance is considered, determination of the availability of a potable water supply should be made as early as possible in the severance approval process.

Section 4 of the guidelines is to be consulted for lot creation by severance.

In areas where groundwater quantity or quality are considered marginal with respect to domestic requirements, as many as one test well per lot may be required;

ii) The areal distribution of test wells must be such that hydrogeological conditions across the site are adequately represented. Depending on the areal configuration and hydrogeological complexity of the site, more than the minimum number referred to in section i) may be required;

iii) Consideration must be given to past or present land uses. Existing improperly abandoned wells should be identified since they may impact on ground water. Moreover, any contaminant spills on or adjacent to the site which may affect water quantity or quality should be identified and evaluated for their impact on groundwater.

The hydrogeologist's report should include recommendations for the proper abandonment of test wells that are not used for subsequent water supply and any existing water supply wells on the subject site that will not be used for water supply in the future or used and maintained as a monitoring well.

Where there is an imminent risk of impact on groundwater quality or personal safety (e.g., methane gas discharging out of a well or associated with water in the well), the hydrogeologist should immediately advise the appropriate authority (typically the MECP and Ottawa Public Health). Where exceedances of health parameters are detected in an existing water supply well that is used as a source of water for human consumption, the owner of the well having the exceedance must be notified immediately. The notification should be done in writing as well as orally. The oral and written notifications must recommend that the homeowner contact Ottawa Public Health with any question they may have. Any exceedance and notifications of exceedances are to be clearly documented in the consultant's report.

The test well(s) should be located in an area which would permit a proper assessment of these impacts;

iv) Test wells must be located and constructed in such a way as to permit the prediction of the quantity and quality of groundwater which domestic wells will supply in the future. Accordingly, the construction of these wells must be typical of wells which will be used in the development in the future, and must comply with Ontario Regulation 903, with the requirements of other jurisdictions, and with any additional specifications recommended by the consultant and/or MOEE.

Test wells must be constructed in accordance with future domestic well design. If the test wells are not installed according to the recommended domestic well design, then additional test wells will be required. For example, if a test well program finds an issue in

the shallow aquifer and a recommendation is made to construct deeper wells cased through the shallow aquifer, then additional wells will be required to ensure there is a minimum number of representative wells, in accordance with Section 3.2.4.2.i) of these guidelines, completed in the deeper aquifer meeting water quantity and quality requirements.

> ***Existing water wells located on the site or in the immediate proximity of the site may be used as test wells, provided they fulfill i) to iv) above, and are fully incorporated into the well water quantity and quality testing 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 test well, new or existing, located on the site.***

Any existing water supply well that is to be used as a test well must have an MECP water well record and be assessed by the hydrogeologist to verify the well can be used as part of the report. The integrity of the existing water supply well and its record are essential to ensure that comparison is being made based on reliable information.

> ***If the consultant and licensed well contractor properly locate and construct the test wells, or if there are pre-existing wells on the property which meet the requirements of iv) above, the developer may use them later as domestic water wells. They must, however, yield potable water and meet the construction requirements indicated in the approved study recommendations, which are implemented by provisions in the development agreement between the municipality (or its administrative equivalent) 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; abandonment must be recommended in the hydrogeological study report and must be implemented by the development agreement. To ensure that the recommendations of the report are properly implemented, the consultant's report may include recommendations for supervision of well construction by a qualified consultant at the time the well is being constructed by the (licensed) well contractor.***

Dedicated monitoring well

As a condition of approval of a plan of subdivision, the developer will be required to drill and dedicate a monitoring well equipped with water level and barometric dataloggers, to the satisfaction and at no cost to the City. The City will have unlimited access to this well to monitor groundwater conditions. Where the subdivision has several phases, one monitoring well may be required for each phase of development. The City, at its discretion, may determine to not require a monitoring well where there are enough wells already provided to satisfy the City monitoring program.

The dedicated monitoring well will typically be in addition to the required test wells, unless a test well is in a location acceptable to the City, in which case it may be used as the dedicated monitoring well. The location, design and instrumentation of the dedicated monitoring well are to be to the City's satisfaction. The Hydrogeological and Terrain Analysis report is to show the location of the monitoring well on a plan. The preferred location for the dedicated monitoring well is on a parcel owned, or to be owned, by the City. In some cases, the dedicated monitoring well may be located on an easement, provided the City is able to access the well in perpetuity. The well must be drilled in accordance with the recommendations in the report, instrumented and dedicated to the City prior to registration of the subdivision.

> ***4.3 Well Water Quantity Testing***
>
> ***Each of the test wells must be subjected to a pumping test. The tests may be done sequentially, using the other wells as observation wells, or several wells could be pumped simultaneously. The report must contain all well logs, Water Well Records, raw pumping test data and graphs, and hydrogeological cross section(s), and must discuss the sustainability of domestic well yields, the potential for supply interference and site aquifer characteristics such as hydraulic gradient, transmissivity and boundary conditions. (Note that in most cases where on-site sewage systems are proposed, the impact assessment requires a determination of the hydraulic gradients.)***

In certain cases, as will have been discussed at technical pre-consultation, consideration should be given to pumping a test well at the combined water demand rate (if possible)

in order to clearly demonstrate the capacity of the aquifer to supply the anticipated demands, or to assess well interference.

Dataloggers are to be used for all pumping tests. Pumping test reporting must include a detailed discussion regarding the pumping test procedure, including the pumping rate measurement methodology, the location of the discharge and the frequency of manual water level measurements to confirm datalogger accuracy. The report must also include the calculated transmissivity, storage coefficient, specific capacity, well efficiency, sustainable well yield (Q20, where applicable), pumping and recovery water level data, and an assessment of well quantity interference within the development and neighbouring properties.

4.3.1 Pumping Test Procedure

The following pumping test procedure is recommended;

- ***the test wells should be fully developed prior to the pumping test in order to avoid unacceptable turbidity levels at the time of sampling;***

Wells must be developed until the field turbidity is below 5 NTU (or FTU) and the other field parameters have stabilized. This will normally occur during the pumping test. The report must identify if a longer pumping test was required to reduce turbidity, and an analogous recommendation should be included for future development.

Step tests can be completed in order to assess well efficiency. The information gained from the step tests will be useful when designing the pumping test program, particularly where it is anticipated that pumping at higher rates would be useful.

If the water taking during the test will exceeds a prescribed quantity, the MECP should be contacted in advance to ensure the required permits or registrations are in place.

- ***the pumping test must begin with a static water level and must be performed at a fixed rate (±5%) for a minimum period of six hours (longer where supplementary storage systems are necessary) of "continuous" pumping (no stoppages); water levels must be monitored in the test well and***

observation wells at an appropriate frequency; water must be discharged at an appropriate distance from the test wells to ensure that artificial recharge does not occur;

Pressure transducers/dataloggers are to be installed in all test wells and monitoring wells. Water levels measured by the loggers must be periodically confirmed with manual measurements. At least one barologger is to be installed within the development boundary, so that the data can be corrected for atmospheric pressure variations. Loggers are to be installed and monitoring is to be started a minimum of one week prior to starting the pumping tests and must be monitored for at least one week following the test to determine background water levels.

- ***immediately following the pumping test, water level recovery must be monitored in the test wells until 95% recovery occurs or for 24 hours, whichever is less ; where sufficient recovery does not occur, the issue of the long- term safe yield of the aquifer is especially significant and must be addressed; and***

- ***the test rate will be at least the minimum rate discussed below (also see Section 4.4.1).***

4.3.2 Calculation of Minimum Test Rate and Well Yield

The minimum pumping test rate and well yield required for a particular development must be calculated as follows:

The per-person requirement shall be 450 litres per day. Peak demand occurs for a period of 120 minutes each day. This is equivalent to a peak demand rate of 3.75 litres/minute 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 MOEE's satisfaction, a minimum of four bedrooms shall be used in the calculation. However, regardless of the results of this calculation, this rate shall not be less than 13.7 litres/minute.

Step tests are desirable in order to derive the maximum pumping rate that will be sustainable for the duration of the test. As a minimum, each test well is to be pumped at a sufficient rate and length of pumping in order to generate drawdown in the observation wells.

In all cases, unless explicitly stated by the City for a development, the minimum pumping rate shall be based on a 4-bedroom dwelling unit (i.e., 18.75 L/min).

> ***The only instance where rates lower than these may be used is where preliminary results indicate that the pumping 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 rate of test pumping may be decreased, but the duration must be proportionately increased such that the total amount pumped equals the amount that would have been pumped if the test had been conducted using the procedures and minima discussed above. The yield requirement must then be applied to the well and to the compensatory system on a daily basis. These systems and any special water treatment devices that may be necessary for their proper functioning must be fully described in the report.***

A compensatory system may include a larger pressure tank or separate storage (e.g., a cistern) in conjunction with the pressure tank. It is recommended that the storage system be sized to compensate for peak use, irrigation (if contemplated) and emergency storage to allow for repair of a failed pump. Wherever compensatory storage is proposed there shall be mandatory consultation by the proponent's hydrogeologist with the review hydrogeologist and the City.

> ***Regardless of whether systems to compensate for low yields are required, the report must demonstrate that future domestic wells will sustain repeated pumping at the test rate and duration at 24-hour intervals over the long-term.***
>
> ***Where a test well can safely provide water at the calculated rate, it is not acceptable to conduct pumping tests at low rates and subsequently recommend the use of systems to compensate for low well yields simply in order to limit the migration of poorer quality water into the well.***

Consultants must provide a statement indicating that, in their opinion, the probable well yields determined on the basis of their investigations are representative of the yields which residents of the development are likely to obtain from their wells in the long term.

Aquifer tests using data from observation wells typically provide better aquifer characteristics than data from the pumping well; furthermore, observation wells are necessary in order to obtain storativity values. For these reasons, aquifer responses in a minimum of two other wells serving as observation wells will be required for all subdivisions and may also be required for other development applications, particularly when large water takings are anticipated; or in instances where well interference may be an issue. Any deviation from this requirement should be discussed with the reviewer at pre-consultation or during the study.

The other test wells may serve as observation wells, provided a suitable response is seen in the observation wells in a relatively short time during the pumping test. It is also necessary to monitor all other test wells (in addition to the two wells used as observation wells) during the pumping test on any test well. The distance between the test well and the observation wells should be considered by the hydrogeologist when designing the test program.

The observation wells are to be completed at approximately the same depth and within the same aquifer as the pumping well.

Note that if a case is being made for aquifer isolation, there may be a need to install additional monitoring wells, at various depths, in order to confirm the characteristics and extent of the isolating layer(s).

Aquifer characteristics should be derived from the observation wells whenever possible. In the report, the hydrogeologist shall compare the transmissivities calculated from pumping wells and observation wells. If the transmissivities are not comparable, a rationale must be provided as to why the results are different. For the design of pumping test wells and monitoring wells, and the analysis of data, the hydrogeologist should be guided by recognized scientific literature[1].

[1] Such as Kruseman and de Ridder (1990) and resources by the USGS—available online, or other recognized sources.

The hydrogeology of the City is complex and there are locations where the response to pumping will not fit a theoretical Theis solution[2]. In these cases, other analytical solutions are to be investigated by the hydrogeologist (semi-confined, leaky, phreatic, boundary and/or recharge effects, etc.). With aquifer analysis software these investigations are greatly simplified. Input parameters are however to be explained and justified (e.g., leakage factor reasonableness, where applicable). All analyses are to be related to the conceptual understanding of the aquifer(s) and aquitard(s) (where present) at the site. Although the use of software aids in the analysis, the report is to present the analysis of the data in a manner that is consistent with traditional methods, so that the information can be verified (i.e., standard graphs, type curves, etc.). The raw data (pumping rate measurements, drawdown, recovery, atmospheric pressure, etc.) is also to be included.

The data from pumping wells, observation wells and their recovery are to be analyzed and a single set of aquifer properties is to be justified and reported for the target aquifer and any other hydrogeological unit of interest. If the data varies greatly, then a rationalization for this variability must be provided.

4.3.3 Additional Information

Shallow wells and unconfined aquifers are susceptible to seasonal fluctuations in water level. In these cases, the consultant must address this issue and may need to perform additional investigations to determine the possibility of future well water quantity problems.

Groundwater heat pumps which do not return water to the aquifer of origin are not permitted. If treatment systems which require additional amounts of water for their operation are to be used, those rates must be added.

[2] Theis Assumptions: Aquifer has infinite areal extent, aquifer is homogeneous and of uniform thickness, control well is fully or partially penetrating, flow to control well is horizontal when control well is fully penetrating, aquifer is nonleaky confined, flow is unsteady, water is released instantaneously from storage with decline of hydraulic head, diameter of a pumping well is very small so that storage in the well can be neglected (Theis, C.V., 1935).

If a proponent proposes to use open loop groundwater ground source heat pumps, the hydrogeologist shall address the taking and discharge of the system in the report to ensure protection, management and conservation of the groundwater.

If the hydrogeologist will be suggesting water softeners or other water treatment units that require backwash, the hydrogeologist shall address where the backwash will be discharged.

The report must address the potential for Secondary Dwelling Units and whether they should be permitted and on what basis. Additional nitrate loading and water taking must be assesses and documented if Secondary Dwelling Units are contemplated in the future.

A monitoring program to establish a baseline of private well groundwater quality and water levels will be required for serviced developments in the vicinity of privately serviced lots. The distance within which wells must be sampled may but up to 500 m, particularly if blasting will be required.

> ***Consultants should address the issue of whether the groundwater withdrawals in the proposed development and in other existing or planned developments in the area will exceed the long-term safe yield of the aquifer, or significantly decrease baseflow to sensitive water courses (trout streams, etc.). Relevant information may be available from the local planning authority, other ministries and agencies, municipal offices, and local residents.***

Methods, such as the Q20 concept, where applicable (such as sites where a single pumping well is proposed), can be used by the hydrogeologist to assess the long-term interference effects from single proposed pumping wells. The effect of the combined well field must also be addressed for the worst-case scenario/location within the subject site and at the closest off-site well. In addition to long-term effects, it may be necessary to assess the effects of single and combined short-term peak flow, depending on the particular circumstances.

> ***Where there is established development in the vicinity, information from residents and other sources regarding well yield problems (water shortages, replacement wells etc.) should be obtained.***

4.4 Well Water Quality Testing

4.4.1 Raw Water Quality

The consultant must obtain and analyze sufficient water quality samples during each pumping test in order to determine the physical, chemical and bacteriological quality of the water. At least one of these samples must be collected during the last hour of the test. It is the consultant's responsibility to address water quality changes over time and to demonstrate that the water quality data are representative of the quality of water which future residents can expect in the long term.

The collection of groundwater samples must be in accordance with sampling and preservation protocols undertaken to current industry standards (e.g., ASTM, CSA, etc.).

Sampling must be carried out using methods consistent with up-to-date practices such as those identified by the Canadian Council of Ministers of the Environment, the United States Geological Survey National Field Manual, Puls and Barcelona, 1996 (low flow, for certain types of sampling) or other published and peer-reviewed practices. The water samples shall be submitted using proper quality assurance practices to a laboratory that holds a licence under the Safe Drinking Water Act.

Parameters that must be tested in the field include colour, pH, temperature, conductivity, turbidity, hydrogen sulphide (using the Methylene Blue method) and chlorine residual, and should be carried out following current methods. Manufacturers, model numbers and calibration records for the field equipment must be presented in the report.

If water samples are collected from neighbouring wells, then details regarding the well must also be included in the report. The details must include a well record, well depth, construction details, sampling location and the results of a visual inspection of the sampled well.

Prior to any testing for water quality, there must be no chlorine residual. Chlorine residual tests must be performed at the well head at the time that bacteriological samples are obtained, and must be reported.

This requirement assumes that the well and the well drilling and testing equipment have been chlorinated prior to testing. Free residual chlorine levels must be reported, even if zero.

Where there are wells in nearby established developments, information should 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 (see Section 4.5) 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 address the risk of contamination and recommend measures which will reduce that risk.

The minimum set of parameters for which the analyses must be performed is listed in the Appendix, along with the applicable Ontario Drinking Water Objectives. Other parameters, such as heavy metals, pesticides, tannins, sulphide, phenols, and fluoride, may be required by the Regional MOEE office in your area. Please contact the office for more information. The consultant must also determine whether conditions specific to the site or its surrounding area require the inclusion of additional parameters. Complete documentation of sampling times, any on-site analytical methods, and all analytical results must also be included in the report.

All water samples are to be tested for what is locally known as the "Subdivision Package" suite of parameters, which is an expansion (HPC, F, H_2S, phenols, Tannin and Lignin, TKN, Ion Balance and K) to the list of parameters in the Appendix below. In addition, there may be site-specific parameters that the hydrogeologist will recommend, based on the Environmental Site Assessment, local setting or past/present adjacent land use. Representative sampling for trace metals (see definition) and VOCs will be required for subdivisions and may be required for other application types depending on water taking and proposed use for the drinking water. Requirements for additional water quality sampling should be discussed at the pre-consultation meeting.

If methane or other potentially explosive gases are encountered during the water supply assessment, the consultant must make recommendations to adequately control this hazard.

Note: Where health-related ODWOs or treatment limits for aesthetic ODWOs 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 boundary of the site is required.

4.4.2 Treatment Systems

For some aesthetic parameters, the ODWOs may be exceeded provided that concentrations are below the treatment limits noted in Table 3. 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 should be addressed to people on sodium restricted diets and should be registered on title. In addition, if water softening is utilized to reduce hardness, a warning should be registered on the title with a recommendation that a separate tap, which by-passes the softener, be installed to supply un-softened drinking water.

If the raw water from the wells exhibits values for aesthetic parameters that are above the ODWOs but below the treatment limits, or if supplemental storage systems are proposed which require special treatment systems, the municipality's assent to development based on treatment systems must be obtained in the

form of a Resolution of Council, prior to the MOEE recommending draft approval (see Section 5.0 Implementation).

If treatment is required, "Comments on Treatment" listed in Table 3 of the Appendix are provided for the purpose of assisting applicants and municipalities in deciding whether development based on treatment systems should proceed. Prior to the municipality considering approval of the development proposal and/or Official Plan Amendment, it is the applicant's responsibility, based on advice from a qualified consultant, to satisfy the municipality that the concept of using treatment systems is appropriate. MOEE staff will not comment on the acceptability of the various proprietary treatment systems available.

The treatment systems mentioned in Table 3 of the Appendix are suggested for treatment for single parameters. 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.

4.5 Well Construction

Construction specifications for future domestic wells in the proposed development must be addressed by the consultant in the hydrogeological report. Minimally, the construction of both the test wells and future domestic wells must comply with Ontario Regulation 903 made under the Ontario Water Resources Act, and with municipal requirements - where applicable.

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.

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. Due to the risks associated with large numbers of sewage systems discharging effluent into the shallow subsurface and the high density of wells, the City will not approve subdivisions that use dug or driven-point wells.

The hydrogeologist should work with the owner's planner and civil engineer to produce the private servicing plan (see Section 3.3). Wells and sewage systems need to be incorporated at an early stage in the site design, thereby optimizing site resources for water supply and sewage treatment. Stormwater management should also be taken into consideration when siting the wells and sewage systems.

The Hydrogeological and Terrain Analysis report will have a section with a clear set of technical recommendations. Well locations and construction recommendations, along with other recommendations in the report, will be included as requirements in the Draft Conditions and Subdivision Agreement. It is expected that City staff will incorporate these recommendations, with appropriate wording by the City, into the Draft Approval Conditions and Subdivision Agreement.

> ***Water quality may vary between aquifers or with depth in the same aquifer. The consultant should recommend appropriate well construction, methods and requirements, and must comment on the potential for cross-contamination between aquifers.***
>
> ***The consultant or the MOEE 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 this Guideline, in order for the data to be deemed representative.***
>
> ***Subsections 13(2) and 13(3) of Ontario Regulation 903 require that wells be constructed such that the casing of a drilled well protrudes at least 30 centimetres*** **[now 40 cm]** ***above ground surface or above the floor of a well pit. Well water contamination***

caused by the entry at the well head of water originating at or near the surface may occur if the well head is buried. Subsection 20(3) requires that the well owner maintain the well in a manner sufficient to prevent such contamination. Where well heads are buried, locating, inspecting and servicing the well are difficult and expensive.

Subsections 13(2), 13(3) and 20(3) are often contravened when, after a well is constructed, contractors or residents bury the well head for reasons of convenience or aesthetics. Contractors and residents should be reminded of the intent and requirements of these portions of the Regulation, and of their responsibility to ensure that the finished grade of the ground surface allows the casing to protrude the required distance. This is necessary to prevent ponding at the well head or, in the case of well pits, prevents flooding of the pit. Where flowing well conditions occur, the requirements of Regulation 903 must be met.

All new wells must be supported by a satisfactory well inspection report in conjunction with the building permit and inspection process.

4.6 Land and Water Use Conflicts

Land uses within a minimum of 500 m of the site must be described. Where wells exist on or adjacent to the site, a survey of well owners, and sampling and analysis of representative well water, should be performed and reported. The potential for an adverse impact on the development must be addressed, when there have been, are, or may in the foreseeable future be significant potential sources of groundwater contamination (e.g., from old, operating or proposed waste disposal sites, road salt storage facilities, farming activities, locations of contaminant spills, etc.), or potential causes of quantity interference with groundwater resources or well water supplies (e.g., from municipal wells, dewatering activities, etc.) within a minimum of 500 metres of the site. The issue of whether additional water quality parameters should be included in the testing must also be addressed.

4.7 Phased Developments

Where a development application relates to an additional phase of a phased development, even though previous phases may already have been approved on the basis of previous hydrogeological studies which encompassed those phases or the entire site, a supplementary study and report is required. Water samples from wells that are located on nearby developed lots in previous phases that are in use and representative of the same formation, must be analyzed for the required parameters, and the well owners should be interviewed (where possible) regarding their experience with their well water quantity and quality. This information, as well as the Water Well Records and a map showing the locations of all wells in previous phases, must be provided. The original hydrogeological report must be re-assessed in light of the new information obtained and according to any new criteria or guidelines which may not have been in effect at the time of the original study. Where well water quality or well yield in the previous phases are not comparable to that found in the original test wells or predicted by the original hydrogeological study, the new study should investigate and explain the causes and provide new recommendations based on a re-assessment of the original report. Where new guidelines require information which is not included in the original report, the new report must provide it.

Prior to proceeding to the next phase of a subdivision that has been draft approved in phases, a servicing review study shall be prepared. The servicing review study will include all the well records for the wells drilled in previous phases (the City can provide all available well inspection reports and the associated water well records). The servicing review study will also include the results for the sampling and water quality testing of at least 20% of the wells in the previous phase, provided the wells are evenly distributed and representative. All original test wells, if still in place, located in the new phase must also be sampled, and the results compared with the original sampling program. The parameters to be tested will be the “Subdivision Package” suite of parameters, plus any parameter of concern identified in the approved Hydrogeological and Terrain Analysis report. Water levels in the test wells for the previous and current phases are to be measured and reported.

The purpose of the phasing review is not to assess the long-term performance of the wells and sewage systems (as potential issues could take years or decades to arise), rather the purpose is to verify the results of the original report and confirm the validity of the original recommendations.

If the new phase does not contain test wells from the original study, new ones must be installed. Where additional study involving new test wells is necessary, most or all of the criteria set forth in this Guideline will apply. Professionals should discuss these issues with MOEE staff before proceeding.

5.0 IMPLEMENTATION

MOEE staff will implement this guideline through comments and advice supplied to municipalities, the public, and approval authorities on documents circulated under the Planning Act.

City staff, or their designate, will be implementing these guidelines and reviewing the reports prepared in support of land development.

It should be noted that the MOEE will not recommend approval for official plan amendments and draft plans of subdivision or condominium unless the MOEE (or its agents) is satisfied that the hydrogeological report demonstrates that sufficient water is available. Where groundwater of adequate quality and quantity is demonstrated to be available to service the proposed development, the MOEE will require, as a condition of final approval, that the MOEE receive a copy of a fully executed subdivision or condominium agreement or other suitable development agreement between the municipality and the developer, which requires that the recommendations of the hydrogeological report as approved by the MOEE (or its agents) be implemented. The municipality should ensure that MOEE comments have been adequately addressed within the fully executed agreement.

The recommendations of the report will be incorporated in the conditions of approval.

If groundwater open loop heat pumps are being considered for use in the proposed development, they must be included in the hydrogeological study to ensure that domestic potable water supplies will not be adversely impacted. If the issue of groundwater heat pumps is not addressed in the report, MOEE 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.

Open loop groundwater heat pumps are not permitted unless addressed in detail in the Hydrogeological and Terrain Analysis report. The report shall have a statement regarding open loop heat pumps, whether they are or are not permitted.

The possibility of using systems to compensate for low well yields (for example, controlled pumping to supplementary storage) is discussed earlier in this Guideline. However, while the MOEE may provide technical guidance, it is the municipality's responsibility to decide whether development on the basis of such systems should be allowed. If the municipality agrees to their use, notification must be given through the development agreement between the municipality and the proponent(s). The municipality shares responsibility with the proponent(s) for ensuring that the terms of the development agreement are completed.

With respect to water quality, the following will apply (except for the 20 mg/L warning level for sodium):

Where health and aesthetic ODWO criteria are met, MOEE will comment favourably on approval of the Official Plan Amendment or on draft approval of the Plan of Subdivision or Condominium.

Where health-related ODWO criteria are not met, MOEE will recommend against approval of the proposal on the basis of individual wells.

Where health-related ODWO criteria are met but aesthetic objectives are exceeded, it may be possible to use in-home water treatment systems to reduce the values of the aesthetic

parameter(s) concentrations to a level below the limits, and thereby meet the objectives.

This guideline lists concentrations considered treatable for several aesthetic parameters and some possible treatment systems (see Table 3 of the Appendix). However, it is the municipality's responsibility to decide whether development on the basis of in-home treatment systems should be permitted. Following MOEE's review of a study which includes recommendations for such treatment, MOEE will notify the municipality (or its equivalent), the proponent, and the consultant that the MOEE will only recommend draft approval following receipt of a Resolution of Council. The Resolution must advise that the municipality concurs with development based on use of these systems. The development agreement between the municipality and the proponent shall contain provisions for implementation of the recommendations, including treatment, in the approved hydrogeology study. The municipality shares responsibility with the proponent for ensuring that the terms of the development agreement are carried out.

The City will allow treatment of aesthetic parameters that are below the Maximum Concentration Considered Reasonably Treatable (MCCRT) in Table 3 without a resolution of Council. For health-related parameters with an exceedance, or in the case of an exceedance, for residential use, of the MCCRT for aesthetic parameters, the City will not grant approval based on treatment.

For commercial and industrial uses, it is expected that every effort will be made to find a source of groundwater water meeting the MCCRT parameters; however, in cases where these aesthetic parameters exceed the limits, the proponent is to discuss the results with the review hydrogeologist and the City planner. In certain cases (e.g., where the Official Plan and Zoning By-Law are already in place for the proposed use), approval may occur, on a site-specific basis, provided the health-related parameters do not exceed the limits.

Where health objectives are exceeded or where treatment limits for aesthetic objectives are exceeded, the local municipality and the approving authority should only consider development on the

basis of a communal water system. MOEE approvals are required for Water Works for municipal and communal systems, as defined under the Ontario Water Resources Act and set out in MOEE Guideline B-14, Treatment Requirements for Municipal and Communal Water Works Using Groundwater Sources. The municipality shall assume ownership of and responsibility for the water works following completion.

6.0 DEFINITION

Individual wells:

Private water wells supplying five or fewer residences (or the equivalent for other types of development) are referred to in this guideline as "individual wells".

7.0 REFERENCE DOCUMENTS

Other documents that should be used in conjunction with this Guideline include:

- ***The Provincial Policy Statement, Ministry of Municipal Affairs & Housing;***
- ***"Technical Guideline for Individual On-Site Systems: Water Quality Impact Risk Assessment", MOEE.***
- ***"Water Management - Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy", MOEE Guideline B-1-1 (July 1994).***
- ***Ontario Water Resources Act, RSO 1990.***

- ***"Water Wells & Ground Water Supplies in Ontario", MOEE 1989.***
- ***Regulation 903, made under the Ontario Water Resources Act.***
- ***"Levels of Treatment for Municipal and Private Sewage Treatment Work Discharging to Surface Waters", MOEE Guideline F-5.***
- ***"Treatment Requirements for Municipal and Communal Water Works Using Groundwater Sources", MOEE Guideline B-14.***

- Implementation Guideline to Policy Statement B7, "Planning for Sewage and Water Services", Ontario Ministry of Environment and Energy (MOEE);
- Maathuis, H. and G. van der Kamp, 2006. The Q20 Concept: Sustainable Well Yield and Sustainable Aquifer Yield. Saskatchewan Research Council Publication No. 10417-4E09. Available at https://www.wsask.ca/
- Kruseman, G.P. and N.A. de Ridder (1990) Analysis and Evaluation of Pumping Test Data; 2nd edition, International Institute for Land Reclamation and Improvement (ILRI), Wageningen, ISBN 90-70754-20-7.
- Puls, R.W. and M.J. Barcelona, 1996, GROUNDWATER ISSUE PAPER: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures; U.S. Environmental Protection Agency, EPA/540/S-95/504, 12 pp.
- Canadian Council of Ministers of the Environment (CCME). Guidance Manual on Sampling, Analysis and Data Management, Volume 1: Main Report PN 1101 and Volume 2: Analytical Summaries PN 1103.1993.
- http://www.ccme.ca/files/Resources/csm/pn_1101_e.pdf
- http://www.ccme.ca/files/Resources/csm/pn_1103_e.pdf
- USGS Field Manual for Collecting Water-Quality
- Datahttps://water.usgs.gov/owq/FieldManual/

APPENDIX

GROUNDWATER QUALITY PARAMETER TABLES

Published documents have been the main source of information regarding the water quality limits appearing in the tables below. Additional parameters may be required by the Regional MOEE office in your area. Also, when new water quality limits are formally instituted by the relevant authority, this guideline 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 AND REPORTED. It is, therefore, highly recommended that consultants maintain regular contact with the MOEE.

TABLE 1: HEALTH-RELATED BACTERIOLOGICAL PARAMETERS

Parameter	***Ontario Drinking Water Objective (See Note 1)***	***Comments***
Escherichia coli	***0***	***Indicators of contamination*** Fecal coliforms are no longer part of the Drinking Water Standards, and should not be tested.
~~***Fecal coliforms***~~	~~***0***~~	
Total coliforms	***0***	***Indicator of possible or potential contamination***

Note 1: These are expressed as the plate count per 100 ml of sample. Every bacteriological sample must be submitted for analyses for all the above and the 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, etc.

While the stated ODWO for Total Coliform is 0 counts per 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 private water wells not subject to approval under the OWRA, the MOEE and Health

Units have historically used the limit of <5 counts per 100 ml in the absence of a chlorine residual as indicating acceptable water quality. For the purposes of the assessment described by this Guideline, Total Coliform counts of less than 6 per 100 ml of sample (and 0 for E. coli and fecal coliforms) shall be considered as indicative of acceptable water quality.

The chlorine residual must be zero before any bacteriological sample can be taken.

TABLE 2: HEALTH -RELATED CHEMICAL AND PHYSICAL PARAMETERS

Parameter	*Ontario Drinking Water Objective (See Note 2)*	*Comments*
Nitrate (as N)	*10.0 mg/L*	*contamination indicator; exceedence may be dangerous to infants and others*
Nitrite (as N)	*1.0 mg/L*	*contamination indicator*
Sodium	*20 mg/L* *(see note 3)*	*levels may be significant for persons with medical conditions requiring low-salt diets*
Turbidity	*1 NTU or 1 FTU (see note 4)*	*Could indicate problems in well construction or a naturally occurring problem; may interfere with water treatment*
Other parameters	*(see note 5)*	

2. *Except for sodium, the Ontario Drinking Water Objective for parameters in Table 2 are Maximum Acceptable Concentrations under the Ontario Drinking Water Objectives. Units of measure and, where required, conversion factors must be provided. For more information on the Objectives, refer to the MOEE publication entitled "Ontario Drinking Water Objectives".*

3. *This health-related limit is a "warning level" only. Exceedence calls for a recommendation that the local Medical Officer of Health be notified in order to alert persons with relevant medical conditions. Sodium also has an Aesthetic Objective of 200 mg/L (see Table 3). If water softening is used, a separate tap supplying unsoftened water should be used for drinking purposes.*

4. NTU = Nephelometric turbidity unit; FTU = Formazin turbidity unit. These terms are interchangeable. NTU is the term used in the ODWOs. For the purposes of this guideline, the consultant must note that if turbidity is present, particular care must be taken during testing to ensure that the bacteria requirements of Table 1 are met.

5. See also section 5.5.1: "Raw Water Quality", above, regarding the responsibilities of the proponent or consultant to add parameters where necessary; the consultant must also provide the relevant information on any drinking water quality limits, including those from other jurisdictions.

TABLE 3: COMMON AESTHETIC, ANALYTICAL AND INDICATOR PARAMETERS

Parameter	*General Comments*	*Ontario Drinking Water Objectives (see note 6)*	*Maximum Concentration Considered Reasonably Treatable*	*Comments on Treatment*
Alkalinity	*useful analytical parameter*	*-*	*-*	*-*
Ammonia	*contamination indicators*	*-*	*-*	*-*
Background Bacteria				
Calcium	*see Hardness*	*-*	*-*	*-*
Chloride	*associated with salt problems*	*250 mg/L*	*250 mg/L*	*not considered reasonably treatable above the limit*
Colour	*associated with certain metals and organic substances*	*5 TCU (True Colour Units)*	*7 TCU*	*carbon filter treatment systems (see note 7)*
Conductivity	*useful analytical parameter*	*-*	*-*	*-*
Dissolved Organic Carbon	*taste , odour, colour, turbidity, precursor for harmful contaminants after chlorination*	*5.0 mg/L (as C)*	*10.0 mg/L (as C)*	*carbon filter treatment systems*

Parameter	*General Comments*	*Ontario Drinking Water Objectives (see note 6)*	*Maximum Concentration Considered Reasonably Treatable*	*Comments on Treatment*
Hardness	*taste, encrustation and reaction with soap*	*500 mg/L as $CaCO_3$ (see note 7)*	*-*	*water softener (see note 8)*
Iron	*may cause staining of plumbing fixtures and laundry*	*0.3 mg/L*	*up to 5.0 mg/L*	*water softeners or manganese greens and filters*
			5.0 to 10.0 mg/L	*oxidation with filtration through proprietary filter media or chlorination followed by sand or multimedia filtration*
Magnesium	*see Hardness*	*-*	*-*	*-*
Manganese	*may cause staining of plumbing fixtures and laundry*	*0.05 mg/L*	*1.0 mg/L*	*water softeners or manganese green sand filters*

Parameter	*General Comments*	*Ontario Drinking Water Objectives (see note 6)*	*Maximum Concentration Considered Reasonably Treatable*	*Comments on Treatment*
pH	*associated with corrosion or encrustation or contamination by other substances*	*6.5 - 8.5*	*-*	*-*
Sodium	*taste*	*200 mg/L (see note 9)*	*200 mg/L*	*not considered reasonably treatable above the limit*
Sulphate	*laxative*	*500 mg/L*	*500 mg/L*	*not considered reasonably treatable above the limit*
TDS (Total Dissolved Solids)	*corrosion or encrustation of metal fixtures or appliances; taste; must be measured independently of Conductivity; turbidity*	*500 mg/L*	*-*	*requires written rationale that corrosion, encrustation or taste problems will not occur*

Parameter	*General Comments*	*Ontario Drinking Water Objectives (see note 6)*	*Maximum Concentration Considered Reasonably Treatable*	*Comments on Treatment*
Turbidity	*5 NTU or 5 FTU (see Note 10)*	*5 NTU or 5 FTU*	*5 NTU or 5 FTU*	*-*
Other parameters	*(see note 11)*	*-*	*-*	*-*

6. Except for hardness, the drinking water quality limits in Table 3 are Aesthetic Objectives under the Ontario Drinking Water Objectives. Units of measure and, where required, conversion factors must be provided. For more information on the Objectives, refer to the MOEE publication entitled "Ontario Drinking Water Objectives".

7. Higher, iron-related colour may be removed by manganese greensand treatment; however, the nature of the constituents causing excessive colour must be determined. See section 4.4.2: "Treatment Systems", above.

8. 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 Objectives", states that waters with hardness" in excess of 500 mg/l are unacceptable for most domestic purposes". A maximum treatable value is not available.

9. Sodium also has a health-related "warning level" of 20 mg/l (see Table 2). Since water softening results in high sodium levels, a separate tap, which supplies unsoftened water, should be installed for drinking purposes.

10. For the purposes of this guideline, the consultant must note that if turbidity is present, particular care must be taken during testing to ensure that the bacteria requirements of Table 1 are met.

11. See also section 4.4.1: "Raw Water Quality", above, regarding the responsibilities of the proponent or consultant to add parameters where

necessary; the consultant must also provide the relevant information on any water quality limits, including those from other jurisdictions.

3.3 Terrain Analysis

The overburden geology of the development site is to be characterized throughout. The field methods used to characterize the overburden will vary from site to site but will typically involve digging test pits and putting down boreholes. For some sites it may be beneficial to put down a series of hand auger holes to supplement the test pit program in order to fill in gaps. In most cases, boreholes will also have to be put down through the overburden so that the full depth of the overburden is logged and in order to install monitoring wells for the determination of groundwater flow gradients and background nitrate concentrations.

The overburden is to be characterized through a test pit and borehole program, including grain-size distributions (sieve and hydrometer tests). The depths of the exploratory holes are to be based on the geological setting and the type of analyses to be performed. The soil is to be described using the Unified Soil Classification system, unless otherwise indicated. The description must consider deposition (till, marine, fluvial, etc.), texture (boulders, cobbles, gravel, sand, silt, clay, organic), structure (stratified. fissured, lensed, friable, platy, massive, prismatic, blocky, granular), consistency (very soft, soft, medium, stiff, very stiff, hard), plasticity (liquid limit, plastic limit, plasticity index), colour (incl. mottling), stratification, density and odour, Soil moisture conditions are also to be provided in direct reference to observation depths.

All test pits, boreholes and auger hole logs are to include the above information and be appended to the Hydrogeological and Terrain Analysis report. A geodetic (i.e. metres above sea level) survey is to be completed of the ground surface and measuring points at each test location/installation. The geodetic survey benchmark is to be provided, with corresponding metadata.

Based on the test pits, hand auger holes, boreholes and the test wells, a terrain unit map must be prepared. A terrain unit is an area with a distinctive geological setting, typically based on soil type and water table considerations, but may also include areas with other similar characteristics (e.g., similar depth to bedrock). In the body of the report, a general servicing scenario is to be outlined for each terrain unit. The depths of the terrain unit materials are to be discussed in the report, as well as the implication for infiltration.

Using the terrain unit map and the topography as guides, a private Servicing plan is to be prepared. The private servicing plan will show a well, a sewage system envelope and a house on each lot. Although the exact location of these components will be determined

at the building permit stage, the private servicing plan will demonstrate the preferred, and sometimes the necessary layout, based on the factors encountered during the study. Wells are to be located upgradient from sewage systems as much as possible. The envelope for the sewage system is to be based on a conventional absorption trench leaching bed (i.e. not a shallow buried trench system or other small systems) with a minimum design flow of 2,000 L/d. For raised beds the sewage system envelope is to include the side slopes and if an imported mantle will be required the sewage system envelope is to include the mantle as well.

The private servicing plan and the terrain analysis section of the report will be consulted later by the Ottawa Septic System Office (OSSO) as part of the process for the issuance of the sewage system permit.

In addition to the above, other information forming part of the terrain analysis component is summarized as follows:

- Airphoto(s) of the site
- LiDAR map or other City topographic mapping
- Post-development preliminary grading plan (where available)
- Surficial geology mapping
- Regional drift thickness mapping (such as from ARIP 191 or OGS)
- Source protection SGRA and HVA mapping
- Karst mapping
- Grain-size distributions
- Test pit and borehole logs
    - Photos of test pits and sediments
- Geodetic survey information

4.0 SEVERANCES

4.1 Statement of Principles

This section applies to residential commercial, industrial and institutional severances. As a general principle, the City will only support the creation of new properties on private services where these services are sustainable in the long-term. The threshold for the adequacy of well water quality and quantity is found in the MECP Procedure D-5-5 and the allowable impact from the sewage system on existing wells in the vicinity of the subject land is set out in Procedure D-5-4. The specific procedure for severances (see below) outlines the scoped application of the MECP guidelines for severances.

As with all planning applications, before filing an application for a consent to sever, applicants should contact a City planner to discuss the severance proposal. The discussion should include technical pre-screening for private servicing. Where a severance is proposed in an area of known issues, City staff may recommend that a hydrogeological report be prepared in advance of filing an application or scheduling a Committee of Adjustment meeting. This is to alleviate unnecessary costs for applicants, and to give more time to resolve issues. A hydrogeological report is required prior to lot creation for all severance applications where a building lot is created.

4.2 Procedure

4.2.1 Test Well(s)

At least one well must be tested in accordance with the methodology outlined in Section 3.2. The test well will typically be a new drilled well in support of the severance; however, testing an existing well may be permitted under certain conditions. As a minimum, the following circumstances must be present for any existing well used as a test well:

i) The MECP water well record is available.

ii) The existing well is either on one of the proposed new parcels (i.e., severed or retained) or close enough to the subject land as to offer a reasonable expectation that the hydrogeological conditions at the test well location will be the same as the conditions on the subject land.

iii) The construction of the existing well is representative of what is being proposed for the well(s) to be constructed on the subject land. Support for the representative nature of the well must be provided, including a review of the local geology.

The above circumstances are to be to the satisfaction of the City.

In accordance with Section 4.2 of MECP Procedure D-5-5, where groundwater quantity or quality are considered marginal, as many as one test well per lot may be required. Severances will normally not be approved based on dug wells, unless it can be demonstrated, to the satisfaction of the City, that a drilled well is likely to produce unacceptable water quantity or quality. Technical pre-consultation is mandatory if dug wells are contemplated. If a severance is being proposed based on a dug well, the dug well must be completed in an aquifer. Wells in aquitard materials, such as clay, silty clay, or low permeability tills, will not be accepted.

4.2.2 Water Quantity and Quality

The yield of the well and the quality of the raw water are to conform to the provisions of Section 3.2. The Subdivision Package suite of parameters will be required. Other parameters may be required, based on land use and/or geological setting. The anticipated demands (average day, maximum day and peak hour) for commercial/industrial/institutional severances are to be presented and justified.

4.2.3 Impact Risk Assessment

An impact risk assessment is to be prepared in accordance with Section 3.1. The predicted impact is to be calculated for each lot (severed and retained). For severances, the assessment of background nitrate concentration will typically not require the installation of monitoring wells and multi-season data. In most cases, the test well sampling results can be used to assess the absence of undue surface impacts. In cases where the consultant or reviewer is aware of surface impacts, additional information may be required to support the impact risk assessment.

In cases where a system isolation approach is being proposed, pre-consultation must take place.

5.0 SITE PLANS

5.1 Statement of Principles

The Site Plan Control application is typically the last stage in the planning process, and typically applies to non-residential developments. The viability and sustainability aspects of private servicing should have been addressed at earlier stages of development—typically as part of a Subdivision, Zoning By-Law Amendment or Severance. The actual water supply is established as part of the application for Site Plan Approval and the design of the sewage system is finalized. The production well(s) must therefore be drilled and tested prior to the issuance of Site Plan Approval and a hydrogeological report must accompany the application. A well inspection report (see definition) is to be provided.

The sewage system design must be submitted with the application. If the design flow is 10,000 L/d or less, the permit from the Ottawa Septic System Office must be issued prior to Site Plan Approval being granted. If the design flow exceeds 10,000 L/d, a Reasonable Use Assessment must accompany the application to the City. Sewage systems with design flows exceeding 10,000 L/d require the issuance of an Environmental Compliance Approval (ECA) from the MECP prior to Site Plan Approval being granted. Although the approval of the sewage system will be issued by the MECP, the City will also be reviewing the Reasonable Use Assessment and the design details, as these pertain to other elements of the Site Plan.

5.2 Procedure

5.2.1 Technical Pre-Consultation

Site Plan are different from other types of planning application, as they include the establishing of the water supply that will be used at the site. In order to avoid having to relocate and abandon wells, technical pre-consultation with the review hydrogeologist should be considered mandatory for all Site Plans.

5.2.2 Location of Well(s)

The well(s) must be located at least 3 metres from property lines, buildings and parking lots, and in a landscaped area with drainage away from the well. Wells must be located a minimum of 15 metres from a sewer line and typically 15 metres from a stormwater

management pond or other potential sources of contamination. The elevation of the top of casing and the ground at and around the well must be shown on the grading plan. The well must be protected from vehicular traffic and not be in a snow storage area. The well must be accessible in the future by a drilling rig.

5.2.3 Type of well

Site Plans will normally not be approved based on dug wells, unless it can be demonstrated, to the satisfaction of the City, that a drilled well is likely to produce unacceptable water quantity or quality. Technical pre-consultation is mandatory if dug wells are contemplated. If a Site Plan is being proposed based on dug wells, these must be completed in an aquifer. Wells in aquitard materials, such as clay, silty clay, or low permeability tills, will not be accepted.

5.2.4 Water Quantity and Quality

The test procedure is to follow the provisions in Section 3.1, with the following modifications:

i) The well(s) must be pumped at a rate at least equal or greater than the proposed maximum day water demand; however, in some cases the well(s) may have to be pumped at the hourly peak demand (or other acceptable increment)—for example, when the aquifer yield is low and neighbouring wells are near. Methods, such as the Q20 concept by Maathuis and van der Kamp (2006), can be used to assess the long-term interference effects from single proposed pumping wells. It is strongly recommended to pre-consult with the hydrogeological reviewer before proceeding with any work, but is mandatory for sites where the flows will exceed 10,000 L/d. Terms of Reference are to be prepared for sites with flows exceeding 10,000 L/d.

ii) For maximum day water demands exceeding 10,000 L/d, the duration of the pumping test must be at least 12 hours. Also, the pumping test must be representative of the water demand cycles. The appropriate MECP authorization is to be obtained in advance of the pumping test (e.g., Permit To Take Water or EASR registration).

iii) Observation wells are desirable, particularly when the maximum day water demand exceeds 10,000 L/d.

iv) Recovery must be measured.

v) The Subdivision Package suite of parameters will be required, as well as trace metals and VOCs. Other parameters may be required, based on land use and/or geological setting. Aesthetic and operational water quality exceedances must be identified, treatment systems are to be specified, where these are recommended, and shown on the plans. The development may not be approved if health-related parameters are exceeded in the raw water.

5.2.5 Impact Risk Assessment

As stated above, a Reasonable Use Assessment will be required where the design flow exceeds 10,000 L/d. Where the design flow is 10,000 L/d or less, the City will require sufficient information to assess the likelihood that the operation of the on-site sewage system will not adversely impact the well(s) to be constructed on the subject property or existing wells on surrounding properties.

5.2.6 Previous Studies

The consultant is to ensure that the well and the sewage system meet the recommendations of previous studies completed as part of any Official Plan Amendment, Zoning By-Law Amendment, Subdivision, Severance, or any other study related to the subject site.

5.2.6 Mineralized Water

Any well with mineralized water will require written authorization by the MECP, in accordance with the Wells Regulation, prior to Site Plan Approval.

6.0 COACH HOUSES

Terms of Reference: Scoped Hydrogeological Studies for Coach Houses

(Approved by City Council on October 11, 2017)

6.1 Drinking Water Well

- Perform a six-hour pumping test, at a pumping rate in accordance with the number of dwelling units to be connected to the well (one or two).
- Submit one raw water sample, collected at the end of the pumping test, to an approved laboratory for analysis of the "Subdivision Package" list of parameters.

6.2 Assessment of Sewage System Impact

- Determine whether the development area is hydrogeologically sensitive (for example, karstic areas, areas of fractured bedrock exposed at surface, areas of thin soil cover, or areas of highly permeable soils).
- If the lot is one hectare or larger no additional assessment, beyond the determination of hydrogeological sensitivity, needs to be provided.

If the lot is less than one hectare, it will have to be determined whether: a) the sewage system(s) is (are) isolated from the receiving aquifer or b) the impact from the sewage system(s) is acceptable.

6.3 Reporting

A letter-report is to be prepared by the professional geoscientist (P.Geo.) or professional engineer (P.Eng.) under whose supervision the above work has been performed. The letter-report will include the results of the study, the analyses and the MECP water well record (if the record is available). The proposed Coach House will only be approved if the professional can demonstrate the following:

i) The raw water quality meets health-related water quality standards;

ii) the raw water is within the following aesthetic limits:

a. Chloride: 250 mg/L

b. Dissolved Organic Carbon: 10 mg/L (as C)

c. Iron: 10 mg/L

d. Manganese 1.0 mg/L

e. Sodium: 200 mg/L

f. Sulphate: 500 mg/L

iii) the water supply is sustainable;

iv) the area of development is not hydrogeologically sensitive; and

v) a) the sewage system is isolated from the receiving aquifer, or b) the impact of the primary dwelling plus the Coach House is less than 10 mg/L nitrate-nitrogen at the development boundary.

The letter-report shall be to the satisfaction of the City.

7.0 OFFICIAL PLANS AND ZONING BY-LAW AMENDMENTS

7.1 Statement of Principles

Official Plan Amendments (OPA) and Zoning By-Law Amendments (ZBA) are high-level planning applications. The City's Official Plan sets out the general policies for future land uses and the City's Comprehensive Zoning By-Law puts the plan into effect and provides for its day-to-day administration. Any change in land use must be viable and sustainable from a servicing perspective. Where private services are proposed, an adequate hydrogeological report must accompany the application.

7.2 Procedure

The scope of the hydrogeological study in support of an OPA or ZBA will vary depending on the proposal and on the hydrogeological conditions in the area of the subject lands. Where there is abundant information on aquifers and where the development is of low density, a limited scope study may be acceptable. In areas where the hydrogeological conditions are not well known, where the available data shows marginal water quality and quantity, or where the proposed development will consist of high density or high design flows, a more detailed study will be required. A water quantity and quality assessment will need to be completed prior to approval if the proposed use includes higher design flows or if conditions are unknown. The consulting hydrogeologist is strongly urged to liaise with the technical reviewer before proceeding with any field work. In many cases a written work plan, prepared by the consultant and agreed upon by the reviewer, will be desirable. The purpose of the work plan is to outline the minimum extent of the work in general. The work may have to be expanded as a result of the data collected during the study. Good communication between the consultant and the reviewer is encouraged.

8.0 COMMUNITY DESIGN PLANS AND MASTER SERVICING STUDIES

8.1 Statement of Principles

Community Design Plans (CDP) and Master Servicing Studies (MSS) are large scale studies typically associated with new development areas. Hydrogeology forms an integral component of these types of multidisciplinary studies.

8.2 Procedure

8.2.1 Terms of Reference Requirement

In the case of serviced areas, the hydrogeological report will address the impact of the proposed development on on-site and neighbouring wells and natural features, assess dewatering issues during and after construction, provide recommendations on stormwater management features, gather the necessary hydrogeological data for the water budget assessment and targets, and provide recommendations for any other site-specific circumstances requiring hydrogeological input. In the case of unserviced areas, the study will also address the viability and sustainability of private servicing.

For these types of studies, it is mandatory to consult with the City and the Conservation Authority and for the hydrogeological consultant to prepare Terms of Reference (ToR) for approval by the review agencies, prior to any work being done. The ToR is to reflect discussions with all disciplines (civil, environmental, stormwater management, transportation, geotechnical, water budget, etc.) and include the hydrogeological data and analyses required for all aspects of the CDP or MSS.

8.2.2 Serviced Areas

In serviced areas, the hydrogeological study in support of a CDP or MSS will assess the issues related to the construction of municipal services in the short and long terms and the impact of the development on the local hydrogeologic function. A test pit, borehole and monitoring well program is to be outlined in the ToR. The exploratory holes and associated testing must be completed at various depths, including well below the conceptual elevations of the linear infrastructure and stormwater management (SWM) features. Hydraulic conductivity testing is to be carried out in-situ. Water samples must

be collected at various depths and tested for the parameters outlined in Section 3.2, including VOCs, PHCs and trace metals in all cases and any other parameter(s) of concern identified by the consultant or the reviewer.

The study will describe the hydrogeologic conditions at and surrounding the subject site. The ToR will specify the scope of the work, which will typically include the following minimum assessments:

- Groundwater recharge, discharge
- Local and regional flow systems
- Hydraulic conductivity
- Groundwater quality and quantity
- Water table and piezometric surfaces for deeper aquifers
- Natural features sustainability and function
- Risk to existing private services
- Potential sources of contamination

8.2.3 Unserviced Areas

For CDPs in unserviced areas, the hydrogeological report must assess all the possible impacts the development could have within and surrounding the subject land, including impacts to the receiving aquifer and environmental features. The viability and sustainability of the proposed private services must be addressed, as well as the impact from the proposed sewage systems, in accordance with Section 3. For areas that have been previously developed and are being brought into a CDP, a groundwater characterization study may be performed by the City. These studies consist mainly of sampling programs, where 10 to 20% of private wells are sampled. Consultants for the CDP lands will, in these cases, consider the City's groundwater characterization study in their assessments.

8.2.4 Integrated Approach and Background Documents

The hydrogeologist for the developer will typically be working as part of a consulting team taking an integrated approach involving several disciplines. The required hydrogeological background will vary on a site-specific basis, but will include as a minimum the incorporation of the following:

- Official Plan Policies
- Secondary Plans
- Groundwater studies (regional and local)
- Historical Land Use Inventory
- Source Protection Assessment Reports
- Subwatershed Studies
- Natural features and natural hazards
- Bedrock and surficial geological mapping (including karst mapping)
- Aggregate Resource Inventory Paper 191
- MECP Water Well Information System
- Permit To Take Water database
- Environmental Compliance Approval database
- MECP spill inventory
- MECP Environmental Site Registry
- TSSA fuel storage data
- Landfill inventory
- Existing sewage systems (on and off site)
- Existing wells (on and off site)—the City can assist in the identification of existing properties that are not serviced with public water

8.2.5 Field Work

The site investigations will be detailed in the work plan established at the beginning of the project, but will include as a minimum:

- The characterization of the overburden through a test pit and borehole program (see Section 3.3)
- Bedrock lithology
- Bedrock fracturing
- Water table and piezometric surfaces (determined through monitoring wells read over at least four seasons)
- Presence and extent of karst
- Hydraulic conductivity of all pertinent layers (slug and pumping tests)
- Logging of loose sediments

The analyses of the data must be in conjunction with the work being performed by the other disciplines (civil, environmental, stormwater, transportation, geotechnical, water budget, etc.) in order to ensure an integrated approach in the overall conceptual design of the development area, taking into consideration all constraints and opportunities.

9.0 PITS AND QUARRIES

9.1 Statement of Principles

Pits and quarries are licenced by the Ministry of Natural Resources and Forestry (MNRF) under the Aggregate Resources Act (ARA). Typically, the lands will already be designated in the City's Official Plan but will require a Zoning By-Law Amendment in order for the pit or quarry to proceed, as the MNRF will not issue a licence unless the lands are appropriately zoned. In rare instances the lands may be already zoned, in which case the City may decide to use means outside the Planning Act in order to protect the interests of its residents (e.g., filing an Objection under the ARA).

9.2 Procedure

The application for a licence under the ARA is proponent-driven and the approval function is by the MNRF. The Ministry of the Environment, Conservation and Parks (MECP) is typically circulated for the review of the impact assessment on private wells that could be impacted by the pit or quarry. The Conservation Authority is also involved from the perspective of protecting environmental features and provides comments to the MNRF directly.

In most cases, a Zoning By-Law Amendment will be required. As with all planning applications, there will be a mandatory pre-application consultation with a City planner and technical staff. The proponent will be advised that the City must be provided with all the reports and correspondence to and from all review agencies. A hydrogeologist at the City will be assigned to the file and will participate in the process, and in many cases will also be performing an independent review. If it appears early in the process that there will be issues, the City may choose to place an Objection under the ARA application with the MNRF. This will be done in order to ensure that the City is fully involved in the process at the Provincial level.

In rare cases where a Zoning By-Law Amendment is not required, the City may decide to place an Objection to the ARA application with the MNRF to ensure that the City's interests are protected (for e.g., when the pit or quarry is in proximity to a municipal well or where private properties have a moderate to high level of risk of being impacted).

The hydrogeologist at the City will normally only recommend approval of the Zoning By-Law Amendment once the external agencies are satisfied (MNRF, MECP, CA, and any

other agency, or peer reviewer retained by the City) and the proposed zoning properly addresses the licencing requirements.

10.0 STORMWATER MANAGEMENT

10.1 Statement of Principles

In most instances, there will be a hydrogeological component to the planning and design of stormwater features (SWM ponds, infiltration systems, Low Impact Development, etc.). Hydrogeologists will normally be involved from the earliest stages (Community Design Plans and Master Servicing Studies) up to and including the detailed design stage. There is a need for a thorough understanding of the interaction between surface water and groundwater in order to ensure that the stormwater feature will operate as intended and that surrounding properties are not unduly impacted, and groundwater will not be contaminated.

10.2 Procedure

Terms of Reference outlining the scope of the work to be undertaken are to be prepared by the consulting hydrogeologist and approved by the City prior to any work being undertaken. Logged boreholes and hydraulic testing will normally be required in order to establish groundwater table elevations, infiltration rates and/or to determine whether liners will be required (e.g., SWM ponds in rock or permeable soils). Water budgets are required for most stormwater planning and design. The methodology for the water budget is to follow well established protocols (e.g., Thornthwaite Mather, MECP SWM Manual, MECP water surplus partitioning, etc.). The water budget will either be completed by the hydrogeologist for the proponent or by another consultant that will be supported by the work performed by the hydrogeologist. Seasonal groundwater elevations will typically be required.

Beyond these guidelines, there are several other SWM guidelines and requirements (e.g., City's Sewer Design Guidelines / SWM section, MECP LID guidance, MECP SWM Planning and Design Manual, etc.) that must also be fully considered.

11.0 REPORTING REQUIREMENTS

11.1 Statement of Principles

The City requires a final hydrogeological and terrain analysis report in order to make critically important planning decisions with respect to the viability of long-term drinking water supplies and the safe on-site disposal of treated septic effluent, or regarding the protection of natural features. The time between when a study is undertaken and when the related report is referenced following its original acceptance is sometimes very long. In between these events, the developer and the hydrogeologist responsible for the original study are typically no longer available to discuss the site's hydrogeology. As a result, the final report must contain a complete and detailed account of the project from inception to completion. This is critical for the ongoing sustainability of neighborhoods.

The final hydrogeological and terrain analysis report is to contain a complete account of the project, from the rationales used to scope the work up to the final recommendations that will be included in the subdivision agreement. Rationales, background information, site specific (raw) data, critical metadata, sample calculations and the tabulated results of analyses are to be presented for all aspects of the work. The report must be fully narrated in a manner that will make it easy to follow and so that each calculation and conclusion can be recreated from the data by the reviewer.

There shall be only one hydrogeological report for each planning application. The report is to be revised through the review process, as necessary—i.e., supplemental or additional reports will not be accepted. If agreed upon in advance, electronic interim copies could be provided for review. The final report will always be provided in both electronic and paper formats (the City should be consulted for the number of paper copies).

The Hydrogeological and Terrain Analysis report must be completed to current professional practices and must refer to the standards that were used. Amongst other aspects of a Hydrogeological and Terrain Analysis report, the professional standards that should be referenced include: design of the hydrogeological field work program; specific field methods; data presentation and analyses; mapping, etc. Professional standards are available from such institutions as the Ontario Geological Survey, ASTM, International Organization for Standardization (ISO), etc.

11.2 General Reporting Details

The presentation of the report can conform to the consultant's internal protocols, but should typically include the following elements:

- Title Page
- Table of Contents
- Qualified Professional Statement
- Introduction
- Planning Rationale
- Background - information and discussion
- Methodology - rationale and description
- Results and Analyses
- Discussion and Conclusions
- Recommendations
- Tables
- Figures (Regional & Site-specific)
- Appendices
- Digital data

Checklist are provided in Section 12 to assist in ensuring the required items are included.

11.3 Data Requirements

In addition to paper and pdf copies of reports, water quality data is to be provided in a tabular digital data format acceptable to the City for input into a database. All stations (boreholes, auger holes, test pits, wells, monitoring wells, etc.) are to be referenced to the MTM (Zone 9) coordinate system. The data format will be provided by the City when requested.

12.0 CHECKLISTS

Statement of Principles

The following series of checklists is provided as an aide for developers, consulting and reviewing hydrogeologists, and municipal planning staff to understand content requirements or to confirm required content is included in a Hydrogeological and Terrain Analysis report.

These checklists cannot be used independently to plan or conduct a hydrogeological and Terrain Analysis project or to report on the hydrogeological and terrain conditions at a proposed development site. These checklists must be read and interpreted in reference to the section(s) of these guidelines related to the type of development to be undertaken and in reference to current industry standards.

12.1 Background Review, Work Planning and Pre-consultation

Background Review

- ☐ All relevant regulatory and existing hydrogeological information was directly considered in the scoping of the study's work plan.
- ☐ Anticipated integration with parallel technical studies (e.g. geotechnical, environmental assessment, stormwater management) was identified.
- ☐ Background information was provided to the reviewing hydrogeologist for consideration prior to detailed pre-consultation.

Work Plan

- ☐ Relevant policy was directly considered in the scoping of the work plan.
- ☐ A work plan, presenting the results of the background review, was produced as recommended and circulated to the reviewing hydrogeologist for discussion.

  **Allow approximately one to two weeks prior to pre-consultation.*

Pre-consultation

- ☐ Pre-consultation discussion(s) occurred in direct reference to the above background review and work plan.

12.2 Reports

Terrain Analysis

- Background information was consulted, discussed and provided for reference.
- Geographically and lithologically representative test pits, boreholes and occasionally hand auger holes were installed, logged using the full Unified Soil Classification system, and locations are identified on a map.
- Representative grain-size analyses were completed. Related laboratory reports are appended and cross-referenced to specific locations in specific test pits, boreholes and auger holes and to identified terrain units.
- Terrain units are characterized, including water table depth and sediment type / depth.
- A terrain unit map is presented.
- The terrain aspects of a general servicing scenario are discussed.
- A private servicing plan is presented and portrays all related development constraints.

Impact Assessments

General Evaluation

- Design flows are presented and supported.
- On-site and adjacent land use practices that can produce nutrient and/or other related contaminant loading were investigated and are discussed.
- The most probable receiving groundwater for septic system effluent is identified.
- Clear rationale for the field investigation into representative background nitrogen species' concentrations is discussed in reference to an identified receiving groundwater, rationale includes consideration of temporal, spatial, lithological and depth.
- Representative existing background nitrogen species' levels in the receiving groundwater were analysed and laboratory results are included and cross-referenced to the sampled wells.
- Groundwater sampling standards are discussed and affirmed.

- When background nitrate levels are found between 2.5 and 10 mg/L in the receiving groundwater: additional sampling events were undertaken and the long-term trend established; and a reasonable explanation (suitability and stability) for the existing levels of nitrogen species in the receiving groundwater is presented.
- The direction of groundwater flow in the receiving groundwater was assessed and the most likely downgradient development boundary is defined and identified, the details for which are presented.
- The report provides an assessment of site hydrogeological sensitivity (i.e. karst, fractured bedrock exposures, areas of thin soil cover or areas with highly permeable soil); assessment is based on appropriate technical information and analyses (i.e. test pit logs, borehole logs, grain-size analyses, onsite hydraulic testing, regional geological mapping, water well record review, hydrogeological conceptual models, terrain unit mapping, etc.)
- A strong position, based on multiple pre-defined lines of evidence is presented to demonstrate the long-term sustainability of on-site sewage system effluent disposal when the site, or part of the site, is identified to be hydrogeologically sensitive.

Three-Step Assessment Process (only one applicable 'Step' needs to be completed below)

Step One: Lot Size Considerations:

- Confirmation is provided (i.e. Draft Plan) that proposed lots are an average of 1 hectare (minimum), with no proposed lot area less than 0.8 hectare.

Step Two: System Isolation Considerations:

- The most probable lower hydraulic boundary of the receiving groundwater is defined.
- An assessment of potential existing and future receptors of the receiving groundwater is provided (i.e. potential for shallow (dug) wells, sensitive surface water environments, etc.)
- Evidence is presented that approximately 10 metres of massive unfractured clay underlies the site, including beyond the development boundary in the downgradient direction; or that other circumstances that produce hydraulic isolation exist and will be maintained.

Step Three: Contaminant Attenuation Considerations:

- An infiltration zone map is presented based on hydrologic catchments, the terrain unit map and post-development land cover and topographic character.
- A post-development water budget assessment, in accordance with these guidelines, is presented.
- For residential development, a predictive contaminant attenuation assessment was completed for each site-specific infiltration zone and is summarized to demonstrate that nitrate (as nitrogen) levels are expected to be less than 10 mg/L at the identified downgradient development boundary on an average annual basis.
- For commercial or industrial development, a predictive contaminant attenuation assessment was completed for each site-specific infiltration zone. The maximum allowable flow and users were calculated, on a lot by lot basis, based on the provisions of the intended zoning designation.

Water Quantity and Quality

Test Well Requirements

- At least the minimum number of representative test wells were installed/used and a rationale is provided based in consideration of spatial coverage, lithology, hydrogeologic setting, well depths and well construction.
- Where existing and former land use is of interest, representative down-gradient test wells were installed to investigate potentially related influences.
- The test wells were inspected by a qualified person working under the supervision of a hydrogeologist, and the required certifications are included in the report (see definition of well inspection report for requirements).
- For all test wells used in the study: locations are field-truthed and related data are tabulated and mapped
- Field tests indicated that wells were sufficiently developed prior to testing and field results are provided as support.

Well Water Quantity Testing

- Legible water well records for the area around the site are provided and mapped. Related aquifer yield and representativeness is assessed.

- ☐ The report contains a discussion (conceptual model) of regional and site geology and hydrogeology (aquifer characteristics, groundwater flow regime, recharge and discharge areas, interaction with local surface water features, etc.) and provides all related mapping.
- ☐ Technically appropriate hydrogeological cross-section(s) of the site is(are) provided which incorporates applicable hydrogeological information in the area.
- ☐ The hydraulic gradient in the water supply aquifer is evaluated and presented.
- ☐ Pressure transducers were deployed in all test wells and observation / monitoring wells and periodic manual measurements recorded before, during and after the aquifer test.
- ☐ Aquifer test methodologies are described in the report and meet standard industry practice.
- ☐ Test wells were pumped at or above the minimum justified rate and duration; water levels were monitored in test wells and observation wells during the aquifer test at an appropriate frequency, and recovery was monitored until 95% recovery or for 24 hours (whichever is less).
- ☐ Raw field data and technical analyses (graphs) are provided for the aquifer tests (pumping and recovery) for test wells and observation wells.
- ☐ Aquifer test results from each test well are presented.
- ☐ Analyses are provided to address the long-term safe yield of the aquifer and long-term sustainability of the proposed 24-hour pumping cycles; and for any potential supply interference.
- ☐ An assessment of long-term safe yield of the aquifer and impact to existing users (i.e. well users and sensitive surface water features) is included.
- ☐ Information from residents and other sources at nearby established developments is included regarding well yield problems (i.e. water shortages, replacement wells).

Well Water Quality Testing

- ☐ Field data, original laboratory reports and technical analyses are provided for at least two raw water quality samples from each test well. Field data indicates that

chlorine residuals were zero at the time the bacteriological samples were obtained; and that raw water turbidity is acceptable.

- Report must clearly specify water sampling methodologies; methods must meet current industry practice. Specifically, report must describe: adequacy of purging volume (if sampling outside of the normal pumping test); identify instruments used for field samples and instrument calibration routine; confirm field parameter stability prior to sampling; describe sampling method including sample filtration (dissolved or undissolved sample), sample bottle preservatives, low flow sampling (only where required), and changes employed at a specific test well.
- Lab analyses are provided for the common Subdivision Package suite of analyses and all other required parameters, as set out in these guidelines.
- The report provides a determination of whether conditions specific to the site or its surroundings require inclusion of additional parameters (see guidelines for details). Additional relevant parameter sampling is included in analyses, lab results are provided and included in the overall analysis of drinking water quality suitability.
- High TDS values require written rationale, with supporting analyses, that corrosion, encrustation or taste problems will not occur.
- Report demonstrates that water quality data are representative of expected long-term water quality.
- Raw water quality from each well meets the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG) and is below the provincial maximum concentration considered reasonably treatable (MCCTR) for aesthetic/operational parameters.
- Where raw water quality parameters are within the D-5-5 MCCRT, water treatment recommendations are discussed, and treatment interference is explained (only when multiple treatment systems are proposed in series).

Well Construction

- The report recommends appropriate well construction and comments on the potential for cross-contamination between aquifers.

Land and Water Use Conflicts

- ☐ Land uses within a minimum of 500 m of the site are described, related documentation is provided, and potential adverse impacts of former or current land uses are addressed.
- ☐ A well owner survey and groundwater sampling results are provided from representative existing wells in adjacent developments.