OAK RIDGES MORAINE CONSERVATION PLAN
Technical Paper Series

16 - Sewage and Water System Plans

1 Purpose and Overview

This technical paper provides guidance to assist approval authorities, land developers, consultants and other proponents in planning and developing sewage and water system plans for the implementation of the provisions of Section 43 of the Oak Ridges Moraine Conservation Plan (ORMCP). It is the intent of the ORMCP that sewage and water system plans should be developed with consideration of the ecological integrity of hydrological features and key natural heritage features. In addition, groundwater and surface water quality and quantity, including baseflows, are to be maintained, and natural groundwater flows are not to be disrupted during or after construction. The projected water use for the developments is to be sustainable, applicable watershed, water budget, and conservation plans are to be complied with. It is also the intent of the ORMCP that with the exception of a few conditions specified, the construction or expansion of partial services is prohibited.

This technical paper will assist in identifying feasible potable water supply sources, establishing considerations for the selection of alternative servicing routes, siting of treatment facilities, and mitigation of impacts. It is not the intent of this technical paper to provide comprehensive guidance on all aspects of sewage and water system plans. Where appropriate, the reader will be directed to existing guides and references.

2 Related Considerations

When preparing Sewage and Water System Plans, it is suggested that the reader also review the highlighted, associated topic areas as discussed in the ORMCP, as shown in Figure 1 below.

Clean Water Act, 2006

The *Clean Water Act, 2006* was passed on October 19, 2006. Associated regulations, Director's Rules and technical modules are currently being developed. Readers of this technical paper should take note that the requirements of the *Clean Water Act, 2006* may have implications to initiatives undertaken to implement the ORMCP. Information concerning the *Clean Water Act, 2006* is available at: www.ene.gov.on.ca/en/water/.

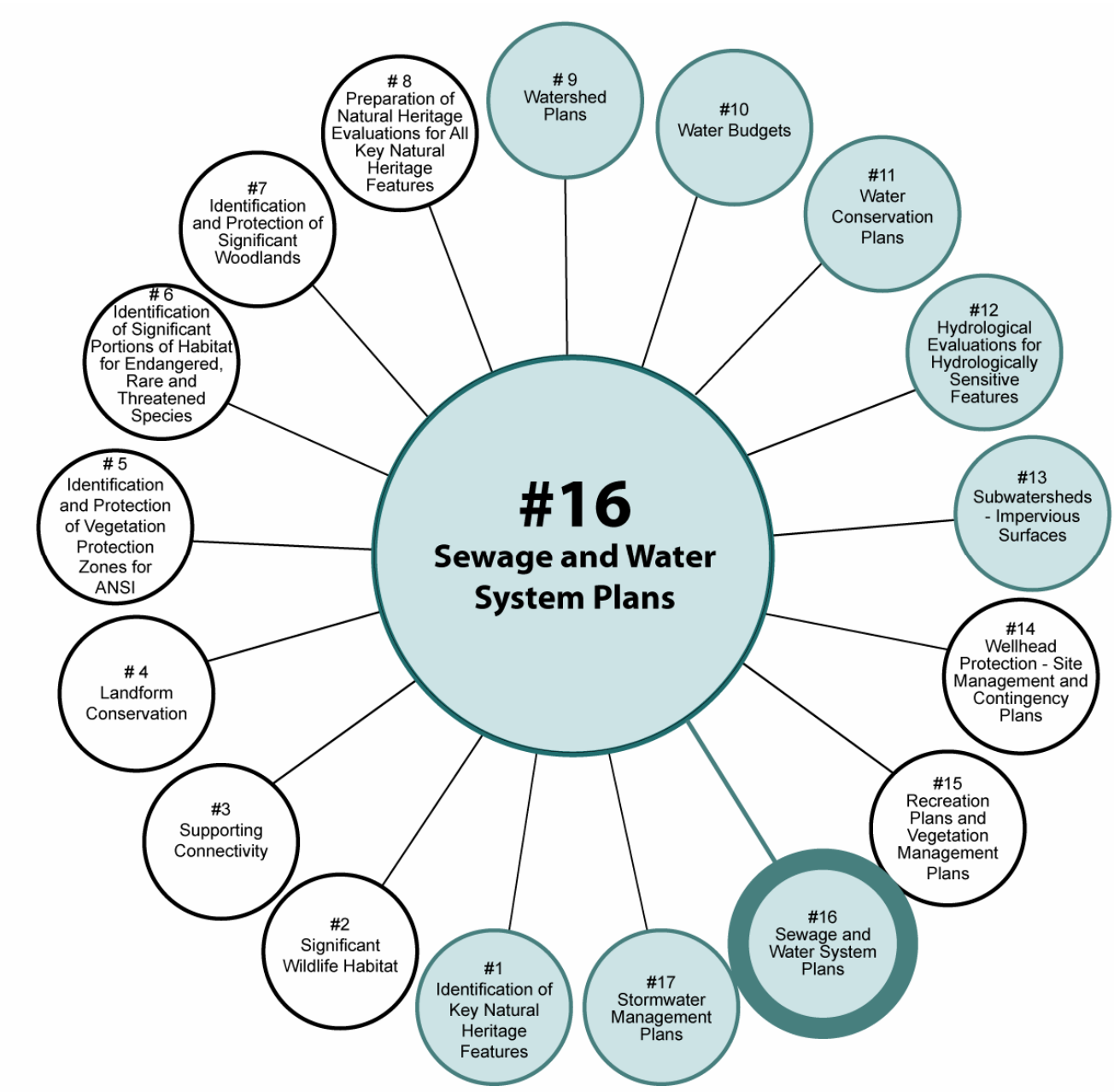
Environmental Assessment Act, 1990

If an application pertains to a municipal sewage or water infrastructure proposal, it may be subject to the environmental assessment process and may require approval from the Minister of the Environment under the *Environmental Assessment Act.*

Further Reading

Please also refer to the additional list of resources and references listed at the end of this technical paper.

Figure 1 ORMCP Topic Areas and Linkages with Technical Paper 16 - Sewage and Water System Plans



3 Requirements of the Oak Ridges Moraine Conservation Plan

The Oak Ridges Moraine Conservation Plan (ORMCP) states:

Sewage and water services

43.

(1) An application for major development shall be accompanied by a sewage and water system plan that demonstrates,:

a) that the ecological integrity of hydrological features and key natural heritage features will be maintained;

b) that the quantity and quality of groundwater and surface water will be maintained;

c) that stream baseflows will be maintained;

d) that the project will comply with the applicable watershed plan and water budget and conservation plan; and

e) that the water use projected for the development will be sustainable. O. Reg. 140/02, s. 43 (1).

(2) Water and sewer service trenches shall be planned, designed and constructed so as to keep disruption of the natural groundwater flow to a minimum. O. Reg. 140/02, s. 43 (2).

Partial services

44.

(1) The construction or expansion of partial services is prohibited. O. Reg. 140/02, s. 44 (1).

(2) Subsection (1) does not apply to prevent the construction or expansion of partial services that is necessary to address a serious health concern or environmental concern. O. Reg. 140/02, s. 44 (2).

(3) Subsection (1) does not apply to prevent the construction or expansion of partial services if,

a) the construction or expansion was approved under the Environmental Assessment Act before November 17, 2001; and

b) the period of time during which the construction or expansion may begin has not expired. O. Reg. 140/02, s. 44 (3).

Section 44 of the ORMCP also states that the construction or expansion of partial sewage and water services is prohibited, except for the provisions noted. "*Partial service*" means connections linking a building to, (a) a communal sewage or water service or a full municipal sewage or water service, and (b) an individual on-site sewage or water system.

This technical paper should be used as a guide to develop sewage and water system plans for major developments. All information requirements of the ORMCP should be provided with the application to the appropriate approval agency. All relevant Oak

Ridges Moraine (ORM) technical papers should be consulted during the preparation of the application.

4 Rationale for the Requirements

Section 3 of the ORMCP defines major development as consisting of:

(a) the creation of four (4) or more lots,

(b) the construction of a building or buildings with a ground floor area of 500 m2 or more, or

(c) the establishment of a major recreational use as described in Section 38 of the ORMCP.

The provision of new water and sewage services could result in negative impacts if the planning, design and construction procedures are not conducted in accordance with the ORMCP requirements. Complementing this aspect is the requirement to follow the Municipal Class Environmental Assessment process for new municipal water and wastewater facilities.

As noted in section 2 of this technical paper, partial services are prohibited under the ORMCP. To avoid partial services, both sanitary and water services need to be considered together.

A new water supply source may need to be considered if no municipal water distribution system with sufficient capacity exists near the proposed development. Typically, water supply for a development could be from either ground water from wells or, less likely, surface water from kettle lakes/watercourses. Withdrawal of water from surface water bodies and potential damming of watercourses for intakes could reduce downstream flows or cause water level fluctuations in small lakes, and impact water quality (e.g. runoff from irrigation of golf courses which may contain fertilizers/herbicides). Similarly, withdrawal of groundwater could lower the groundwater level locally, reduce baseflows of nearby watercourses and could impact existing well users in the area. The sustainability of water use for the development during drought conditions should be a major consideration. In addition, the consideration of alternate water supplies should include the water supply safety as required by provincial regulations. Applicable legislation governing these requirements are identified in Section 6 of this technical paper.

If new development is deemed appropriate, the new municipal system could tap ‘low vulnerability’ water source such as deep confined groundwater systems. This will reduce the amount of raw water treatment required to the meet the requirements of the *Safe Drinking Water Act* and minimize potential impacts (land use restrictions) in the resulting wellhead protection areas for new groundwater systems (as envisioned under the *Clean Water Act,2006*).

Once the water is used, it will need to be treated before it is returned to receiving waters as treated wastewater. The hierarchy for preferred treatment under the Provincial Policy Statement is as follows: municipal system, communal system and septic tank system. Section 44 of the ORMCP prohibits the construction and expansion of partial services. Unless a municipal sewer system exists adjacent to the site of the new major development to which the sewage flows can be connected, alternative sewage treatment options should be considered. These could range from communal

treatment package plants and communal septic tanks to local septic tank systems. However, effluent from communal package plants and lagoons can impair water quality in receiving waters if not properly operated and maintained. Similarly, septic tanks can adversely impact groundwater and surface water if not properly maintained and operated.

If water and sewage systems do not exist near the subject site to connect into or, if they do exist, but the systems do not have the required capacities, the servicing of Settlement Areas will require the construction of separate water and wastewater treatment facilities, as well as infrastructure which includes watermains, sewers and corresponding appurtenances. If not properly designed and implemented, the construction of these services could create short-term impacts to ecologically sensitive areas, potentially disrupt natural groundwater flow and could also pose erosion and sedimentation problems.

5 Implementation of the Requirements

To meet the requirements of Section 43 of the ORMCP, an eight (8) step process is recommended as shown in Table 1 and discussed in the following sections. The development of the sewage and water system plan shall focus on supply management, which seeks to conserve the water resource, use water more efficiently and expand existing facilities rather than build new ones. In addition, the plan shall follow the hierarchy of use of full municipal services, followed by communal services, and then private facilities.

While it is generally preferential to expand an existing facility, in some cases this may not be possible and a new one may need to be constructed. Factors that need to be considered in this assessment include the ability to integrate new and up-to-date technologies, space to expand, cost, etc.

It is also recognized that approval authorities may have requirements in addition to those offered in this technical paper. For example, municipal site plan requirements and agency and government permit approval processes may call for additional and/or more detailed information beyond the requirements of the ORMCP. For instance, municipal undertakings which are carried out routinely or have predictable and mitigable environmental effects may be subject to the Municipal Engineers Class Environmental Assessment process whereas other projects may require an Individual Environmental Assessment. Without limiting the range of issues that approval authorities may wish to consider in developing sewage and water system plans, approval authorities may wish to review their current requirements and the requirements of agencies and government ministries such as MOE, taking into account the issues outlined in this technical paper.

6 Regulatory Requirements

MOE requirements that must be considered in the implementation of the requirements include the following:

- *Ontario Water Resources Act* - a Permit to Take Water for water takings exceeding 50,000 L/day, where no services are present, is a typical requirement of the MOE. Information submitted in support of a Permit to Take Water considers the potential for adverse effects on existing users, ecological features, and natural functions of the ecosystem. Early planning for proposals that will require a Permit to Take Water shall identify potential impacts on nearby wells, possible effects on ecosystem features including fish habitat and wetlands. In addition, contingencies for water supply for nearby users and triggers for implementing water supply contingencies should be incorporated or referenced in the management plan. Additional information regarding Permits to Take Water is available at: www.ene.gov.on.ca/envision/water/pttw.htm.
- *Ontario Water Resources Act* - A Certificate of Approval may be required from MOE regarding the proposed sewage servicing facilities and proposed stormwater management facilities. Environmental impact assessment of the sewage disposal facility must be in accordance with MOE guidelines to determine appropriate effluent limits.
- *Safe Drinking Water Act* - The *Safe Drinking Water Act* is a compilation of all legislation and regulations relating to the treatment and distribution of drinking water. The purpose of the *Safe Drinking Water Act* is to recognize that all citizens of Ontario are entitled to safe drinking water, and to protect human health from hazards associated with drinking water by controlling drinking water systems and drinking water testing. All new or replacement municipal drinking water systems should be established with the Director of the Ministry of the Environment's approval under Part V of the *Safe Drinking Water Act* or a drinking water works permit issued by the Director. Any amendments to existing municipal drinking water systems can only be made after applying to the Director for an amendment to the approval, drinking water works permit, or municipal drinking water license for the system. Non-municipally regulated drinking water systems cannot be established, replaced, altered or operated except in accordance with the requirements that apply to the system or under the authority or approval of the Director, if an approval is required. Additional information regarding drinking water legislation is available at: www.ontario.ca/ONT/portal51/drinkingwater.

Table 1 Key Steps in Developing a Sewage and Water System Plan

Key Steps in Developing a Sewage and Water System Plan
Step 1: Prepare Background Information
Step 2: Define Water Budget
Step 3: Determine Projections for: • Water Demand • Sanitary Sewage Flow Generation
Step 4: Identify Feasible Water Supply Sources • Municipal Water System • Surface Water / Groundwater Supplies • Sustainability of Water Use
Step 5: Identify Alternative Servicing Routes and Siting of Treatment Facilities
Step 6: Plan protection of Surface water and Groundwater During Construction
Step 7: Prepare the Plan
Step 8: Monitor

6.1 Step 1: Prepare Background Information

Prepare or obtain studies and documentation related to the identification of Hydrological Features, Key Natural Heritage features, as well as Water Budget and Conservation Plan, Land and Water Use and Environmental Monitoring plan. Some of this information would be available from the preparation of watershed/subwatershed plans for the area of interest. Other useful background information may be collected from other sources such as Environment Canada, MOE or local municipalities including precipitation records from nearby meteorological stations, streamflow and/or well monitoring information. All this information should be supplemented with suitable topographic mapping at one metre contour intervals for the specific site under consideration.

6.2 Step 2: Define Water Budget

Water Budgets prepared for watersheds may have been already completed in some areas by Conservation Authorities and may be of use for the subject area.

These water budgets, however, having been prepared at the watershed/ subwatershed scale, may be too broad for the area of interest, and may require further definition or upgrading in order to determine the sustainability of the water supply source at the local level. Certain proponents may accordingly require a specific water budget related to their undertaking. Where a specific water budget is required, it should be prepared in accordance with the Water Budget technical paper, which addresses the requirements of Section 25 of the ORMCP. Information from the local level water budgets will be used as input for the development of future scenarios in the watershed scale water budgets. This

allows for the consideration of potential impacts and assessment of the project in context with the broad hydrological framework.

6.3 Step 3: Determine Projections for Water Demand and Sanitary Sewage Flow Generation

Water demand and sanitary sewage flow projection rates for the proposed development need to be established in order to provide the required servicing. The key components of this process are described below.

6.3.1 Water Demand

To estimate the water demand, design criteria should be used either from the local municipality or from the Ministry of the Environment document entitled “Guidelines for the Design of Water Distribution Systems”. Design criteria normally vary from municipality to municipality.

The steps that should be followed in the estimation of water demand should, as a minimum, include the following:

- An estimation of the design period to forecast the population and land use, since this will determine the period for the water demand;
- For residential areas, use population forecasts based on either population density (persons/hectares) for each type of housing (e.g. single family, semi-detached, townhouse, apartment, etc.) or persons/unit if the exact number of dwellings is known;
- Apply water consumption rates in concert with municipal water conservation plans;
- For commercial and institutional water uses, unit rates should be used. These rates vary for shopping centres, hospitals, schools, trailer/mobile home parks, campgrounds and hotels/motels;
- An estimation of maximum daily and maximum hourly peaking factors for the residential and commercial/institutional sectors;
- Consideration of fire demand to meet the current requirements of the Fire Underwriters Survey and Ontario Regulation730/81 “Fire Code”;
- Design the water supply systems to satisfy the greater of the following demands:
    - Maximum day plus fire flow (where fire flow is to be provided); or,
    - Peak flow rate (maximum hourly demand);
    - Conduct preliminary sizing for the watermain(s) servicing for the development based on the above criteria.

6.3.2 Sanitary Sewage Flow Generation Rates

Sanitary sewage flows consist of wastewater discharges from residential, commercial, institutional and industrial establishments plus extraneous flows from inflow and infiltration sources. To estimate the sewage flow

generation rates, design criteria should be used either from the local municipality or the Ministry of the Environment document entitled "Guidelines for the Design of Sanitary Sewage Works." Design criteria normally vary from municipality to municipality.

The steps that should be followed in the estimation of sanitary sewage flow generation, as a minimum should include the following:

- A determination of the design period for the population forecast and land use;
- For domestic sewage flows, use population forecasts based on either population density (persons/hectares) for each type of housing (e.g. single family, semi-detached, townhouse, apartment, etc.) or persons/unit if the exact number of dwellings is known;
- For commercial and institutional sewage flows, apply average daily sewage flow rates for shopping centres, hospitals, schools, trailer/mobile home parks, campgrounds and hotels/motels;
- An estimation of peak domestic sewage flows based on the peaking factors from either the Harmon or Babbit Formulas;
- Extraneous (inflow and infiltration) sources in the sanitary flow projections;
- Conduct preliminary sizing for the sanitary sewer(s) servicing the development based on the peak sewage flow plus inflow/infiltration contribution;

6.4 Step 4: Identify Feasible Water Supply Sources

Water supply sources can include connection to an existing nearby municipal potable water system or the development of local groundwater or surface water supplies. The sustainability of ground and surface water supply is an important consideration as well as that of the watershed and the specific location of the water supply relative to the watershed, and the location where the treated effluent is to be discharged.

Considerations for feasible water supply sources are described further below. The assessment of these sources needs to take into account the requirements outlined in Regulation 170/03, *Safe Drinking Water Act*.

6.4.1 Municipal Water System

The opportunities and constraints associated with connecting to an existing system need to be considered in terms of environmental impacts, including adherence to the ORMCP: technical feasibility; and cost. In addition, the proponent will need to initiate dialogue with the local municipality at an early stage in the process.

6.4.2 Surface Water / Groundwater Supplies

To assess potential groundwater supplies, the sustainability of the aquifer has to be estimated by taking into consideration cumulative impacts

associated with other major takers. To ensure the accuracy of these assessments, the proponent needs to access water taking permit information. In addition, as a minimum, the following issues need to be considered in order to minimize any adverse impact on the natural functions of the ecosystem and preserve ambient water quality of the aquifer:

- The aquifer characteristics, including aquifer thickness, extent, capacity, and sustainable yield;
- The source areas contributing to aquifer recharge;
- The presence of ecosystem features (e.g. HSFs or KNHFs) within the capture zone;
- The presence of potential contaminants within the capture zone and the upgradient catchment area;
- The consideration of land use designations (upper and lower tier) and their implications to the pumping field, recharge zone and development area; and
- The presence of nonconforming (and potentially contaminating) land uses.

Surface water supplies are generally categorized as run-of-the-river, rivers or streams containing impoundments, or natural lakes. Considerations for a feasible surface water supply source include:

- The security of the source and quantity of available water;
- Good quality water without pollutants;
- A location in same sub-watershed as the development to eliminate the need to divert water from one sub-watershed to another;
- The distance from the development to the water source and potential impacts on the environment from routing of the service; and
- The possibility of a gravity feed system.

The impact of water takings on other users and on the natural functions of the ecosystem needs to be assessed when considering the feasibility of surface and groundwater supplies.

6.4.3 Sustainability of Water Use

Maintaining the available water source is critical to the sustainability of the development. Withdrawals may impact fluctuations in lake levels, reduce downstream baseflows, lower groundwater levels, or impact other well users in the area. In addition to the preparation of water budgets as referenced in Step 3, additional investigations may be required to assess the sustainability of the local water sources and any associated impacts on lakes and impoundments, streamflows and groundwater from the proposed water withdrawals.

The analyses should be conducted under steady-state in order to assess the worst-case scenarios that may impact the sustainability of the supply source. A pre- and post-development water balance of the site should be conducted considering, as a minimum, the following factors:

Groundwater Source

The assessment of sustainable aquifer yield is critical to the success of the development. "Sustainable aquifer yield" is the amount of water that can be developed and used in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences. (Alley, W. M., and Leake, S. A., 2004).

In order to ensure that sustainable aquifer yield is maintained, the regional aquifer system and its interactions with the natural environment and local water users must be understood. Delineation of the anticipated worst-case zone of influence, and identification of potential receptors within the zone of influence and in the surrounding area are necessary to assess the aquifer's potential sustainability.

Lakes and Impoundments

The sustainability of water sources from lakes or impoundments can be assessed by conducting a water balance that considers:

- The average monthly precipitation data, evaporation data, soils and vegetation information (Some of this information is available on the MNR's Land Information Ontario database);
- The drainage area of the supply source; and
- The estimated monthly runoff volume and infiltration.

It should be noted that the proponent is not required to undertake fieldwork to collect precipitation and evaporation data since this information is available from appropriate sources such as Environment Canada, regional municipalities, and Conservation Authorities.

Streamflow Source

The sustainability of water sources from streams can be assessed by conducting a water balance that considers:

- The available flow data, for the particular stream or nearby watercourse;
- The flow rate and frequency of low flow events. If not available, the MOE document entitled "Regional Analysis of Low Flow Characteristics" August 1995, for various regions in the province can be used to estimate low flows;
- Other takings from the surface water source;
- The natural discharge to streams (baseflow) and to wetlands; and
- The drainage area.

The above investigation needs to consider the MOE Permit to Take Water (PTTW) program, due to its relevance to the sustainability of water supply and the assimilative capacity of surface water receivers for wastewater effluent. Section 34 of the *Ontario Water Resources Act* (OWRA) mandates obtaining a PTTW for any withdrawal of more than 50,000 litres/day of groundwater or surface water.

Water conservation programs need to be incorporated in the sewage and water system plan to ensure sustainability. The details of the water conservation plan are included in the Water Conservation technical paper.

6.5 Step 5: Identify Alternative Servicing Routes and Siting of Treatment Facilities

The routing of the watermains/sanitary sewers and the siting of any associated water and wastewater treatment systems could have potential impacts in the ecologically sensitive ORM. Unless the new development can be serviced from a nearby municipal water supply and sanitary sewer system, stand-alone water and wastewater treatment systems will be required. Depending on the population of the development, the water system could include a conventional water treatment plant, a package communal water treatment system or private wells. It is a requirement that:

- All water for domestic use must meet the MOE Ontario Drinking Water Standards and the *Safe Drinking Water Act*;
- The degree of treatment required will depend on the chemical and bacteriological quality of the raw water, the presence of hydrogen sulphide or methane gases and the presence of iron and manganese; and
- All potable water supplies need to be disinfected using appropriate technology.

Wastewater treatment will be required to treat the water once it has been used. Treatment alternatives can range from conventional wastewater treatment plants, package treatment plants, or sewage lagoons to septic tank systems. The potential impact of the discharge on the receiving waters must be in assessed in accordance with MOE policy and guidelines (i.e. Environmental Assessment process) to determine the appropriate effluent limits. Ultraviolet disinfection is preferred over chlorination.

The siting of facilities should consider the following:

- Compliance with the watershed plans to ensure consistency with recommendations;
- Avoidance of hydrologically sensitive features and key natural heritage features as identified in other sources;
- Avoidance of high vulnerability zones of Wellhead Protection Areas and Intake Protection Zones;
- Use of pervious pavement concepts for parking lots and other hard surfaces to promote infiltration according to stormwater management plans;

- Maintenance of proper set-backs from watercourses and other hydrological/natural heritage features in accordance with the ORMCP as well as other requirements from conservation authorities, the Ministry of Natural Resources and other agency guidelines; and
- Minimizing the construction of the facility below groundwater level to avoid interference with groundwater flow patterns.

Depending on the location and type of the water supply source and the ecological sensitivity of the area, alternate routes may need to be considered for the watermains and sanitary sewers. The selection of the preferred route will consider:

- Avoidance of hydrologically sensitive features and key natural heritage features as identified in other sources in accordance with Section 41 of the ORMCP;
- Avoidance of areas with high groundwater table since the granular material from the trench will tend to create a preferential pathway;
- Minimizing the removal of vegetation and disturbance of aquatic/wildlife habitats;
- Possible interference with existing underground utilities/services;
- Location of intake (surface water source) and outfall (sanitary sewage);
- Maintenance of a gravity system for the sanitary sewer, thereby eliminating the need for pumping;
- Ensuring the proposed alignments do not puncture any fine-grained soil units that confine underlying aquifers;
- Minimizing social and environmental impacts; and
- The cost of the various alternatives.

6.6 Step 6: Determination of Assimilative Capacity of Receiving Water Courses

During Step 6, work should be undertaken to derive effluent requirements for wastewater discharges, taking into account the characteristics of the wastewater and the receiving environment. Typically, this will involve undertaking an assessment of the impact of the proposed wastewater discharge on the groundwater and/or the surface water receiving environment, as appropriate. Guidance regarding MOE water quality policies and impact assessment methods is available at:

www.ene.gov.on.ca/en/publications/forms/index.php#resources

www.ene.gov.on.ca/en/publications/forms/index.php#sewage

6.7 Step 7: Plan Protection of Surface Water and Groundwater During Construction

The protection of surface and groundwater resources is crucial during construction of the infrastructure. The key impacts will be from groundwater pumping, construction of trenches and erosion or sedimentation.

The need for construction dewatering should be assessed during the design phase so that excessive dewatering can be avoided. Dewatering may be required in situations where elevated groundwater levels are observed, highly permeable sands or granular material are present, if the proposed alignment breaches confining layers or the confining layer is thin and is not capable of sustaining the piezometric head as determined from geotechnical studies. Potential groundwater pumping impacts may be assessed by the development of numerical models or a comprehensive monitoring plan to ensure protection of the natural functions of the ecosystem as well as other water users.

Impacts from the construction of trenches can be minimized by:

- Excavating vertical trench walls by the use of trench boxes;
- Application of trenchless technology in sensitive areas by considering, for example, micro-tunnelling, jack and bore, and tunnelling,

The construction of water and sewer service trenches can alter the flow of groundwater since these can act as conduits of preferential flow. This influence can be minimized by:

- Locating the bottom of the trench above the groundwater level, where possible
- Provide an impermeable, flexible collar around the sewer service trenches at regular intervals to block preferential migration along granular or re-worked geological materials.

Erosion and sedimentation controls typically consist of management practices, source controls and structural controls as outlined below. The application of these controls should be consistent with those specified in the Stormwater Management Plan.

Good management practices are an important component of the sediment and erosion control plan since they can reduce the need for the implementation of extensive structural controls. These practices typically include:

- Limiting land disturbance by physically marking off a site with snowfencing, tape, signs or other methods so that workers can see areas to be protected;
- Requiring the contractor to educate all workers on major provisions of the sediment and erosion control plan;
- Requiring the contractor to undertake on-going inspection of sediment and erosion control measures during construction to ensure they are functioning properly;
- Placement of siltation fences around the drip line of trees to protect the root system during any excavation;

- Undertaking temporary seeding as soon as possible after grading;
- Delineating storage and staging areas prior to construction and enforcing this throughout the contract; and
- Clearly delineating the limits of construction on engineering drawings.

Source controls are the first line of defence to control erosion. It is easier to control erosion than to contend with sediment after it has been carried downstream. Source controls that need to be implemented will include:

- The establishment of temporary and permanent vegetative cover practices as soon as possible. Stabilization of disturbed areas shall be accomplished by seeding, mulching, hydroseeding and planting. Temporary measures may also include the use of geotextile mats or nets. Chemical stabilization should not be used due to the ecological sensitivity of the area;
- Directing storm runoff away from exposed soil surfaces;
- Intercepting sediment as close to the source as possible;
- Minimizing the length and steepness of slopes to the extent possible to prevent erosion of the surfaces; and
- Stabilizing all stockpiled and dredged materials a safe distance away from water bodies;
- In-channel construction should be avoided and other options such as the use of trenchless technology techniques should be pursued. Construction should be undertaken in accordance with timing windows specified by local Conservation Authorities, the Department of Fisheries and Oceans (DFO) and the Ministry of Natural Resources (MNR). Furthermore, construction shall be undertaken during dry weather flow conditions. Construction undertaken in the dry season would involve diversion of flow by pumping around the site. Only clean material, free of fine particulates, should be used;
- Controlling all the activities, including maintenance procedures, to prevent the entry of petroleum products, debris, rubble concrete and other deleterious substances into the water. Vehicular refuelling and maintenance must be conducted away from the watercourses.

Structural practices are generally more expensive to implement and less effective than management and source controls. They are usually employed in series with the other practices to provide a second line of defence in the capture of sediments. These practices commonly include:

- Installation of continuous siltation fences along the perimeter of the construction site;
- Installation of temporary sedimentation basins where major overland flow routes are impacted by excavation;
- Installation of filtration traps consisting of rock or straw bales, flow check dams, etc. for minor overland flow routes;

- Protection of trees/shrubs by temporary protection barriers (e.g. snow fencing, t-bar stakes, etc.). These barriers should be erected around trees/shrubs, outside the drip line of the plant, prior to the commencement of construction to prevent accidental damage or removal. Trees to be removed should be marked.

6.8 Step 8: Prepare the Plan

Once Steps 1 to 6 are completed, the sewage and water system plan must be prepared. The plan should include the following components:

- Documentation of the work undertaken in the steps identified above;
- A conceptual layout of the system showing all major components and sizes;
- An implementation program along with schedule and cost;
- A construction remediation plan for the protection of surface and groundwater quality and quantity; and
- The development of a plan to monitor water quality and quantity.

The sewage and water system plan needs to ensure that the ecological integrity of hydrological features and key natural heritage features will be maintained, groundwater and surface water quality and quantity, including baseflows, are maintained, the projected water use for the developments is sustainable, applicable watershed and water budget and conservation plans are complied with, and natural groundwater flow not be disrupted during construction. It is necessary that these requirements of Section 43 of the ORMCP be met in addition to compliance with other requirements identified in Section 2 of this technical paper.

6.9 Step 9: Monitoring

Figure 2 shows a suggested hierarchy of monitoring related to the water provisions of the ORMCP. The scope of monitoring will vary for each program or project based on the requirements of the ORMCP, environmental targets identified in a plan, and specific conditions of an approval.

It is suggested that details of the monitoring to be undertaken, such as the frequency at which samples will be collected or observations made, the locations to be monitored, the methods to be used, and the duration of monitoring be designed to suit the specific needs of the particular program or project.

The Ontario government, in consultation with approval authorities, shall over time identify performance indicators for monitoring the effectiveness of the ORMCP (see the Implementation section of the ORMCP). The Province, in partnership with appropriate stakeholders, shall establish a monitoring network to collect, summarize, and evaluate performance indicator data to:

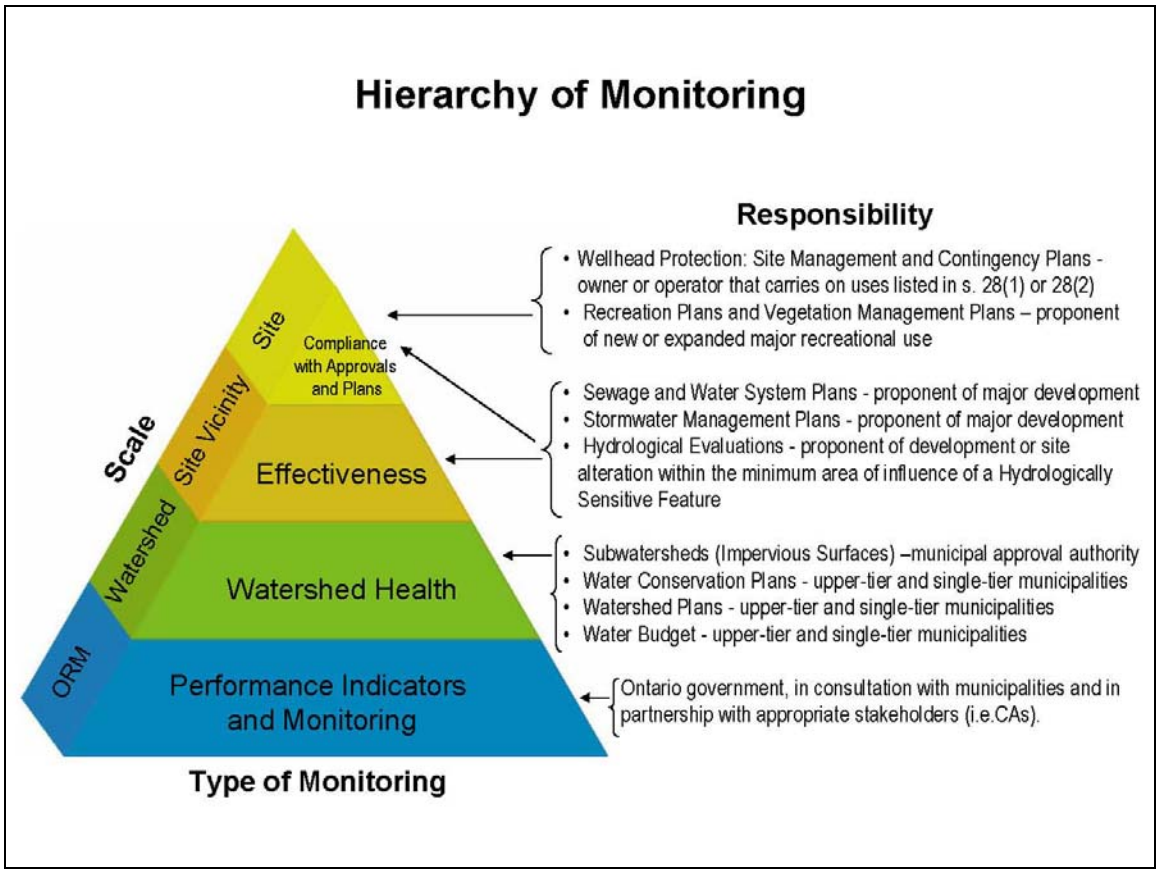
- Assess changes in the ecological integrity of the Moraine;
- Assess the effectiveness of the policies of the Plan in achieving the Plan's vision and objectives;

- Help identify improvements that would address problems encountered in implementing the Plan.

In addition to satisfying the needs of local watershed plans or specific projects, monitoring at the other scales (i.e. at the site, site vicinity, and watershed scales) may provide valuable information that will contribute to the overall monitoring of the ORMCP.

When preparing Sewage and Water System Plans, it is suggested that proponents of major development, which may include approval authorities or land developers, include in their plans an outline of proposed monitoring to be undertaken during and after development.

Figure 2 Hierarchy of monitoring related to the water provisions of the ORMCP



Although it is not specified as a requirement in the ORMCP, monitoring of the site during the construction phase, as well as ongoing monitoring after construction, is suggested to assess whether the major development is consistent with the Sewage and Water System Plan. Monitoring of the site and site vicinity may be used to evaluate the effectiveness of the measures identified in the Sewage and Water System Plan with respect to:

- maintaining the ecological integrity of hydrological features and key natural heritage features;
- maintaining the quantity and quality of groundwater and surface water;

- maintaining stream baseflows; and
- minimizing the disruption by water and sewer service trenches of natural groundwater flow.

It is suggested that the Sewage and Water System Plan also specify who will take responsibility for the monitoring after development. The proponent of major development may be required to conduct monitoring as a condition of site plan approval. Where the approval authority is responsible for approving the major development, monitoring by the approval authority would be at the discretion of the approval authority.

7 References and Resources

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