Chloride Impact Study

PURPOSE:

This document provides guidance for the completion of a Chloride Impact Study, which may be required for the submission of an application under the *Planning Act*. All Chloride Impact Studies shall follow the requirements referenced in this document.

A Chloride Impact Study provides information for a Planning Application where:

- The proposed development is in a Wellhead Protection Area;
- The proposed development site is located within an area designated as Highly Vulnerable Aquifers; and/or,
- The proposed development is located where a Chloride and/or Sodium Issue has been identified.

The primary purpose of the study is to assess if Chloride loading due to winter de-icing activities from a proposed development will cause adverse source water quality concerns in the context of the Ministry of the Environment, Conservation and Park's (MECP) Reasonable Use Concept (RUC) water quality guidelines.

The Reasonable Use Concept establishes limits for the allowable concentrations of contaminants based on background groundwater quality and the reasonable use of groundwater on an adjacent property. The limits are set such that there would not be any significant effect on the use of the groundwater on the adjacent property.

PREPARED BY:

A Chloride Impact Study must be prepared by a licensed Professional Geoscientist in the province of Ontario or an exempted Professional Engineer as set out in the *Professional Geoscientists Act of Ontario.* The study should follow generally accepted methods outlined in the *Professional Practice Guidelines for Groundwater Resources Evaluation, Development, Management and Protection Programs in Ontario* (APGO, 2004).

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A Chloride Impact Study is required to the satisfaction of the City prior to the draft plan approval for a subdivision/condominium for lands to be developed with industrial, commercial, or institutional uses where Chloride will be applied on the road or large parking lots. Based on the total length of roads and parking lot areas, and the amount of

Chloride applied, the hydraulic loading to groundwater must be assessed relative to the MECP's *Reasonable Use Concept* water quality guideline for chloride. In determining the hydraulic loading, a pre- and post-construction water balance (water budget) is required whereby consideration is given to the hydraulic properties of the underlying soil materials, the area of imperviousness, and the overall stormwater management strategy for the site.

Predicted chloride concentrations need to be determined prior to development to evaluate if the proposed land use is reasonable and if preventative measures should be implemented through the development approval process. The MECP's *Reasonable Use Concept* was not strictly developed for this purpose; however, it is one approach to assessing stormwater-related impacts to groundwater recommended in the *Stormwater Management Planning and Design Manual* (MOE, 2003).

Two assessments may be required as part of an overall Chloride Impact Study for a particular area:

- an assessment of the impact of the individual development on groundwater quality; and,
- an area-wide assessment of the cumulative impact on municipal water supply well(s).

The first assessment noted above is to ensure that the proposed development does not have an adverse impact on local groundwater quality. The second assessment is necessary in the case of secondary plans, new major roads (i.e. roads requiring a Municipal Class Environmental Assessment), etc. where the cumulative impact of roads and parking lots in a specific area could result in increased chloride loadings to a particular municipal water supply well(s) as a result of winter de-icing activities.

This guideline is provided for the first type of assessment: an assessment related to Chloride loading associated with individual developments. In the case of an area-wide assessment, the proponent should contact City of Hamilton staff for additional guidance.

All information requested below must be included in the Chloride Impact Study.

1. Hydrogeological Assessment

A hydrogeological characterization should be completed according to generally accepted professional practice guidelines before initiating the Chloride Impact Study. The hydrogeological characterization should include the following information:

- location and condition of boreholes and monitoring wells;
- location and condition of domestic and municipal water supply wells;
- local and regional-scale hydro stratigraphy in cross-section (conceptual hydrogeologic model), including depth to municipal water supply aquifers and aquitards and hydraulic properties;
- Source Water Protection areas, including vulnerability scores;
- intrinsic susceptibility of water supply aquifers;
- seasonal groundwater contours and flow direction;

- seasonal horizontal and vertical hydraulic gradients;
- identification of recharge and discharge areas; and,
- background groundwater quality, including sodium and chloride.

2. Chloride Impact Study

In addition to the information in the Hydrogeological Assessment above, the Chloride Impact Study will require soils investigations to determine soil profiles and the hydraulic properties of the native geologic materials to estimate infiltration rates across the subject property. Representative infiltration rates are required for all soil types on the property.

The Chloride Impact Study should also include an evaluation of the proposed Stormwater Management Plan for the subject property and its ability to minimize the infiltration of Chloride-laden winter runoff and to mitigate impacts to source water quality.

It is necessary for the proponent to determine existing background chloride concentrations and include a discussion of the concentrations relative to potential sources.

Background chloride concentrations in the groundwater prior to anthropogenic impacts in the City are typically between 2.5 and 15 mg/L. Where background concentrations cannot be determined the maximum concentration (15 mg/L) should be used to assess the impact from a development.

The following additional site-specific information is also required:

- the total length of roads in the development (in 2-lane-kms) and type of roads (e.g. primary, secondary, or local);
- the area of parking lots;
- anticipated winter maintenance service level and Chloride application rates (based upon the type of roads proposed or other available information); and,
- anticipated proportion of Chloride that will infiltrate to the ground water.

Based on the proposed road network, parking lot area, and the anticipated Chloride loading the hydraulic loading to the groundwater must be assessed. In determining the hydraulic loading, an existing and proposed conditions water balance will be required which must be consistent with the water balance determined as part of the Stormwater Management Plan for the subject property.

2.1 Assumptions

2.1.1 Chloride Application Rates

For roads, the proponent should assume the following:

- 44 tonnes/two-lane-km (primary roads);
- 22 tonnes/two-lane-km (secondary roads); and,

- 2.2 tonnes/two-lane-km (local roads).

Instead of the rates above, loading rates reported by the City of Hamilton may also be used based on a minimum 3-year rolling average. Justification will be required if lower Chloride loading rates than those recommended above are used.

For parking lots, data provided by the Smart About Salt (SAS) program indicates that there is a wide range reported in terms of Chloride application rates and the number of times Chloride is applied per year by winter maintenance contractors. The proponent should assume an average loading rate of 50 g/m2/event to parking lots with Chloride applied on average 37 events per year (WESA, 2013).

2.1.2 Chloride Infiltration Rate

The proponent should assume 28% of the Chloride that is applied to the road infiltrates to the subsurface in catchments where there is a surface water outlet or 100% of the Chloride that is applied to the road infiltrates to the subsurface in catchments with no outlet (e.g. in the case of end-of-pipe infiltration facilities). If road Chloride is applied to roads with impervious boulevards the amount of Chloride infiltrating may be reduced.

Any other assumptions used in the assessment should be clearly stated and justified to the satisfaction of the City.

2.2 Reasonable Use Concept

The study must demonstrate that chloride levels in groundwater found at the site boundary under proposed conditions meet provincially-accepted Reasonable Use Concept water quality criteria as set out in the 1994 MOEE document *Guidelines B-7 – Incorporation of the Reasonable Use concept into MOE Groundwater Management Activities*. RUC criteria for chloride evaluate whether groundwater concentrations at the site boundary exceed the following:

RUC = background chloride concentration (in groundwater on the subject land) + 50% of 250 mg/L (ODWS aesthetic objective for chloride)

3. Reporting and Recommendations

The Chloride Impact Study should discuss the final anticipated chloride concentrations in the groundwater as a result of the proposed development relative to the calculated Reasonable Use Concept water quality guideline.

Recommendations should be made for mitigating the impacts of winter de-icing in terms of the overall layout of roads, parking areas, snow storage, etc. in the proposed Development Concept Plan.

Recommendations should also be provided to guide the Stormwater Management Plan to prevent or mitigate the impacts of winter de-icing on the municipal drinking water supply and to enable opportunities for environmental restoration or enhancement with respect to water resources.

As well, recommendations should be made in terms of the overall winter de-icing activities for the proposed development, including Chloride Management Plans, snow storage, and other winter de-icing best practices. The Chloride Impact Study should also include discussions of the existing and proposed conditions water balance, as well as the overall effect of development on the watershed water budget, if applicable.

OTHER INFORMATION:

Ministry of the Environment, Conservation and Parks (formerly the Ministry of the Environment and Energy) 1994, GUIDELINE B-7 Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities.
https://www.ontario.ca/page/incorporation-reasonable-use-concept-moee-groundwater-management-activities-guideline-b-7

Ministry of the Environment, Conservation and Parks (formerly the Ministry of the Environment) 2003, Stormwater Management Planning and Design Manual.
https://www.ontario.ca/document/stormwater-management-planning-and-design-manual-0

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