



Chloride Impact Assessment

155 – 171 Guelph Avenue
City of Cambridge

GMBP File: 417132

October 2018

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CHLORIDE IMPACT ASSESSMENT**155 – 171 GUELPH AVENUE****CITY OF CAMBRIDGE****OCTOBER 2018****GMBP FILE: 417132**

1. INTRODUCTION AND SITE INFORMATION

GM BluePlan Engineering Limited have prepared this chloride impact assessment in support of the Draft Plan of Subdivision and Zoning Bylaw Amendment for 155 – 171 Guelph Avenue in the City of Cambridge.

The site is bound by existing residential development to the north, existing natural area to the east, the Canadian National Rail Line and existing industrial site to the south and Guelph Avenue to the west.

2. SALT IMPACT ANALYSIS

In areas where road salt is of concern, the groundwater chloride levels can be evaluated using the Reasonable Use Concept (RUC) methodology provided within Guidelines B-7 – Incorporation of the Reasonable Use Concept into MOECP Groundwater Management Activities (MOECP, 1994).

Based on the RUC, the groundwater chloride level at property line is calculated as follows:

$$\text{RUC} = \text{background concentration} + (50\% \text{ of ODWQS limit})$$

Note: the Ontario Drinking Water Quality Standard (ODWQS) for chloride concentration is 250 mg/L.

2.1 Pre-Development Conditions

For the 155-171 Guelph Avenue Subdivision development, the background concentration of chloride is unknown. In cases where the background concentration is unknown, a maximum concentration of 15 mg/L may be utilized.

Therefore, the groundwater chloride level at property line is calculated as follows:

$$\text{RUC} = 15 \text{ mg/L} + (50\% \text{ of } 250 \text{ mg/L})$$

$$\text{RUC} = 15 \text{ mg/L} + 125 \text{ mg/L}$$

$$\text{RUC} = 140 \text{ mg/L}$$

2.2 Post-Development Conditions

As part of the 155-171 Guelph Avenue development, approximately 0.21km of existing two-lane roadway along Guelph Avenue and approximately 0.04km of existing two-lane roadway along Shaw Avenue East will be utilized to support the proposed residential development.

Within the Region of Waterloo, roads are classified as either primary roads, secondary roads or local roads. The generally accepted salt loading rates for primary and secondary roads are 44 tonnes per two lane km and 22 tonnes per two lane km. Please note a local road is identified as a road for which no winter maintenance activities will occur, therefore the generally accepted salt loading rate is 0 tonnes per two lane km.

Since the development at 155-171 Guelph Avenue utilizes the existing two-lane roads (Guelph Avenue and Shaw Avenue East), an estimated salt loading rate of 11 tonnes per two lane km of road will be utilized to represent that 50% of the salt loading is contributable to the proposed residential development.

Therefore, the anticipated salt loading rate is calculated as follows:

$$\begin{aligned} \text{Salt Loading Rate} &= (0.21 \text{ km of two-lane road on Guelph Avenue} + \\ &0.04 \text{ km of two-lane road on Shaw Avenue East}) \times 11 \text{ tonnes per two-lane km} \\ \text{Salt Loading Rate} &= 2.75 \text{ tonnes per year} \end{aligned}$$

Based on the general composition of road salt, in which 60% is chloride and 40% is sodium, the salt loading rate is reduced as follows:

$$\begin{aligned} \text{Salt Loading Rate} &= 2.75 \text{ tonnes per year} \times 60\% \\ \text{Salt Loading Rate} &= 1.65 \text{ tonnes per year} \end{aligned}$$

During the placement of salt, only salt that is overspread beyond the limits of the internal road network, or splashed onto grassed areas and boulevards, will have the potential to infiltrate. Based on the layout of this development and the typical road cross-section for Guelph Avenue and Shaw Avenue East, which includes boulevards and sidewalks, it is assumed that 25% of the chloride placed on site will infiltrate. Therefore, the chloride loading rate to groundwater is calculated to be 0.41 tonnes per year (1.65 tonnes per year \times 25% = 0.41 tonnes per year).

Due to the layout of the development, site grading constraints and native on-site soils, the opportunity for lot level infiltration of runoff is limited. Based on an estimated average annual precipitation of 916 mm, the potential for evapotranspiration from this site is estimated to be 230 mm for pervious surfaces and 150 mm for impervious surfaces, with approximately 686 mm and 766 mm available for recharge and runoff from pervious and impervious surfaces, respectively. Therefore, based on the annual infiltration rates, the annual average groundwater recharge occurring within the 5.27-hectare site is estimated to be approximately 3,745 m³ under post-development conditions. This annual average groundwater recharge will dilute the chloride concentration infiltrating to the groundwater.

Based on the chloride loading rate of 0.41 tonnes per year, the estimated chloride concentration of the infiltrating recharge is 109 mg/L. This represents 78% of the Reasonable Use Concept (RUC) concentration of 140 mg/L.

A recommended mitigation measure that may be implemented by the City of Cambridge to further reduce the estimated chloride concentration is the application of a salt/sand mixture when site conditions require the application of salt. The recommended salt/sand mixture consists of 25% salt and 75% sand.

If the City of Cambridge were to utilize a salt/sand mixture, the salt loading rate for the 155-171 Guelph Avenue development would be further reduced as follows:

$$\begin{aligned}\text{Salt Loading Rate} &= 1.65 \text{ tonnes} \times 25\% \\ \text{Salt Loading Rate} &= 0.41 \text{ tonnes per year}\end{aligned}$$

Using the salt loading rate of 0.41 tonnes per year, the chloride loading rate to groundwater is recalculated to be 0.1 tonnes per year ($0.41 \text{ tonnes per year} \times 25\% = 0.10 \text{ tonnes per year}$). Based on the recalculated chloride loading rate of 0.1 tonnes per year and the estimates annual recharge of 3,745 m³/year, the estimated chloride concentration of the infiltrating recharge is 27 mg/L.

Therefore, the salt loading due to the proposed development will result in a background chloride concentration below the Reasonable Use Concept concentration of 140 mg/L. The use and application of a salt/sand mixture by the City of Cambridge is recommended to further reduce the estimated chloride concentration in groundwater to approximately 27 mg/L.

3. CONCLUSIONS AND RECOMMENDATIONS

From the foregoing analysis, the following conclusions are drawn:

- Based on the Reasonable Use Concept, the groundwater chloride level at the property line is 140mg/L.
- The groundwater chloride level at property line for the 155-171 Guelph Avenue development will be 109 mg/L under the post-development conditions, which is below the Reasonable Use Concept.
- It is recommended that the City of Cambridge utilize a salt/sand mixture to further reduce the chloride concentration to 27 mg/L.

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED

Per:



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