PH3 Cambridge IP Park

Chloride Impact Study – Preliminary Report

Developer
Torhill Developments Inc.

Project Number
KCH-00249478-B0

Prepared By:
EXP Services Inc.
405 Maple Grove Road, Unit 6
Cambridge, ON N3E 1B6
Canada

Date Submitted
June 2019

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1 Introduction

1.1 Overview

EXP Services Inc. (EXP) was retained by **Torhill Developments Inc.** to undertake a Preliminary Chloride Impact Study in support of a Draft Plan Application for the proposed development of the Phase 3 Lands, IP Park Project located in Cambridge, Ontario, hereinafter referred to as the 'Site'.

The subject Site includes two (2) distinct parcels with the municipal addresses of 250 Allendale Road and 105 Middle Block Road in Cambridge, Ontario. The Site is irregular in shape, approximately 120.91 ha in size and is presently occupied by agricultural fields, rural residential, forest and wetland. The Site mostly consists of a large block of land bound by Riverbank Drive to the west, Middle Block Drive to the north, Fountain Street North to the east and Allendale Road to the south (**Drawing 1**). The IP Park Project Phase 2 Lands are located immediately south of the Site across Allendale Road. A woodlot is present within the northeast corner of the Site, with Allendale Creek present along the western portion of the Site, which drains to the west towards the Grand River. The proposed development includes the creation of new commercial/industrial buildings, all to be serviced with municipal water and sewer services, set at conventional depths.

A hydrogeological assessment is still ongoing at the Site, and this Preliminary Chloride Impact Study is based upon results to date and is subject to change. This report should be read in conjunction with the Hydrogeological Assessment and Water Balance Report (EXP, 2019).

1.2 Purpose

A Chloride Impact Assessment is required by the Region of Waterloo as a Significant Groundwater Recharge Area (SGRA) was identified on the Site which has a vulnerability score of 2. A Chloride Impact Study has been completed, which includes the calculation of salt loading from de-icing operations to the groundwater to ensure that groundwater chloride concentrations will remain within Reasonable Use Concept (RUC) Guidelines established by the Ministry of the Environment (MOE; now Ministry of Environment Conservation and Parks, MECP). The assessment presented considers the following:

1) Water Quantity: Ensure aquifer recharge is maintained or enhanced for post-development.
2) Water Quality: Ensure that the ultimate steady-state concentration of chloride in the groundwater will not exceed the MOE's RUC.
3) Hydrogeologic Impact Assessment: Identify the Regional and Site geology and hydrogeology and evaluate potential groundwater impacts in relation to the applicable source water protection governing Acts/Policies:
    a) Clean Water Act (MOE, 2006)
    b) Assessment Report (LERSPC, 2015).

The purpose of this study is to assess impacts to the groundwater system (both quality and quantity), and if necessary, mitigate the impacts by proposing enhanced development technologies and construction techniques. To address the groundwater quality, a hydrologic model was analysed to determine infiltration rates and then a mass balance was completed to quantify potential winter salt application impacts (chloride) to the existing groundwater quality per the reasonable use concept (RUC) criteria.

1.3 Reasonable Use Concept

In the Region of Waterloo, the assessment of road salt and its impact on groundwater quality must be made for all new developments located within the capture zone of municipal wells. This assessment can be made by estimating the total chloride levels post-development due to road salting activities and comparing the

estimated value with specific target criteria for chloride concentrations. Although the Region of Waterloo has yet to establish a groundwater quality criterion for chlorides, the Ontario Drinking Water Standard (ODWS) for chloride of 250 mg/L generally defines the upper limit of acceptability. In recent years the MOE's Reasonable Use Concept (RUC) has been adopted for various studies conducted in the Region to assess the impact of road salt on groundwater quality per the Region's document entitled *Draft Protocol for Evaluating Road Salt Impacts to Groundwater Using the Reasonable Use Concept,* dated January 2008.

The RUC establishes limits for the allowable concentrations of contaminants based on background groundwater quality and the reasonable use of groundwater on 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. As a result, the quality of groundwater may not be degraded by an amount in excess of:

- 50% of the difference between background and the Ontario Drinking Water Objectives for non-health related parameters (e.g. chloride), or
- 25% of the difference between background and the Ontario Drinking Water Objectives for health related parameters (e.g. lead).

The Reasonable Use Concept (RUC) has been incorporated in Regulation 232/98. The RUC has been included directly as performance specifications for the site-specific design approach. In cases where the reasonable use of groundwater is other than drinking water, for example where background groundwater quality is poor, the RUC guideline allows alternative concentration limits to be set. These alternative limits would be determined on a case-by-case basis.

The RUC is calculated for a parameter based on the following expression:

$$Cm = Cb + x (Cr – Cb)$$

Where:

Cm = concentration of a parameter which complies to the RUC at the downgradient boundary

Cr = maximum acceptable concentration of a parameter (Cl = 250 mg/L)

Cb = background concentration of the parameter (averaged value of 30 mg/L) prior to any man-made contamination

For health related parameters x = 0.25 and for non-health related parameters x = 0.5

Therefore,

$$Cm = 30 \text{ mg/L} + 0.5 (250 \text{ mg/L} – 30 \text{ mg/L})$$

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

For this Site, the background chloride level of 30 mg/L has been averaged from the natural concentrations of chloride found in the groundwater. Monitoring well MW10 was found to have a chloride concentration of 709 mg/L which is considered an anthropogenic influenced value. This concentration was excluded from the averaged value of 30 mg/L. The full water quality results can be referenced in the IP Park Phase 3 Hydrogeological Assessment (EXP, 2019). It is noted that groundwater monitoring is on-going, and the Chloride Impact Assessment will be updated with additional water quality data when available. Thus, given the Ontario Drinking Water Standard (ODWS) for chloride is 250 mg/L and the background anthropogenic chloride concentration in the groundwater is approximately 30 mg/L, the **RUC concentration of chloride in groundwater is 140 mg/L.**

2 Chloride Impact – Mass Balance Analysis

To quantify potential winter salt application impacts (chloride) to the existing groundwater quality, a conservative mass balance analysis was completed for the proposed development.

The mass balance analysis approach used is considered a conservative evaluation since it does not include any dilution from groundwater already present in the system, any flow through dilution effects, or any off-site effects. All these effects would result in additional dilution of the chloride concentrations.

As the runoff from the development will be collected and channeled through storm sewer systems to discharge at the Grand River, the assumed percentage of infiltration is 28%, as per the Region of Waterloo Guidelines. The proposed SWM system includes a 50 m wide corridor of open channel which outlets to a SWM pond that eventually outlets to a culvert under Riverbank Drive and to the Grand River. All rain from rooftops on all buildings of each block is proposed to be infiltrated to onsite infiltration galleries.

The results of the mass balance analysis are summarized in the following **Table 1**:

Table 1. Mass Balance Calculation

Mass Balance Calculations – Secondary Roadway	Value	Total
Length of Roadway (Intermarket Road) (km)	1.2135	
Annual Salt Application Rate – Secondary Road (22 tonnes/two-lane-km/year) (1)	22	
Total Salt applied (Roadways) (tonnes/yr)		26.7
Mass Balance Calculations – Parking Lots		**Total**
Area of paved surfaces (parking lots) (m^2)	418,068	
Annual Salt Application Rate (events/year)	37	
Salt Applied (g/m^2/event) (1)	50	
Total Salt Applied (tonnes/year)		773.4
Mass Balance Calculations – Total Site		**Total**
Total Salt Applied (tonnes/year)	800.1	
Total Salt Applied (mg/year)	8.0E+11	
Assumed Percentage of Infiltration into Subsurface (%)	28	
Total Salt with 28% Infiltration (mg/year)	6.3E+10	
Total Estimated Infiltration Volume per year (L/yr) (2)	2.9E+08	
Total Groundwater Chloride Concentration from Roadways (mg/L)	217	
Molecular weight ratio of chloride to salt (sodium chloride)	0.606	
Estimated Total Groundwater Chloride Concentration (mg/L) (3)		132

Notes:

(1) The road salt application rates are based on values presented in the Region of Waterloo Report: *Road Salt Management and Chloride Reduction Study Phase 2: Evaluation of Chloride Reduction Options*, Stantec Consulting Ltd., 2003. These rates are considered conservative since they do not include the 25% target reduction or take into consideration more recent application loading data.

(2) Refer to Water Balance Completed as part of the Hydrogeological Assessment (EXP, 2019).

(3) The amount of additional chloride input to the groundwater is based on dilution calculations and the molecular weight ratio of chloride to salt (0.606).

Results from the mass balance analysis indicate the total additional chloride input to the subsurface from the proposed development areas is approximately **132 mg/L**, which is below the RUC limit of **140 mg/L**.

3 Mitigative Measures

The estimated post-development groundwater chloride concentration of **132 mg/L** is below the RUC limits of 140 mg/L. However, implementation of mitigation measures will decrease these anticipated chloride concentrations further and will assist in lowering the potential for groundwater quality impacts. Salt Risk Management Plans (SRMP) are now generally required for development properties within the Regional Municipality of Waterloo/City of Cambridge.

3.1 Salt Risk Management Plans (SRMP)

For the large industrial buildings, it is likely that snow removal and ice control will be undertaken by a private winter maintenance service provider. As such it is recommended that a site specific SRMP be required and implemented as part of the future development of each site. The purpose of the Salt Management Plan will be to reduce the impact of all winter maintenance activities involving salting practices on the surface water and groundwater resources. The SRMP should outline operational practices and strategies and should include considerations for:

- Awareness;
- Planning;
- Equipment;
- Application;
- Snow Removal;
- Site Drainage;
- Salt Storage; and
- Record Keeping.

An example Salt Risk Management Plan is included as **Appendix A**.

The example SRMP includes a recommendation for a road salt application limit of 29 g/m^2 (2.9 kg/100 m$^{2)}$. As it is understood that the roadways will be maintained by either the Region of Waterloo or City of Cambridge, this salt application reduction is only applicable to the parking lot areas of the development. Based on the reduced application rate of 29 g/m^2, an estimated groundwater chloride concentration of **77 mg/L** could be expected at the property boundary. **Table 2** below shows the reduced application rate used for parking lots and the modified calculations.

Table 2. Chloride Concentrations with SRMP

Mass Balance Calculations – Parking Lots	Value	Total
Area of paved surfaces (parking lots) (m^2)	418,068	
Annual Salt Application Rate (events/year)	37	
Salt Applied (g/m^2/event)(1)	29	
Total Salt Applied (tonnes/year)		448.6
Mass Balance Calculations – Total Site		Total
Total Salt Applied (tonnes/year) – Secondary Roads	22	
Total Salt Applied (tonnes/year) – Total		470.6
Infiltration Rate into Subsurface (%)	28	
Total Estimated Infiltration Volume per year (L/yr)(2)	2.9E+08	
Molecular weight ratio of chloride to salt	0.606	
Estimated Total Groundwater Chloride Concentration (mg/L)(3)		77

Notes:

(1) The road salt application rates are based on values presented in the Region of Waterloo Report: *Road Salt Management and Chloride Reduction Study Phase 2: Evaluation of Chloride Reduction Options*, Stantec Consulting Ltd., 2003.

(2) Refer to Water Balance Completed as part of the Hydrogeological Assessment (EXP, 2019)

(3) The amount of additional chloride input to the groundwater is based on dilution calculations and the molecular weight ratio of chloride to salt (0.606).

4 Conclusions and Recommendations

Based on the foregoing analyses, it is concluded that:

1. Based on a conservative mass balance analysis, completed for the proposed development, the expected average post-development groundwater chloride concentrations is 132 mg/L, which is below the Reasonable Use Concept limit of 140 mg/L.
2. The mass balance analysis performed in this study is considered to be a conservative evaluation since it does not include any dilution from groundwater already present in the system, any flow through dilution effects, or any off-site effects, all of which would result in additional dilution of the chloride infiltration.
3. Based on the hydrogeological conditions, the site soils are permeable and extensive with the capacity to infiltrate the derived flows, while likely not causing any adverse impact to local or regional groundwater supplies.
4. Reductions in salt application rates of at least 42% (= 1-29/50) would reduce the expected chloride concertation in groundwater at the Site boundary to 77 mg/L, which is well below RUC limits. This can be accomplished through less salt application or the use of sand and salt mixtures.

This Chloride Impact Assessment is required by the Region of Waterloo as a Significant Groundwater Recharge Area (SGRA) was identified on the Site which has a vulnerability score of 2. Recommendations for mitigations of salt de-icing activities are included as part of this study, even though the expected average post-developed groundwater chloride concentration is below the Reasonable Use Concept limit of 140 mg/L.

It is recommended that:

- Salt Risk Management Plan be prepared and formalized with the Region for each site at the Site Plan Approval stage. An example Plan has been provided as Appendix A.
- That the maximum salt application rate of 29 g/m^2/event, or an alternative equivalent mitigation, be incorporated into Site Plan Agreement for each industrial block.

5 References

EXP Services Inc. (EXP). 2019. Hydrogeological Assessment and Water Balance – Preliminary Report Phase 3 Lands, IP Park Project, Cambridge, ON. Project No KCH-00249478-B0. March 2019.

Ministry of the Environment and Energy, 1994, Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities, GUIDELINE B-7.

Ministry of the Environment (MOE). 2008. Technical Rules: Assessment Report, Clean Water Act, 2006

Regional Municipality of Waterloo. 2008. Draft Protocol for Evaluating Road Salt Impacts to Groundwater Using the Reasonable Use Concept (DOCs #409317, Version 1.0).

Stantec Consulting Ltd. 2003. Road Salt Management and Chloride Reduction Study Phase 2: Evaluation of Chloride Reduction Options.

6 Experience & Qualifications

EXP Services Inc. provides a full range of environmental services through a full-time Earth and Environmental Services Group. EXP's Environmental Services Group has developed a strong working relationship with clients in both the private and public sectors and has developed a positive relationship with the Ontario Ministry of the Environment, Conservation and Parks (MECP) and local Conservation Authorities. Personnel in the numerous branch offices form part of a large network of full-time dedicated environmental professionals in the EXP organization.

This report was prepared by Heather Jaggard, M.Sc., P.Geo., QP. Ms. Jaggard is a hydrogeologist and environmental geoscientist with more than 9 years in the environmental field and is a licensed Professional Geoscientist (P.Geo.) in Ontario. She obtained a Master of Science (M.Sc.) in 2012 from Queen's University in Kingston, and has worked in the Hydrogeological and Environmental fields since that time.

This assessment report was reviewed by Mr. Reinhard Zapata, Ph.D, P. Geo.

APPENDIX A

Road Salt Risk Management Plan
Phase 3 Lands, IP Park Project

Part of Lots 15, 16, 17 and 18, Beasleys Broken Front Concession,
City of Cambridge, Region of Waterloo, Ontario

1.0 Introduction

The proposed Phase 3 of the IP Park Development includes two (2) distinct parcels with the municipal addresses of 250 Allendale Road and 105 Middle Block Road in Cambridge, Ontario, and hereinafter referred to as the 'Site'. The legal description of the Site is listed as Part of Lots 15, 16, 17 and 18, Beasleys Broken Front Concession, City of Cambridge, Region of Waterloo (RoW). The Site is located within a RoW Municipal Well Head Protection Area (WHPA) and, as such, is subject to applicable policy requirements of the RoW's Regional Implementation Guideline for Source Water Protection Studies related to use of road salt. In accordance with RoW's policy RW-MC-36, a Risk Management Plan (RMP) is required to manage roads and parking areas where salt application may pose a significant drinking water threat. The RMP presented herein provides measures for the management road salt on Site driveways, parking lots and sidewalks to minimize potential risks from road salt releases and protect employees and visitors to the Site from falls and other potential hazards associated with accumulate ice and snow.

2.0 Objective

The objective of the salt RMP is to provide measures for the effective management of road salt at the Site that minimizes potential risks to Region's WHPA and is protective of the safety of individuals during ice causing winter time conditions. The specific objective is the implementation of measures that control or prevent the bonding of ice/snow to pavement or concrete. (effective salt management)

3.0 Applicability

The salt RMP is applicable to the individual development blocks of the Phase 3 IP Park development, and eventual maintenance staff or contractors associated with the properties that are undertaking snow and ice management at the Site.

4.0 RMP Components

The RMP presents general measures for the management and use road salt at the site which encompasses the following components:

- Awareness
- Planning
- Equipment
- Application

- Snow Removal
- Site Drainage
- Salt Storage
- Record Keeping

4.1 Awareness

General

All Maintenance staff and contractors engaged in snow/ice management operations for the site parking areas are to be made aware of the importance of implementing best management practices in relation to WHPA area vulnerability to road salt use. Maintenance staff and contractors are to be made aware of benefits of an effective salt management strategy at it relates to the control of winter maintenance and material costs, preventing and reducing corrosion damage to structures and utilities and damage to vegetation.

Considerations

- Maintenance staff or contractors engaged in snow and ice control should be trained or be knowledgeable on the storage, handling and application of road salt to minimize use.
- Maintenance personnel and contractors should be trained or be knowledgeable to assess weather conditions (i.e., temperature, type and extent of precipitation), and surface conditions to implement the best/most appropriate strategy (e.g. anti-icing, de-icing) for a given set of conditions.
- All individuals operating de-icing equipment should have the necessary training or experience especially in controlling application rates of road salt and salt containing materials to minimize releases to the environment.
- Prior to each winter season, the maintenance manager should meet with maintenance staff and or/the contractor engaged in snow and ice control operations to re-iterate the importance of applying best management practices related to assessment of conditions and event planning, material handling and application, and equipment operation and maintenance.

4.2 Planning

General

Storm event pre-planning relates to the evaluation of expected weather conditions to identify the measures that should be implemented as they are related to surface application materials (anti-icing versus de-icing), quantities and application rates, placement and timing.

Considerations

- Review weather forecasts and radar images to identify the type of precipitation event - snow, frost or freezing rain - and when the event may be expected.
- Implement surface specific and condition specific measures.
    - Implement anti-icing measures in advanced of a storm to prevent surface bonding of ice or snow.
    - Use abrasives with lower salt content (i.e. to prevent freezing and particle clumping) such as sand where conditions permit.

  - Use condition specific quantities of road salt or related agents (i.e. lesser amounts/lower for frost events and greater amounts for freezing rain events).
  - Use broadcast spreaders for parking lots and driveways and drop spreaders for walkways.
  - Plow snow where accumulations are expected to exceed 2 cm.
- Monitor treated surfaces for residual chemical presence to avoid unnecessary use of road salt or road salt containing products.
- If possible, monitor asphalt and concrete surfaces temperatures to determine if road salt or a related agent is required or if temperatures are too cold for application of road salt or the related agent.
- Apply road salt or a related chemical agent after plowing only if the pavement temperature is above the agent specific freezing point and where there is remnant ice or snow that could not be removed by a plow.

4.3 Equipment

General

Proper equipment maintenance and calibration should be used to minimize road salt or salt containing material usage.

Considerations

- Mechanical equipment should be used for snow removal and snow and plough blades set to the lowest possible clearance.
- Spreaders should be equipped with appropriate controls to adjust spreading rates for specific conditions.
- Spreading equipment should have on/off operator controls to avoid excess release of materials.
- Spreaders should have necessary controls to disperse materials across target areas only.
- Combination plow and spreaders should be used for more efficient snow removal and road salt or salt containing material spreading.
- Broadcast spreaders should be used on parking lot areas and a drop spreader for the sidewalk areas
- Spreaders should be calibrated following manufacture requirements and the calibration check before and during the operational season to confirm spreading rates.
- Spreading equipment should be inspected before and during the operational season.
- If possible, salt should be pre-wetted to enhance the activation time of the salt
- Pre-wetting tanks should be design to prevent spillage of entire tank contents in the event of a failure.
- Liquid product spray trucks should be equipped with a spray bar for the roadway and parking lot areas.

4.4 Application

The potential release of road salt to the subsurface of the Site is to be controlled through practices related to weather condition and surface assessment, anti-icing and de-icing, material selection, and use and application rates.

Considerations

- Alternative methods and materials should be used and road salt or road salt containing product use avoided altogether where possible.
- Use mechanical methods to remove accumulate snow and ice and slush including plow-equipped trucks, snow blowers and power brooms.
- Where conditions permit, use sand as an abrasive in place of solid salt. To prevent freezing and clumping, sand may be mixed with a small amount of salt, which should not exceed 3 to 5% by volume. Sand and salt should be mixed by mechanical means to obtain a homogeneous mixture.
- Use liquid agents for anti-icing instead of road salt. Apply liquid anti-icing agents on dry pavement in advance of a light snow or frost but not in advance of freezing rain or sleet where dilution of product is likely to occur. Apply anti-icing treatments under appropriate conditions as summarized as follows:

Table 1: General Conditions for Using Anti-Icing Agents (1).

Agent	Lowest Temperature (°C)	Application Rate (2)	Comments
Road Salt	-9	2.9 kg/100 m^2	Apply for dry snow
Liquid Salts	-7	3.2 L/100 m^2	Apply for wet snow

Notes:
(1) ITSS Lab, Department of Civil & Environmental Engineering, University of Waterloo, "Optimal Snow and Ice Control of Parking Lots and Sidewalks", January 2015.
(2) Specific application rates are to be determined from an assessment of storm event and surface conditions.

Kg = kilograms

L = litres

m^2 = square metres

- Use pre-wetted salt either by mixing a liquid with salt at the spreader or chute or adding liquid to a solid stockpile or pre-treating stockpiles to reduce salt use
- Do not use specific products/ materials below their freezing point temperatures, where they become ineffective:
    - rock salt (sodium chloride) – less than -10°C
    - Brine (23% by volume sodium chloride) less than -7°
- Application rates for de-icing should be adjusted for conditions in relation to snow type (e.g. lose or packed snow or ice), traffic, type of surface and pre-wetting.
- Road salt should be applied at specific rates for surface (parking stalls, road ways/ramps, sidewalks), temperature and snow and ice conditions.
    - Salt and sand mixtures at lower temperatures
    - Lower rates under frost or light snow
    - Higher rates under colder temperatures and heavier snows
    - Apply specific amounts to know areas

General application rates for asphalt surfaces under different temperature and snow conditions are summarized in the following table

Table 2: General Application Rates for Dry and Wetted Road Salt De-icing [(1)].

Temperature Range	Application Rate (kg/m^2) [(2,3)]			
	Loose Snow	Fresh Snow	Packed Snow	Freezing Rain and ice
-1 to -3	1.0 / 0.8[(4)]	1.3 / 1.1	2.0 / 1.6	10.6 / 8.4
-4 to - 6	2.5 / 2.0	3.3 / 2.6	5.0 / 4.0	26.4 / 21.1
-6 to - 9	5.8 / 4.6	7.7 / 6.2	11.6 / 9.2	62.6 / 49.3

Notes:
(1) ITSS Lab, Department of Civil & Environmental Engineering, University of Waterloo Optimal Snow and Ice Control of Parking Lots and Sidewalks, January 2015.
(2) Estimated application rates based on a snow thickness of up to 2 cm and a 3 to 4 hour return time to bare pavement.
(3) Specific application rates will vary with storm event and surface conditions.
(4) The first number is the application rate using dry road salt and the second number is the rate using wetted salt.

- Application equipment should be properly maintained and where possible calibrated.
- Logs should be maintained documenting all application events and equipment maintenance calibration.
- Salt materials should be inspected before for clumping and clumps removed
- Experienced contractors aware and knowledgeable of salt inputs should be employed

4.5 Snow Removal

General

Melting snow is a potential source of salt either from on Site or off Site ice management activities and should be managed to minimize salt releases.

Actions

- Snow should be plowed and stored in such a manner to minimize the requirement for Off-Site removal and the potential concentration of road salt in melted snow.
- Snow should be stored on the low side of pavement to direct melt waters away from pavement or salt vulnerable areas.
- Snow should be stored in areas where melt water is not being directed towards parking and roadway areas to prevent re-freezing and additional salting operations.
- Melt water should be directed to the perimeter swales/ditches.
- Snow removed from the Site should be transported to a proper snow disposal facility.
- Salt or salt containing products should not be added to promote rapid melting of snow.
- Mechanical agitations or spreading may be used to promote melting.
- Snow should be stored in sun exposed areas to promote melting.
- Snow should not be store over drains.

4.6 Site Drainage

General

Directing surface water flows away from asphalt surfaces to prevent ponding or puddle formation and the creation of areas prone to ice formation is a proactive measure to minimize road salt use. The grades of the Site parking areas are designed to direct surface water flow to perimeter ditches/swales, where it is to conveyed to the storm water management. These measures are to be maintained to avoid unnecessary use of road salt or related products on ponded areas.

Considerations

- Parking lot grades are to be constructed and maintained as per the Site surface features design/drainage plan, where drainage is directed away from pavement areas.
- Drainage from roof downspouts should be directed away from pavement areas.
- Underground utility corridors should be constructed in a manner that avoids the creation of undulations susceptible to ponding.
- Periodic maintenance inspections of parking lots and driveways for ponding should be conducted and records of such inspections maintained.
- Ponded water should be dispersed using power brooms or leaf blowers.
- Snow should be piled on low areas or on the back side of curbs such that melt water is directed away from pavement areas (see snow removal).
- Should areas of noticeable ponding developed, repairs should be made to these areas as directed by a paving engineer in a timely manner during the next repair season.
- Repair low areas where puddles may form and which may be prone to freezing.

4.7 Salt Storage

General

Storage of salt, sand/salt mixtures or liquid agents are potential source of uncontrolled releases and as a best practice should be prohibitive at the Site.

Considerations

- On-Site handling of road salt by contractors should be prohibited.
- If road is stored On-Site, practices to be followed should include:
    - Storage in a permanent enclosed structure constructed with a pad of impervious asphalt or concrete.
    - Site drainage should be directed away from road salt or salt containing product areas.
    - Spreading equipment should be loaded on pads constructed of impervious asphalt or concrete and should not be overloaded.
    - Immediate cleanup and return of all spilled materials to the storage shed/building and documentation of cleanup activities.
    - Stored salt should consist of non-aggregate materials free of clumping.
    - Road salt should be stored in original container or in secondary containers/bins and not stockpiled.
    - Logs should be kept of salt and salt containing product transfers including any material spillage and the measures taken to control and clean up the spills or to contain and recover spilled materials.

- Liquid product storage tanks should be protected from potential vehicle collisions and provided with secondary containment or located in an accessible area that provides for prompt product recovery.
- Spreading equipment should not be cleaned or washed on Site and such activities should only be undertaken at facilities where salt containing wash waters are collected.
- Annual and periodic inspections of the salt storage enclosure and tanks should be conducted for pad cracks and other signs of deterioration. Repairs to pads and tanks should completed where possible in a prompt manner and should be inspected and reviewed by the Site maintenance manager or by person designated by the manager with appropriate training and experience to undertake such reviews. Inspection observations and repairs to pad, tanks etc. should be logged.

4.8 Record Keeping

General

Records and logs should be kept documenting the salt management practices and the effectiveness of such practices in meeting the Site objectives.

Considerations

Related documentation should include but not be limited to:

- Equipment calibration and maintenance records
- Employee training
- Contractor Agreement
- Daily logs documenting:
    - Date and type of treatment
    - Weather conditions including type of precipitation, air temperature, thickness of snow cover, asphalt conditions
    - Snow removal activities including plowing, blowing, sweeping
    - Materials and quantities used
    - Unusual conditions – areas not treated or problem areas.

5.0 References

ITSS Lab, Department of Civil & Environmental Engineering, University of Waterloo, “Optimal Snow and Ice Control of Parking Lots and Sidewalks”, January 2015.

Transportation Association of Canada, Syntheses of Best Practices. 10.0 Salt Use on Private Roads, Parking Lots and Walkways, April 2003.