Identification of Salt Vulnerable Areas: A Critical Step in Road Salt Management

Executive Summary

Northern communities repeatedly encounter snow and ice conditions forming hazardous environments on road networks during winter months. Millions of tons of road salts are applied in urban watersheds in North America for winter de-icing operations. De-icing agents containing chloride ions used for winter road maintenance have the potential to negatively impact urban stream water quality and groundwater resources used for drinking water supplies. Increasing numbers of agencies involved with winter road maintenance are working proactively to develop salt management plans that minimize the adverse environmental effects of de-icing chemicals. However, the attention that has been given to another important aspect of developing a salt management plan, the identification of salt vulnerable areas (SVAs), seems to be lacking. This presentation demonstrates a new methodology using readily available spatial data and site specific salt application data to identify SVAs for urban streams and groundwater wells.

This methodology is developed to help road maintenance authorities to prioritize implementation of better management practices for road salt applications. The approach uses simple mass-balance terms to calculate the probable chloride concentration statistics at specific points in the urban stream network or for wellhead protection areas of drinking water wells. The calculated chloride concentrations within urban streams are compared with known aquatic species exposure tolerance limits to characterize the vulnerability scores. The total number of aquatic species, in a given urban stream, that will likely be exposed to acute chloride concentrations are calculated using mean daily stream chloride cumulative probability distribution function and reported as the salt vulnerability scores of the urban stream. The calculated chloride concentrations for drinking water wells are compared with established drinking water quality standards (chloride 250 mg/L), developed by Canadian Council of Ministers of the Environment, and a risk score is calculated based on the resulting ratio.

The method has been applied to perform a vulnerability assessment on seven urban stream sites, in four watersheds in the Greater Toronto Area and validated using the Hanlon Creek watershed in Guelph, and on twenty municipal water supply wells, in the Grand River watershed, Ontario, Canada. The calculated urban stream and groundwater recharge chloride concentration for the supply wells are strongly correlated to the measured chloride concentrations in the case

study evaluation, with an R^2 = 0.96 and R^2 = 0.84, for urban streams and groundwater wells respectively. Several of the Study Areas in the Coty of Toronto (Don River, Highland Creek and Humber River) indicated that high chloride concentrations exist during winter months. These high chloride concentrations create toxic environments for sensitive aquatic species. The drinking water wells located in Waterloo center and Cambridge near the 401 have been identified to be in significant risk with regards to drinking water quality. Immediate attention must be given to reducing the chloride loading in these areas to protect the drinking water source.

The new method provides a simple, robust, and practical method for municipalities to assess the long-term risk of chloride contamination in urban streams and drinking water supply wells due to road salt application. This methodology can also be used to predict the impact future development can have on urban streams and drinking water supply wells, as well as, the positive effects decreasing road salt application rates can have on our resources. The results from this research further the understanding of the effects road salts have on waterways and aid in developing a more focused salt management plans.