Problem and Research Objectives:

Winter de-icing chemicals are undeniably beneficial by helping to mitigate the inherent transportation hazards during the snow and ice storm seasons. On the other hand these chemicals tend to accumulate in local aquifers leading to a gradual increase of Na and Cl in the impacted aquifer systems. The current effort under this program is to determine a set of realistic boundary conditions in an aquifer exposed to high road salt loading conditions and correlate the impact with increasing sodium and chloride concentrations in the public drinking water supply and in the local drainage system (aquatic life). The observed parameters will be used as inputs into a computer model to simulate the de-icing chemicals pathways between their sources and the discharge points along the local drainage systems. The study is carried out on the Old Pond Meadows aquifer in Norwell, Massachusetts.

Methodology:

For the purpose of monitoring we set up 5 separate sites: 3 for spatial monitoring and 2 for temporal long term monitoring.
The spatial monitoring plan includes two 2-D vertical cross-sections and one 1-D track along a stream for baseflow discharge characterization. During this effort we collected a total of 170 representative water samples from 23 monitoring wells located near a public water supply pumping well for the Town of Norwell. All samples were analyzed by ion chromatography for ionic species and by Inductively Coupled Plasma Spectrometry for 15 metals.

Long term monitoring is achieved by installing AquaTroll 200 sensors in a cluster of 3 monitoring wells each reaching a different depth within the aquifer and by distributing 6 similar sensors at selected sites in the stream that is the principal drainage of the same aquifer. The sensors are deployed for long term (month to years) monitoring of temperature, water column depth, and specific conductance at 15 minute intervals. Specific conductance data were calibrated to yield concentrations of chlorides for monitoring dissolved levels of chloride de-icers.

Principal Findings and Significance:

To this date not all data have been yet fully evaluated and at this moment more data are still being acquired. However several important findings can be identified as critical to our understanding of how dissolved de-icers move inside an aquifer. Perhaps most revealing is the scale and extent of observed heterogeneities of dissolved de-icers within the aquifer due to preferential pathways in both the lateral and vertical directions. A better understanding of these pathways will help to better constrain our future effort to simulate de-icers migration paths and consequently to design better management practices of both the de-icer application rates and the preservation of drinking water resources for the future. Final report funded by this WRRC program will be submitted in the Fall 2013.

Student Support

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