Groundwater monitoring in an aquifer contaminated by road salt

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Groundwater Monitoring in an Aquifer Contaminated by Road Salt

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BC GIS Contest

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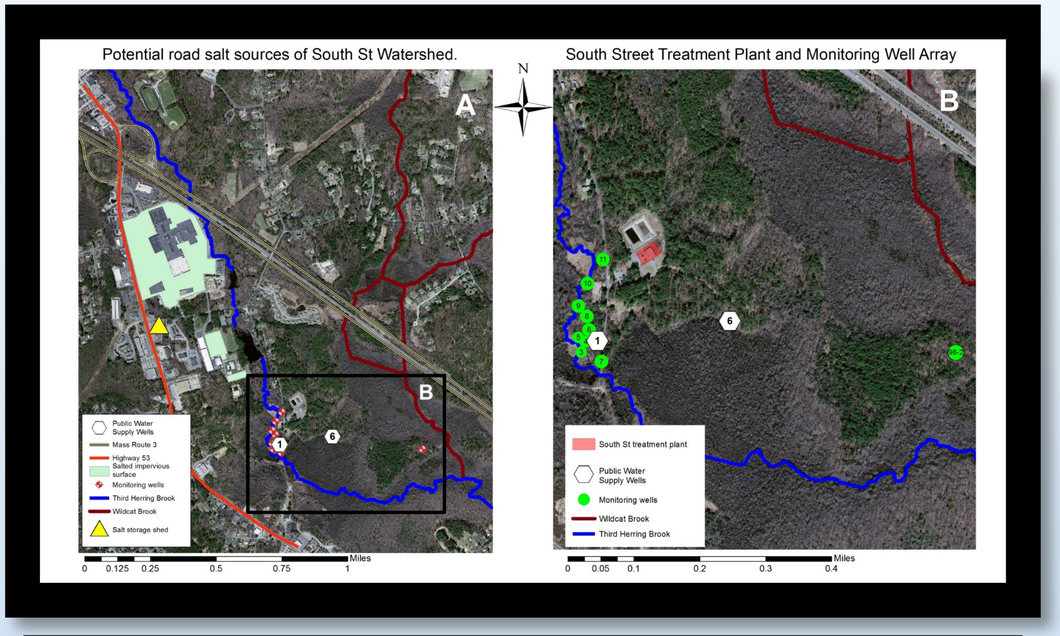

Figure 1 – 1A: Potential sources of deicer contamination in Norwell, Massachusetts. 1B: South St. water treatment plant with public supply wells and monitoring well array. USGS Color Ortho Images and Massachusetts Water Feature layer were downloaded from MassGIS.

ABSTRACT – This project focuses on groundwater contamination from road salt deicing agents in a small headwater catchment in SE Massachusetts. There are three major areas of study that will delineate preferential pathways of road salt from the sources to a public supply well and quantify the extent of the impact that road salt is having on the water quality of the aquifer. Those three areas of study are 1) subsurface hydrology of the aquifer 2) yearly road salt loading estimates and 3) water quality/chemistry.

GIS played two major roles in this project:

- Spatial analysis of water chemistry parameters (Cl^- concentration, Na/Ca ratio, percent TDS from road salt) throughout Massachusetts as well as a small catchment in Norwell, Ma (figures 3 and 4). This allowed areas of high contamination to be seen with respect to potential sources.
- Land use analysis to determine amounts of salted roadways (in lane miles) and commercial / residential surfaces (in acres) in the watershed. This data was then used to quantify annual salt loading (figure 2).

DISCUSSION – Water chemistry analysis show three distinct water types in the aquifer; 1) low salinity water from the eastern edge of the aquifer 2) high salinity water from the northwest of the aquifer 3) surface waters from Third Herring Brook that enter into pump NOR-1 from the south by monitoring well 7. NOR-1 pumps water that is a 40/35/25 ratio of these endmembers, while NOR-6 pumps water that is a 65/35/0 ratio. The fact that NOR-6 receives more of its water from the eastern edge of the aquifer (endmember 1) explains why this public supply well produces water with lower Na^+ and Cl^- concentrations. The additional salt entering into NOR-1 comes from Third Herring Brook surface waters (figure 5).

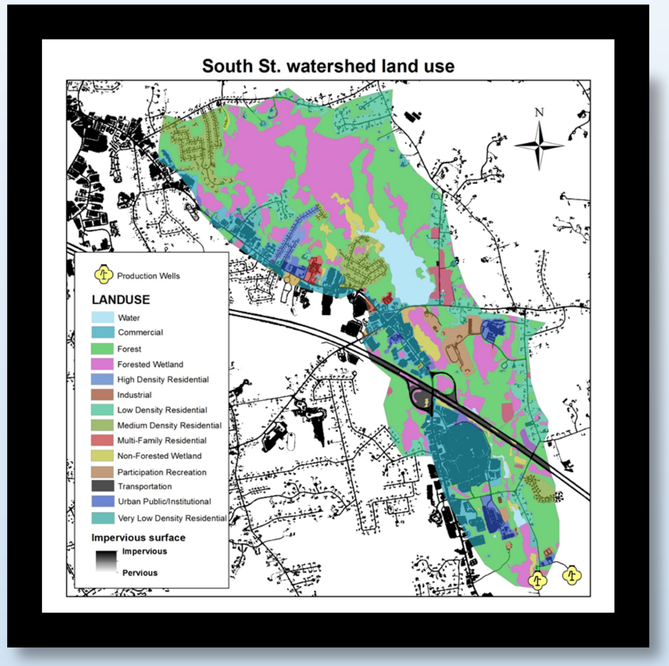

Figure 2 – Analyzing land uses of the South St. watershed for the purpose of calculating impervious surfaces and lanes miles of roadway – where these values will be used to estimate yearly salt application to the catchment. Land Use and Impervious Surface layers downloaded from MassGIS.

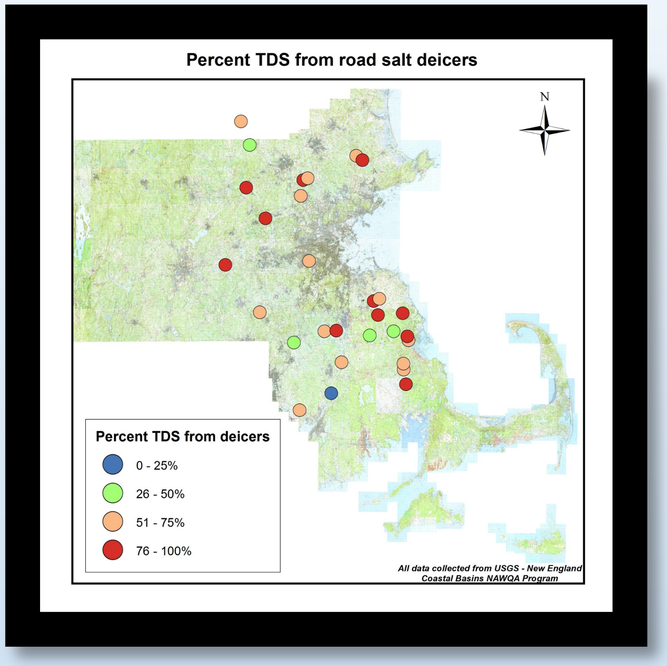

Figure 3 – The degree of groundwater degradation in eastern Massachusetts. 11 of 29 monitoring wells produce water with 75%+ of Total Dissolved Solids (TDS) coming from road salt deicers. Water quality data was obtained from USGS 1999 NAWQA NECB land use study.

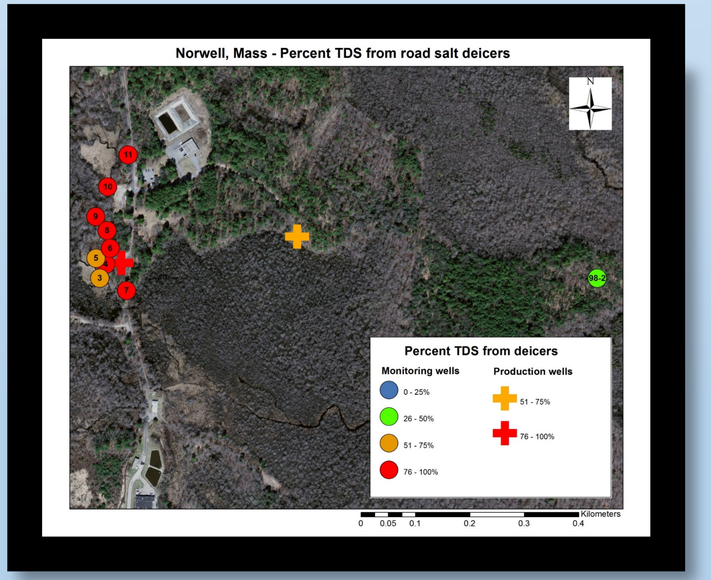

Figure 4 – The degree of degradation of groundwater in monitoring wells near the South St. treatment plant. 7 of 10 wells have water with 75%+ of TDS coming from road salt deicers. USGS Color Ortho Images were downloaded from MassGIS.

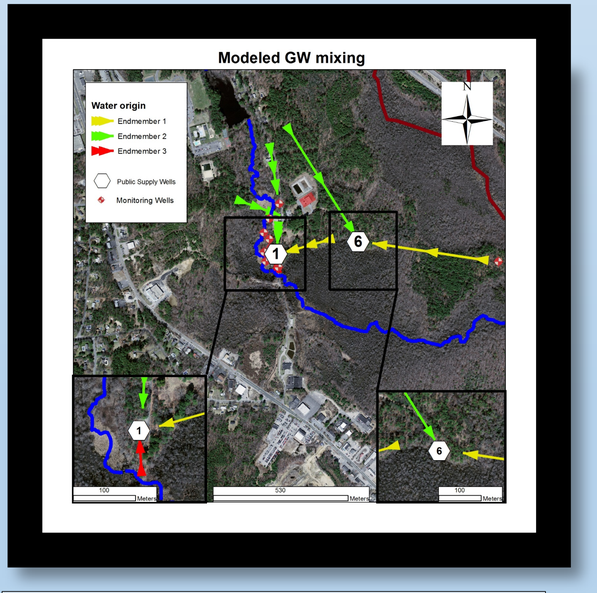

Figure 5 – Modeled groundwater flow / endmember mixing based on water chemistry analysis. USGS Color Ortho images and Massachusetts Water Feature layer were downloaded from MassGIS.

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