**PROJECT TITLE: Adaptive management to reduce road salt pollution**

**I. PROJECT STATEMENT**

**We will develop a tool to help cities understand how the transport of road salt in the environment is affected by modifications to salt application (e.g. form and amount) and plowing practices (e.g. frequency or blade type). The work will include the crucial step of iteratively incorporating feedback from public works personnel in the development of road de-icing scenarios and the resulting road salt transport, with the ultimate goal of reducing chloride pollution of lakes and streams from winter road management.**

Chloride is now considered one of the most important and urgent water pollution problems in Minnesota. This project seeks to improve road salting (“de-icing”) operations by developing simple tools to show the relationship between chloride levels in urban runoff with specific de-icing practices, on an event-by-event basis. Our findings will allow snowplow operators to see the environmental impacts of their de-icing practices and enable them to make improvements. Multiple benefits of the work include water quality improvement, reduced corrosion of infrastructure, possibly reduced de-icing costs, and tools that will be useful to all cities throughout the state.

We will compare road salt inputs and outputs in at least five cities, each of which has agreed to provide data on salt application (“salt inputs”), including from computerized salt trucks. We have or will acquire data on flow and chloride in runoff from several watershed managers within these cities (“salt outputs”). Finally, we will acquire relevant spatial and weather data from about 10 cities located throughout the state, so that findings can be applied statewide. Using these data we will determine the type of weather events that require major de-icing operations, and for each event and at annual scale, the fraction of applied chloride that ends up in direct runoff, in roadside “plow-off”, and in sub-surface groundwater. Other outputs include estimates of steady-state groundwater chloride and peak runoff chloride levels. The tool we develop will model impacts to these chloride transport characteristics in response to *management scenarios* of modified salt application and plowing practices. This approach is innovative, but builds upon a solid conceptual basis developed by the PIs in several ongoing and recently completed projects. It holds promise of enabling cities to efficiently reduce chloride contamination in surface and groundwater, while maintaining the goal of traffic mobility, very soon after completion of the project.

We will develop *management scenarios* by conducting five “feedback” workshops comprising snowplow operators and public works managers, building upon our positive experiences in a previous study. We anticipate that across five workshops, attendees would envision a dozen or so alternative de-icing practices that could evaluated with our scenario modeling tool.

**II. PROJECT ACTIVITIES AND OUTCOMES**

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| **Activity 1 Title: Develop tool inputs from acquisition of salt application, discharge, and weather data** **Description:** *For the case study watersheds (~ 5) we will compile computerized plow truck data (salt application rates, speed, etc.) along with water quality (discharge, chloride) data for the drainage. We will conduct roadside snow pile coring to estimate chloride accumulation in snowpiles along several types of roads. Weather and street type data will be compiled for major cities throughout the state.* **ENRTF BUDGET: $164,817**  |  |

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| **Outcome** | **Completion Date** |
| *1. For each case study watershed, a database of salt application rates, snowpile chloride accumulation, and storm drain water quality on a daily scale.* | *June 2022* |
| *2. Compilation of weather and street type data for major cities throughout the state.* | *June 2022* |

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| **Activity 2 Title: Develop tool to assess chloride loading from de-icing operation scenarios****Description:** *Using data from Activity 1, we will develop chloride balances (applied de-icer vs. output in runoff and groundwater) for each watershed at two time scales: a de-icing event (~days) and annual (relevant to TMDL plan development). We will then develop an open-source* ***de-icing scenario tool*** *can be used to estimate the impacts of altering de-icing operations on downstream chloride concentrations and annual loading. The scenario tool will be simple enough to be used by public works departments without external consultants.***ENRTF BUDGET: $164,817** |  |

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| **Outcome** | **Completion Date** |
| *1. De-icing scenario tool to assess chloride pollution potential on event and annual scales in response to modified de-icing practices* | *Dec. 2022* |

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| **Activity 3 Title: Workshops with de-icing operators to develop and simulate chloride reduction strategies****Description:** *We will conduct adaptive management workshops with snowplow operators, sharing our key findings with them, getting their ideas for modifying operations, and testing the effects of these altered operations on chloride loading from the test watersheds using our scenario analysis tool (Activity 2). An adaptive management approach using the tool will be developed and described in a Users Guide.***ENRTF BUDGET: $108,332** |  |

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| **Outcome** | **Completion Date** |
| *1. Five workshops to present findings and gain insight from road maintenance personnel, conducted at various locations throughout the state* | *June 2023* |
| *2. A users guide “Adaptive management to reduce chloride contamination from road de-icing”, written for an audience of snowplow operators and city public works departments.* | *June. 2023* |

**III. PROJECT PARTNERS AND COLLABORATORS:**  *Project partners will include several cities in the Twin Cities Metro Region (Shoreview, Roseville, St. Anthony Village, and Chanhassen), and one outstate city (to be identified), and the Mississippi Watershed Management Organization.*

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:** *We anticipate that cities will project use the proposed tool to refine their de-icing operations. Long-term implementation may require an active, overarching adaptive management process, modeled after the approach developed in our proposed project. Such a process would lead to continuous improvement – reduced salt use with no little or no loss of traffic mobility.*