

## **Project Title**

Campus Salt Reduction – Environmental Impact  
Monitoring and Mitigation Prototyping

## **Person who proposed it**

Salt Mitigation Task Force (SMTF)

Members: Eric Berliner (PPD), Lynn Wood (PPD), Adam Holmes (PPD), Matthew Walker (PPD), Kevin Sweeney (PPD), Paul Campo (Custodial Services), Kris Stepenuck (RSENR Faculty), Courtney Giles (CEE Faculty), John Lens (CEE Faculty), Gioia Thompson (Office of Sustainability), Joshua Faulkner (RSENR Faculty)

## **Decision**

Funding Approved

## **Budget**

\$35,570

## **Project explanation**

### **The Background**

The UVM Salt Mitigation Task Force (SMTF) was established in January 2021 to address an emergent and widespread problem with salt/deicing practices on campus. This cross-campus group of facilities managers, staff, and faculty identified this problem is costly in environmental and economic terms and is a wider infrastructure problem not well addressed by government, institutions, and industry. Our first of year work has already engaged over 160 students from varied disciplines and colleges at UVM and is fertile with opportunities for continued student engagement.

### **The Problem.**

Records from 2017 through the winter of 2019-2020 show UVM has applied approximately 53 tons of sidewalk de-icing agents (Source: Paul Campo, UVM Custodial Services), 2000 tons of salt, and 17,000 gallons of liquid magnesium chloride to campus roads and walkways (Source: Matthew Walker, UVM Grounds Services). Facilities personnel have observed significant impacts to infrastructure, including corrosion and failure of walkways, stairs, doorways, manholes (vaults), steam and hot water lines, and building structures (Figure 1), totaling more than \$1.7M in replacement costs. De-icing agents have known ecological impacts in freshwater systems, including the Lake Champlain Basin [1, 2].

Centennial Brook, a severely impacted stream in the UVM watershed, regularly exceeds the EPA acute toxicity level for chloride (860 mg/L), a major constituent of de-icing agents. As recently as winter 2020, chloride levels in Centennial Brook ranged from 945 to 2175 mg/L (Source: Kris Stepenuck). Mitigation of winter maintenance of roads and walkways necessary to maintain campus safety has seen some institutions implement alternative maintenance strategies with positive impacts to infrastructure and the environment [3]. The Part 1 goals outlined below are to explore similar opportunities for reducing the use of de-icing agents on the UVM campus.

### **The Approach to Creating Solutions.**

UVM embarked on reducing the impacts of salt/deicing practices beginning in the latter portion of the winter of 2020-2021 through a multi-faceted approach involving students concurrently with physical plant, grounds, and custodial services, including engaging faculty and the Lake Champlain Sea Grant program resources. This started with focus on reducing salt/deicing application in a responsible manner to keep travel ways safe and two student REU (research experience for undergraduates) projects funded by CEE. One project involved developing a water quality sampling and testing plan for the stormwater ponds for both baseline measurements (summer and fall before deicing) and during the winter. The second started identifying and characterizing the campus infrastructure damage by deicing chemicals.

The SMTF was successful in obtaining funding from the SCF last year for a new truck-mounted deicing spreading device to be linked to geo-location monitoring (with student support) of the deicing application, and for a student-led baseline stormwater monitoring and planning in the summer of 2021 through winter 2021-2022. A summary of SMTF activities through fall 2021 can be seen in this video (<https://www.youtube.com/watch?v=ftB3vCpixhs>), which was developed under the leadership of Lynn Wood for presentation at the 2022 Adirondack Salt Summit, as well as a new webpage (<https://www.uvm.edu/physicalplant/salt-mitigation>) created to share campus-wide activities.

Student engagement was expanded by Courtney Giles (CEE faculty) to involve approximately 160 students in her Fall 2021 CEMS 050 First-year seminar course who were asked by Paul Campo of UVM Custodial Services to provide solutions to reducing deicing chemical use, as part of their course project. Forty-two student teams took on the challenge, presenting a range of ideas to an

audience of faculty, UVM facility staff at a poster session held at the Davis Center in December 2021. Some of the ideas from this session, including the use of salt-concentrating plants on campus, have developed into co-curricular projects led by Joshua Faulkner (RSENR Faculty), the newest member to join the SMTF.

Student involvement continues this spring with students continuing to sample and test water in the stormwater ponds during this winter (See article,

<https://www.uvm.edu/news/sustainabilityoffice/task-force-aimed-reducing-uvms-road-salt-consumption>), and two students working on an REU this winter with John Lens to develop prototypes for mitigating deicing damage, through reducing the need for deicing by utilizing heated walkways and developing more durable walkway and associated surfaces.

This spring 2022 application for funding from the SCF is to continue the work of student engagement in the water quality monitoring (Part 2 goals below) and expand into the development of mitigation technology to reduce chemical deicing needs and damage (Part 1 goals below).

### **Project Goals.**

The Campus Salt Reduction Pilot Studies encompass near-term scoping goals established by the SMTF. These goals include:

1. Testing alternative methodologies that could reduce the amount of salt application on campus and which cannot otherwise be supported by the department. In this case, this is to investigate prototype heated walkway test-sections and associated durability testing of new surface treatments of walkways exposed to de-icing.
2. Gathering information on the composition of de-icing agents to inform purchasing decisions, which cannot otherwise be supported by the department.
3. Creating real-world learning opportunities for students to understand the impacts of deicing agents on the environment, including the analysis of water quality and soil conditions in UVM watersheds and impacts to infrastructure.

With evidence gathered in these first- and second-year preliminary studies, the SMTF aims to develop a sustainable campus-wide salt management plan to mitigate damage to infrastructure and the environment.

Part 1. To address the first goal, the physical plant department seeks to test heated walkway prototypes for effectiveness in maintaining traction and ice control and measuring associated energy use. Funds are requested both for constructing the walkway prototype sections, embedded heating elements, and energy monitoring equipment, and to fund student intern(s) in summer through winter/early spring 2022-23. Students would work with the physical plant staff to select, specify, and install heating and monitoring devices, and be involved in the prototype testing. Department funds are not currently available for this material and equipment or for student interns and therefore this prototype study will not progress without another source of funding.

Part 2. To address goals 2-3, student-led water and soil analysis will continue into summer and fall 2022 and spring 2023 with the goal of continuing the collection of baseline water quality data for comparison in future years of the salt-reduction project. New automated water quality monitoring equipment will be purchased and piloted in a single stormwater pond to determine the feasibility of collecting data 'hands-free' through the winter. This will allow the SMTF to collect data on salt levels at a much higher frequency than currently possible by student researchers to align water quality impact monitoring with the campus salting events. Students will continue to develop and implement experimental procedures to analyze the chemical composition of de-icing agents used at UVM. The soil testing component will help facilities managers determine the corrosion potential of heavily salted soils surrounding utilities vaults and pipes, which will inform the choice of materials for replacements and repairs (Note: this analysis is in progress. No new funds requested). Associated costs for Part 2 include sampling equipment, lab supplies, and external lab analyses, and exceed the funding currently available in the department for course supplies. Student labor cost contributions in fall 2022 and spring 2023 can be covered by the CEMS Research Experience for Undergraduates (REU) program. Summer project work will need to be covered by SCF support.

Benefits. This work will benefit multiple stakeholders at UVM. Student engagement is embedded in all aspects of the SRTF planning and pilot work. The identified projects align with current learning outcomes in CEE and RSEN and will enhance students' learning experiences by providing hands-on opportunities to address a significant sustainability goal while providing valuable data and support to facilities personnel. Funding for this project will enable the SRTF to reach beyond

what is currently available for pilot projects, equipment, teaching supplies, and student interns.

Importance. The project environmental monitoring work has shown itself to be successful in tracking progress of reduced salt use practices and has obtained baseline measurements for measuring future progress. This information on the impact of UVM's current deicing practices and environmental impacts, combined with the prototype testing will lay the groundwork for a campus-wide sustainable salt management plan. Ultimately, this plan will allow to be proactive in its environmental stewardship goals and infrastructure sustainability needs.

References:

[1] Hintz, W. D., and R. A. Relyea (2019). "A review of the species, community, and ecosystem impacts of road salt salinization in fresh waters." *Freshwater Biology* 64(6): 1081-1097.

[2] Smeltzer, E., et al. (2012). "Environmental change in Lake Champlain revealed by long-term monitoring." *Journal of Great Lakes Research* 38: 6-18.

[3] Cobb, B., et al. (2019). *A Blueprint for Salt Sustainability on the University of Wisconsin-Madison Campus*. Nelson Institute for Environmental Studies, University of Wisconsin-Madison. Retrieved 2 March 2021, from

<https://nelson.wisc.edu/graduate/water-resources-management/wrm-executive-summary-dig.pdf>

**Budget table**

<b>This Money will Supply</b>	<b>Requested funds</b>	<b>Justification</b>
Walkway Materials and Construction, heating elements, and monitoring equipment	\$15,000	Materials, including construction by UVM physical plant- Excavation, formwork, electrical wiring, controls, monitors
Student Labor	\$4,824	10 weeks at 15 hours/week for 2 students = 300 hours at \$15 an hour with a 7.6% benefit rate
Consumables for water testing	\$4,600	Calibration standards, sampling supplies, (bottles, sample tubes, filters, batteries, replacement cables) PPE

Automated Monitoring Equipment	\$4,000	Water quality sonde with sensors for continuous monitoring of dissolved oxygen, depth, and temperature; Cables, battery, etc.
Testing for elemental and ionic concentrations	\$7,128	500 samples at \$7/sample and 10hr training for students at \$40/hr and 10wks x 10hrs/wk x 2 students= 200 hrs x \$15/hr + 7.6%