CLEAR ROADS
research for winter highway maintenance

# RESEARCH BRIEF

MARCH 2026

# LEVERAGING SOLAR RADIATION TO DEICE ROADS

## RESULTS SUMMARY

Managing roadside vegetation and tree canopy cover can enhance the effects of sunlight on winter roads by melting snow and deicing roads more quickly, improving safety, efficiency and sustainability.

## PROJECT DETAILS

**Project Title:** Using Vegetation Management Practices Near Roads to Leverage the Benefits of Solar Radiation

**Project Number:** CR23-04

**Project Cost:** $123,086

**Report Date:** January 2026

**Project Chair:**
Aidan Neely
Connecticut Department of Transportation
aidan.neely@ct.gov

**Investigator:**
Carolyn Dindorf
Bolton & Menk, Inc.
carolyn.dindorf@bolton-menk.com

## Need for Research

Vegetation along roadsides can shade pavement and slow the melting of snow and ice. However, there has been limited detailed information on how increased sunlight exposure influences melt rates, leaving both road maintenance professionals and the public without sufficient guidance for corridor management decisions.

A quantitative assessment was needed to understand the safety and sustainability benefits associated with faster melts. This information would help winter maintenance managers realize the advantages of sunlight, prioritize vegetation management, and communicate the benefits of managed roadside greenery to the public.

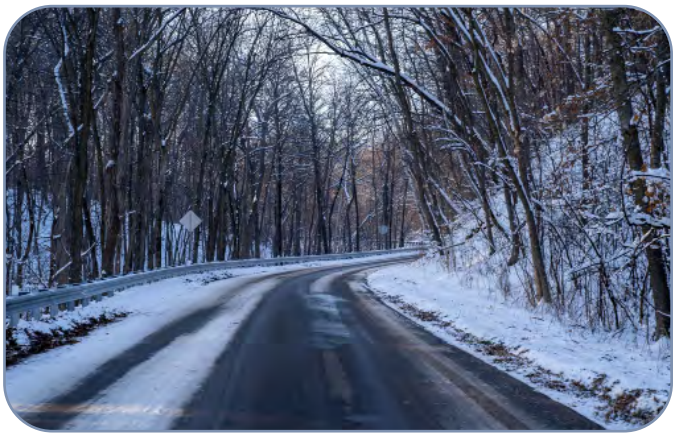
## Objectives and Methodology

The purpose of this project was to provide evidence and guidance on how roadside vegetation affects wintry pavement conditions and how strategic vegetation management can improve safety, efficiency and sustainability. While winter maintenance managers intuitively knew that roads would return to bare conditions faster with the aid of sunlight, the specific details and benefits of increasing solar radiation exposure were unclear.

In this project, a literature review focused on the effects of roadside vegetation on pavement conditions in winter, current vegetation management practices implemented by transportation agencies and the side effects of removing or pruning roadside vegetation. Simultaneously, a national survey of winter maintenance agencies identified those employing vegetation management and the reasons for supporting it. Next, a desktop analysis of vegetation removal sites and a controlled field study in Minnesota examined patterns in daily temperature curves and responses during precipitation to understand maintenance needs.

Using the results from these findings, researchers developed and produced a vegetation management guide that offers strategies for identifying shade-prone road segments, prioritizing vegetation removal or pruning, and developing best practices that balance environmental impacts, safety and community preferences. The guide includes a shadowcasting tool and technical specifications for the tool to calculate the benefits of solar exposure and support vegetation management.

CONTINUED



Strategically managing roadside vegetation can maximize the benefits from solar radiation while also providing desired vegetation for the public.

## Results

Field test results indicated that shaded pavement was significantly colder than sun-exposed pavement, sometimes by up to 20°F. This shading extended the presence of snow and ice on pavement by an average of 5.2 hours. Pavement exposed to sunlight not only returned to bare conditions faster, but in certain conditions provided potential salt use savings greater than 50 pounds per lane mile.

Of note from these results was the effect of prestorm cloud cover, which minimized the temperature difference between shaded and sun-exposed pavement areas.

The vegetation management guide created in this project will help transportation agencies quantify the potential benefits of solar radiation on shade-prone road segments and guide the strategic removal or pruning of roadside vegetation.

According to the guide, effective maintenance may take several decades and require a combination of strategies, including clear-cutting, replacement planting, selective removal and pruning. The optimal strategy will depend on the location and layout of the road, the variety of vegetation present, local topography and the width of the right of way.

The shadowcasting tool provides impact assessments of solar exposure and shading on roads. It incorporates site-specific inputs, vegetation characteristics and solar position calculations to estimate shading effects and energy loss due to obstructions. The results support and optimize vegetation management strategies by estimating solar exposure and safety impacts that can be communicated to winter road maintenance agencies and the public.

In addition to enhancing the benefits from sunlight, effective vegetation management can mitigate the negative effects of winter storms such as preventing blowdowns, creating windbreaks that decrease wind speeds across roads and act as living snow fences, and improving airflow to reduce the incidence of disease on trees where air stagnates.

## Benefits and Future Research

The research findings, vegetation management guide and shadowcasting tool offer ready-to-use materials for winter maintenance managers to improve winter road safety, reduce maintenance costs and support sustainable operations.

Future research could validate these results in other regions, integrate vegetation management with drainage and pavement design, and refine remote sensing tools for shade mapping.

"This project demonstrated the benefits of vegetation management. The guide and tool that were developed will help agencies optimize and support their vegetation management strategies."

**Project Chair Aidan Neely**
Connecticut Department of Transportation
aidan.neely@ct.gov



Produced by CTC & Associates LLC on behalf of the Clear Roads pooled fund project #TPF-5(479), led by the Minnesota Department of Transportation.