



Center for Weather Impacts  
on Mobility and Safety

# Safety and Mobility Impacts of Winter Weather – Phase I

tech transfer summary

Winter weather and its corresponding surface conditions have an impact on the safety and mobility of thousands of drivers annually.

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## RESEARCH PROJECT TITLE

Safety and Mobility Impacts of Winter  
Weather – Phase I

## SPONSORS

Iowa Department of Transportation  
(InTrans Project 10-370)  
Midwest Transportation Consortium

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## ABOUT CWIMS

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The Center for Weather Impacts on Mobility and Safety (CWIMS) focuses on research to find better and safer ways to travel whenever weather is a problem.

CWIMS is an Iowa State University Center administered by the Institute for Transportation.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the project sponsors.

## Objective

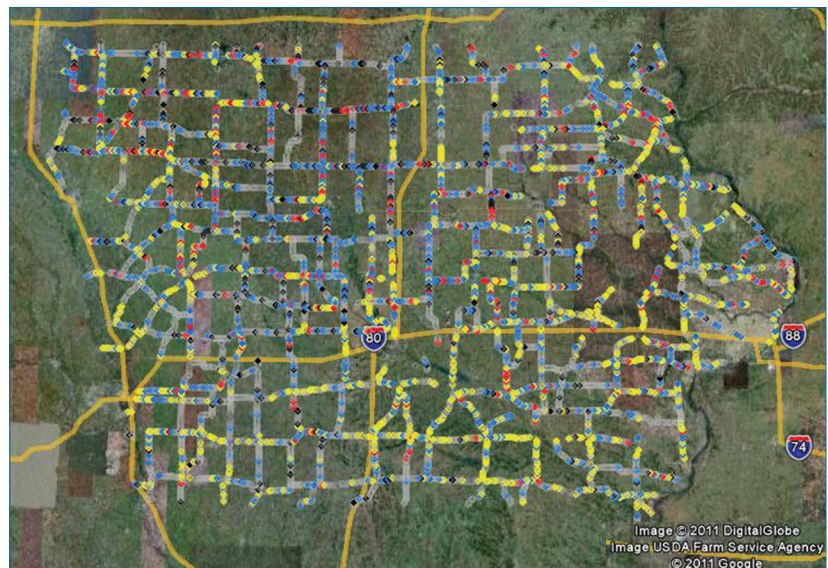
The primary objective of this research was to develop several preliminary means for the Iowa Department of Transportation (DOT) to identify locations of possible interest systematically with respect to winter weather-related safety performance based on crash history.

## Problem Statement

Highway agencies spend millions of dollars to ensure safe and efficient winter travel. However, the effectiveness of winter weather maintenance practices on safety and mobility are somewhat difficult to quantify.

During the winters of 1995/6 to 2004/5, approximately one-third of all crashes occurring on rural, state-maintained highways in Iowa were winter weather-related. Moreover, approximately half of the rural Interstate crashes were winter weather-related. These crashes were generally found to be more severe than other winter crashes.

Several research projects have investigated possible use of historic crash data for planning winter maintenance and operations strategies. However, while some informal practices exist, most state DOTs do not have formal mechanisms in place to utilize such data in their maintenance activities.



Sample Google Earth map showing the proportion of crashes for all segments of state-maintained two-lane roads in Iowa

## Research Description

Through this research, the Iowa DOT ultimately wishes to be able to identify locations of possible interest systematically with respect to winter weather-related safety performance. In supporting this goal, these components were critical in Phase I:

- Define the appropriate extent and segmentation of the reference roadway network
- Assimilate winter crash history
- Develop safety-related evaluation metrics

Each component is detailed in the Phase I report. The metrics were developed to assist in identifying possible habitual, winter weather-related crash sites on state-maintained rural highways in Iowa.

In addition, the current state of practice, for both domestic and international highway agency practices, regarding integration of traffic safety- and mobility-related data in winter maintenance activities and performance measures were investigated.

Finally, a critical component of this project is to be able to convey analysis results effectively in various forms. Effective visual presentation allows users to quickly identify possible locations of interest as well as compare locations on a system-wide basis—both within the same metric and among all metrics. The underlying crash data, in conjunction with other pertinent data sets, may then be used to assess sites further.

### GIS-Based Hard Copy Maps

Because both the crash and roadway data used in this project exist geospatially, these data sets, as well as the analysis results, were integrated and managed within a geographic information system (GIS) environment, specifically Environmental Systems Research Institute, Inc. (ESRI) ArcGIS.

This tool was also used to create hard copy maps presenting analysis results for the four metrics (density, proportion, severity, composite) for three road types (freeway, expressway, two-lane road) for the two analysis periods (winter 1995/96 to winter 2008/09 and winter 2001/02 to winter 2008/09). Each map presented four basic layers to aid in visualization:

- Road segments, color coded by final category
- Primary roads in Iowa
- Iowa county boundaries
- Iowa urban areas

### Keyhole Markup Language (KML) Maps

To expand the availability of the analysis metrics to a wider audience, the GIS-based data sets were converted to keyhole markup language (KMZ/KML) files for use in an Earth browser such as the Google Earth mapping service or Google Maps mapping service.

Use of an Earth browser provides additional flexibility, and depth, in review. For example, some basic underlying data, such as total winter weather-related crashes, crash density, and category, were associated with each road segment, allowing general users access to more data.

In addition, aerial images, street-level views, and any other information available through these browsers may be viewed interactively. And, full documentation for use and interpretation of the data within an Earth browser was provided to the Iowa DOT.

## Key Findings

In this project, four winter weather-related crash metrics, and associated databases, were developed to facilitate system-wide, preliminary evaluation of the rural, primary highways:

- Winter weather-related crash density
- Winter weather-related crash proportion
- Winter weather-related crash severity
- Composite winter weather-related crash score

Categorization of these metrics was completed for three different road types (freeway, expressway and two-lane) and two different analysis periods (winters of 1995/1996 to 2008/2009 and winters of 2001/2002 to 2008/2009). Statistical analysis suggested that the differences in metrics for the two analysis periods were not statistically significant. Therefore, use of the longer period in additional analysis may be beneficial, providing more crash data for evaluation.

Analysis results may be reviewed through use of either GIS- or Google Earth-based data sets. These metrics and their corresponding categories should not necessarily be evaluated independently, as anomalies may occur. They are best evaluated in parallel.

The analysis results do not absolutely convey site rankings, present problem locations, or represent locations where action is needed. However, the results may be used as a foundation for additional site evaluation and review. This is discussed, in part, in a preliminary work plan developed for the Iowa DOT.

## Implementation Benefits

The work plan from this research focuses on outlining possible systematic use of the data from Phase I of this project in support of winter maintenance activities and site evaluation. The plan is considered a working document, intended to initiate discussion regarding use of the products of this project.