A SYSTEMATIC APPROACH FOR LOCATING ROAD WEATHER INFORMATION SYSTEM (RWIS) STATIONS IN CANADA

Tae J. Kwon[a], Liping Fu[a], Max S. Perchanok[b] and Heather McClintock[b]

[a]Innovative Transportation System Solution (iTSS) Lab, Department of Civil & Environmental Engineering, University of Waterloo. [b]Ontario Ministry of Transportation.

University of Waterloo

Introduction

BACKGROUND

North American transportation agencies expend more than **$3.3 billion dollars** annually on various winter road maintenance (WRM) activities to keep roads safe and mobile.

Snow and Ice Control

WRM uses large amount of road salt which has become a public concern due to their detrimental effects on environment, infrastructure, and vehicles. Real-time information from road weather information system (RWIS) can help improve the effectiveness of WRM and reduce the salt usage.

Infrastructure **Vehicle** **Environment**

Effects of Salt
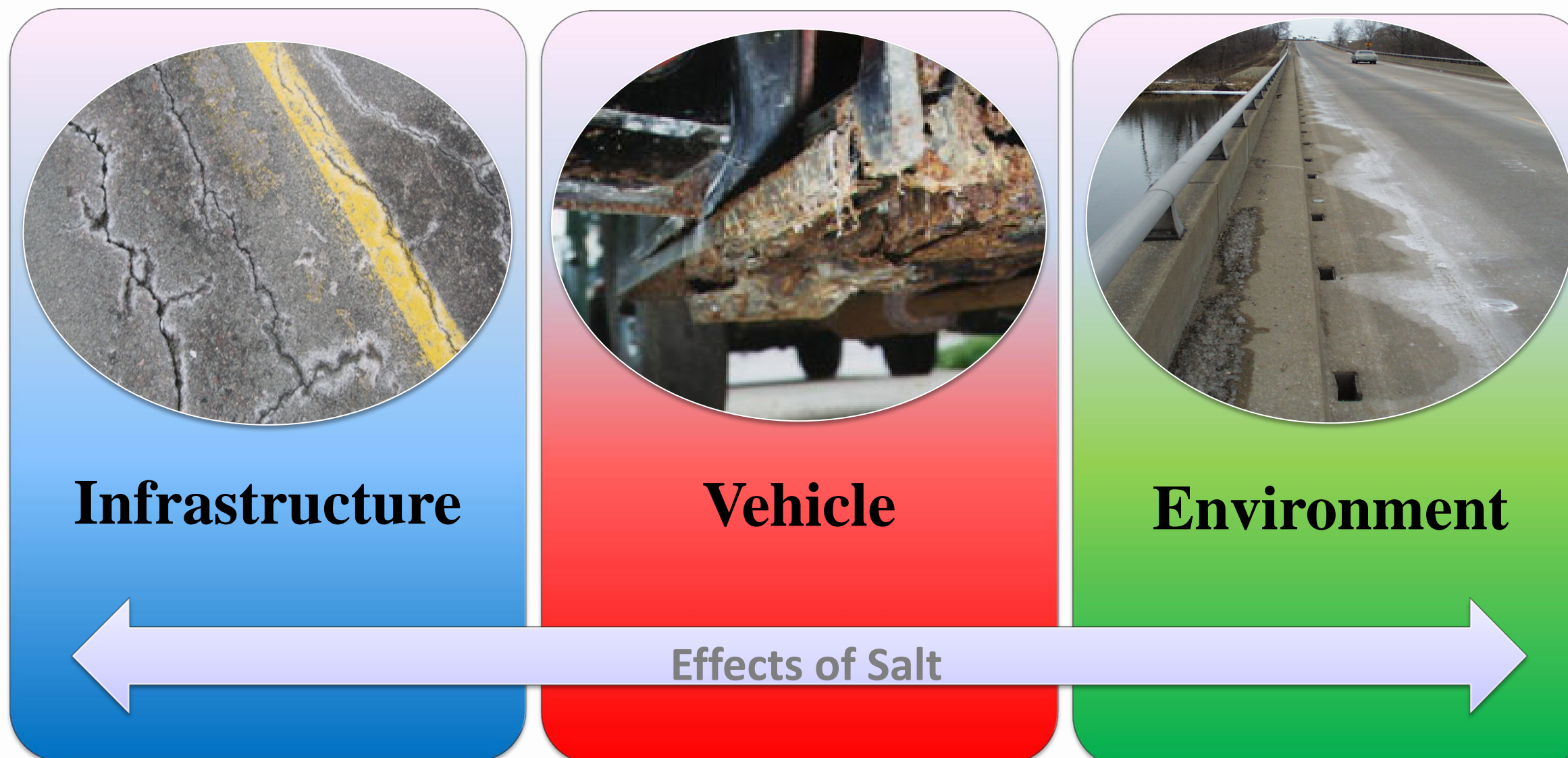
RWIS and Benefits

Road weather information systems (RWIS) provide information on current and near-future road weather conditions based on the data gathered at RWIS stations.
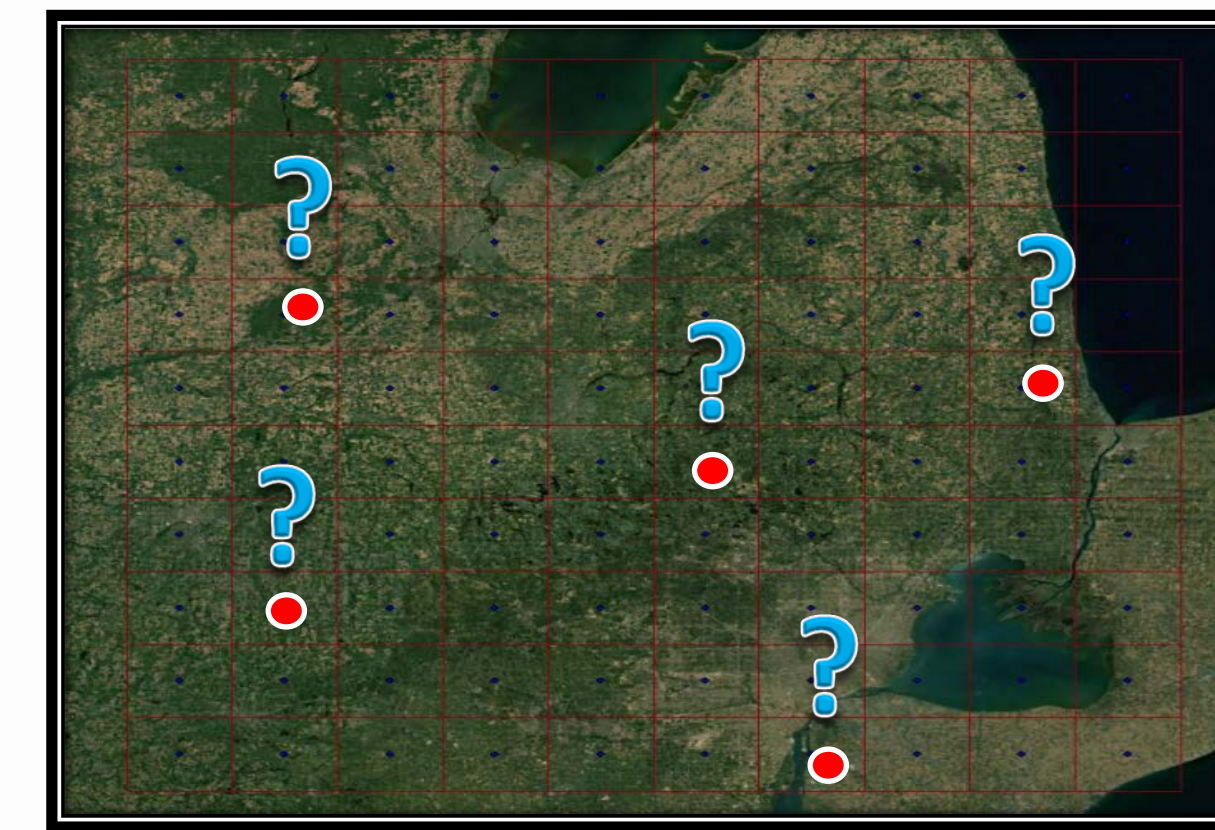
RWIS Station

Benefits of RWIS:
➤ Improve the decision-making of winter related maintenance operations (e.g., salting, plowing, de-icing, and anti-icing)
➤ Reduce use of routine patrols
➤ Use cost-effective allocation resources
➤ Provide travelers better information
➤ Promote higher level of service (LOS)

RESEARCH MOTIVATION & OBJECTIVE

RWIS stations are **COSTLY** to install and operate, and can only be installed at a **LIMITED** number of locations. Therefore RWIS stations then must be placed **STRATEGICALLY** to provide most **INFORMATIVE** inputs.

The primary objective is to construct a systematic approach for determining the candidate RWIS station locations at the regional level.
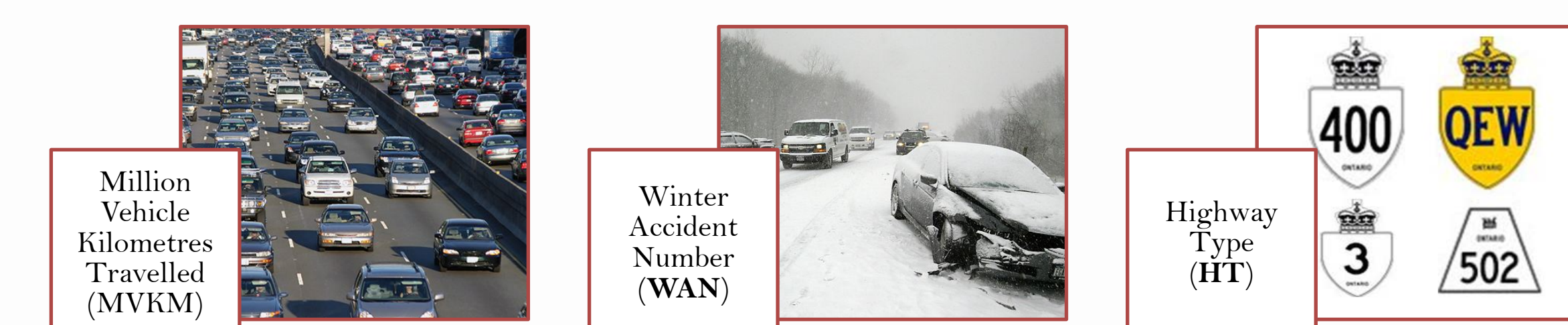
"Good" Locations?

Weather-related factors

➤ Intuitively, RWIS stations should be placed to areas that experience severe yet less predictable weather patterns.

Variability of Surface Temp (VST)
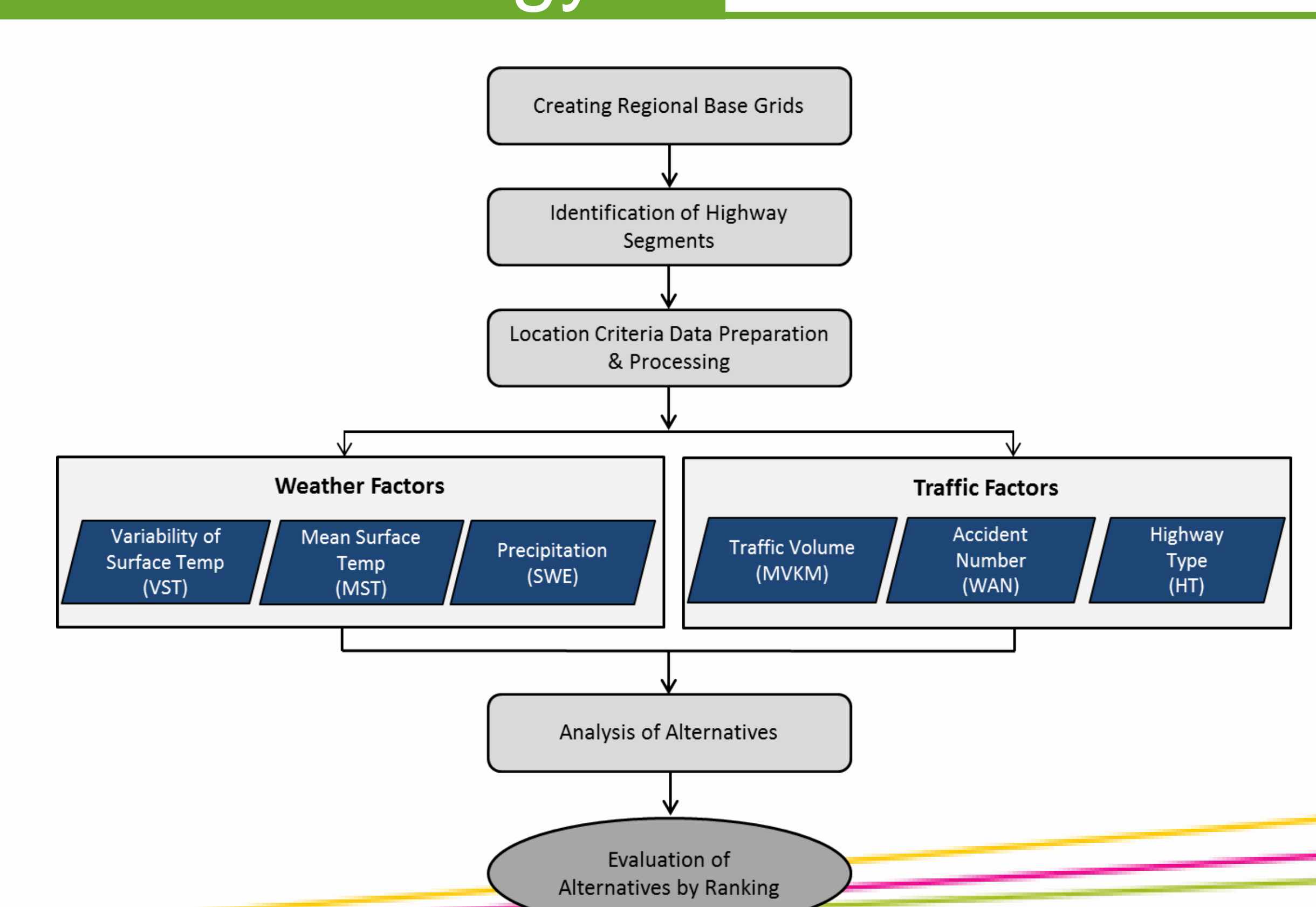Min- Mean Surface Temp (MST)
Precipitation (SWE)
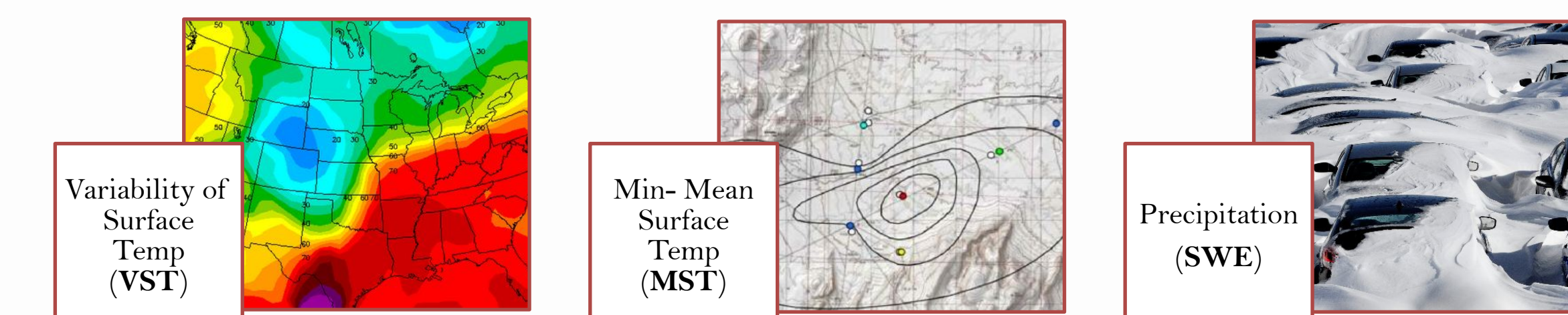
Traffic-related factors

➤ Intuitively, RWIS stations should be placed to areas with a greater number of road users and a higher chance of accidents.
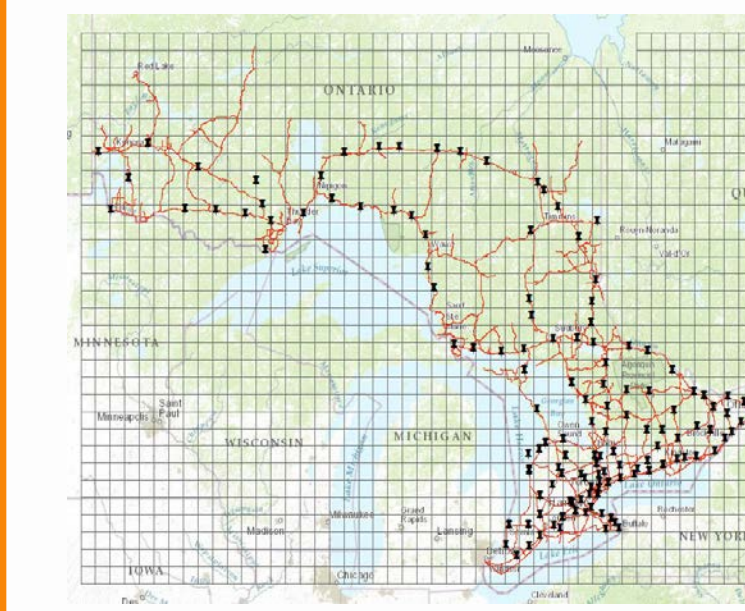
Million Vehicle Kilometres Travelled (MVKM)
Winter Accident Number (WAN)
Highway Type (HT)

Methodology

Creating Regional Base Grids
↓
Identification of Highway Segments
↓
Location Criteria Data Preparation & Processing
↓

Weather Factors: Variability of Surface Temp (VST) | Mean Surface Temp (MST) | Precipitation (SWE)

Traffic Factors: Traffic Volume (MVKM) | Accident Number (WAN) | Highway Type (HT)
↓
Analysis of Alternatives
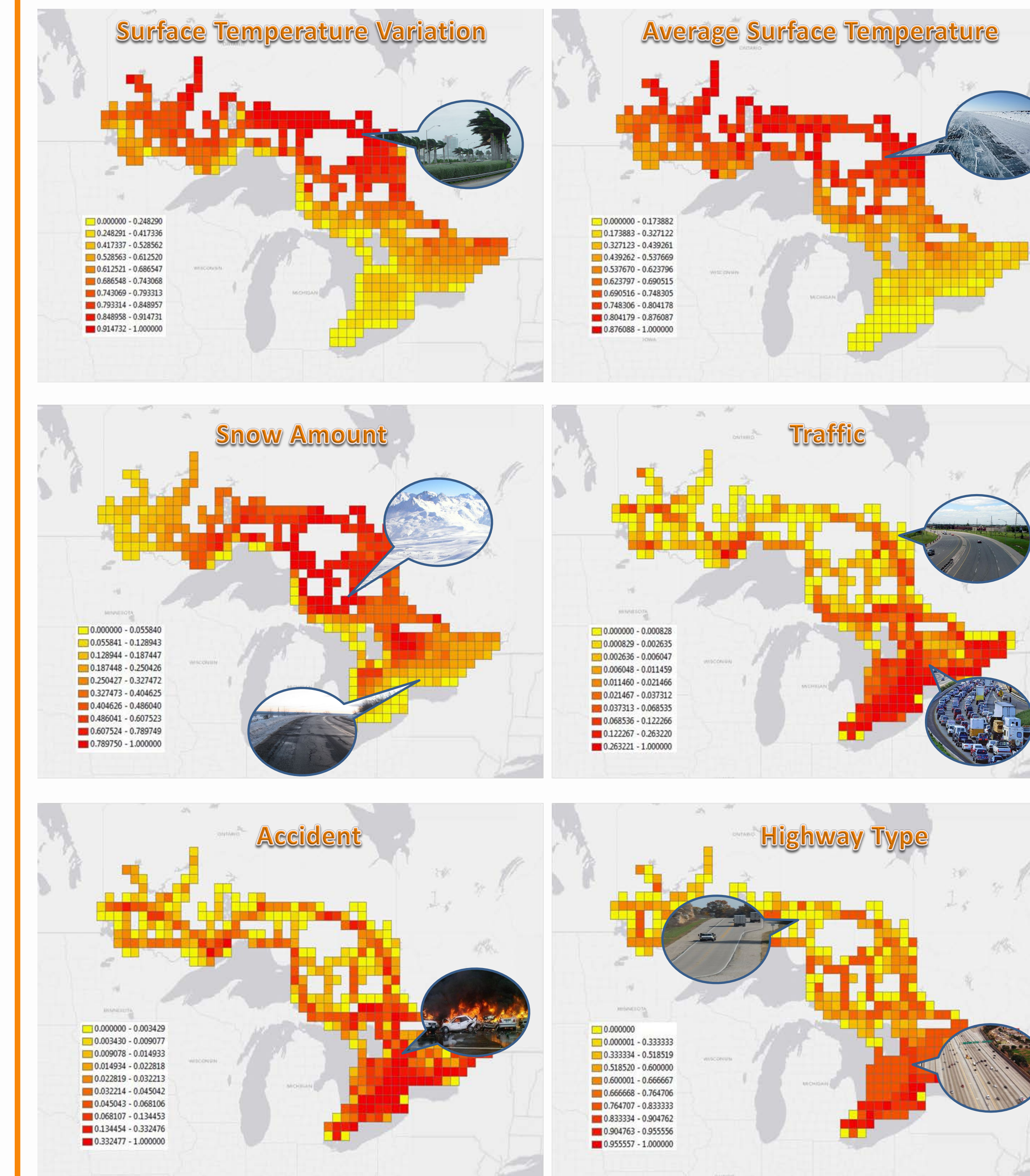↓
Evaluation of Alternatives by Ranking
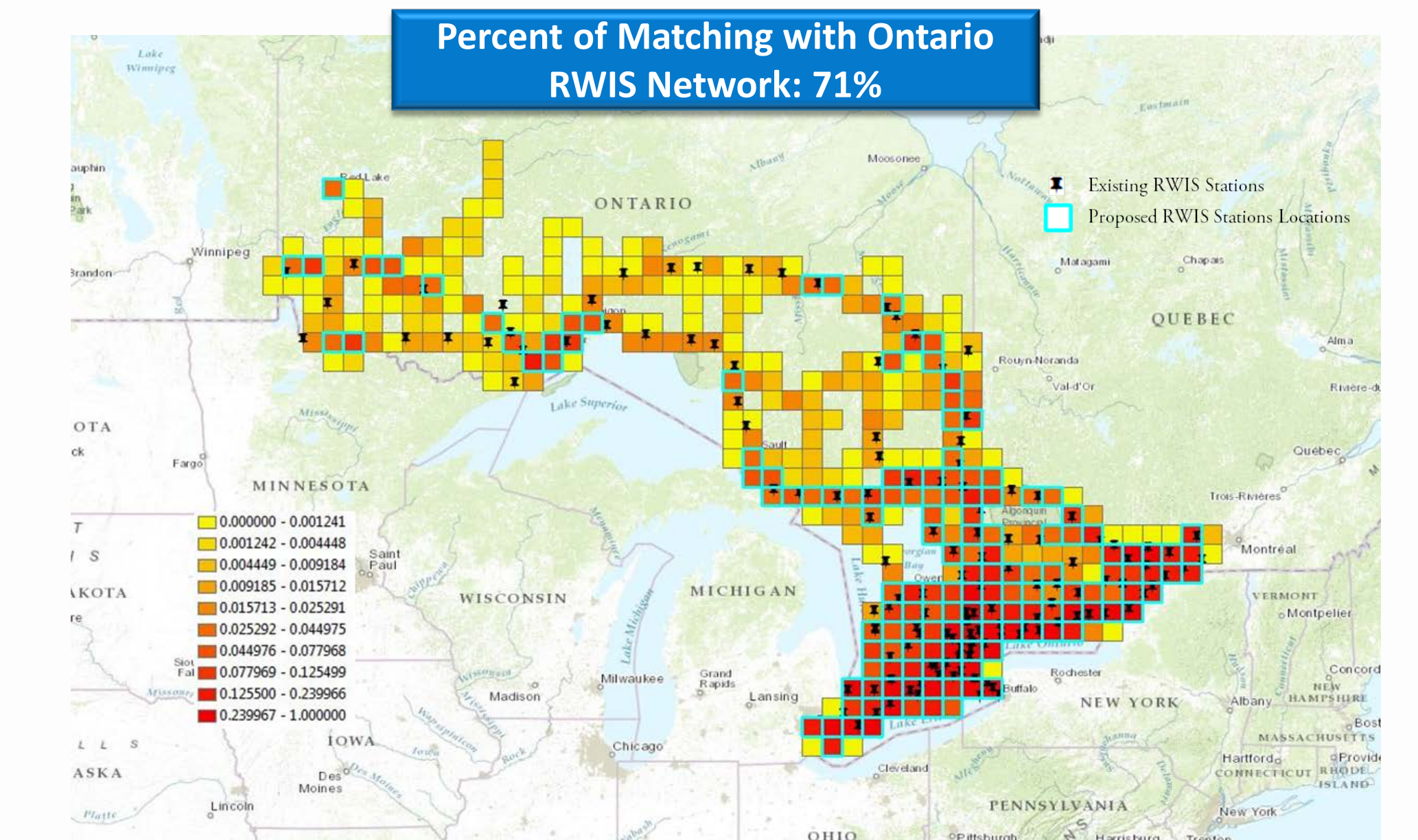
Case Study

ONTARIO RWIS NETWORK

➤ MTO currently owns and operates a total of 140 RWIS stations covering approximately 234,000 kilometers of roads.

➤ A grid of equal-sized cells each having an area of 50x50 km² is used.

OPTIMAL LOCATION BASED ON DIFFERENT CRITERIA

Surface Temperature Variation | Average Surface Temperature
Snow Amount | Traffic
Accident | Highway Type

Evaluation

Alternative I: Weather Factors Combined

Percent of Matching with Ontario RWIS Network: 26%

Alternative II: Traffic Factors Combined

Percent of Matching with Ontario RWIS Network: 71%

Alternative III: Weather & Traffic Factors Combined

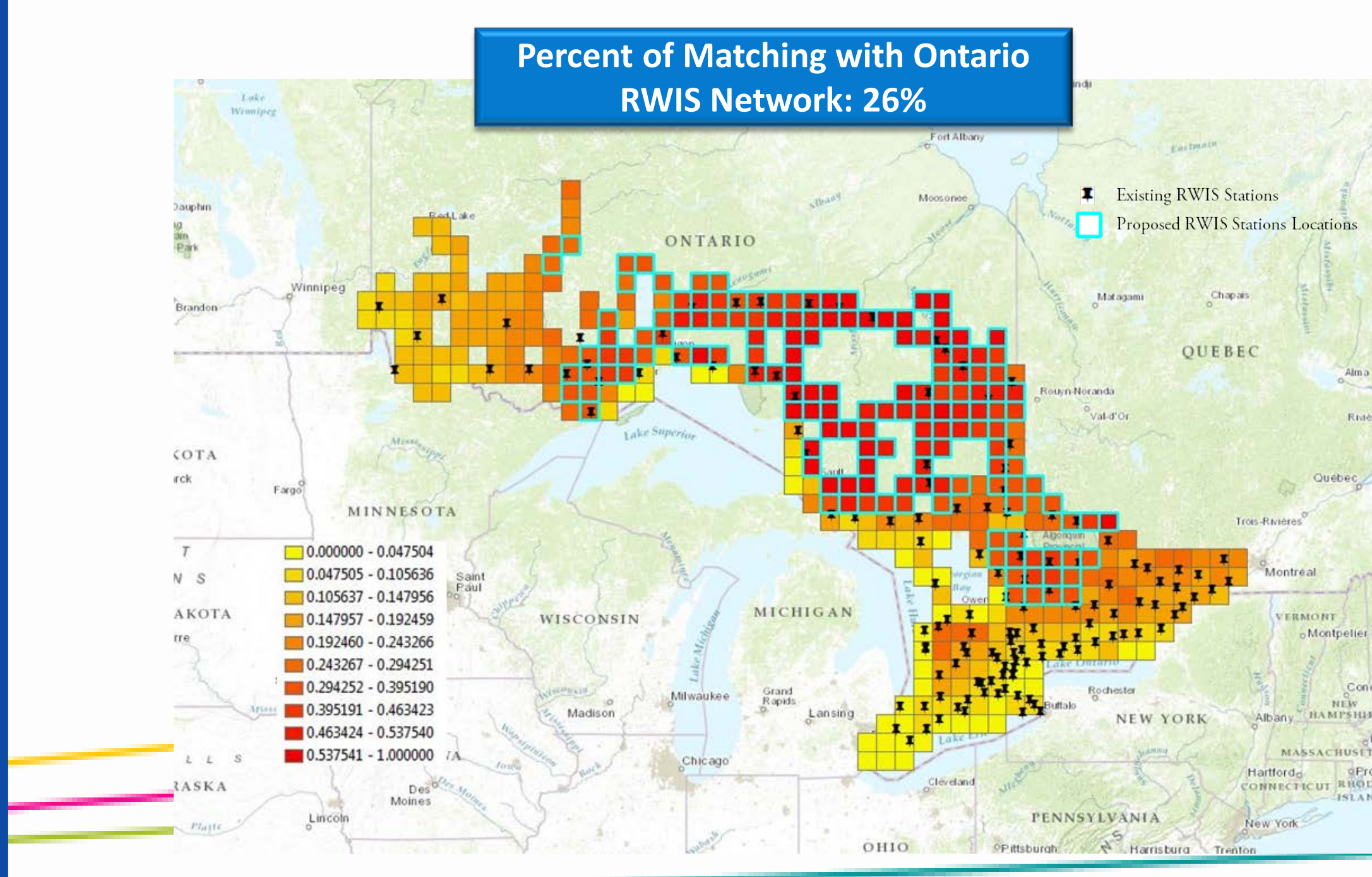Percent of Matching with Ontario RWIS Network: 66%
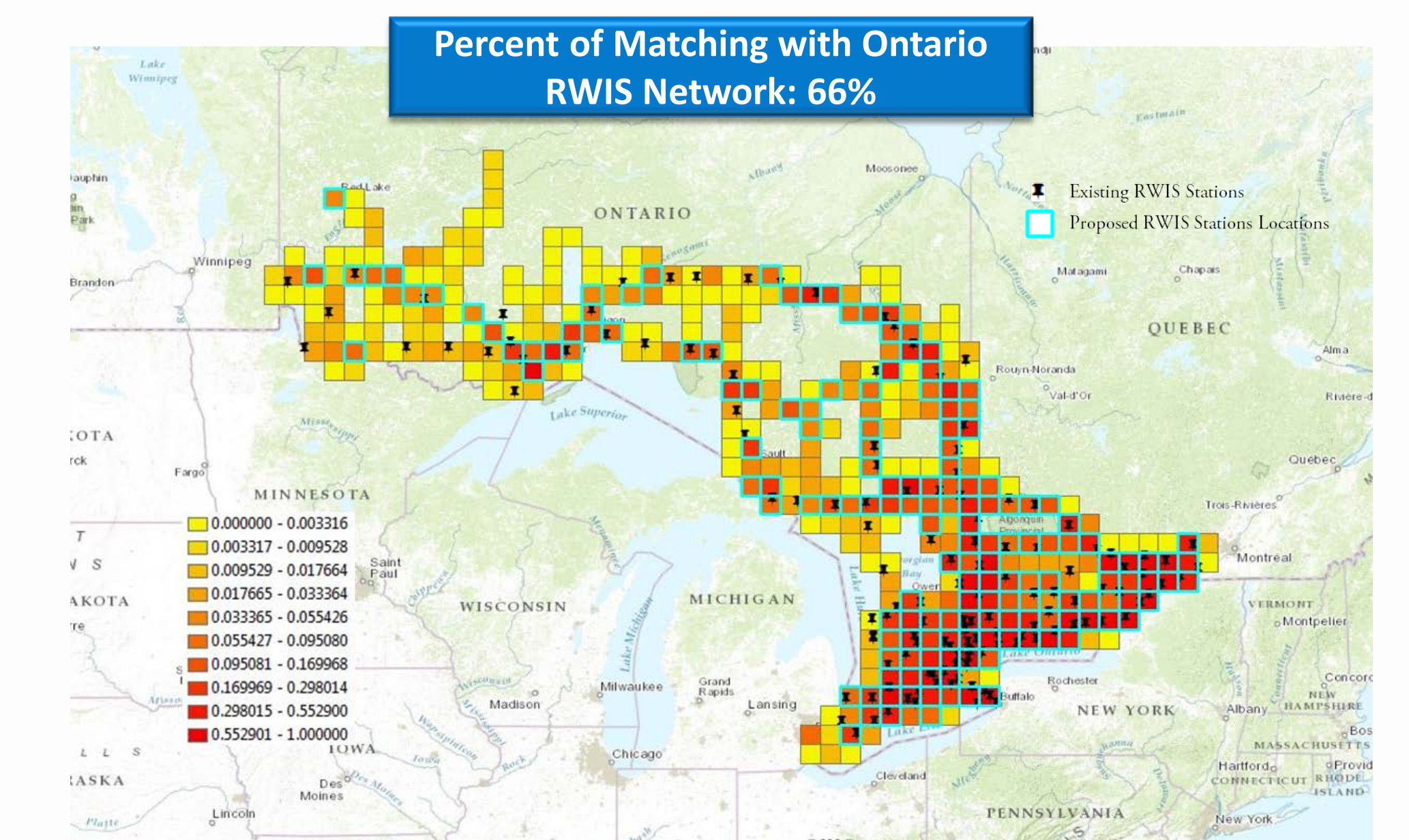
Conclusions

➤ Alternative 1 is more focused on the northern region comprising of highly varying weather conditions
➤ The high matching rate of the alternative 2 indicates that the current RWIS network has been set up in such way that it predominantly considers the need of covering the road network.
➤ The alternative 3 well balances the limitations of the first two alternatives by showing the potential candidate RWIS locations across the whole province.
➤ The proposed framework is easy to apply when planning a RWIS network expansion by introducing different weights to individual criteria based on their importance.

Acknowledgements

NSERC CRSNG | Ontario Transportation | Ministry of Transportation | Aurora working to advance road weather information systems technology | iTSS LAB | WATERLOO ENGINEERING