Heavy rain, snow, ice, dust, fog and other adverse weather conditions can have significant impacts on roadway safety, mobility, and economic productivity. Over the last decade, weather was responsible for nearly 21 percent of all vehicle crashes, resulting in approximately 5,400 deaths and more than 418,000 injuries annually.¹ Further, adverse weather causes about 15 percent of all non-recurring delays,² costing the freight industry roughly $8.7 billion per year.³

The Weather-Savvy Roads (WSR) initiative aims to tackle the problem of weather impacts on the transportation system head on. Deployed by the Federal Highway Administration (FHWA) under round four of its Every Day Counts (EDC-4) program, WSR consists of two innovative road weather management solutions: Pathfinder and Integrating Mobile Observations (IMO). Pathfinder is a collaborative effort among state departments of transportation (DOTs), the National Weather Service (NWS), and weather service contractors to share forecasts and road conditions and translate that information into consistent transportation impact messages for the public. Imple-

Weathering the Storm: Making a difference with weather-savvy roads

Road weather management strategies are helping transportation agencies better manage their roadways before and during adverse weather conditions, saving lives and enhancing mobility
menting Pathfinder involves a multi-step process of assessing the types of information to share and when and how to share it before, during, and after high-impact weather events. The goal is to provide the public with consistent and actionable messages on potential impacts on the transportation network.

IMO promotes collecting weather, road, and vehicle data from agency fleets to improve situational awareness of road conditions. It builds on vehicle-based technologies like automatic vehicle location (AVL) and real-time communication, which most states have already implemented in their vehicle fleets. Ancillary sensors collect data on weather and road conditions, such as air pressure, air and surface temperatures, spreader rate and materials, windshield wiper status and rate, and relative humidity. The data provide maintenance managers with a detailed view of local conditions, as well as the location of assets along the highway network. This information can support maintenance and operations decision-making related to road weather forecasts, end-of-shift reporting, material management, traveler information, and performance management.

State and local agencies can adopt one or both of these solutions to manage their roadway networks proactively, ahead of and during adverse weather events. “It’s really important to have the ability to monitor weather events and their potential impact on roads,” says Randy Graham, Deputy Chief Science and Technology Infusion Division at NWS Central Region, “because weather is one of the only things that has an impact on the entire road system at one time.”

The Benefits of Implementing WSR

Both Pathfinder and IMO result in improved highway safety, mobility, and productivity, yet each offers a unique set of benefits. Broadly, Pathfinder benefits can include enhanced decision-making and better-informed travelers, thanks to consistent and targeted messaging regarding traveler information. “One thing that we find with the traveling public is that they look to multiple sources for weather information,” says Jeff Williams, weather program manager, at the Utah DOT. “If we can provide the same message about the storm impacts, no matter what medium they’re using to get this information, we see the traveling public react.” Other benefits of Pathfinder deployments include the potential for reduced vehicle miles traveled (VMT), improved maintenance operations given fewer motorist impediments, and increased overall safety.

A key benefit resulting from an IMO deployment is material savings, which include reductions in salt and sand usage. Real-time information about road conditions and fleet vehicle locations help maintenance staff make better decisions about material applications. Another benefit is agency efficiencies, such as improved reporting, reduced time spent on relaying information, better situational awareness, and fewer responses to emergencies. More comprehensive and accurate real-time information about resource consumption provides agencies with the data needed for decision-making. Over time, FHWA officials expect IMO deployments might also lead to reduced equipment usage and lower legal costs from small tort claims.

Truckee, California: Adopting Pathfinder Principles

Truckee, California, is a resort town located on I-80 near the Nevada border. The town’s population greatly increases on weekends and holidays during the summer and winter seasons, which can create extreme vehicle and truck crowding during winter closures on the interstate. Winter weather can include large amounts of snow and heavy rain, which often cause a high risk of flooding. Town officials agree that that one cohesive message, coordinated with other agencies, is essential to ensuring safe mobility and reducing confusion during severe weather events that could result in dangerous driving conditions.

Using Pathfinder principles, the town has built direct relationships with the NWS to obtain and discuss the impacts of severe weather forecasts, warnings, and watches ahead of major weather events and with Caltrans District 3 for insights related to I-80 operations and traffic impacts. These relationships are essential to Truckee’s road operations decisions and communication with travelers. In addition, the town maintains relationships with law enforcement and emergency responders to coordinate operations and public messaging during severe weather events. Through these relationships, Truckee staff works across these agencies to implement Pathfinder to ensure the public receives consistent, meaningful messages to help travelers make smart decisions. Since implementing Pathfinder, Truckee has noted the following benefits:

• Enhanced weather knowledge. Developing a direct relationship and communication with
the NWS office has significantly enhanced Truckee’s knowledge of expected severe weather, allowing them to more effectively prepare their response (staff call-outs and clear streets/drainage).

- **Expanded public information and outreach.** Providing critical information to the public about road conditions through Truckee’s web portal has improved operations, increased safety, and improved public trust.

- **Improved efficiency and effectiveness of road operations.** Enhanced weather knowledge and public outreach have made improved road operations possible. Resources are better allocated, known problem areas can be mitigated, fewer motorists on the roads equates to more effective operations, environmental impacts have been reduced, and roads are generally in better condition year-round which enhances safety.

- **Increased public relations.** Providing complete information to the public and stakeholders, including trouble spots and real-time road operations, has significantly increased public relations between the town, the traveling public, and improved coordination with other entities.

**West Des Moines: A City’s Approach to Vehicle-Based Technologies**

West Des Moines, Iowa, is a suburban community of 68,000 residents with 800 lane miles of pavement. Located at an interstate crossroads, the daytime population increases to over 150,000 people. The extensive commuter traffic, combined with winter weather conditions in the area, demands effective road weather management strategies.

The West Des Moines Public Services Department leverages available resources to deploy new technologies and equipment to improve its winter maintenance operations. Efforts have included deploying road weather information systems (RWIS); infrared sensors for determining pavement friction; AVL and mobile sensors on plows and other agency vehicles; and software, including that for route optimization and a maintenance decision support system (MDSS) for material type and application determination. Since implementing these IMO-related technologies, West Des Moines has found the benefits greatly exceed capital, operational, and maintenance costs. The benefits include:

- **Material savings.** The city found that the savings made possible by reducing salt and material use, while providing the same level of service, far exceed the technology costs. The city’s MDSS uses the available real-time road weather conditions and fleet vehicle locations to provide recommendations on material type, application rates, and timing for maintenance staff to make better decisions. Specifically, the West Des Moines Public Services Department has reduced chloride application by 30 percent, saving about $150,000 annually.

- **Agency efficiencies.** Route optimization has increased efficiency, reducing the time needed to clear various areas, fuel consumption, and wear and tear on the plow truck fleet, resulting in about $50,000 savings per year and the ability to do more with less. In addition, with increased data available for review after a winter weather event, agency staff can examine the storm’s progression using available road weather data, such as friction data and RWIS photos, and then compare it to the operational strategy and results.
In this way, the city can modify and enhance its strategy for truck placement, material type, and timing of material application to better meet level-of-service goals for future winter weather events.

**Implementing WSR in Your Region**

“IMO and Pathfinder are two strategies that enable transportation agencies to better manage the system, ultimately saving lives and keeping traffic moving safely and smoothly,” notes Roemer Alfelor, transportation specialist, FHWA’s Road Weather Management Program. Are you interested in deploying Pathfinder and/or IMO in your region? If so, check out the following resources for more information or contact FHWA’s Road Weather Management Program Team Leader Paul Pisano at Paul.Pisano@dot.gov.

- FHWA’s Weather-Savvy Roads Toolkit houses fact sheets, case studies, videos, guidance documents, and other implementation resources in one central location! [https://go.usa.gov/xnSqy](https://go.usa.gov/xnSqy)
  - To check out **IMO Early Adopter Final Reports**: [https://collaboration.fhwa.dot.gov/dot/fhwa/RWMAX/SiteAssets/resources-early-imo.aspx](https://collaboration.fhwa.dot.gov/dot/fhwa/RWMAX/SiteAssets/resources-early-imo.aspx)
- For more information on funding mechanisms, check out the FHWA Center for Accelerating Innovation website: [https://www.fhwa.dot.gov/innovation/](https://www.fhwa.dot.gov/innovation/)
  - For STIC Incentive Program information: [https://www.fhwa.dot.gov/innovation/stic/](https://www.fhwa.dot.gov/innovation/stic/)
  - For AID Demonstration Program information: [https://www.fhwa.dot.gov/innovation/grants/](https://www.fhwa.dot.gov/innovation/grants/)

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1. NHTSA Fatality Analysis Reporting System (FARS) and NHTSA Crash Report Sampling System (CRSS) databases – [https://www.nhtsa.gov/research-data](https://www.nhtsa.gov/research-data)