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# REAL-TIME INFORMATION DISSEMINATION REQUIREMENTS FOR ILLINOIS PER NEW FEDERAL RULE

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16. Abstract

Travelers on U.S. freeways could now be better-informed than ever before, because of a new federal legislation. The Final Rule 23 CFR 511 has mandated that after November 8, 2014, states provide real-time traveler data along all limited-access roadways, and that traveler information must also be provided along routes of significance in all metropolitan areas (with populations exceeding one million) two years after that. Furthermore, this law requires information be available 90% of the time, with an 85% rate of accuracy. This study was conducted, with the collaboration from the Illinois Department of Transportation (IDOT), to provide guidance on meeting the new rule effectively and quantifiably.

To amass the necessary data, we reviewed published documents on the topic and conducted interviews and conference calls with stakeholders throughout the rural and urban transportation districts of Illinois to identify the routes that require real-time information, information sharing needs and possible changes and updates to ITS architectures. Moreover, an online survey was conducted to gather information on different practices addressing the requirements of 23 CFR 511 in other state DOTs.

After gathering information from these sources, researchers recommended best strategies to satisfy the real-time traveler information dissemination requirements in Illinois. Accordingly, the routes requiring real-time information and the measures of effectiveness were identified, including methods to quantify accuracy and availability. Revisions to the ITS architectures relating to Illinois were proposed along with new interfaces that need to be added.

The outcome of this study includes methods by which the quality of travel information for Illinois roadways can be measured by IDOT. In addition, this study proposed recommendations for archiving data, revising policy documents, updating ITS architectures, reviewing compliance with 23 CFR 511, and deploying infrastructure, all of which provide guidance towards complying with the 23 CFR 511 requirements.

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# EXECUTIVE SUMMARY

National legislation (Public Law 109-59 sec. 1201) followed by regulation 23 CFR 511.311 mandated that, by November 8, 2014, States provide real-time traveler information along all limited-access roadways and that traveler information must also be provided along routes of significance in all metropolitan areas (with populations exceeding 1 million) 2 years after that. Furthermore, this law required a 90% availability of this information with an 85% rate of accuracy (23 CFR 511.309, 2010). Although the Illinois Department of Transportation (IDOT), the Illinois Tollway, and other agencies currently provide real-time traveler information in many parts of the state, no strategies have been universally chosen for measuring the accuracy and availability of this information.

The objectives of this research were to collaborate with IDOT to provide recommendations to enhance its real-time information dissemination strategies to meet the requirements of the program as defined in 23 CFR Sec. 511.311 (b-d). The research described herein provides guidance to IDOT officials to help them select traveler information systems to meet the new rule effectively.

Each part of this research included the following four main types of information: travel-time information, construction information, traffic incident information, and weather information. A literature review was completed to identify best practices from all over the world for collecting, processing and disseminating these types of traveler information. The findings of the literature review guided the researchers during their interviews of IDOT personnel active in traveler information. These meetings and conference calls collected information on current IDOT practices related to collecting, processing and disseminating their information. To gather best practices from other state transportation agencies throughout the United States, researchers conducted an online survey, which targeted operational engineers and Intelligent Transportation Systems (ITS) coordinators in each state.

The information from the interviews, published sources, and the nationwide survey guided the researchers to recommend optimal strategies that would comply with the rule and integrate with best practices IDOT already had in place. These strategies for evaluating data quality included details on how IDOT should measure the accuracy, availability, coverage, and timeliness of the traveler information they provide to the public. Additionally, these strategies include details about what types of information should be collected and disseminated. Key recommendations included the following:

- Starting to archive certain traveler information disseminated to the public so accuracy can be measured;
- Changing a portion of the Specification to Highway and Bridge Design to promote timely reporting of construction lane closures;
- Updating the IDOT-Illinois State Police Joint Operational Policy Statement to promote timely reporting of roadway and lane-closing traffic incidents;
- Expanding coverage of travel times on the fringes of the Chicago, Illinois and St. Louis, Missouri, metropolitan areas;
- Establishing responsibilities for the 24-hour communication of the traveler information along expressways/freeways throughout Illinois;
- Evaluating the accuracy and availability of traveler information on an annual basis; and
- Upgrading infrastructure in Traffic Management Centers.

The last aspect of our study involved identifying information sharing needs and possible changes and updates to ITS architectures guiding ITS deployments in Illinois. These architectures were published between 2005 and 2007 and included the Illinois statewide ITS architecture, as well as regional ITS architectures for Champaign–Urbana–Savoy, DuPage, Peoria–Pekin, St. Louis, and Springfield–

Sangamon. Each ITS architecture was reviewed to identify missing connections, and data flows. The findings from this portion of the research can support the update of each ITS architecture that guides transportation planning efforts in Illinois. The findings also suggest that to support 23 CFR 511 for states with distributed control of ITS infrastructure, additional functionality should be added to future versions of the U.S. National ITS Architecture (see Chapter 6).

There are several references in this report pertaining to USDOT Final Rule (23 CFR Part 511) that requires Real-Time System Management Information Programs (RTSMIPs) to be operational on all interstate highways by November 8, 2014. While the recommendations contained in this Final Report are being published after the November 8, 2014 compliance deadline, the suggested courses of action provide the Illinois Department of Transportation (IDOT) necessary guidance to reach compliance with the RTSMIP requirements that took effect in November 2014. The recommendations will also provide vital guidance for IDOT to comply with the additional RTSMIP requirements that take effect November 8, 2016.

In conclusion, the efforts of this research project have helped identify strategies that IDOT can implement to comply with 23 CFR 511. The strategies for evaluating compliance have been reviewed and endorsed by the Illinois Division of the U.S. Federal Highway Administration. These strategies and the other recommendations identified during this research project have been summarized in an implementation guide (see Appendix A). Following the recommendations herein will help IDOT maintain compliance and provide high-quality and reliable traveler information to users on its expressways and interstates. This information can promote informed travel decisions, benefiting commuters, commercial carriers, and visitors throughout Illinois.

# CONTENTS

# ACRONYMS

| | |
|---|---|
| API | Application Programming Interface |
| ATIS | Advanced Traveler Information System |
| ATMS07 | Regional Traffic Management System service package |
| ATMS08 | Traffic Incident Management System service package |
| ATMS21 | Roadway Closure Management service package |
| AVI | Automatic Vehicle Identification |
| AVL | Automated Vehicle Location |
| CAD | Computer-Aided Dispatch |
| CARS | Condition Acquisition and Reporting System |
| CCTV | Closed-Circuit Television |
| CFR | Code of Federal Regulations |
| CMAP | Chicago Metropolitan Agency for Planning |
| CVRIA | Connected Vehicle Reference Implementation Architecture |
| DMS | Dynamic Message Sign |
| DOT | Department of Transportation |
| DXFS | Data EXchange Format Specification |
| EM08 | Disaster Response and Recovery service package |
| ESS | Environmental Sensor Station |
| FHWA | Federal Highway Administration |
| GPS | Global Positioning System |
| GTIS | Gateway Traveler Information System |
| HAR | Highway Advisory Radio |
| HOT | High-Occupancy Toll |
| HQ | Headquarters |
| ICT | Illinois Center for Transportation |
| IDOT | Illinois Department of Transportation |
| IEEE | Institute of Electrical and Electronics Engineers |
| IM | Incident Management |
| IRIS | Integrated Roadway Information System |
| ISP | Illinois State Police |
| ITS | Intelligent Transportation Systems |
| MADIS | Meteorological Assimilation Data Ingest System |
| MC08 | Work Zone Management service package |
| MSA | Metropolitan Statistical Area |

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|---|---|
| MS/ETMCC | Message Sets for External Traffic Management Center Communication |
| NTCIP | National Transportation Communications for Intelligent Transportation System Protocol |
| NWS | National Weather Service |
| PCMS | Portable Changeable Message Sign |
| PSAP | Public Safety Answering Point |
| RIMS | Road Information Management System |
| RTMC | Regional Traffic Management Center |
| RTRDS | Real-Time Route Diversion System |
| RTSMIP | Real-Time System Management Information Program |
| RWIS | Roadway Weather Information System |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users |
| SDDOT | South Dakota Department of Transportation |
| STOC | State Travel Operations Center |
| TIM | Traffic Incident Management |
| TMC | Traffic Management Center |
| TMDD | Traffic Management Data Dictionary |
| TOCC | Traffic Operations and Communications Centers |
| TRP | Technical Review Panel |
| TTS | Text-To-Speech |
| USDOT | U.S. Department of Transportation |
| V2I | Vehicles-to-Infrastructure |
| V2V | Vehicles-to-Vehicles |
| V2X | Vehicle-to-X (other vehicles, infrastructure, or other external devices) |
| WisLCS | Wisconsin Lane Closure System |
| WSDOT | Washington Department of Transportation |

# FIGURES

# TABLES

# CHAPTER 1 INTRODUCTION

Part 511 of Title 23 of the United States Code of Federal Regulations (23 CFR 511) was enacted November 8, 2010. The Federal Regulation 23 CFR 511 promises to improve the traveler information that assists motorists in making better travel decisions. In accordance with this regulation, all state departments of transportation (DOTs) are required to provide real-time traveler information about construction activity, lane-blocking incidents, adverse weather conditions, and travel times on certain limited access roadways.

Real-Time System Management Information Programs (RTSMIPs) are required to be operational for all U.S. interstates by November 8, 2014. All 50 states, Washington, D.C., and Puerto Rico have interstates and will be affected by this regulation. Next, RTSMIPs are required to be operational by November 8, 2016, for routes of significance in Metropolitan Statistical Areas (MSAs) with a population greater than 1,000,000 people. State DOTs must collaborate with local or regional agencies to designate non-interstate routes of significance (FHWA, 2010).

Currently, the Illinois Department of Transportation (IDOT) has an interactive map available through its websites. The map has the ability to show the locations of all construction activities within the state. Similar to most states, all roadway construction project information is reported by project engineers prior to the start of the project and updated as the project progresses. Additionally, the state utilizes its Illinois Traffic Alert System to provide texts and emails about current traffic conditions in some areas of the state. While IDOT provides information in several areas, the travel-time coverage observed during this project required expansion to meet the requirements of 23 CFR 511. The activities of this research resulted in recommended methods for measuring the accuracy and availability of information being provided by IDOT to travelers.

There are several references in this Final Report titled “Real-Time Information Dissemination Requirements for Illinois Per New Federal Rule” pertaining to USDOT Final Rule (23 CFR Part 511) that requires Real-Time System Management Information Programs (RTSMIPs) to be operational on all interstate highways by November 8, 2014. While the recommendations contained in this Final Report are being published after the November 8, 2014 compliance deadline, the suggested courses of action provide the Illinois Department of Transportation (IDOT) necessary guidance to reach compliance with the RTSMIP requirements that took effect in November 2014. The recommendations will also provide vital guidance for IDOT to comply with the additional RTSMIP requirements that take effect November 8, 2016.

Chapter 2 of this report is the literature review findings, which starts with an overview of the new rule. After that, Chapter 2 summarizes research on four types of traveler information: travel times, construction information, traffic incidents, and weather information. The review encompasses travel-time research published between 2001 and 2014 that included findings on accuracy and data collection tools. Literature on construction traveler information was sparse but included studies related to information on construction road or lane closures. Traffic incident studies mostly focused on methods of detecting these events, including closed-circuit television and other agencies’ computer-aided dispatch (CAD) systems. Next, Chapter 2 reviews how environmental sensor stations and vendors of weather information can provide weather information for travelers. Finally, the chapter recaps the findings of eight other state compliance studies from a report on the North/West Passage Coalition.

In the third chapter, a review of stakeholder interviews and findings is presented. The research team arranged meetings or conference calls with those involved in the operations of each IDOT district and headquarters. These meetings helped researchers identify IDOT’s current practices in traveler information collection, processing, and dissemination. These findings guided the future steps by demonstrating the commonalities and differences in practices throughout the state.

To gather best practices from others facing this same rule, researchers conducted an online survey to collect information from state DOTs and their FHWA representatives. The survey was targeted at operational engineers and Intelligent Transportation Systems (ITS) coordinators in each state and was distributed via email. The survey included five parts: travel-time information (ten questions), construction information (five questions), traffic incident information (five questions), weather information (three questions), and general information about the survey respondents (eight questions). Chapter 4 discusses the information regarding the survey and findings in more detail.

Chapter 5 describes the recommendations for implementing IDOT's Real-Time System Management Information Program. These recommendations were developed iteratively over the spring and summer of 2014 and the methods for measuring compliance were endorsed by the Illinois Division of the Federal Highway Administration.

Chapter 6 is intended for systems engineers or consultants who will lead the update of state or regional ITS architectures. The chapter describes how each architecture should be revised to align with current practices and support IDOT's Real-Time System Management Information Program.

Chapter 7 concludes the report by describing how the findings from the individual tasks integrate to support the overall objective of this study. The activities of this research project will guide IDOT in meeting several requirements of the new rule. Through these activities, several recommendations were also made to help continue improving the provision of traveler information in Illinois.

Appendix A of this document provides an implementation guide that summarizes recommendations along with their completion schedule.

# CHAPTER 2 LITERATURE REVIEW FINDINGS

## 2.1 INTRODUCTION

As technology continues to increase the ability to collect real-time information, the public's expectations of those services also grow (USDOT Joint Program Office, 2013). Perceiving this need, the federal government passed a rule that requires all state departments of transportation to provide real-time travel information and ensure its quality. To meet the rule, states have started to analyze their current Intelligent Transportation Systems (ITS) infrastructure and travel information collection and reporting processes. The following sections will present the current state of knowledge about travel information, including a review of 1) recent legislation, 2) travel-time information, 3) construction travel information, 4) traffic incident information, and 5) weather information for travelers.

According to previous research and case studies (FHWA, 2013), there is no single best technique for collecting all of the travel information required by this law; therefore, best techniques should be considered for each type, with an understanding of travelers' use, perception, and responses to each type of travel information. Advancements in technology have made it easier to collect travel information. Data can now be collected using various automated systems such as loop detectors, cameras, and radar sensors. However, even with current technologies, field inspection is still necessary. Information about how many lane-blocking incidents and how adverse weather conditions are impacting roads cannot always be determined using sensors and cameras.

Real-time data collection occurs at some level in almost all state transportation agencies. The most important difference between agencies is the scope of the real-time data collection. Almost every agency collects freeway speed data. In most cases, this is done using agency field equipment, but a subset of agencies purchase the speed data from private companies. For example, the South Carolina Department of Transportation receives near real-time speed data from a private company called INRIX (INRIX, 2014) under a contractual agreement. INRIX collects speed data through several sources, such as commercial vehicles acting as speed probes and cell phone tracking of volunteers (INRIX, 2014).

Most state agencies have speed data collection capabilities on freeways near major metropolitan areas. Less common is the collection of real-time speed data for major arterials, although it's becoming more common and is included in many regional ITS applications (Consensus Systems Technologies; Cambridge Systematics, 2013). This trend is promising because some of these facilities will be considered routes of significance and therefore will require real-time information monitoring under 23 CFR 511.

## 2.2 FEDERAL REGULATIONS AND DEADLINES

Part 511 of Title 23 of the United States Code of Federal Regulations (23 CFR 511), issued November 8, 2010, established provisions and parameters for Real-Time System Management Information Programs (RTSMIPs). In accordance with the federal regulation, all state departments of transportation are required to provide real-time travel information (i.e., construction activity, lane-blocking incidents, adverse weather conditions, and travel times) along U.S. interstate system highways as well as along routes of significance within Metropolitan Statistical Areas (MSAs). Title 23 CFR 511 was designed as a two-step implementation of the RTSMIPs (2010).

First, RTSMIPs are required to be operational for all U.S. interstates by November 8, 2014. All 50 states, Washington, D.C., and Puerto Rico have interstates and will be affected by this regulation. While Alaska, Hawaii, and Puerto Rico do not have interstate highways that connect to the contiguous United States, they all have highways that receive funding through the interstate program. In total, there are 72 primary interstates denoted with a one- or two-digit number and 153 auxiliary interstates denoted with three-digit numbers. In total, 48,299 miles of interstates are being funded by this program.

It is noteworthy that Illinois operates the third-most interstate miles among all States. A detailed table of the miles of interstates for each state and the states that have to consider routes of significance can be found in Appendix B.

Next, RTSMIPs are required to be operational for routes of significance in MSAs by November 8, 2016. State DOTs must collaborate with local or regional agencies to designate non-interstate routes of significance. When identifying these routes, the following factors should be considered:

- "Roadway safety (e.g., crash rate, routes affected by environmental events)
- Public safety (e.g., routes used for evacuations)
- Economic productivity
- Severity and frequency of congestion, and
- Utility of the highway to serve as a diversion route for congested locations" (FHWA, 2010)

Only MSAs with a population greater than 1,000,000 people must comply. According to the 2010 Census, there were 52 MSAs that meet this population requirement in 38 states, Washington, D.C., and Puerto Rico. In Illinois, 2 MSAs meet this criteria; the Chicago and the eastern portion of the St. Louis areas. The 12 states not affected by this portion of the regulation are Alaska, Hawaii, Idaho, Iowa, Maine, Montana, Nebraska, New Mexico, North Dakota, South Dakota, Vermont, and Wyoming.

The regulation also includes minimum requirements for timeliness, accuracy, and availability. Timeliness requirements specify either 10 or 20 minutes, depending on the type of information and the surrounding population density. Information about travel times along limited-access roadway segments within metropolitan areas must be disseminated within 10 minutes or less from the time that the travel-time calculation was completed. Travel times are not required outside of metropolitan areas; therefore, timeliness criteria were not specified. Information about construction that closes or reopens roadways or lanes must be provided within 10 minutes of the time of the closure for interstates within metropolitan areas. Outside of metropolitan areas, information about these construction activities must be provided within 20 minutes of the time of the closure or reopening. Additionally, the timeliness for information about lane- or roadway-blocking traffic incidents must be within 10 minutes in metropolitan areas and 20 minutes otherwise. This time is measured from the moment a transportation agency is notified of an incident and can verify its presence.

Additionally, information about dangerous driving conditions and lane/roadway blockages because of weather conditions must be provided within 20 minutes of the time the conditions or blockages are reported. Finally, all real-time information programs are required to be 85% accurate at a minimum and must be available at least 90% of the time (FHWA, 2010). These parameters are summarized in Table 1.

Table 1. Data Quality Measures of Effectiveness

| | Travel Time | Weather Information | Construction Activities | Traffic Incidents |
|---|---|---|---|---|
| Accuracy | >85% | N/A | >85% | >85% |
| Availability | >90% of time | >90% | >90% | >90% |
| Timeliness | <10 min. | <20 min. | <10 min. urban<br><20 min. rural | <10 min. urban<br><20 min. rural |

States are required to establish real-time information programs that are consistent with the minimum regulations defined in 23 CFR 511. However, the federal regulation does not specify any requirement for the technologies used in the collection or dissemination. The regulation recommends that the RTSMIPs should take advantage of and build upon existing monitoring systems for travel facilities. Currently, the technologies utilized and the areas covered vary from state to state. Due to the array of technologies available for use, it would be difficult to establish a uniform method for calculating the accuracy and quality of the information. Each state is required to establish a method for ensuring the quality of the information based on the technology being used (Federal Register, 2010). Examples of the technologies being utilized by states are discussed in the sections that follow.

In 2011, the United States Department of Transportation (USDOT) started developing the Data Exchange Format Specification (DXFS) to simplify communications between real-time traffic and travel information systems among public agencies and private entities. The primary goal of DXFS was to establish a standard-based specification for RTSMIP interfaces. These interfaces include those between traffic, transit, and transportation-related weather. While DXFS covers all the information required in 23 CFR, the scope of DXFS recommendations have been extended to include transit and additional traffic information. DXFS can assist transportation agencies, public safety agencies, traveler information providers (public or private), and contractors deploying these systems (Consensus Systems Technologies; Cambridge Systematics, 2013). This new specification can be leveraged as a tool to help meet the requirements of the RTSMIP.

## 2.3 PREVIOUS WORK ON TRAVEL-TIME INFORMATION

Historically, DOTs have focused their collection and dissemination of real-time traveler information in urban areas. Although some efforts have succeeded for rural traveler information, challenges include collecting consistent and reliable traveler information and the availability of technology for real-time data collection for rural areas (Burgess, et al., 2012).

Previous studies on the topic of travel times have measured the accuracy of numerous data collection tools. Early work, published in 2001, described how a travel-time prediction system operated in Dayton, Ohio. This system used radar sensors for detecting the vehicle traffic on each highway lane and 220-MHz radios for communication between sensors, computers, and dynamic message signs (DMSs). To evaluate the accuracy of this system, researchers conducted 119 travel-time runs over a 3-day period. The accuracy of the predicted travel times was found to be 88% within a range of ±4 minutes from the actual travel time. When the margin of error was reduced to ±2 minutes, the accuracy was found to be between 65% and 70%. Overall, the travel-time accuracy decreased for longer segments (Zwahlen, et al., 2001) (Zwahlen, et al., 2002) (Zwahlen, 2001).

Later, in 2003, a quantitative method was established for evaluating the accuracy of travel time. The developers of this method noted that measuring day-to-day variability was challenging and recommended collecting travel times along the same route, during the same times, over 20 or more days. These recommendations stated that if accuracy was below 15%, additional work should be undertaken to measure day-to-day variability within the road network (Toppen, et al., 2003).

In metropolitan areas where inductive loop detectors or other speed sensors are typically prevalent, travel times are often estimated by extrapolation of the sensor data. This method estimates travel times based on measurements from many vehicles instead of relying on particular probe vehicles. However, due to the discrete nature of detectors, the spot speed measurements must be extrapolated to estimate travel times across a corridor, which can lead to a reduction in accuracy. The emergence of Bluetooth, radar, microwave, and other non-invasive detectors has led to increased monitoring and estimating of travel times on arterials and rural roads.

The important consideration in measuring travel time is that the representative sample of data point collection would be ensured. If detectors are not reliable across the network, then the accuracy of different segments can vary widely. Additionally, accuracy might be lower during peak hours because inductive loop detectors are less accurate at low speeds. It is a best practice to use probe vehicles to collect ground-truth travel times for several routes at various times of the day. Because probe vehicles cannot collect the quantity of data that methods such as license plate matching can, widely sampling the network is very important. Based on minimum sample size statistics and the marginal cost of each data point collected, some recommend collecting approximately 100 data points for the accuracy measurement. First, while license plate matching is the most robust in terms of ensuring reliable and accurate ground-truth measurements, it is costly for the amount of data that can be collected. Second, to measure variability, data must be collected at the same time over multiple days, which would involve a lot of setting up and breaking down of equipment. For a single study, it makes the most sense to use video cameras and manual transcription (Toppen, et al., 2003).

Real-time data collection for transit agencies consists mostly of transit vehicle location information. Use of automated vehicle location (AVL) systems is common for large and medium-sized transit agencies. In most cases, the transit agency receives the AVL data directly from transit vehicles through wireless communications links, but sometimes a third party collects the data and provides real-time location information to the agency (Consensus Systems Technologies; Cambridge Systematics, 2013).

Traditional travel-time prediction methods mainly assume a constant variance and predict point values for future traffic conditions. Because travel-time changes significantly throughout the day, the point prediction method is less reliable and accurate when it deals with uncertain traffic conditions (FHWA, 2014). Different techniques for collecting travel-time data in the field are described in the *Travel-Time Data Collection Handbook* (Turner, et al., 1998). These techniques can be grouped into methods that are based on probe vehicles; license plate matching; and up-to-date technologies such as cell phone tracking, automatic vehicle identification (AVI), and inductive loop signature matching (Turner, et al., 1998).

In 2011, researchers compared travel times from GPS-equipped probe vehicles with traveler information system estimates from loop detectors. For evaluation of a real-time traveler information system, this method can collect only a limited number of travel times during a time interval; therefore, the limitation of sample size influences the statistical significance of the comparison for 1 day (Richardson, et al., 2012).

Bluetooth re-identification technologies have also had a notable impact on the ability of traveler information systems. Because so many travelers use Bluetooth devices in their vehicles, a significant sample size is available for measuring travel times along freeways and arterials. The emergence of this technology has enabled agencies to apply statistical sampling methods at very low cost and improve the confidence of the travel time data these agencies estimate (Alexander M. Hainen, 2011).

Recent travel-time research has focused on the abilities of vehicles to communicate with each other and with roadside equipment. Vehicle communication with roadside infrastructure is termed vehicle-to-infrastructure (V2I), and communication between vehicles is termed vehicle-to-vehicle (V2V). These communication links can enable a plethora of abilities in future vehicles. One of the features of the V2I communication technology is probe vehicle data collection, in which vehicles collect information such as their location and speed. The speed information can be used for travel-time estimation. A study found that microscopic data collected using V2I, provided reliable assessment of traffic conditions and prediction of travel time, with the use of an artificial intelligence–based algorithm, along a corridor (Ma, et al., 2012; Ma, et al., 2009).

Roadside equipment can be also used for estimating travel times in a V2I communication environment. On this topic, researchers have developed methods for optimizing the placement of roadside infrastructure that communicates with passing vehicles in a V2I environment. This study has helped researchers make initial predictions of the number of roadside communication devices required for determining accurate travel times (Kianfar Jalil, 2013). V2V and V2I communication will enable transportation agencies to efficiently manage traffic operations such as high-occupancy toll (HOT) lane management by processing toll payments through in-vehicle units (Misener, et al., 2010) or by providing dynamic lane-use instructions to drivers through on-board units (Park, 2008). However, selection of appropriate communication technologies for V2V and V2I for traveler information will be challenging. There are several competing technologies (e.g., DSRC, Wi-Fi. WiMAX, Cellular) that could be used for traveler information systems (Dar, et al., 2010)

Vehicle-to-infrastructure and vehicle-to-vehicle can be collectively termed V2X. Other research on V2X communication found that the traffic data collected and disseminated in such a system would provide great benefits to travelers, but the costs could reach $44 billion. V2X could help meet several objectives that concern travel-time data collection, including providing more accurate and timely road condition alerts and traveler information and reducing dependence on DOT traffic monitoring infrastructure (Hill, et al., 2011). Dynamic routing of vehicles utilizing V2X infrastructures to provide real-time traveler information will help to reduce incident recovery time (Bhavsar, et al., 2014). Active research on V2X is ongoing and has the potential to reshape the way travel-time information is collected along the roadside and disseminated to travelers.

FHWA has developed the national ITS architecture and Connected Vehicle Reference Implementation Architecture (CVRIA) to promote the research and development of V2X applications (FHWA, 2014) (FHWA). CVRIA has identified three application areas for traveler information: 1) advanced traveler information systems, 2) dynamic travel planning, and 3) a smart parking support information system (FHWA). The national ITS architecture identified ten service packages to support different ITS applications for traveler information purposes (FHWA, 2014).

## 2.4 PREVIOUS WORK ON CONSTRUCTION TRAVELER INFORMATION

Smart work zone technology has been an important part of work zone management for a few years. This technology provides travelers real-time information through websites or DMSs while on the route. Smart work zone technology not only helps to increase safety and provide travelers with delay and travel-time information, but also the collection of historic and real-time traffic data can be used for both the design and construction period (Jackson, 2010).

## 2.5 PREVIOUS WORK ON TRAFFIC INCIDENT INFORMATION

Most transportation agencies have a network of closed-circuit television (CCTV) cameras monitored at a central facility that are used to identify and classify incidents, which are then tracked in a software system. Another primary source of incident information is a data feed from computer-aided dispatch (CAD) systems of public safety and law enforcement centers such as public safety answering points (PSAPs) (Consensus Systems Technologies; Cambridge Systematics, 2013).

Van Aerde and Yagar (1990), researchers underscored the importance of including both freeway and arterial routes when evaluating the impact of traffic incidents. When including both of those facility types, researchers were able to predict that route guidance benefits can increase with incident duration (Chang, 2004), that dynamic route guidance can reduce travel times between 11% and 21% (Plaisant, et al., 1999), and that route guidance should be integrated with the dynamic adjustment of corridor signal timing and phasing plans.

In March 2009, the Florida Department of Transportation released a report about a Real-Time Route Diversion System (RTRDS). In the report for real-time traffic information and message dissemination, a modular design with an interface to SunGuide was presented. Given an incident, RTRDS provides available real-time and historical traffic data and finds efficient alternative routes with minimal operator input. The operator can use RTRDS to review and choose from alternate routes that can be generated on demand or previously constructed (Hua, 2009).

## 2.6 PREVIOUS WORK ON WEATHER INFORMATION FOR TRAVELERS

Previous work on travel weather information has focused on two topics: environmental sensor stations and contracted weather services. Road weather data are collected from a network of environmental sensor stations. States that experience ice and snow use these sensors to gather atmospheric and pavement weather data. In some cases, private contractors collect the data and provide it to transportation agencies for a fee (Consensus Systems Technologies; Cambridge Systematics, 2013).

The Clarus Initiative was established in 2004 by the FHWA Road Weather Management Program cooperatively with the ITS Joint Program Office. The initiative focused on creating a powerful aggregate data source with close to real-time atmospheric and pavement observations. This program collected data from a network of environmental sensor stations along freeways. Research has compared the data from these sensor stations, finding that they are accurate (2014).

The current use of the Road Weather Information System (RWIS) by state DOTs is widespread (Rall, 2010). According to 2009 data collection, at least 44 states and the District of Columbia reported using RWIS. Moreover, according to the reports, 33 state DOTs and three local transportation agencies were sharing RWIS data via the Clarus Initiative. A North American integrated weather observation and data management system collects and quality-checks road weather information and makes it available to all transportation users and operators (Rall, 2010).

The New York City Department of Transportation has contracted with the National Weather Service (NWS) to use weather information from several weather instruments arrayed outside the NWS office building. Some of the information used includes satellite imagery, local temperature, precipitation data, and Doppler radar information—one of the most advanced weather radar technologies in the world (Nat14; Dop14).

## 2.7 DISSEMINATION OF TRAVELER INFORMATION

The two primary purposes of real-time traveler information dissemination are 1) providing information directly to travelers so that they can make better travel decisions and 2) providing information to other agencies and third-party providers so that they can make better decisions about operating and maintaining the transportation network (Consensus Systems Technologies; Cambridge Systematics, 2013). The new rule (23 CFR 511) does not specify any particular technique of disseminating information to the public. The following subsections summarize previous research on common methods of disseminating real-time traveler information to the public.

In this report, the methods for disseminating traveler information have been divided into three sections: 1) current methods such as DMSs, websites, and 511 systems; 2) emerging methods such as smartphones and social media; and 3) legacy methods, such as Highway Advisory Radio (HAR).

### 2.7.1 Current Methods

In 2004, FHWA issued guidance to transportation agencies for displaying their travel-time information on DMSs (Paniati, 2004).Weather-related information, primarily where hazardous conditions can exist, is the primary output to travelers resulting from the collection of road weather data. Providing the weather-related information to travelers should be via roadway devices (e.g., DMSs, HAR, and connected vehicles) and through traveler information outlets (e.g., 511, websites, social media) (Consensus Systems Technologies; Cambridge Systematics, 2013).

511 in most states provides real-time traffic information for all interstates and other major highways within the state, including congestion, crashes, construction, lane closures, road conditions, and severe weather information (West Virginia Department of Transportation, 2012).

### 2.7.2 Emerging Methods

Another way of providing real-time traveler information to travelers is through websites and smartphones. In recent years, the use of websites that update in real-time have become popular (Robinson, et al., 2012). Recent research has defined information equity as “providing real-time information through at least two dissemination media, in both audio and visual formats” to travelers (TCRP, 2013).

#### *2.7.2.1 Social Media*

Social media, such as Twitter and Facebook, are being widely used. The posts are usually brief and contain travel-time data, average speed data, incidents that cause lane closures, and an expandable map of the region showing traffic congestion (Consensus Systems Technologies; Cambridge Systematics, 2013).

Agencies support the notion that new social media and technology need to be utilized. Agencies indicated that they have an app and/or Twitter account. Recently, social media has been the most popular method of communication in some cases—but not necessarily the most effective (Robinson, et al., 2012).

#### *2.7.2.2 Smartphones*

The University of South Florida has conducted research on the TRACK-IT system, which delivers dynamic travel information. This method uses the real-time location and travel history of individual users to provide highly targeted and hyper-personalized travel time alerts to user cell phones that are relevant for routes chosen by the user. Real-time traffic and public transportation information is integrated with path prediction technology using an application programming interface (API). The project also illustrates a prototype for technology that delivers the information only when the traveler is driving below the speed threshold or has stopped the vehicle. It can also speak to travelers using text-to-speech APIs, so they can get information without checking their phone. Origin-destination flow measurement and differentiated congestion pricing are the two applications examined in the report (National Center for Transit Research, 2011). Both applications require vehicles to be tracked, which could raise privacy concerns. Researchers have identified several methods of protecting privacy during use of these applications. Some researchers propose the use of commutative one-way hash functions to protect privacy (Zangui, et al., 2012).

Several agencies now offer traveler information via apps from mobile phones. For example, the Hawaii Department of Transportation offers the 511 GoAkamai website and mobile apps (Hawaii Department of Transportation, 2013). This system features an interactive voice responsive system that provide real-time travel updates. Travelers can receive current information on roadway delay and travel times by dialing 511. The GoAkamai mobile app for iPhone and Android, which was released in August 2013, provides traffic information 24/7, including travel times and images from more than 200 traffic cameras (Hawaii Department of Transportation, 2013). Similarly, the Lake Michigan Interstate Gateway Alliance (LMIGA) offers the Travel Midwest Mobile App for both iOS and Android devices. These apps allow travelers to access much of the information from the travelmidwest.com website and were most recently updated in 2014 (Lake Michigan Interstate Gateway Alliance, 2014).

### 2.7.3 Legacy Methods

Most of states use HAR transmitters along interstates to provide real-time information via traveler car radios. This information can include construction updates, emergency operations, and traffic delays. Although these systems are not novel, they can still allow travelers to make informed travel decisions. HAR is considered the least effective dissemination technique; nevertheless, 70% of the agencies use it, but only 27% of them take it into account in their evaluation (Robinson, et al., 2012).

### 2.7.4 Traveler Perceptions of Real-Time Information

Many of the prior studies on real-time travel information have been based on user satisfaction. According to (Robinson, et al., 2012), almost 90% of agencies provide information on traffic conditions (e.g., roadway status, CCTV video feeds, incidents, construction zones), and more than 65% don't provide alternate routes. Ninety-eight percent of the agencies believe that traveler information enhances traveling experience; only 30% of agencies have conducted studies to demonstrate the benefits of transportation information systems. According to the same report, 59% of the agencies indicated they provide traveler information because other agencies like them are doing it. Perhaps it is no surprise that 60% of these agencies do not consider themselves more effective than their peer agencies. The report mentions that safety and transit alternatives information are the least important types of traveler information. The common response of the agencies could be summarized as “there is never enough” and “we need more,” when they were asked about availability of funds and what can they do with limited funds.

Information sources that provide the major categories of information are as follows: 1) 511 phone system, 2) highway DMSs, 3) local road DMSs, 4) email and text messages, 5) HAR, 6) mobile smartphones apps, 7) on-board devices, 8) social media, and 9) websites (accessed via laptops, desktops, or mobile devices) (Robinson, et al., 2012). According to the agencies who responded to the Web survey, television, radio, and websites (not mobile devices) at 48.7%, 46.4% and 46.1%, respectively, have a strong role helping travelers make trip decisions, whereas 511, email, and social media are used by just a few travelers. Another statistical report (based on answers from responding agencies) of traveler responses noted that the most common information sources used to make a trip change decision while en route are radio, electronic highway messages, and television (54%, 32.5%, and 26.5%, respectively). The researchers interpreted the findings about television usage to indicate travelers viewed television prior to departure and then considered corroborating evidence before making a final decision en route (Robinson, et al., 2012).

## 2.8 KEY FINDINGS OF OTHER STATE CONFORMANCE STUDIES

In response to 23 CFR 511, states in the North/West Passage Coalition (Idaho, Minnesota, Montana, North Dakota, South Dakota, Washington, Wisconsin, and Wyoming) have already evaluated their compliance. The findings of the “North/West Passage Coalition: Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Section 1201 RTSMIP Conformance Assessment” suggest that the states without a statewide (urban and rural areas) 511 system in place are considering developing such a system in near future. States without MSAs with a population greater than 1,000,000 were already in compliance. The report recommended establishing a 24/7 Traffic Control Center or partnering with agencies to provide information outside of normal business operating hours in support of a 511 traveler information system (Rafferty, et al., 2013). The following sections provide a summary of the findings for each of the eight states in the coalition.

### 2.8.1 Idaho

Idaho provides real-time information to the public by using a traveler information service, Castle Rock Acquisition and Reporting System (CARS), which sends information to the 511 service in the state. Public information can be obtained by calling the 511 number or through the 511 website. In addition to the regular website, a condensed mobile version has been created to be easily viewed using a smartphone. All construction information related to interstates and roads within Idaho are reported by the district offices throughout the state; if there are any changes in the schedule or route, the information is updated immediately. State police and the statewide Communications Center are in charge of all incident information throughout the state. In each section of the state are people in charge of informing the state Communications Center. The state Communications Center works 24/7 and provides road weather information for all roads and segments in the entire state. The report noted that state updates the information every 10 minutes on a 24/7 basis with an accuracy greater than 85%. Therefore, Idaho has met the rule and no additional improvements were required (Rafferty, et al., 2013).

### 2.8.2 Minnesota

Minnesota reports real-time information by using CARS, the Twin Cities Regional Traffic Management Center (RTMC), and a 511 system. Project engineers and construction personnel are responsible for reporting construction information to traffic operations and communications centers (TOCCs) before the construction projects begin and as any updates occur. Unplanned construction activities and incident information are managed by State Patrol Dispatch. The weather information that is reported by the RWIS sensors and dispatch reports are input manually and updated every 4 hours, but if there are new weather conditions, they would be updated at that time. Throughout the state, travel times are calculated using loop detectors, and most areas are covered. There were just a few gaps on limited-access highways. All other coverage exceeds the minimum requirements for timeliness, accuracy, and availability (Rafferty, et al., 2013).

### 2.8.3 Montana

The Montana 511 website, phone, and email services are linked to an Oracle database. The database includes construction, incidents, and road weather information. After data are entered into the system, a map is automatically updated. Construction project engineers in the division offices are in charge of reporting construction information on all interstates. The incident information is verified by field staff before reporting, after being called in by highway patrols and others. All information is updated every 5 to 15 minutes and exceeds the minimum requirement for accuracy and availability (Rafferty, et al., 2013).

### 2.8.4 North Dakota

The North Dakota Traffic Operations Center does not operate 24/7; in the winter months, they don't operate at nights. Traveler information is updated by maintenance staff manually or remotely when outside of business hours. Like Montana, the map application was built and is maintained in-house, while the phone service is hosted by Meridian. The state has the technical systems in place, but they have high latency after office hours. To meet the minimum requirements for timeliness and availability, the state has suggested the possibility of working with partner agencies, such as the Department of Emergency Services, 911 public safety answering points, and highway patrol. Construction information is reported and entered by field engineers; the information is updated automatically after it has been entered. Incident information is reported by highway patrol, and DOT field staff are responsible for covering road weather information. In addition, RWIS stations throughout the state provide weather information to the public (Rafferty, et al., 2013).

### 2.8.5 South Dakota

In South Dakota, real-time information is provided to the public via the Web, 511 phone, apps, text messages, and email. There was no Traffic Operations Center in South Dakota, but there was an ongoing project focusing on planning and 24/7 operation. Construction information is provided by office engineers in the field throughout the state before construction activity starts. Only major incidents are reported to the state DOT, and that information is entered into IRIS software by staff at the 12 field offices located throughout the state. Field maintenance personnel are responsible for road weather information (Rafferty, et al., 2013).

To meet the requirements for incident reporting, the state was considering training highway patrol dispatch officers to use IRIS software. In time, another improvement might entail a data link between the highway patrol CAD system and operations staff. Weather condition reporting was also being addressed. Options being considered include creating a 24/7 operation center, partnerships with other agencies, and use of other automated systems (Rafferty, et al., 2013).

### 2.8.6 Washington

Washington State provides all real-time information related to construction, incidents, and weather for all its interstates. The state patrol CAD system and DOT Traffic Management Centers (TMCs) provide the information. Traveler information is provided to the public, by phone, the Web, apps, social media, and email. Project engineers are responsible for reporting construction information before the start of construction project, and there are coordinators that provide weekly updates. Construction information is entered in the road reporting system, which provides the information for the website, 511 system, social media, and emails. WSDOT operates RWIS stations and uses a weather service for providing forecast information about road weather. In the greater Seattle area, sensors are used to collect speed and occupancy data for providing travel time to the public using a network of DMSs and a website. In addition to routes of significance, all other minimum requirements for timeliness, accuracy, and availability are met in this state (Rafferty, et al., 2013).

### 2.8.7 Wisconsin

Wisconsin provides real-time information to the public by utilizing a 511 Web and phone service. The information related to construction throughout the state is managed by the Wisconsin Lane Closure System (WisLCS). Incident information is provided by the Wisconsin State Patrol and Milwaukee County Sheriff's Office. First, the data are filtered and sent to WisDOT's State Travel Operations Center (STOC). STOC then makes the information available to the public. Additionally, the Wisconsin State Patrol is in charge of providing road weather information from field observations. The study found that travel-time coverage in the Milwaukee area was lacking, but once routes of significance were identified by the state, solutions to the problem would be addressed (Rafferty, et al., 2013).

### 2.8.8 Wyoming

Wyoming disseminates real-time information to the public using websites, text messages, email, and telephone. Construction information throughout the state is entered into the system by field engineers and reported to the Wyoming TMC in Cheyenne. TMC staff input incident-related information to the system, which is provided by the highway patrol. The information is provided to the public via online maps. Wyoming uses redundant systems, allowing a high level of availability (Rafferty, et al., 2013).

# CHAPTER 3 STAKEHOLDER INTERVIEWS AND FINDINGS

## 3.1 INTRODUCTION

To achieve the objectives of this report, the research team collected data from various sources. During the fall of 2013 and the winter of 2013–14, researchers interviewed stakeholders at IDOT districts throughout the state. This chapter details the findings of these discussions. Overall, researchers learned that every IDOT district has slightly different practices for collecting information on travel time, weather, construction activities, and traffic incidents.

The team met with District 8 on November 25, 2013; District 1, the Gateway Traveler Information System (GTIS), and the Illinois Tollway on December 17, 2013; and Districts 3 and 4 on January 23, 2014. Conference calls were held with District 9 on February 10, 2014; District 7 on February 11, 2014; District 2 and the Chicago Metropolitan Agency for Planning (CMAP) on February 13, 2014; District 5 on February 21, 2014; and District 6 on February 27, 2014. Prior to each meeting or conference call, a questionnaire was distributed to the participating agencies and districts.

The following subsections describe what was learned about practices on travel-time information, weather information, construction, and traffic incidents throughout Illinois. Each subsection will include how the agency or district collects, processes, and disseminates information.

## 3.2 TRAVEL-TIME INFORMATION

When determining travel times, there are a variety of tools for collecting raw traffic data, processing raw data into useable information, and providing this information to the public. Note that only Districts 1 and 8 are required to serve travelers in a metropolitan area, as defined by 23 CFR 511. Accordingly, the interviews concluded that only District 1, District 8, and the Illinois Tollway collected travel-time information that must meet the requirements of 23 CFR 511. The interviews also found that District 4 collections and disseminates travel time information for interstates near Peoria, Illinois; but the population of this metropolitan area was not larger than 1 million.

For collecting travel times, District 1 uses loop detectors, side-fire radar, and Bluetooth. District 8 uses side-fire radar, traffic cameras, and loop detectors. The Illinois Tollway uses side-fire radar and wireless pucks to collect travel times; and wireless pucks are also used on freeways for queue detection. These methods are summarized in Table 2.

Table 2. Travel-Time Data Collection Practices of Interviewees

| Method | IDOT District 1 | IDOT District 8 | IL Tollway |
|---|---|---|---|
| Loop Detectors | x | x | |
| Side-Fire Radar | x | x | x |
| Bluetooth | x | | |
| Traffic Cameras | | x | |
| Wireless Pucks | | | x |

Field travel-time data are processed by IDOT using in-house software or vendor software, or by a vendor. District 1 processes its information with in-house software, and the data are checked internally for error, multiple times. District 8 processes its data using vendor software from Wavetronix. Although the Illinois Tollway has a vendor processing its travel-time information, the Tollway plans to process this information in-house in the near future. Data collected from wireless pucks are processed in-house by the Tollway.

There are various methods used to disseminate travel-time information to the public. District 1 disseminated travel-time information via websites: www.gettingaroundillinois.com and travelmidwest.com. Additionally, the Gateway Traveler Information System disseminates this information using XML files, emails (see www.iltrafficalert.com), and over the phone through text messages to those registered in the Illinois Traffic Alert System.

District 8 provides travel-time information on dynamic message signs (DMSs), Highway Advisory Radio (HAR), and the websites www.gettingaroundillinois.com and www.stl-traffic.org. The Illinois Tollway has many methods to disseminate the information to the public. Those methods are DMSs, website, email list, portable changeable message signs (PCMSs), social media (Twitter), and TV. Table 3 summarizes these dissemination practices.

Table 3. Travel-Time Dissemination Practices of Interviewees

| Dissemination Method | IDOT District 1 | IDOT District 8 | GTIS | IL Tollway |
|---|---|---|---|---|
| Website | x | x | x | x |
| Through GTIS | x | | | x |
| XML Files | x | | x | |
| Emails | x | | x | x |
| Phone Calls | x | | | |
| DMS | x | x | | x |
| HAR | x | x | | |
| PCMS | | | | x |
| Twitter | | | | x |
| TV | x | | | x |

### 3.3 WEATHER INFORMATION

According to the 23 CFR 511, information about dangerous driving conditions and lane/roadway blockages because of weather conditions must be provided within 20 minutes of the time the conditions or blockages are reported; therefore, all districts are required to meet the new federal rule.

The interviews revealed that weather information comes from four sources: vendors, Road Weather Information System (RWIS) stations, the national weather service, and IDOT snowplow drivers. There are two vendors used for collecting weather information throughout the state; Schneider Electric for Districts 2 through 9 and Murray and Truttle for District 1. During fair weather, vendors provide updates only twice a day; but provide forecasts with additional storm warnings as needed.

Table 4. Weather Information Collection Practices of Interviewees

| | IDOT District | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | IL Tollway |
| RWIS | x | x | x | x | x | x | x | x | x | x |
| Vendor | x | x | x | x | x | x | x | x | x | x |
| NWS | | x | | | | x | | | | |
| TV | | | | x | | | | | | |

All IDOT districts have several RWIS stations to measure roadside weather conditions (Figure 1.) The RWIS data are processed by IDOT electronically and stream to the Getting Around Illinois website (www.gettingaroundillinois.com) in real-time. Vendor (meteorologist) contracts were arranged for the purpose of supporting IDOT operations staff, particularly during winter weather events, but this information is not disseminated to the public. The Travel Midwest website downloads data from the National Weather Service and geographically filters the data. These filtered entries are converted into announcements and appear on the Travel Midwest website Weather Notices page.


Figure 1. Example of Illinois RWIS station website display (IDOT).

The interviews revealed that all IDOT districts process their information 24/7 during snow events. During these events, snowplow drivers in all impacted IDOT districts report the conditions of roadways to their Dispatch Center at approximately 2-hour intervals. Road conditions are then reported from each district office to IDOT headquarters using a rating scale of 1 through 6, where each number corresponds to a different level of snow cover. These winter road conditions are displayed on a map (on www.gettingaroundillinois.com) that informs travelers whether roads are clear, have patches of ice/snow, or are covered with ice/snow. An example of the winter road condition map is shown in Figure 2.

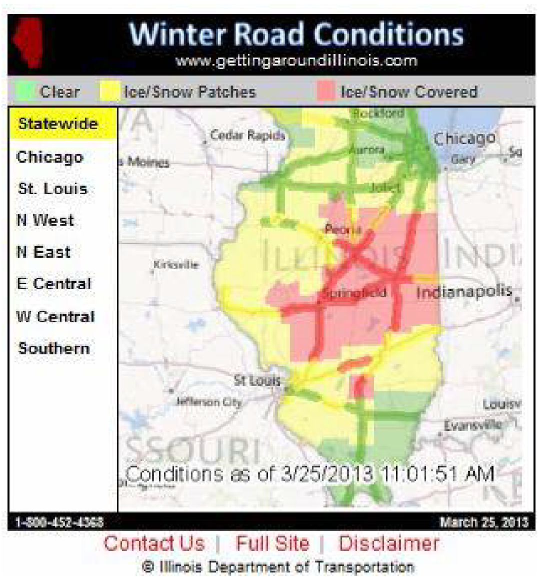


Figure 2. Example of the winter road conditions map (Google, 2013).

Weather information collected from the RWIS stations and snowplow drivers is displayed in www.gettingaroundillinois.com website. While weather information collected through the vendors is not disseminated to the public, it may guide IDOT to post advisory notices. Weather information for public dissemination is sent from all districts to the IDOT Headquarters communications Center, also known as Station 1. Some IDOT districts send weather information through email (Districts 4, 5, and 8) and/or DMSs (Districts 1, 2 and 4). IDOT District 3 has an internal practice to not disseminate weather information because of liability concerns. Table 5 summarizes these weather information dissemination practices.

Table 5. Weather Information Dissemination Practices of Interviewees

| | IDOT District | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Station 1 | x | x | x | x | x | x | x | x | x |
| Website | x | x | x | x | x | x | x | x | x |
| Email | | | | x | x | | | x | |
| DMS | x | x | | x | | | | x | |
| HAR | x | | | | | | | x | |

IDOT districts also refer to other sources for validating the weather information from RWIS or vendors. These sources include television (District 4), the National Weather Service (District 6) and traffic cameras (Districts 1 and 8). IDOT personnel would then determine what information, if any, should be disseminated to the public. Table 4 summarizes these weather information collection practices.

## 3.4 CONSTRUCTION ACTIVITIES

To meet the requirements of 23 CFR 511, IDOT should report construction activities that close or reopen lanes within 20 minutes from closing time outside the metropolitan area and 10 minutes in metropolitan areas. The interviews sought to identify how IDOT personnel commonly gather this information and which entities are responsible for reporting. On the basis of the interviews, the researchers concluded that all IDOT districts collect construction activity information using several different methods, depending on whether the information is for a real-time event or an event planned for the future. Several districts disseminate and receive information to/from other state DOTs.

The researchers learned that IDOT District 1 uses a lane closure system (LCS) that collects real-time information about freeway/expressway construction lane closures. The IDOT District 1 LCS was deployed in July of 2013 and is accessible at www.IdotLcs.com. Contractors must register with the website and their accounts must be approved by District 1 personnel. District 1 engineers review the proposed closures daily and can edit, combine, approve, or reject closures. The LCS assists the engineers by highlighting closures that do not fall within the Districts' own guidelines for allowable closures by expressway location, time of day, day of week, and number of lanes closed. Conflicts are also highlighted, such as closing both the left and right lanes at the same time. Once approved, contractors and their traffic control vendor are notified. Reports are automatically sent out to other District personnel, to www.TravelMidwest.com, and to the media. The Illinois Tollway Authority also sends their construction lane closure information to www.TravelMidwest.com, though not through the District 1LCS. After reviewing the IDOT District one practices, the researchers concluded that this system met the requirements of the new federal rule.

Construction information for future planned lane closures is collected and disseminated in a variety of ways. These methods include spreadsheets, databases, phone calls, and/or completing online forms. The practices do not provide lane closure information in real-time. Among these practices, researchers noted that District 8 has a database of active projects in which contractors or IDOT resident engineers

(REs) can provide real-time lane closure updates. This mechanism could be used to meet the construction information portion of 23 CFR 511. Although some districts (1 and 7) have established responsibilities for reporting this information, interviews overall suggest that gathering construction information is a challenge due to inconsistent real-time reporting from contractors and/or IDOT resident engineers. Table 6 summarizes and compares the data collection practices of those interviewed.

Table 6. Construction Activity Data Collection Practices of Interviewees

| | IDOT District | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Calls** | x | | x | x | | x | x | x | |
| **LCS** | x | | | | | | | | |
| **Spreadsheet** | | x | | | | | | | x |
| **Form Filling** | x | | x | | x | | | | |
| **Website** | x | | | | | | | x | |
| **Database** | | | | | | | | x | |
| **Letting Process** | x | | | | | | x | | |

During the interviews, researchers identified several other challenges to the real-time reporting of construction lane closures. For example, some interviewees noted that it was difficult to update information for moving operations such as rolling lane closures. In the past, it has not always been clear what types of construction should be reported to the public.

Construction information is currently disseminated using a variety of methods. Most commonly, lane-closing construction activities are reported via IDOT's headquarters to be posted on the Getting Around Illinois website (www.gettingaroundillinois.com). In addition, District 1 provides its information to the Gateway Traveler Information System (Travel Midwest) website and to the media and public safety agencies via email and fax. Researchers learned that under the existing IDOT agreement with the University of Illinois at Chicago (UIC) for operation, maintenance, and enhancement of the Gateway Traveler Information System/Travel Midwest website, UIC will be working with IDOT to expand the current IDOT District One expressway construction Lane Closure System (LCS) statewide. After this expansion, the web-based system will receive contractor requests for lane closures in real time, process approvals from IDOT staff, and automatically forward appropriate information to the Gateway Traveler Information System (Travel Midwest) website and other real time traffic information systems for distribution to the public.

The next most common method for disseminating construction information was using DMSs and sometimes portable changeable message signs (PCMSs). The interviews also revealed use of social media tools, Highway Advisory Radio (HAR), and press releases to inform the public about upcoming or real-time construction lane closures. Table 7 summarizes these dissemination practices by IDOT district.

Table 7. Construction Activity Information Dissemination Practices of Interviewees

| | IDOT District | | | | | | | | | IL Tollway |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| Website | x | x | x | x | x | | x | x | x | |
| DMS | x | x | | x | | x | x | x | | |
| PCMS | x | x | | | | | | x | x | |
| Social Media | x | | | x | | | | x | | x |
| Press Release | x | x | | x | x | | | x | | |
| HAR | x | | | | | | | x | | |
| GTIS | x | x | | | | | | | | x |

### 3.5 TRAFFIC INCIDENT INFORMATION

Complying with this requirement means that, from the time an incident is verified, traffic incident information must be disseminated 20 minutes or less outside metropolitan areas and 10 minutes or less in metropolitan areas. A wide variety of methods are used for collecting traffic incident information. One of the most common ways that IDOT is informed of traffic incidents is through the Illinois State Police (ISP) and local police. The second most common method is through phone calls from motorists, through contracted services such as *999, operating in the Chicago metropolitan area. Next, traffic cameras are also frequently used to detect incident in metropolitan areas. Table 8 summarizes and compares traffic incident information collection practices by IDOT districts and other Illinois transportation agencies.

Table 8. Traffic Incident Information Collection Practices of Interviewees

| | IDOT District | | | | | | | | | GTIS | IL Tollway |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| ISP/Local Police | x | x | x | x | x | x | x | x | | x | |
| Phone Calls | x | | x | x | x | x | | | x | x | x |
| Cameras | x | | | x | | x | | x | | | |
| News | x | | | | | x | | x | | | |
| Database | | x | | | | | | x | | | |
| Road Information Management System | | | | | | | | | | | x |
| Local Agencies | x | | | | | | | x | | | |
| Starcom | x | | | | x | | | | | | |
| Verbal Notification | x | | | | | | | | | x | |
| Emails | x | | | | | | | | | x | |
| iPass | | | | | | | | | | | x |
| Sensors | | | | | | | | | | | x |
| Speed Maps | x | | | | | | | x | | | |
| TMCs | x | | | | | | | | | | |

The District 1 Communications Center records and manages responses to traffic incidents by recording actions in a dispatch log and sending information to IDOT Station 1. All districts send information about major incidents to Station 1 through fax, but have limited information about some incidents. Subsequently, Station 1 then disseminates the information on the main IDOT website under the Emergency Road Closure page (www.idot.illinois.gov/home/Comm/emergency-road-closures). District 8 records traffic incidents using a dispatch system in its TMC and sends information to Station 1. During normal business hours, current practices appear to meet the new rule for disseminating traffic incident information. The interviews showed that not all districts can disseminate information in a timely manner outside of their normal business hours because they rely on on-call staff to receive calls, determine actions, and pass along appropriate information.

The most common way that traffic incidents are disseminated to the public is using DMS boards. Other dissemination methods include websites and local news media. Table 9 summarizes and compares these dissemination practices.

Table 9. Traffic Incident Information Dissemination Practices of Interviewees

| | IDOT District | | | | | | | | | GTIS | IL Tollway |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| DMS | x | x | x | x | x | x | | x | | x | |
| Website | x | | x | x | | | | x | x | x | |
| Media | x | | x | | | | | | | | |
| Email | | | | | | | | | | x | |
| XML | | | | | | | | | | x | |
| Station 1 | x | x | x | x | x | x | x | x | x | | |

Overall, the findings from the interviews helped the researchers identify gaps in current IDOT practices that do not comply with 23 CFR 511. These findings were combined with best practices, according to the type of real-time information, to recommend changes. These changes took the form of data collection processes, policy updates, and infrastructure changes.

# CHAPTER 4 NATIONWIDE SURVEY OF STATE PRACTICES

## 4.1 INTRODUCTION

In this chapter, researchers describe the online survey they used to collect information from state DOTs and their FHWA representatives. The survey was targeted at operational engineers and Intelligent Transportation Systems (ITS) coordinators in each state and was distributed via email. The survey included five parts: travel-time information (ten questions), construction information (five questions), traffic incident information (five questions), weather information (three questions), and general information about the survey respondents (eight questions).

The survey was designed so that respondents were able to skip sections they could not answer. For example, a respondent may have intimate knowledge about travel-time data collection and processing but know little about how construction activities are reported. When respondents noted they were unfamiliar, the survey solicited contact information for a more appropriate person, and the research team followed up with those listed.

The survey asked respondents to report their state agency's current practices for complying with Federal Regulation 23 CFR 511. The questions were designed to allow multiple responses where appropriate. Moreover, a space was provided with almost all questions for respondents to add their own answers (titled "other").

The researchers conducted a pilot study, as suggested by Czaja and Blair (Czaja, et al., 2005). The pilot study included review by the research project's Technical Review Panel, two civil engineering professors with expertise in this area, and three practicing consulting engineers.

The survey was distributed to FHWA representatives, state DOT operations engineers, and state DOT ITS coordinators who were active in implementation of their agency's Real-Time System Management Information Program. These included all 50 states, the District of Columbia, and the territory of Puerto Rico. To analyze the data, standard statistical techniques were employed, such as confidence intervals with normal distributions and t-distributions. The survey was distributed in June 2014, and responses were collected until mid-July 2014.

## 4.2 TRAVEL-TIME INFORMATION

The survey received a significant number or responses, which indicates the importance and timeliness of respondents' work regarding the new federal rule. Overall, 38 responses from 32 states, territories, and districts were collected. In Figure 3, the responding states and districts are shaded.

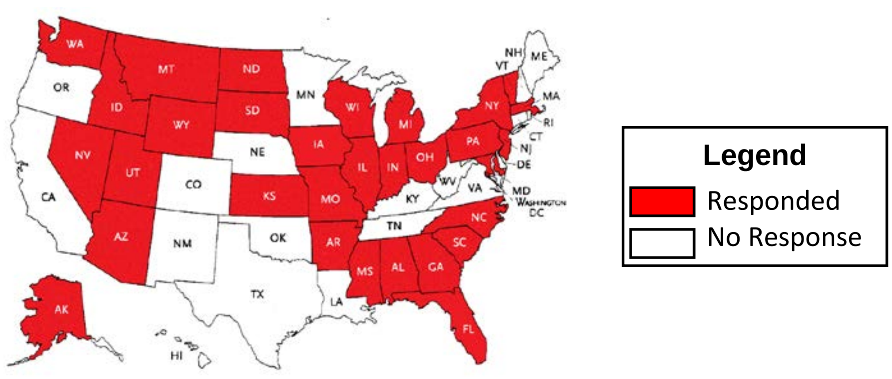


Figure 3. States/districts responding to the survey.

The first question within the travel-time section asked what tools were used for collecting travel-time information; respondents were allowed to select all that applied. Twenty-three responding states indicated that they use third-party data, among which 14 said they always use this method and nine said they do sometimes. The least used method according to the respondents was video surveillance, among which four said always and five said sometimes. A previous study (Martin, 2007) noted the four common methods of measuring travel time but did not present the frequency each was used in practice. The four methods included fixed detection of volumes such as loop detectors and radar, fixed detection of traffic speed, fixed detection using toll tags, and proprietary approaches such as communication monitoring.

The second question in the travel-time section asked how much their agency needed to expand their coverage of travel times within metropolitan areas (greater than 1,000,000 in population). In response, 21 answered that their district or agency had already met the coverage requirements, 12 replied that their district or agency does not serve a metropolitan area, and 6 replied that their district or agency should expand travel-time coverage. Of those needing to expand travel-time coverage, there was uncertainty about the magnitude of the expansion.

The third question asked, “How much does your district/agency process field data into travel times using each of the following tools? ” Figure 4 illustrates the answers for these questions. (The numbers inside each section of the bars represent the number of respondents choosing each option.) Respondents were asked to choose “always,” “sometimes,” “never,” or “planned” for each method (shown as bars in Figure 4). The majority (approximately 70% always or sometimes) of respondents use third-party software to convert field data into travel-time information. The next most common response was software developed within their agency. Last, those reporting they sometimes or always use another method noted that they use vendor software that was significantly modified in-house, developed software with vendor/researcher assistance, or had purchased travel time data that were already processed off-site.

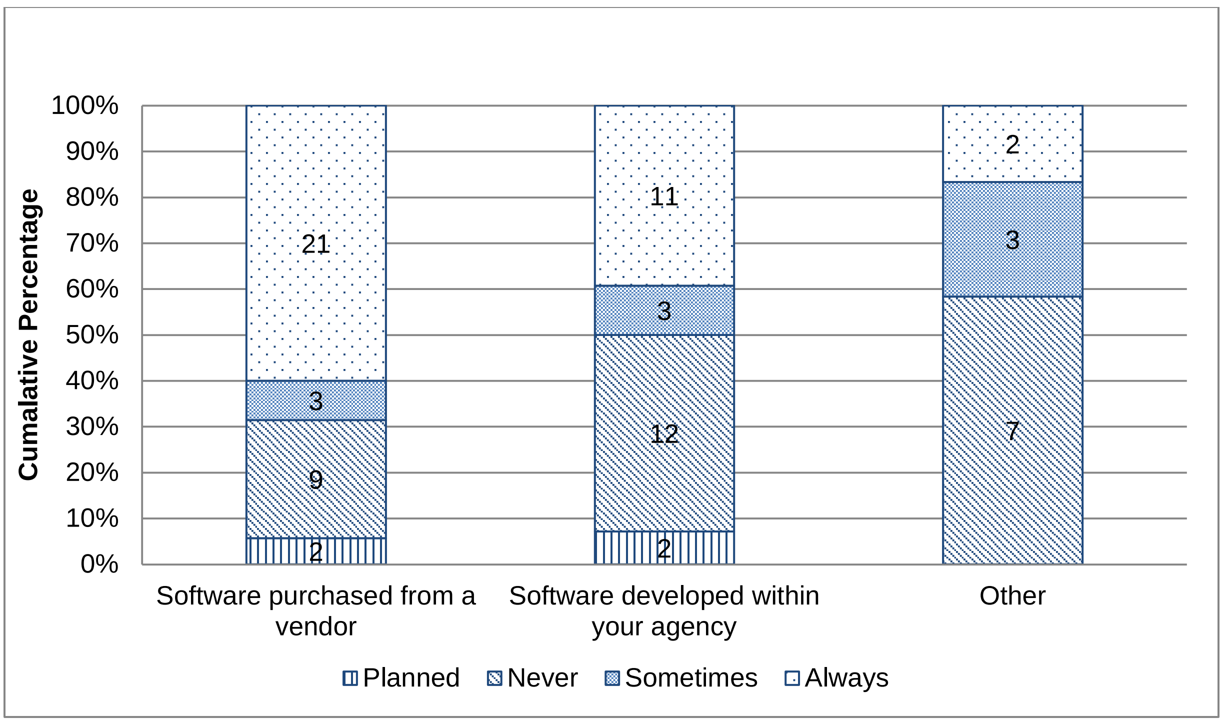


Figure 4. Responses to “How […] does your district/agency process field data into travel times…?”

The next question asked, “What guides or will guide your district’s/agency’s collection, processing, and dissemination of travel-time data?” As shown in Figure 5, the most common answer, with 20 responses, was that their agency/district had a standard practice but those practices were not formalized as either a guideline or a policy. The researchers consider a standard practice as less formalized than a guideline or policy; thus, many agencies lack a solidified structure for collecting, processing, and disseminating travel-time data. Nineteen percent were not aware of anything that guided their travel-time practices.

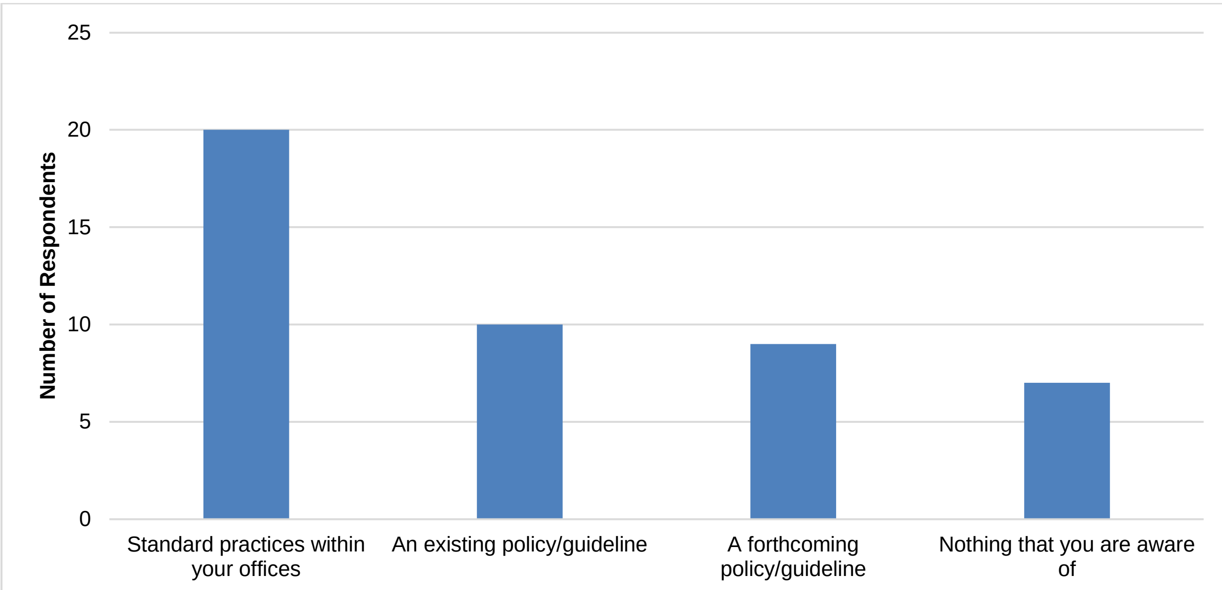


Figure 5. Responses to “What guides or will guide your district’s/agency’s collection, processing, and dissemination of travel-time data?”

The next question asked, “What is your district’s/agency's standard practice for considering travel-time information as ‘accurate’?” Respondents could select from nine choices, including an array of different percentages and minutes, as well as “undefined” and “other.” As shown in Figure 6a, 75% of the respondents define travel-time accuracy by using a threshold that was a percentage, 12.5% use both minutes and percentage, and 12.5% use minutes. (In Figure 6a, the number in the parentheses are number of respondents.) Considering that the new rule requires travel-time information be accurate within 15%, the agencies that were measuring the accuracy by minutes have to change their practices to a percentage.

Figure 6b illustrates the number of responding agencies that use a percentage as their travel-time accuracy measurement. As shown, most agencies selected accuracy thresholds of 15% or less, which means they were in compliance with the new rule. Seven agencies selected “undefined,” meaning they did not provide travel times to their travelers. Some agencies selected more than one option; for example, a respondent might state “within 10%” and “within 1 minute” because the agency uses different practices on different road segments. Altogether, there were six that said they consider accuracy within 1 or 2 minutes. Note that the figure shows both the number of respondents (in parentheses) and the corresponding percentage.

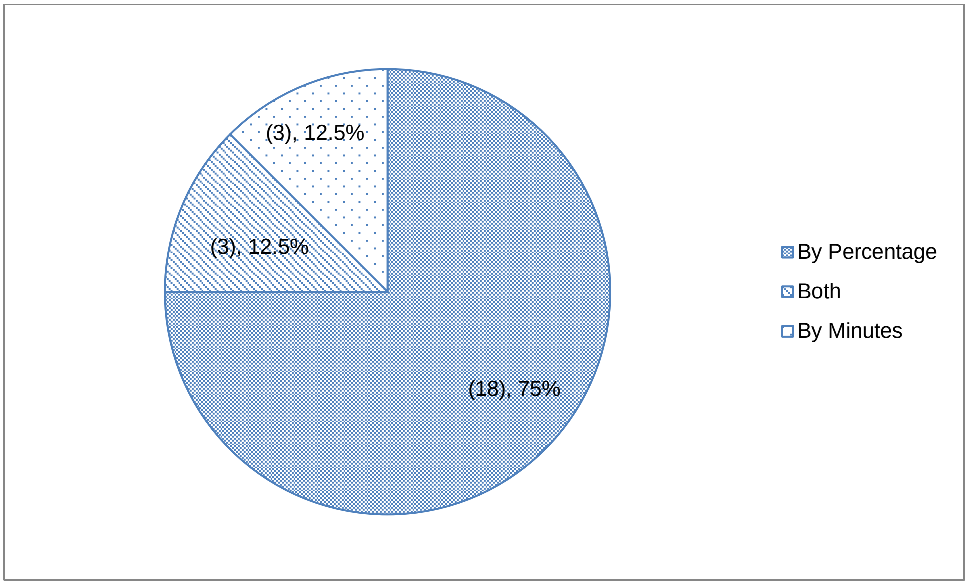


Figure 6a. How agencies measure travel-time accuracy.

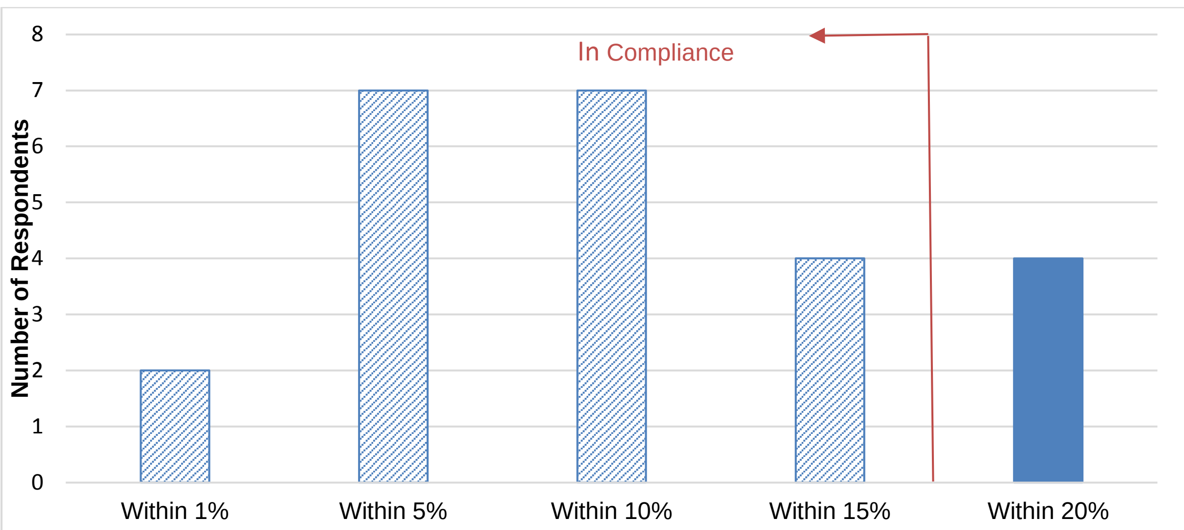


Figure 6b. Agency practices measuring travel time with percentage accuracy.

The next question asked, "How does your district/agency identify if a travel time is not accurate? Select all that apply." The two most common answers were "expertise of personnel (employees intimately aware of average range of times at different traffic conditions)" and "higher than normal calls or complaints from the public," with 26 and 17 responses, respectively. Several (18 respondents) selected "other"; most of those (10 respondents) noted that their agencies did not have practices in place to identify inaccurate travel times. Overall, the responses to this question indicate that transportation agencies are relying on non-technology–based methods for identifying whether travel times are inaccurate. Only two of the responses indicated that technology was used to identify inaccurate travel times.

The seventh question asked, “When you become aware that a travel time may not be accurate, how is travel-time accuracy checked? Select all that apply.” The three most common answers were “field runs with a probe vehicle (such as a freeway service patrol),” with 17 responses; “cameras,” with seven responses; and “online sources such as Google Maps,” with seven responses. The use of cameras and online sources was mutually exclusive; thus, no agencies used both for checking travel-time accuracy. Respondent comments on this question indicate that cameras were used to help identify traffic incidents and other sources of congestion that would create a change in travel times.

The next question asked, “If you collect travel times with probe vehicles, do you follow statistical sampling techniques?” Nineteen respondents answered “no” and only three answered “yes.” The states that indicated that they use these techniques explained that their data-provider vendors use these methods. Additionally, private data providers are able to use agency data as well as data from other sources to verify travel-time accuracy. Although multiple sources are available for practitioners to implement sampling techniques to ensure the validity of their travel-time data (Veeregowda, et al., 2008), it appears that professional judgment currently plays a significant role in the data collection process.

The last question about travel time asked, “Please indicate which of the following are ways that the public can access your district’s/agency’s travel time information. Please enter one response [tool].” As illustrated in Figure 7, the most common way that state transportation agencies provide travel times to the public was via website—27 selected “always” and three selected “sometimes.” After “website,” the common answers were “DMS,” “511 system,” ”apps” and “portable DMS.” Comparing these findings with previous work by (Crowson, et al., 2013) indicates that no major traveler information dissemination shifts have taken place since 2012.

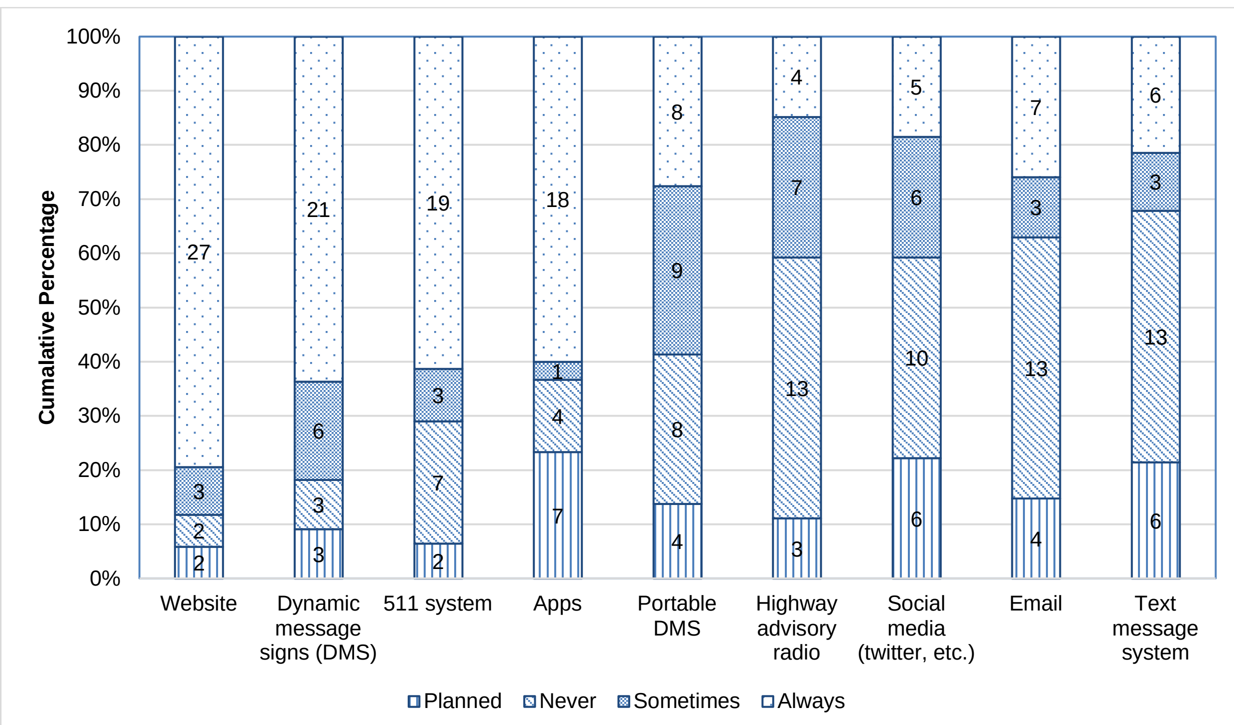


Figure 7. Ways that the public can access travel-time information.

## 4.3 CONSTRUCTION INFORMATION

The Illinois Department of Transportation Standard Specifications for Road and Bridge Construction are developed and adopted by the department for improvements in road contracts. The Standard Specifications highlight the general requirements and covenants that can be used in different contracts. "Special provisions are additions, deletions, and/or revisions to the Standard Specifications" (Roess, et al., 2011). If the requirements are not specified in existing special provisions, they should be covered in plan general notes (Dion, 2002).

The first question in the construction section of the survey asked, "What methods are used to require contractors to provide real-time lane closure information?" As illustrated in Figure 8, the most common answer to this question was "existing specification," with 16 respondents. The next most common answers were "existing special provisions," "existing general notes on plans," and "standard practices" with eight, seven, and five respondents, respectively. Surprisingly, eight of the respondents for this question selected "none," which means that they don't have any guidelines that require the contractor or staff to provide real-time lane closure information.

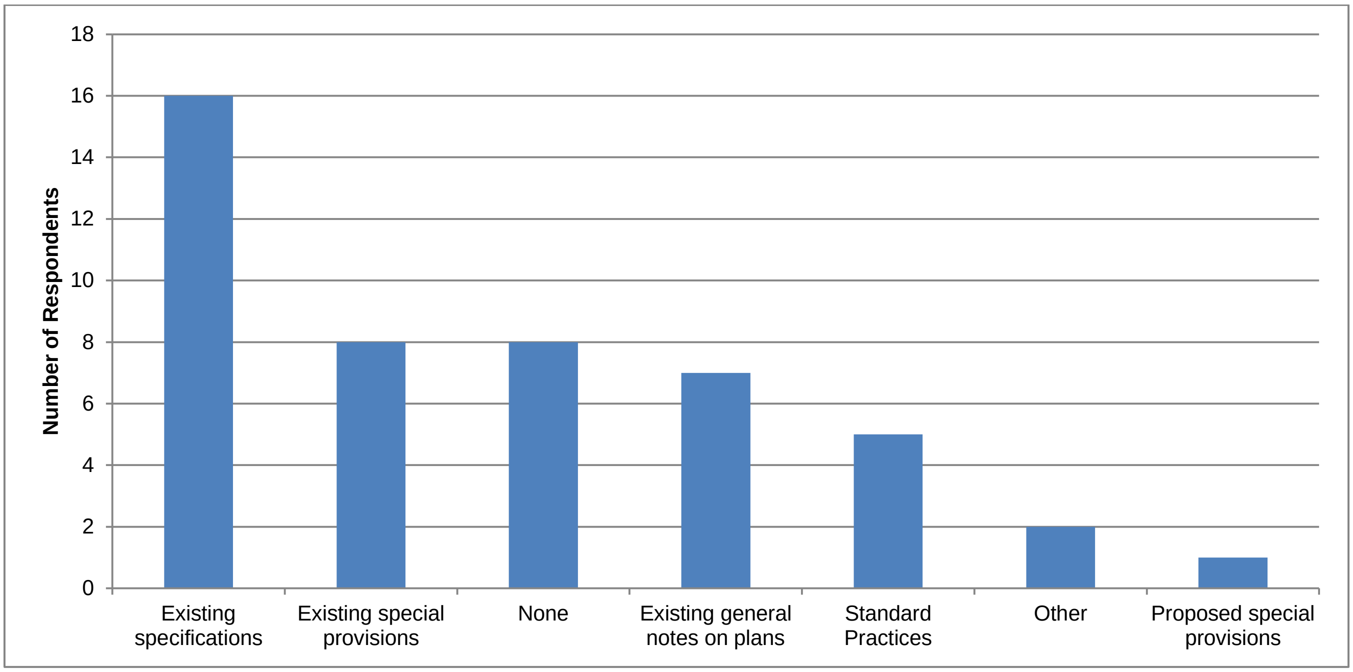


Figure 8. "What methods are used to require contractors to provide real-time lane closure information?"

The second question asked, "How does your district/agency learn about real-time construction lane closures?" As shown in Figure 9, the answer that most agencies chose was "contractors are required to inform our district/agency," with 22 respondents, which was 63% of the survey takers (number of respondents are shown in parentheses in the figure area). Twenty-six percent of the respondents chose "we only know about planned lane closure" and the rest said that their own staff provides the real-time construction lane closure information. Again, the numbers shown in parenthesis indicate the total respondents in each category.

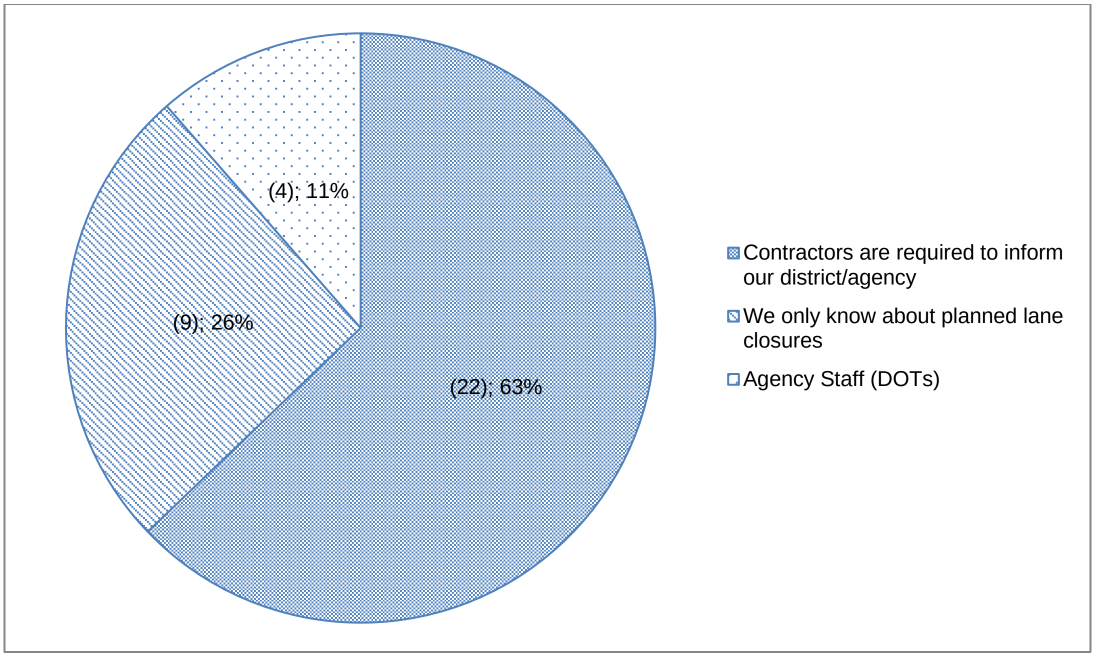


Figure 9. “How does your district/agency learn about real-time construction lane closures?"

The third question in the construction section asked, “How does your district/agency provide construction lane closure information to the public?” (The numbers inside each part of the bars represents the number of respondents choosing each option.) Respondents were asked to choose “always,” “sometimes,” “never,” or “planned” for each method (shown as bars in Figure 10). As shown, the majority chose “website,” with 29 respondents. The other three common answers for this question were “portable DMS,” DMS,” and “511 system,” with 28, 27, and 24 responses, respectively.

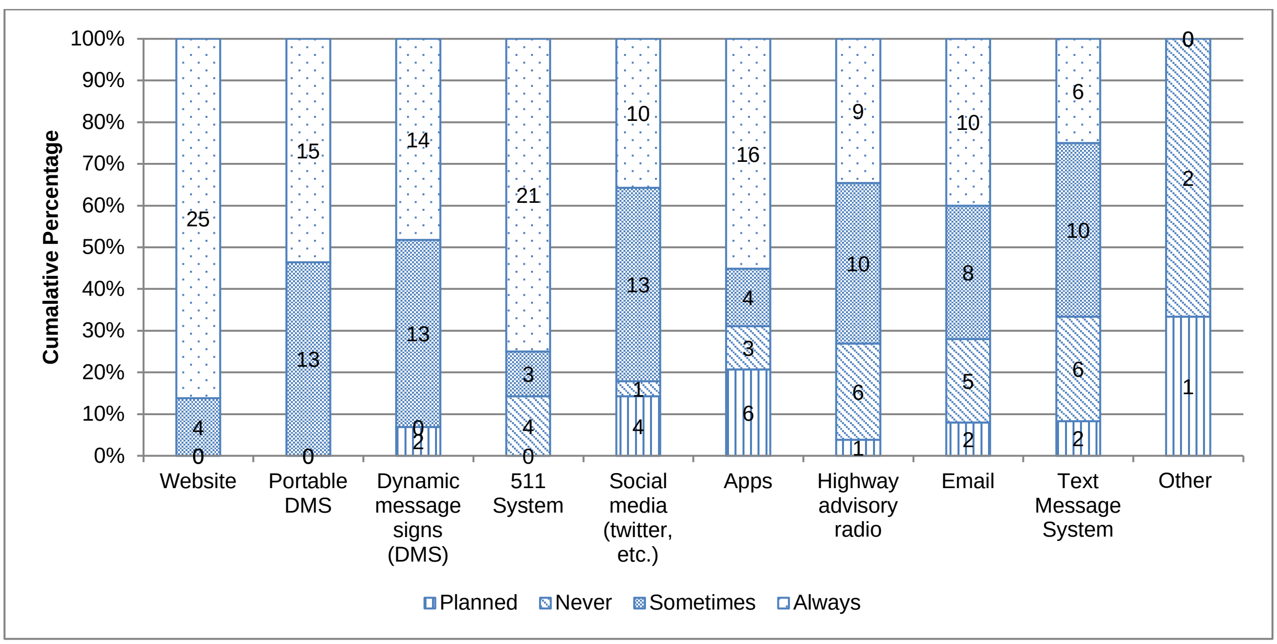


Figure 10. “How does your district/agency provide construction lane closure information to the public?”

## 4.4 TRAFFIC INCIDENT INFORMATION

In the traffic incident section of the survey, the first question asked, “What requires law enforcement and emergency management services to notify your district/agency about traffic incidents (on limited-access roadways) in real-time?” Figure 11 shows the respondents’ answers for this question. “Existing policy/guidelines” was the most common response to this question, with 20 respondents. Eight said, “current standard practices” that require them to notify their district or agency about traffic incidents. In the comment part of this question, two respondents noted that practices vary by the location of the incident.

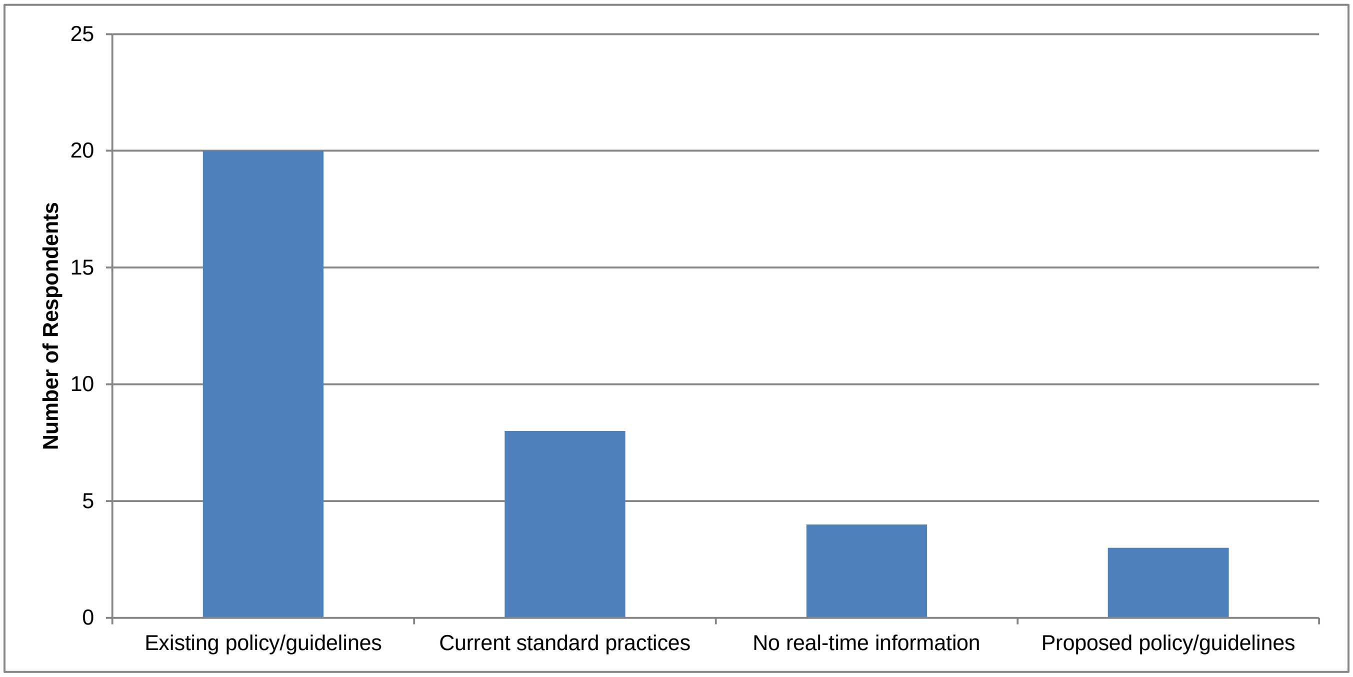


Figure 11. “What requires law enforcement and emergency management services to notify your district/agency about traffic incidents (on limited-access roadways) in real-time?”

The second question asked, “During normal business hours and after you are informed of a traffic incident, how quickly do you normally send this information to the public?” The average time given by 26 respondents from different districts or agencies for providing the information to the public was 11.23 minutes.

According to the survey, the average time for providing the traffic incident information to the public outside normal business hours after being informed was approximately 44 minutes. Only four of the respondents answered this questions because many agencies operated 24 hours a day. Several answered “other” to this question and explained that after-hour incidents are not always reported to the public.

The last question of the traffic incident section in the survey asked, “How does your district/agency provide traffic incident information to the public?” The most common answer, as shown in Figure 12, was “website” (31 respondents), who always or sometimes use this method to disseminate data. The next most common answers for this question were “portable DMS,” “DMS,” “social media,” and “511 system,” with 31, 29, 27, and 26 respondents respectively.

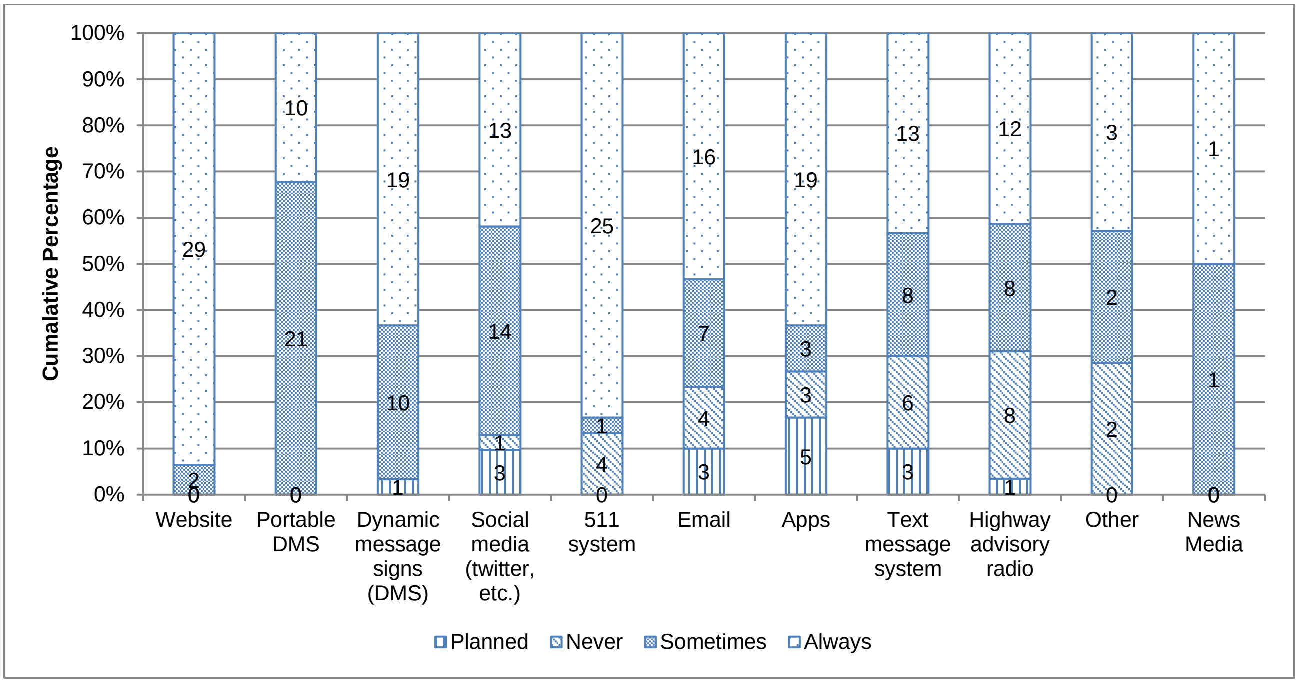


Figure 12. “How does your district/agency provide traffic incident information to the public?”

## 4.5 WEATHER INFORMATION

The first question in the weather section of the survey asked, “How much does your district/agency use each of the following to collect weather information?” As shown in Figure 13, the majority, which was 97% of the respondents, selected “RWIS,” and 93% selected “National Weather Service.” Only one respondent selected “probe vehicles.” One respondent commented that they are going to convert the data from RWIS to MADIS (Meteorological Assimilation Data Ingest System) in the future.

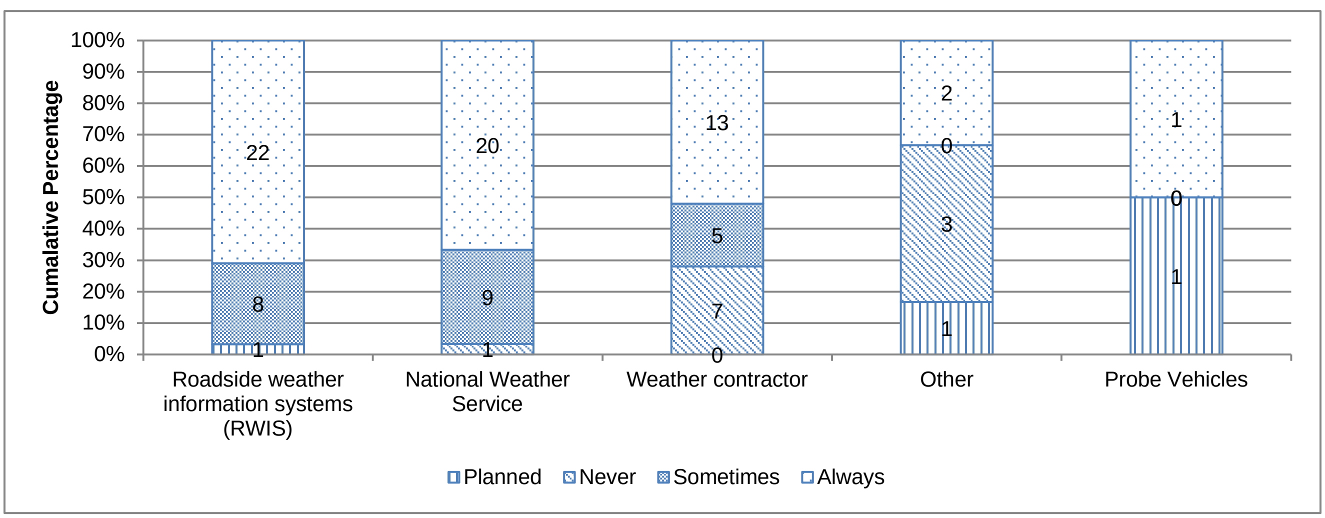


Figure 13. “How much does your district/agency use each of the following to collect weather information?”

The second question in the weather section asked, “During severe weather events, how frequently does your district/agency receive information from field vehicles, such as snowplows, and other sources” (select all that apply).” As illustrated in Figure 14, one of the two most common answers, surprisingly, was “calls from travelers.” with 12 respondents. The other interesting answer selected by three different agencies or districts was “no information from field vehicles.”

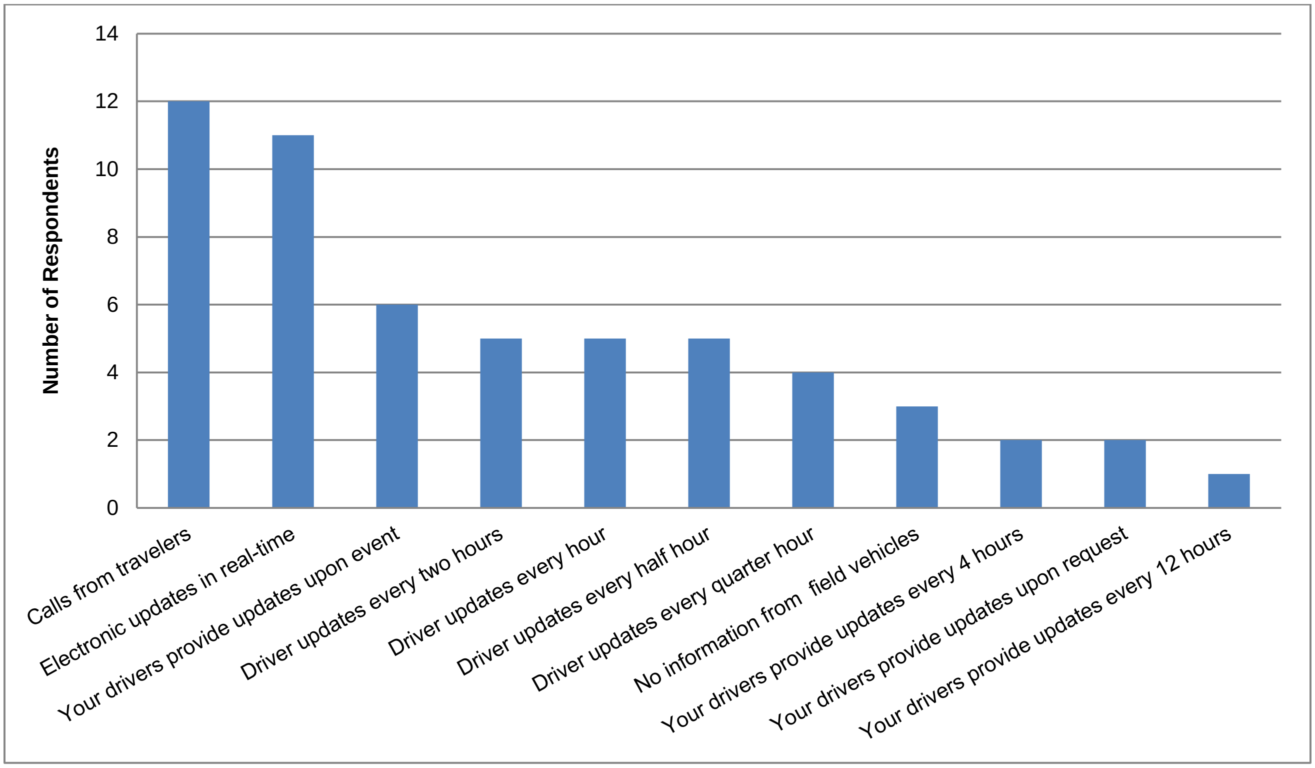


Figure 14. “During severe weather events, how frequently does your district/agency receive information from field vehicles, such as snowplows, and other sources?"

The final question in this section of the survey asked, “How does your district/agency provide weather information to the public?” As shown in Figure 15, a majority of the respondents (28) selected “website” for providing the weather information to the public. The other common answers for this question were “DMS “Social,” “511 system,” “social media”, “511 Systems” and “portable DMS,” with 25, 24, 24, and 20 respondents respectively.

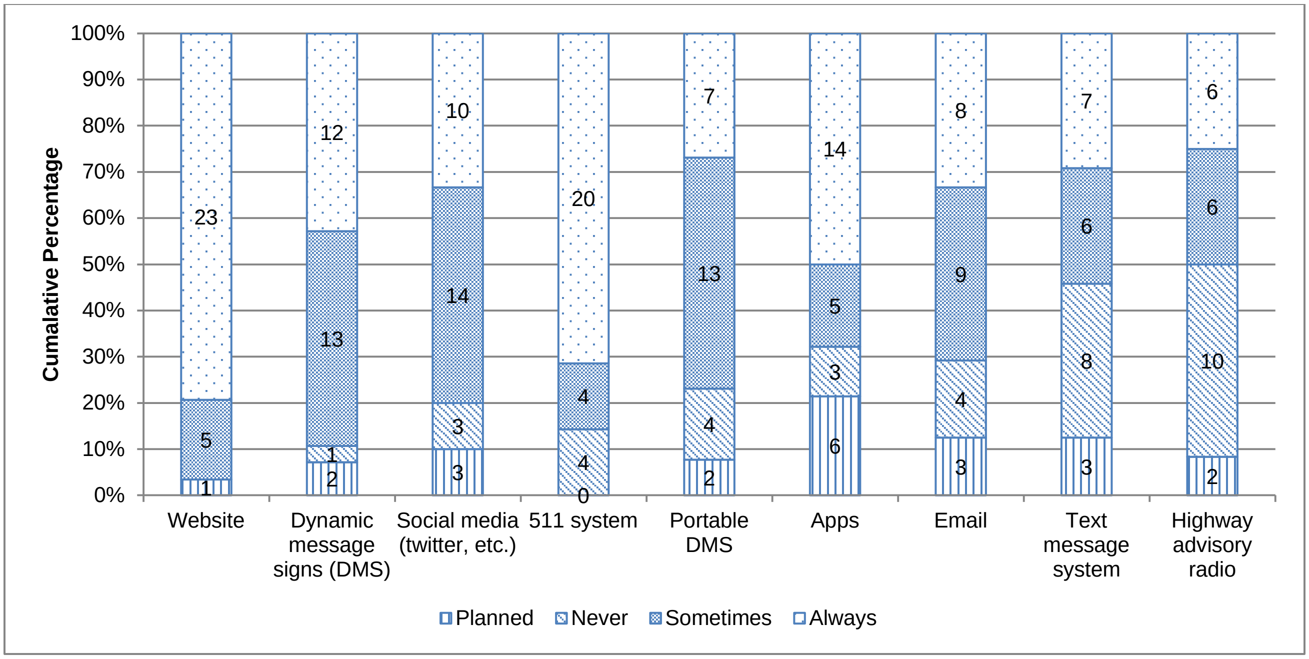


Figure 15. "How does your district/agency provide weather information to the public?"

## 4.6 GENERAL INFORMATION

The last section of the survey was titled “General Information.” The first question asked, “What state/territory do you represent?” States that are shaded in red answered the survey, as previously shown in Figure 3.

The next question asked, “How much do you agree with the following statement: I am familiar with the new federal Real-Time System Management Information Program requirements?” Ninety percent of the respondents agreed with the statement.

Another question in the “General Information” section asked, “In your opinion, how much do you agree that each of the following has prepared your transportation agency for the inter-agency communications needs of the new Real-Time System Management Information Program requirements?” As illustrated in Figure 16, a majority (77%) of the respondents agreed with “following a state Intelligent Transportation Systems (ITS) architecture”, “71% agreed with “Following a regional ITS architecture”, and 66% agreed with “Other inter-agency training.”

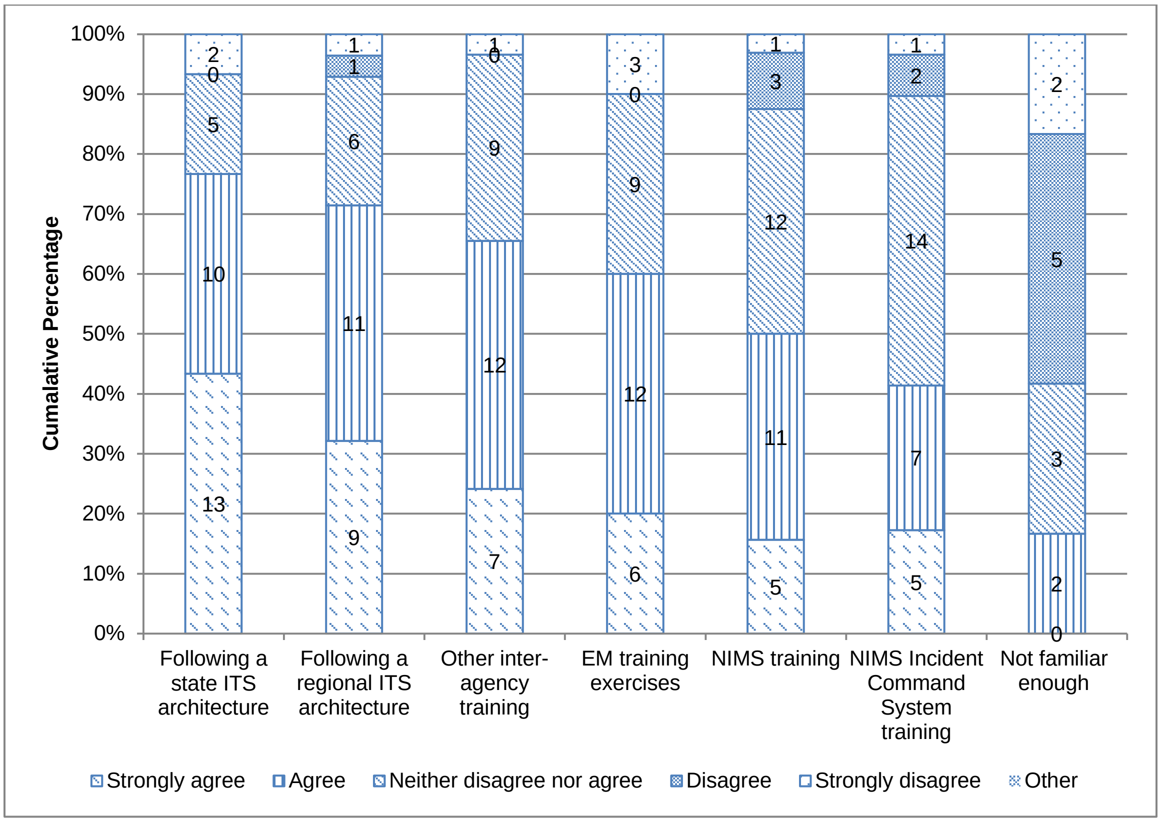


Figure 16. “In your opinion, how much do you agree that each of the following has prepared your transportation agency for the inter-agency communications needs of the new RTSMIP?”

The next question was “Please characterize the population density of the travelers you serve in your coverage area.” The respondents could have selected “urban,” “suburban,” “rural,” and “all.” Figure 17 shows the responses for this question in more detail. As illustrated, 19 selected “all” and six selected “rural,” whereas two selected “urban/suburban” and only one selected “suburban/rural.”

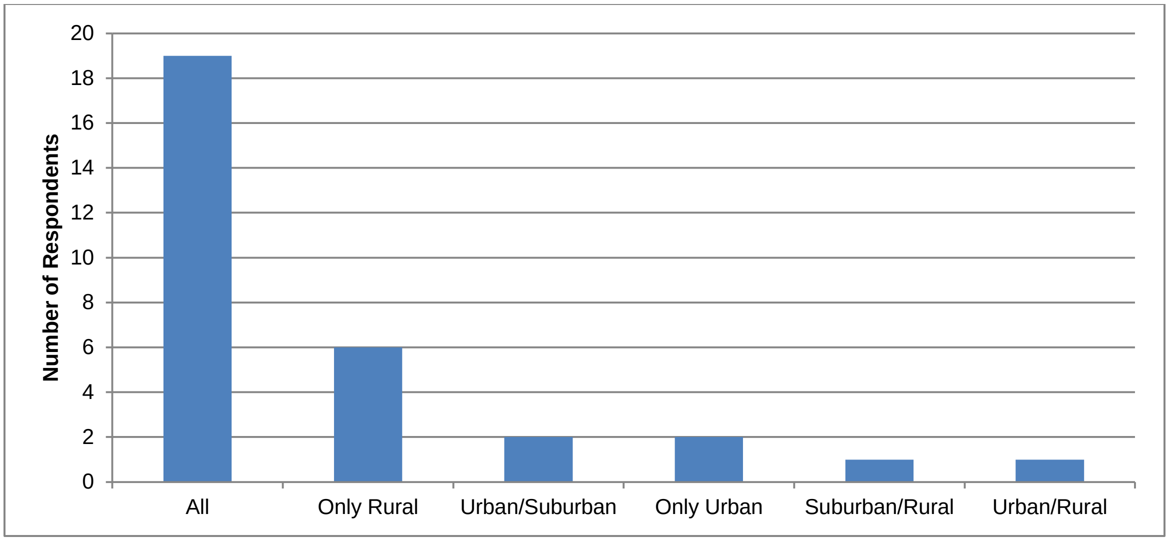


Figure 17. "Characterize the population density of the travelers you serve in your coverage area."

In summary, the survey findings suggested that many states were still seeking to address the details of 23 CFR 511. It appears that the majority of respondents already use established practices to provide for the accuracy and availability of travel times; however, responses were not as consistent for construction, incident, or weather information.

# CHAPTER 5 DATA QUALITY MEASUREMENT RECOMMENDATIONS

Based on the findings of the data collection mentioned in previous chapters, the research team identified the best methods/strategies for collecting information and determining that IDOT's traveler information complies with the new federal rule. Because there were numerous ways to measure data quality, the research team conducted an extensive review of available methods and used a scientific approach to select the optimal strategies to meet IDOT's needs. The team proposed an aggressive approach toward this task to ensure that IDOT had 5 months to implement the chosen strategies.

This chapter discusses proposed methods for measuring accuracy and availability of the information for travel time, construction activities, traffic incident, and adverse weather provided to the public.

## 5.1 PROPOSED METHOD OF MEASURING TRAVEL-TIME INFORMATION QUALITY IN ILLINOIS

### 5.1.1 Introduction

This section discusses a proposed method for calculating travel-time information quality to satisfy the 23 CFR 511 travel-time requirements. Several aspects related to travel times are explained, including how travel times are determined, a proposed guideline for travel-time accuracy and availability, and the changes that would be required to bring IDOT's districts into compliance with 23 CFR 511. Note that the travel-time requirements are applicable only to District 1 (Chicago Metropolitan area) and District 8 (St. Louis metropolitan area). More information about the 23 CFR 511 rule can be found in Chapter 2: Literature Review Findings.

### 5.1.2 Current Practices in Travel-Time Determination

Existing travel-time estimation systems in Illinois use a variety of technologies and software. In some cases, if specific sensors are inoperable, travel times may be reported based on interpolation of data from the upstream and downstream sensors. During periods with low traffic volumes, the last recorded travel times are displayed. Travel times are not reported faster than vehicles can traverse a segment traveling at the speed limit; therefore, when sensors indicate that average travel speeds exceed posted speed limits, standard practice is to report the travel time at the segment's speed limit.

There are several systems that receive and disseminate travel times in Illinois. In particular, it is important to note that the Gateway Traveler Information System and Travel Midwest website is expanding statewide and will serve as the information hub for dissemination of travel time, construction, incident, and weather information on http://www.gettingaroundillinois.com.

### 5.1.3 Proposed Guidelines for Travel-Time Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details proposed practices for measuring travel-time accuracy and availability. Traffic Management Center personnel can identify whether reported travel times are accurate within approximately 10% during both congested and non-congested times. Personnel can identify these errors either through daily monitoring of reported travel times and observed traffic conditions or through traveler complaints. When personnel suspect an inaccurate travel time is being reported, alternative baseline sources should be compared with the reported travel time. Baseline sources could include HERE.com probe vehicle data provided to the metropolitan planning organizations and IDOT from the Federal Highway Administration, Google Maps probe vehicle data, license plate matching tools, or IDOT field probe vehicles. Five-minute probe vehicle data (provided without a sample size) should be compared with 15-minute monthly probe data (provided with sample sizes) to ensure the 5-minute data are likely to have adequate sample sizes. On the basis of meetings with IDOT operations engineers, it is recommended that reported travel times for all routes be compared annually with a baseline source.

When using probe vehicles to measure baseline travel times, the average vehicle method is most appropriate for limited-access roadways. Applying this method requires probe vehicles to traverse the road segment, attempting to maintain the average speed of nearby vehicles (Roess, et al., 2011; Turner, et al., 1998). Travel times can be collected using a stopwatch and landmarks or with technologies such as global positioning systems (GPS).

Travel-time segments should be selected to match information that would be relevant to drivers and traffic managers. Because travel times can change quickly during congested times of the day or just after traffic incidents, IDOT best practices suggest selecting segments less than 15 miles in length, for reporting travel times to the public. If travel-time runs are collected over multiple days, engineering judgment should be used to select times with similar traffic volumes and other prevailing conditions. When collecting travel times, it is recommended that the minimum sample size be no less than six runs for each segment and guided by Equation 1 as follows:

**Equation 1**

$$\mathbf{n} = \frac{\mathbf{3.84 * sd^2}}{\mathbf{E^2}}$$

where

$n =$ the required number of travel time measurements collected in the field

$sd = standard\ deviation\ of\ travel\ time\ measurements\ (seconds)$

$E =$ standard error (seconds)

Equation 1 assumes that the mean and median of the collected travel times are equal. When evidence suggests otherwise, other statistical techniques are available in the *Traffic Engineering Handbook* (Veeregowda, et al., 2008).

After the required number of travel times have been collected, the accuracy of travel times reported can be evaluated using Equation 2 as follows:

**Equation 2**

$$\boldsymbol{Accuracy}\ (\%) = \frac{\mathbf{1}}{\boldsymbol{n}} \left\{ \sum_{i=1}^{n} \mathbf{1} - \left| \frac{x_{i(reported)} - x_{i(collected)}}{x_{i(collected)}} \right| \right\} \boldsymbol{x100}$$

where

$n =$ number of travel time measurements collected in the field
$x_{i(collected)} =$ travel time measured from field tests
$x_{i(reported)} =$ travel time estimated from field devices & reported to the public
$i =$ travel time run number

After percentage accuracy for each travel-time segment has been determined, an average accuracy should be computed for each district. Engineering judgment should be used to determine whether the lengths of the travel-time segments range widely enough to consider using a weighted average; otherwise, each segment should be considered equal when calculating the district’s average accuracy.

To evaluate the availability of travel-time information, an annual review should be conducted to audit the activity and maintenance logs for travel-time dissemination systems, such as websites, in Districts 1 and 8. This audit should identify how many hours the travel-time information was completely unavailable to the public for each road segment. For example, if travel times were not available by any means for 1 hour in July and 2 hours in November, there would be 3 hours of downtime for that segment. Equation 3 should be used to determine the availability of the travel time for each road segment, and then averaged for each district.

**Equation 3**

$$\text{Availability}(\%) = \frac{T_{yr} - T_d}{T_{yr}} x100$$

where
$Tyr =$ 8760 (hours/year)
$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for travel times if both Districts 1 and 8 have average travel-time accuracy equal to or greater than 85% and availability equal to or greater than 90%. After completing each annual review, IDOT should send a report, with summary travel-time accuracy and availability statistics, to the FHWA Illinois Division.

### 5.1.4 Example of Calculating Travel-Time Accuracy

When calculating travel-time accuracy, two sets of data are required to be available. The first set of data required is the estimated travel time reported to the public. The second set of data required is the data collected from an alternative baseline source. The timestamps of IDOT travel times should match those from other baseline sources. With these sets of data, accuracy can be calculated with Equation 2.

To complete this example, the reported travel-time data were taken from the Travel Midwest website as shown in Figure 18. and Google Maps probe vehicle data were chosen as a baseline source as shown in Figure 19.

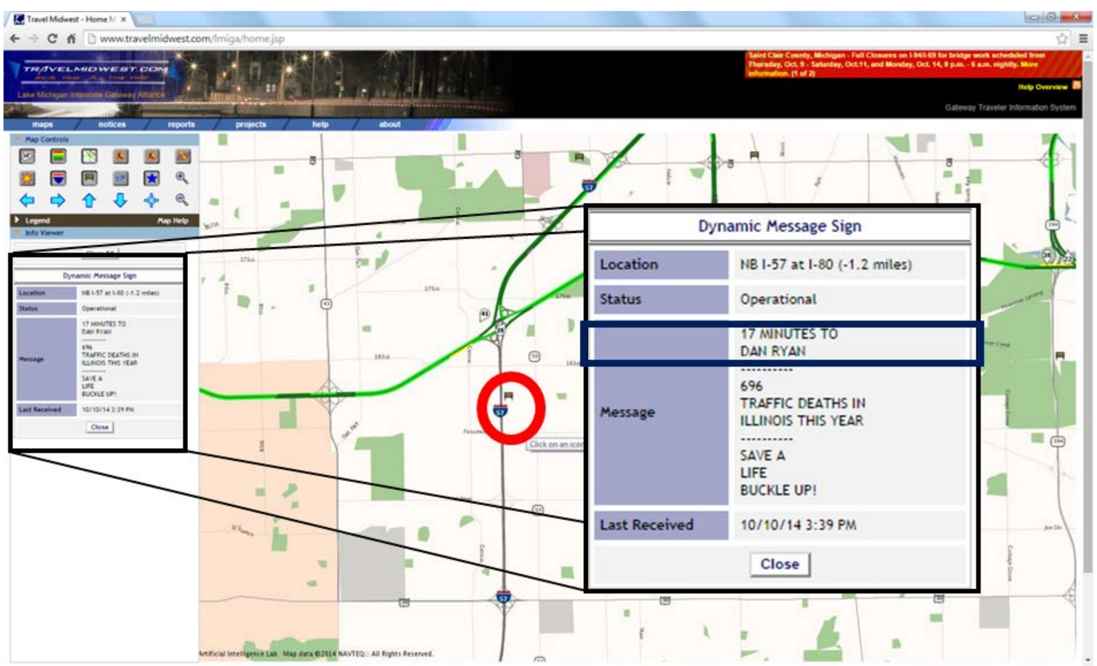


Figure 18. Example of travel-time information IDOT reports to the public.

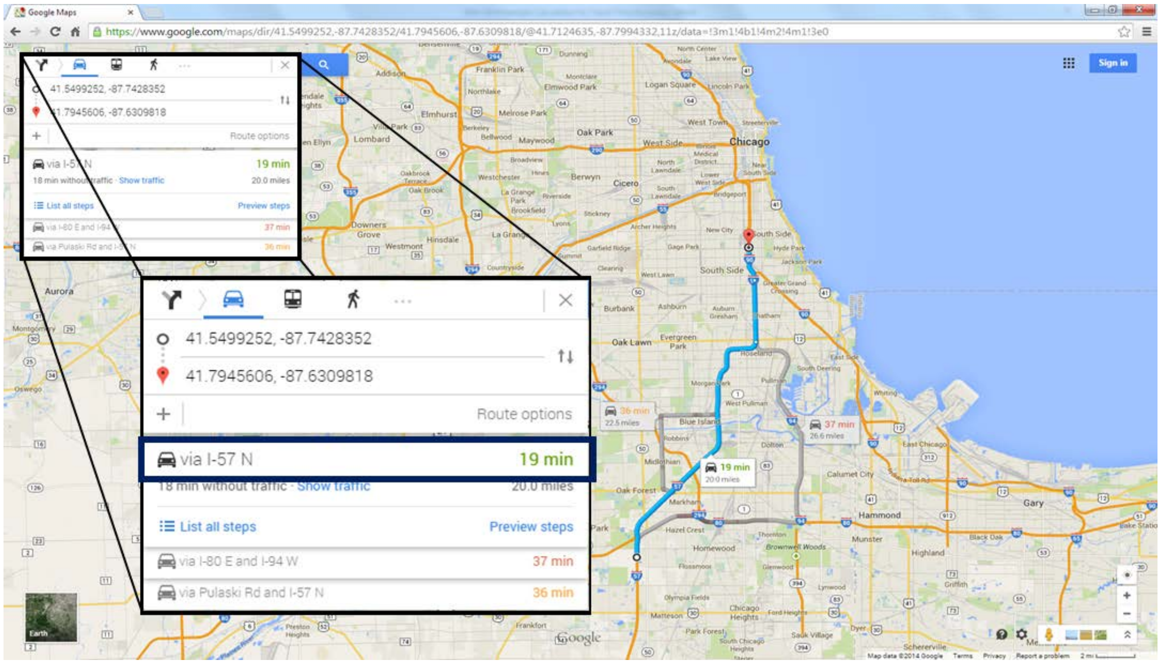


Figure 19. Baseline source data (56).

On travelmidwest.com, the travel time was reported as 17 minutes between the DMS at NB I-57 at I-80 (-1.2 miles) to the Dan Ryan Expressway. This information is considered the reported data. On Google Maps, the same interstate segment was chosen. The travel time calculated was 19 minutes, which is considered the baseline collected data. Plugging those values in the equation will provide the accuracy percentage as follows:

$$Accuracy\ (\%) = \frac{1}{1}\left\{\sum_{i=1}^{1} 1 - \left|\frac{17(travelmidwest) - 19(googleelmaps)}{19(googlemaps)}\right|\right\} \times 100 \ = 89.5\%$$

When collecting travel times, it is recommended that the minimum sample size for each segment be no less than six. The equation could be used in Excel when using many samples or when automated software is used to calculate the accuracy. Table 10 is a sample Excel sheet.

Table 10. Travel-Time Accuracy Spreadsheet

| # | Roadway Segment | | | | Distance (mi) | Travel Time (min) | | Baseline Source | Accuracy |
|---|---|---|---|---|---|---|---|---|---|
| | From | Date & Time | To | Date & Time | | IDOT Reported | Collected (Baseline) | | |
| 1 | NB I-57 at I-80 (-1.20 miles) | 10/10/14 3:39PM | Dan Ryan | 10/10/14 3:39PM | 20.0 | 17 | 19 | Google Maps | 89.50% |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| Overall Calculated Accuracy | | | | | | | | | **89.50%** |

### 5.1.5 Travel Time–Related Changes Recommended to Be Made by November 8, 2014

IDOT District 8 is largely covered by traffic detection sensors that can be used to determine travel times. However, the coverage area should be expanded to the east to the boundaries of the metropolitan area of influence. The required travel-time coverage expansions are under way in District 1. Both districts need to begin a cycle of reviewing the accuracy and availability of the travel information they report to the public. The following specific changes are suggested:

1. Implement data collection procedures to support measurement of accuracy and availability.
2. Complete the in-progress expansion of travel-time measurement in the Chicago metropolitan area further west along expressway I-80 through Aux Sable Township in Grundy County and further south along I-55 to Lorenzo Road. In addition, further expand travel-time measurement to include I-57 south from the current limit of measurement at I-80 to the Will–Kankakee county line and expand measurement along I-55 from Lorenzo Road to the Will-Grundy County line. Figure 20 shows the counties and townships included in the delineation of the Chicago metropolitan area according to (Chicago Metropolitan Agency for Planning, 2014). The yellow line denotes the boundary.
3. Create a system that will record the availability of travel-time data for the District 8 Traffic Management Center.
4. Expand travel-time measurement in IDOT District 8 further east along Interstates 64 and 70 to Route 4, further north along Interstate 55 to Route 143, and further south along Interstate 255 from Interstate 64 to the Missouri state line. This expansion in coverage could be accomplished by installing traffic sensors or by purchasing travel times from a vendor such as INRIX. The yellow line shown in Figure 21 illustrates the Illinois boundary of the St. Louis metropolitan area of influence. This boundary was agreed on by IDOT District 8 and the East–West Gateway Council of Governments in February 2014.
5. Include requirements on accuracy and availability in future contracts where vendors provide real-time traveler information or software calculating such information.

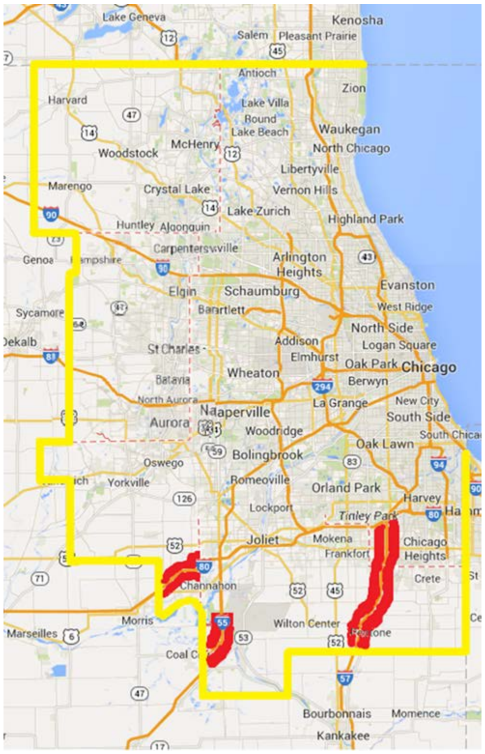


Figure 20. Chicago metropolitan area of influence (Chicago Metropolitan Agency for Planning, 2014).

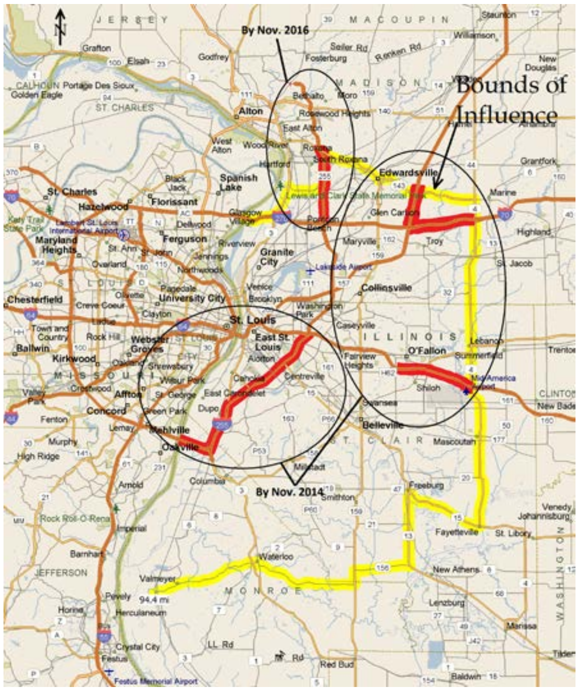


Figure 21. St. Louis metropolitan area of influence (IDOT, 2014).

### 5.1.6 Travel Time–Related Changes Recommended in the Near Term

To assist with providing accurate and available travel times, the District 8 Traffic Management Center (TMC) should be upgraded in the near future. Specifically, this system has encountered frequent problems predicting accurate travel times. Further, this TMC lacks a budget for maintenance in the center or in the field, causing many of the components to fail before reaching full design life.

Additionally, IDOT should consider establishing a traffic detector health program that measures the performance of individual detectors. This program should focus on Illinois metropolitan areas with the objective of identifying and scheduling maintenance or replacement of poorly performing detectors. Improving the performance of these detectors will improve the accuracy of travel information recorded in the field and reduce the need for extensive data cleaning by personnel who disseminate and archive information.

## 5.2 PROPOSED METHOD FOR MEASURING CONSTRUCTION TRAVEL INFORMATION QUALITY IN ILLINOIS

### 5.2.1 Introduction

This section discusses a proposed method for calculating construction travel information data quality to satisfy the 23 CFR 511 travel-time requirements. This section describes how construction information is currently collected and disseminated by IDOT, details a proposed guideline for measuring construction travel information accuracy and availability, and lists the changes that would be required to bring IDOT's districts into compliance with 23 CFR 511.

### 5.2.2 Current Practices in Construction Travel Information

Practices throughout IDOT require either the contractor or the resident engineer to report planned construction activities that close lanes of traffic. Among IDOT districts, there are a variety of methods that specify how to report construction lane closures, and compliance is not consistent. For example, some districts may not be aware whether construction activities end early and contractors reopen lanes ahead of schedule. Currently, there is no formalized requirement throughout the state for real-time reporting of construction lane closures. Methods of construction activity reporting used by IDOT District 1 are the most formalized and included a special provision and an automated lane closure database system. The special provision, titled "Keeping the Expressway Open to Traffic," effective March 22, 1996 (revised February 13, 2014), states:

> The Contractor shall request and gain approval from the Illinois Department of Transportation's Expressway Traffic Operations Engineer at www.idotlcs.com twenty-four (24) hours in advance of all daily lane, ramp and shoulder closures and one week in advance of all permanent and weekend closures on all Freeways and/or Expressways in District One.

These lane closure requests are reviewed to avoid conflicts and, if approved, will be reported as planned construction. Periodic updates are based on the reports from either contractors or resident engineers. Planned construction activities are currently updated on a daily basis.

A new Web-based lane closure system (LCS) replaced the Microsoft Access–based system that had been used by IDOT District 1. Once registered and approved electronically, contractors enter closure requests on the www.idotlcs.com website. The requests are reviewed by IDOT staff. Approved, merged, and canceled closure requests are emailed to the contractors, traffic control, and IDOT staff. A summary report of approved closures is also automatically emailed to a list of interested parties, including the media and other agencies. The Travel Midwest daily construction report for short-term and long-term closures is based on this approved list of closures.

After construction activities are approved, many districts use databases to manage these events. For example, District 8 uses “ITS Event Entry,” a Microsoft Access database. These events are then reported to the public through websites such as those shown in Table 11.

Table 11. Summary of IDOT Traveler Information Websites

| IDOT District | Site Title | Web Address | Managing Center Name |
|---|---|---|---|
| 1 | Travel Midwest | www.travelmidwest.com/lmiga/home.jsp | IDOT D1 Communications Center and Traffic Systems Center |
| 4 | Getting Around Peoria | gettingaroundpeoria.com | IDOT D4 Communications Center |
| 8 | St. Louis Traveler Information | www.stl-traffic.org/ | IDOT D8 Traffic Management Center |
| Headquarters | Getting Around Illinois | www.gettingaroundillinois.com | Station 1, IDOT Headquarters |

Throughout Illinois, travel information is processed and disseminated using a variety of centers with differing names. From here on, these centers will be referred to as Traffic Management Centers to be consistent with the national ITS architecture (USDOT, 2012).

The accuracy of construction lane closures are checked periodically, but the focus is on proper traffic control devices. In some cases, traffic surveillance systems can detect unreported construction lane closures.

### 5.2.3 Proposed Guidelines for Construction Travel Information Accuracy and Availability

In establishing Illinois’ Real-Time System Management Information Program, the following text details proposed practices for measuring construction information accuracy and availability. The Getting Around Illinois website should serve as the central point of construction data, via Station 1.

Construction information is provided to Getting Around Illinois by the Gateway Traveler Information System and Travel Midwest website. In addition, districts may still use their own websites. The Getting Around Illinois website should store information reported to the public for use in evaluating the accuracy and availability as described herein. The accuracy of the reported construction activities should be evaluated annually. During an evaluation, IDOT personnel should randomly select a set consisting of 25% of ongoing lane-closing construction projects throughout the state and compare how the following types of information are reported to the public:

A. Partial or full closure,

B. Road segment with construction activities,

C. Start time of lane closure (each lane if different), and

D. End time of lane closure (each lane if different).

Evaluation of “partial or full closure” should consider a partial closure as any number of lanes less than the total. IDOT should strive towards providing the number of lanes closed and the number of lanes open when that information is available, but need not provide this information for compliance.

Next, evaluators should verify that the construction activities were reported in the correct direction of travel and on the correct segment of roadway (a segment is defined by the portion of road between two interchanges). IDOT should strive towards providing locations based on mile posts when possible, but need not provide mile post locations for compliance.

23 CFR 511 requires that specific timeliness limits are applied to the reporting of the start and end of lane-closing construction activities. In metropolitan areas, as bounded by a yellow line in Figures 20 and 21, these activities must be reported within 10 minutes. Construction lane closures on all other limited-access roadways in Illinois must be reported within 20 minutes. Construction lane closures lasting less than these durations need not be considered.

Construction lane closures can be observed using surveillance equipment or during site visits. If site visits are chosen, it is recommended that they are coordinated with other site visits and resident engineer activities that already take place. For example, IDOT personnel already visit road construction sites to inspect traffic control devices for compliance with the *Manual on Uniform Traffic Control Devices*, as adopted by IDOT (Federal Highway Administration, 2009).

Construction lane closure reports should be recorded from an appropriate source, such as Travel Midwest or Getting Around Illinois, and compared with those observed in the field. The accuracy percentage would be applied individually to each of the four types of information shown above. Future discussions between IDOT and FHWA will guide the calculation of construction information accuracy using these four information types. Each IDOT district should measure its accuracy for each type of information, using Equation 4 as follows:

**Equation 4**

$$\text{Accuracy of Information Type X (\%)} = \frac{\sum \text{Instances of accurate construction information } X}{\sum \text{Construction projects audited for information } X} \text{ x } 100$$

To evaluate the availability of construction information, an annual review should be conducted to audit the activity and maintenance logs of the website or websites that report construction information. This audit should identify how many hours the construction information was completely unavailable to the public. For example, if website maintenance requires 30 minutes once a month, there will be 6 hours of downtime per year. Note that information may be unavailable from activities other than website maintenance. Equation 3 should be used to determine the availability of the construction information for each website individually. IDOT should be considered in compliance for construction information if average construction information accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### 5.2.4 Example for Calculating Construction Activity Information Accuracy

Figures 22 and 23 show two of the various construction activities reported by the Travel Midwest website. The following figures are used as an example to calculate the accuracy of reporting construction activities.

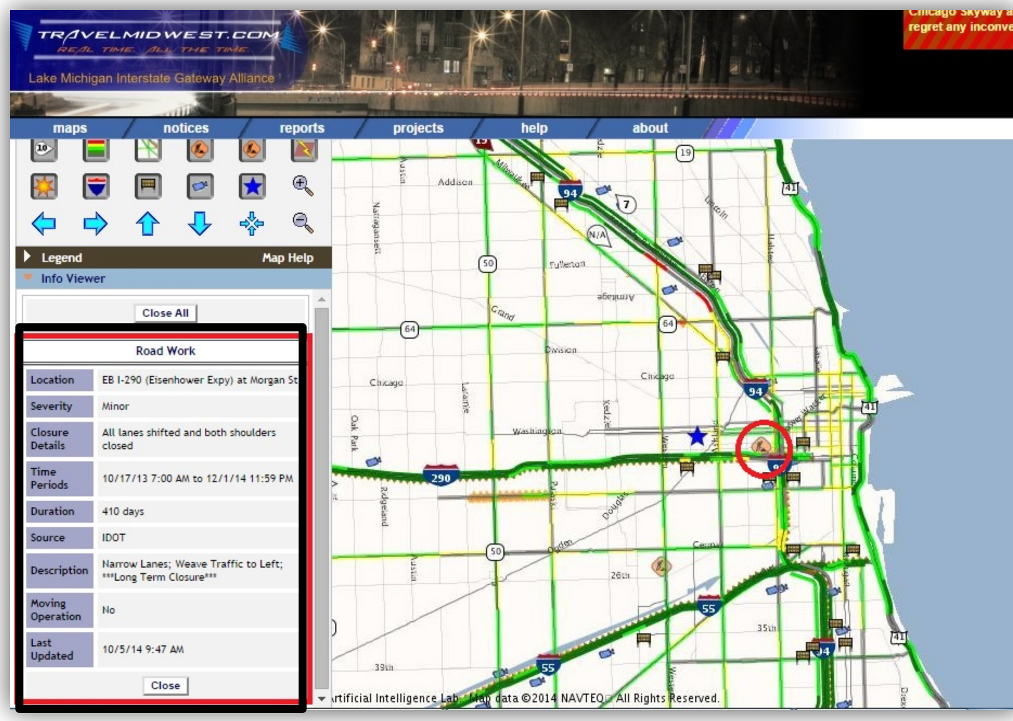


Figure 22. Example of reported construction activity (LMIGA, 2014).

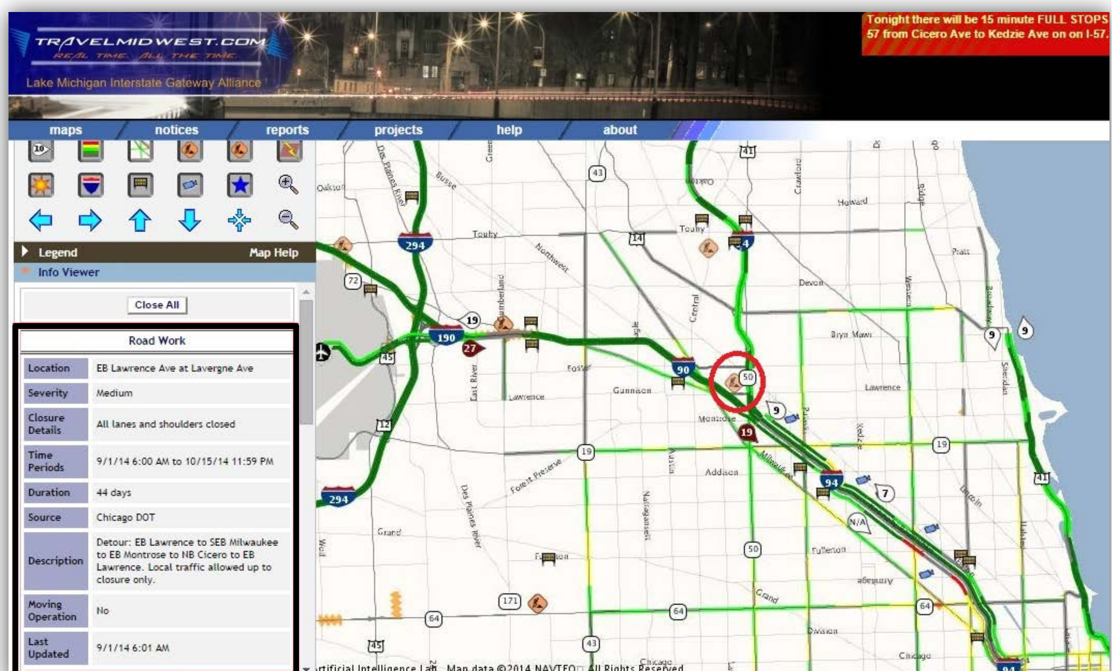


Figure 23. Reported construction activity (LMIGA, 2014).

Table 12. Example Construction Lane Closure Activities Report Log

| Report No. | Date & Time | Location | Call Details | Partial/Full | Segment | Start Time | End Time |
|---|---|---|---|---|---|---|---|
| 13-0001 | xx/xx/20xx 7:00 AM | EB I-290 at Morgan St. (Metro. area) | Resident engineer verified report to IDOT TMC. All lanes closed. TMC disseminated info. in 7 minutes. | Accurate | Accurate | Accurate | |
| 13-0001 | xx/xx/20xx 11:00 AM | EB I-290 at Morgan St. | State police reports all lanes reopened. TMC disseminates info. in 4 minutes. | | | | Accurate |
| 14-0002 | xx/xx/20xx 6:00 AM | EB Lawrence Ave. at Lavergne Ave. (Metro. area) | Resident engineer on site verifies that all lanes are closed on this segment and direction. TMC disseminates info. in 9 minutes. | Accurate | Accurate | Accurate | |
| 14-0002 | xx/xx/20xx 9:00 AM | EB Lawrence Ave. at Lavergne Ave. | Traffic cameras confirm lanes are reopened early, but contractor/RE did not report early finish. | | | | Not Accurate |

On the basis of the information shown Table 12, there was one lane closure activity reported accurately and one not accurately; therefore the accuracy of the first three types of information is 100 percent and the accuracy of end time is calculated as follows:

$$Accuracy\ of\ end\ time\ (\%) = \frac{1(\sum construction\ projects\ accurately\ reported\ end\ time)}{2(\sum construction\ projects\ audited\ for\ end\ time)}\ x\ 100\ = 50\%$$

### 5.2.5 Construction-Related Changes Recommended to Be Made by November 8, 2014

1. IDOT should implement data collection procedures to support measurement of accuracy and availability.
2. IDOT should establish a uniform mechanism for reporting lane closures from construction projects, in real-time. In the near term, researchers recommend text be added to Section 701, Work Zone Traffic Control and Protection, of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction. This text should be reflected in district-specific specifications as well. Currently, Section 701 does not specify freeways/expressways or real-time notification of lane closures and openings. The additional text should formalize the process of who is responsible for reporting construction activities that close or open travel lanes to IDOT. These activities include a late start, a cancellation, or an early finish. Reporting activities should be discussed during the preconstruction meeting, and the contractor's responsible agent for reporting should be identified, including contact information. It should be the contractor's responsibility to update contact information on long-term construction projects. IDOT resident engineers should take responsibility for reporting this information after November 8, 2014 for contracts without these updated specifications.
3. IDOT upper management, construction, and operations personnel should receive information about the requirements of 23 CFR 511 and the importance of information accuracy and availability.

4. IDOT should establish a mechanism to gather real-time construction lane closure information from districts without a 24-hour Traffic Management Center. It is recommended that the existing Traffic Management Centers be leveraged to assist neighboring IDOT districts outside of their normal business hours. Based on a teleconference on September 4, 2014, the research team recommends that outside of regular business hours, District 1 cover District 2 and the northeastern six counties of District 3. Figure 24 shows an IDOT district map with the proposed divisions marked with a red line. Similarly, outside of regular business hours, the District 4 Communications Center should support the western four counties of District 3 and all of District 5. The Central Office Traffic Management Center, also known as Station 1, should support Districts 6 and 7 outside of regular business hours. Last, the District 8 Traffic Management Center should support District 9 outside of regular business hours. These districts should support the reporting of real-time construction lane closures to the public. Because regular business hours may differ by district, each should develop a plan to ensure 24-hour coverage for all areas in Illinois.

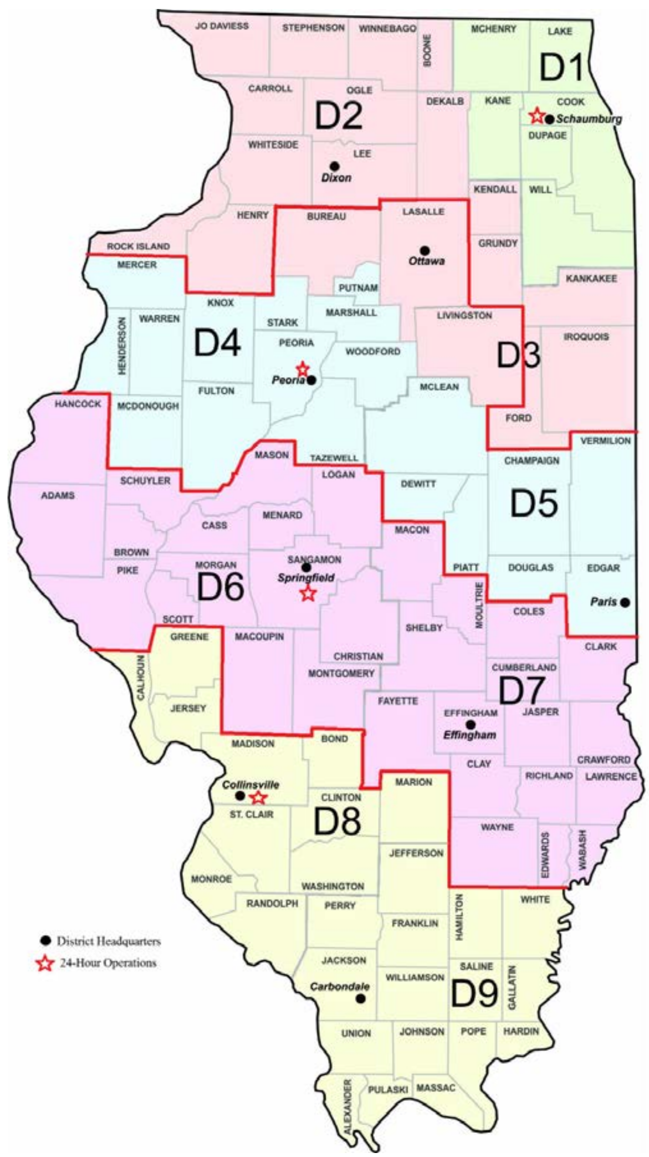


Figure 24. IDOT district map for 24-hour coverage responsibilities (IDOT, 2014).

## 5.3 PROPOSED METHOD OF MEASURING TRAFFIC-INCIDENT TRAVEL INFORMATION QUALITY IN ILLINOIS

### 5.3.1 Introduction and Background

This section discusses a proposed method for determining the accuracy and availability of information for roadway or lane-blocking traffic incidents. This document describes how traffic incident information is currently collected and reported to the public by the IDOT, details a proposed guideline for measuring traffic incident information accuracy and availability, and lists the changes that would be required to bring IDOT districts into compliance with 23 CFR 511.

Figure 25 illustrates the timeline of a traffic incident. 23 CFR 511 requires that information regarding incidents that block lanes be disseminated after $T_2$ and $T_5$. To ensure the roadway or lane-blocking incident information is available, IDOT must receive information from its field devices, personnel, or other agencies when these incidents are verified ($T_2$) and when these incidents are cleared ($T_5$).

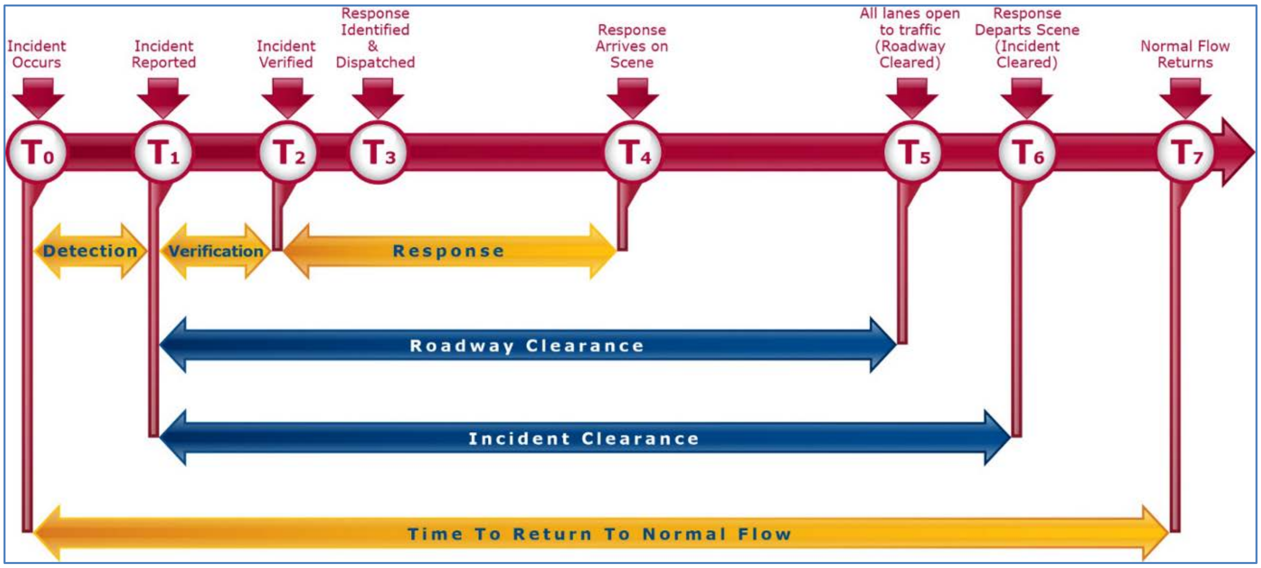


Figure 25. Traffic incident management (TIM) timeline (SHRP, 2014).

### 5.3.2 Current Practices in Traffic Incident Information Reporting

IDOT and the Illinois State Police (ISP) have a Joint Operational Policy Statement, issued in October 2004, for providing a safe and efficient highway transportation system. This statement describes IDOT's and ISP's responsibilities and communication mechanisms for events including traffic incidents, but it focuses on ISP reporting infrastructure damage to IDOT (see Annex B of the statement). The statement does not require ISP to report roadway or lane-blocking traffic incidents to IDOT unless infrastructure is damaged.

IDOT has an established method for timely reporting of roadway or lane-blocking traffic incidents to the public in Districts 1 and 8, both of which serve metropolitan areas. These two districts operate 24 hours a day and report roadway or lane-blocking incidents on their own websites as well as to IDOT's Central Office. The Travel Midwest website will report lane-blocking incidents throughout the state with its statewide expansion. Other districts report roadway or lane-blocking traffic incidents to IDOT's Central Office during regular business hours, but they do not operate 24 hours a day. The IDOT/ISP Joint Operational Policy Statement (IDOT/ISP, 2004) says:

The ISP and IDOT district offices shall develop an interdistrict communications network providing for 24-hour contact.

Thus, there is a need to assist non-metropolitan districts in the timely reporting of roadway or lane-blocking traffic incidents.

### 5.3.3 Proposed Guidelines for Incident Information Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details practices proposed for measuring incident information accuracy and availability. The accuracy of reported roadway or lane-blocking traffic incidents should be evaluated annually.

After the researchers for this project evaluated a sample data set from CMAP for 2013, they found an acceptable percentage of traffic incidents that would ensure a confident ($\alpha = 0.05$) estimate of accuracy with an error of 10%. Accordingly, to ensure a statistically valid sample, IDOT personnel should randomly select 15% of lane-blocking traffic incidents in a year. Engineering judgment should ensure the sample is geographically diverse, including incidents in both rural and urban locations throughout Illinois. During the review, IDOT personnel should compare how the following types of information are reported to the public:

- Partial or full closure,
- Segment of road where incident is located,
- Start of incident notice (after incidents are verified), and
- End of incident notice (after verifying all lanes are open to traffic).

Evaluation of "partial or full closure" should consider a partial closure as any number of lanes less than the total. Although IDOT may strive towards providing the number lanes open and closed, because of the dynamic characteristics of incident management the number lanes should not be included in compliance evaluation.

Next, evaluators should verify that the traffic incident was reported in the correct direction of travel and on the correct segment of roadway (a segment is defined by the portion of road between two interchanges). IDOT should strive towards providing locations based on mile posts when information is available, but need not provide mile post locations for compliance.

23 CFR 511 requires that specific timeliness limits be applied to the reporting of the start and end of roadway or lane-blocking incidents. In metropolitan areas, as outlined in Figures 20 and 21, roadway and lane-blocking traffic incident information must be reported within 10 minutes. Roadway and lane-blocking traffic incidents on all other limited-access roadways in Illinois must be reported within 20 minutes. Lane-blocking traffic incidents lasting less than these durations, respectively, need not be considered.

To evaluate the accuracy of roadway or lane-blocking incidents in Illinois, data logs from Communications Centers/Traffic Management Centers and the Travel Midwest website should be reviewed. The accuracy percentage should be applied to each of the four types of information listed previously in this section. The accuracy of each type should be determined using Equation 5 as follows:

**Equation 5**

$$\boldsymbol{Accuracy\ of\ Incident\ Information}\ (\%) = \frac{\sum \boldsymbol{Instances\ of\ accurate\ incident\ information}}{\sum \boldsymbol{Number\ of\ incidents\ evaluated}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of incident information, an annual review should be conducted to analyze the activity and maintenance logs of the website or websites that report traffic incident information. This review should identify how many hours the reported incident information was completely unavailable to the public. For example, if website maintenance requires 60 minutes once a month, there will be 12 hours of downtime per year. Note that factors other than website maintenance could cause a loss of availability. Equation 3 should be used to determine the availability of the incident information for each website individually.

IDOT should be considered in compliance for roadway or lane-blocking incident information if the average accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### 5.3.4 Example for Calculating Incident Information Accuracy

To evaluate the accuracy of incident information, data logs from Communications Centers/Traffic Management Centers and the Travel Midwest website should be reviewed. During review, IDOT personnel should compare the number of lanes closed, segment of road where the incident is located, start time of incident, and end of incident notification reported to the public. To consider the incident information accurate, all of this information should be reported correctly. After reviewing all incidents, the accuracy can be evaluated according to Equation 5.

An example of an incident data log from a Communications Center/Traffic Management Center is shown in Table 13.

Table 13. Example Incident Data Logs from Communications Center/Traffic Management Center.

| Time | Location | Incident Details | Partial/Full | Segment | Start Time | End Time |
|---|---|---|---|---|---|---|
| 7:44 | NB I-xx at Plymouth | A multi-vehicle accident. Lanes 1 and 2 are down (of three). ISP has been advised as well as Center manager. Partial closure disseminated to public… | Accurate | Accurate | Accurate | |
| 8:14 | | All lanes are now open. Station 1 advised and disseminated to website. | | | | Accurate |
| 23:17 | SB I-yy at xx Road | Partial closure verified at MP xx.x. Center supervisor advised. Website and upstream DMS updated. | Accurate | Accurate | Accurate | |
| 23:34 | | All lanes are now blocked due to incident management personnel. Traffic is getting by on the left shoulder. Center supervisor has been updated, dissemination updated. | Accurate | | | |
| 23:50 | | DOT informed of incident clearance, but call routed to wrong number and not reported to public for 30 more minutes. | | | | Not accurate |
| 13:30 | SB I-xx south of US x (mm xx) | An accident with all lanes blocked on SB I xx south of US x. Called and confirmed information with field units. Information posted to media, etc. within 5 minutes. | Accurate | Accurate | Accurate | |
| 15:00 | | An update advised that all lanes were open to traffic. This information was disseminated within 8 minutes. | | | | Accurate |
| 13:52 | EB I-xx at xx Ave. | Center manager requests a report be started due to a serious accident blocking all eastbound lanes of I-xx at xx Avenue. Illinois State Police are on scene; and will update Control. Information pushed to website within 9 minutes. | Accurate | Accurate | Accurate | |
| 13:53 | | Control inquires about the need for IDOT vehicle assistance, and ISP requires none. | | | | |
| 16:29 | | ISP advised incident started at approximate 12:00 noon and cleared from scene at around 16:00. IDOT sent clearance information to the public within 3 minutes of this notice. | | | | Accurate |

After reviewing the data from Table 13, it can be concluded that all of the information was reported correctly for the first three types of incident information the accuracy rate is 100 percent. Because the end time for one incident was not reported accurately, the accuracy is calculated as follows:

$$Accuracy\ of\ Incident\ End\ Time\ (\%) = \frac{3(\sum Incident\ end\ times\ accurately\ reported)}{4(\sum Incident\ end\ times\ evaluated)}\ x\ 100\ = 75\%$$

To evaluate the accuracy of incident information with a 95% confidence level and 10% acceptable error, it is recommended that 15% of all lane-closing incidents throughout a year be reviewed. The researchers established this threshold by measuring the dispersion of 2013 lane-closing traffic incidents reported to an Illinois Traffic Management Center.

Figure 26 and Figure 27 show two fictional examples of incident information disseminated to the public through the Travel Midwest website. Specifically, Figure 26 shows an example of incident information reported inaccurately according to the proposed methodology. On the other hand, Figure 27 shows an example of incident information reported accurately.

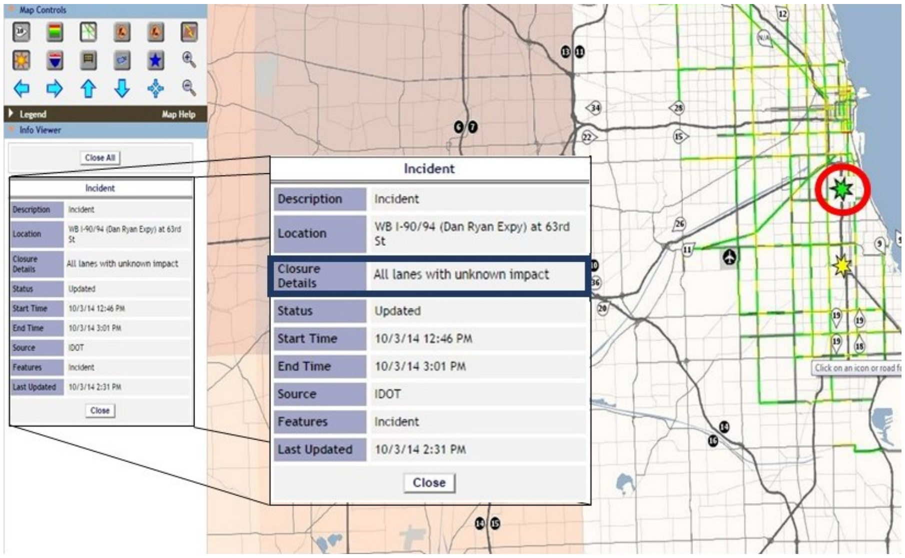


Figure 26. Example of incident information reported inaccurately (LMIGA, 2014).

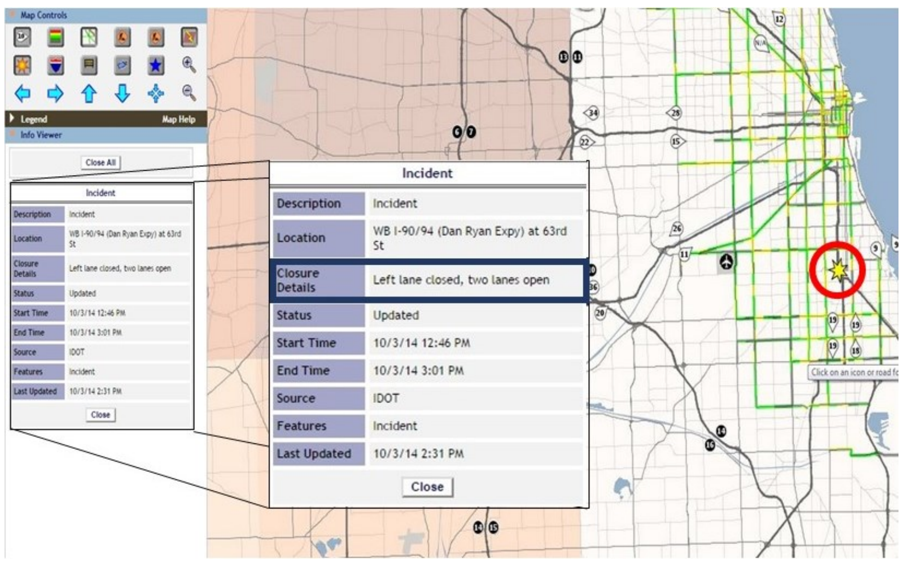


Figure 27. Example of incident information reported accurately (LMIGA, 2014).

### 5.3.5 Incident-Related Changes Required to be Made by November 8, 2104

1. IDOT upper management and operations personnel, as well as local law enforcement agencies, should receive information about the traffic incident requirements of 23 CFR 511 and the importance of information reporting incidents to IDOT with timeliness.
2. IDOT should establish a mechanism to gather roadway and lane-closing traffic incident information from districts without 24-hour operations. It is recommended that existing Traffic Management and Communications Centers be leveraged to assist neighboring IDOT districts outside of their normal business hours. These recommendations will likely require changes in staffing, District policies, and equipment. See Section 5.2.5 (number 4), focusing on construction activities, for recommendations on this mechanism.

### 5.3.6 Incident-Related Changes Recommended in the Near Term

1. To improve the timeliness of reporting traffic incidents to travelers, the IDOT/ISP Joint Operational Policy Statement should be revised. The revisions should include language regarding the timely reporting of roadway or lane-blocking traffic incidents to IDOT. Specifically, the following sentence could be added to the "Initial Agency Responsibilities" section of Annex B of the statement, which describes the responsibilities of IDOT and ISP for administration of traffic incidents on state highways:

   > ISP shall immediately notify the appropriate IDOT district when they 1) verify roadway or lane-blocking traffic incidents, 2) identify a change in the number of travel lanes open at an incident scene, and 3) confirm an incident has been cleared.

   Although a revision to the Joint Operational Policy Statement will address IDOT's incident information need in the long term, a memorandum of understanding could be used to establish the flow of this information in the short term.
2. Revisions to this policy should also add background information about the requirements of 23 CFR 511. For example, the following sentence should be added to the Annex B section overview:

   > According to the new Rule (23 CFR 511) transportation agencies must inform travelers about reported and verified interstate (and other routes of significance) roadway or lane-blocking traffic incidents within 10 minutes in Chicago (District One) and St. Louis (District Eight) metropolitan areas and within 20 minutes for interstates elsewhere in the state.

## 5.4 PROPOSED METHOD OF MEASURING WEATHER INFORMATION QUALITY IN ILLINOIS

### 5.4.1 Introduction

This section discusses a proposed method for calculating weather information quality to satisfy 23 CFR 511 requirements. Several aspects related to weather information are explained, including how information is currently collected, a proposed guideline for measuring weather information accuracy and availability, and the changes that are recommended to assist IDOT's districts with reporting weather information.

### 5.4.2 Current Practices in Weather Data Reporting

The most frequent weather information impacting travel in Illinois is winter weather, including snow and ice. Currently, most IDOT districts receive weather information from a vendor, Schneider Electric, solely for the purpose of operations during these events; however, this weather information is not reported to the public. Instead, information collected from IDOT snowplow vehicles during winter weather events is reported to the public every 2 hours, using a website. These vehicles report a numeric code that indicates the road conditions.

Additionally, the Travel Midwest website gathers information from the National Weather Service and overlays this information on its travel information map. Not all areas of Illinois receive weather information besides winter weather operations.

IDOT has already established a Joint Operational Policy Statement with the Illinois State Police that requires timely communication and collaboration for closing roadways due to adverse weather. 23 CFR 511 requires that IDOT report weather information including hazardous conditions, blockage, or closure, within 20 minutes of when it is reported.

### 5.4.3 Proposed Guidelines for Weather Information Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details proposed practices for measuring weather information accuracy and availability. The accuracy and availability of weather information can be evaluated annually by reviewing the reported weather conditions during two significant weather events, for a minimum of 12 hours total. During this review, IDOT Central Office personnel should compare their reported road conditions to a baseline data source, such as the National Weather Service, a road weather information station, or weather vendor such as Schneider Electric.

The records for each significant weather event should be divided into time intervals based on the frequency of weather observations. These time intervals should be no longer than 2 hours, but they should be no shorter than 20 minutes. Each time interval should be evaluated for accuracy and timeliness (20 minutes). This review should include reporting of road closures and reporting of hazardous conditions such as snow coverage (via the snow coverage map), fog, and flooding. IDOT should measure its overall weather accuracy using Equation 6 as follows:

**Equation 6**

$$\boldsymbol{Accuracy}\ (\%) = \frac{\sum \boldsymbol{weather\ time\ intervals\ accurately\ reported}}{\sum \boldsymbol{weather\ time\ intervals\ evaluated}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of weather information, an annual review should be conducted to analyze the activity and maintenance logs of the website or websites that report weather information. This evaluation should identify how many hours the weather information was completely unavailable to the public. For example, if the website requires maintenance 2 hours per month, there will be 24 hours of downtime per year. Note that information may be unavailable from activities other than website maintenance. Equation 3 should be used to determine the availability of the weather information for each website individually.

IDOT should be considered in compliance for weather information if the accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### 5.4.4 Example for Calculating Weather Information Accuracy

To evaluate the accuracy of weather information, reported weather conditions by IDOT should be compared with a baseline data source such as the National Weather Service. The records for each significant weather event should be divided into time intervals based on the frequency of weather observation. These time intervals should be no longer than two hours, but should not be shorter than 20 minutes. This review should include reporting of road closures and reporting of hazardous conditions. The accuracy can be calculated using Equation 6.

For example, the weather data of Greenville, Illinois, in Figure 28 was obtained from the Getting Around Illinois website for a 20-minute interval. During that period, there was an indication of severe rain in the region. The weather data of Greenville, Illinois in Figure 29 was obtained from www.accuweather.com website for the same duration and is considered the baseline source. There was a severe rain event in that case as well. Therefore, the weather information during the 20-minute period was reported accurately. Thus, the accuracy can be calculated as follows:

$$\boldsymbol{Accuracy}\ (\%) = \frac{\mathbf{20}(\sum \boldsymbol{weather\ time\ intervals\ accurately\ reported})}{\mathbf{20}(\sum \boldsymbol{weather\ time\ intervals\ evaluated})}\ \boldsymbol{x}\ \mathbf{100}\ = 100\%$$

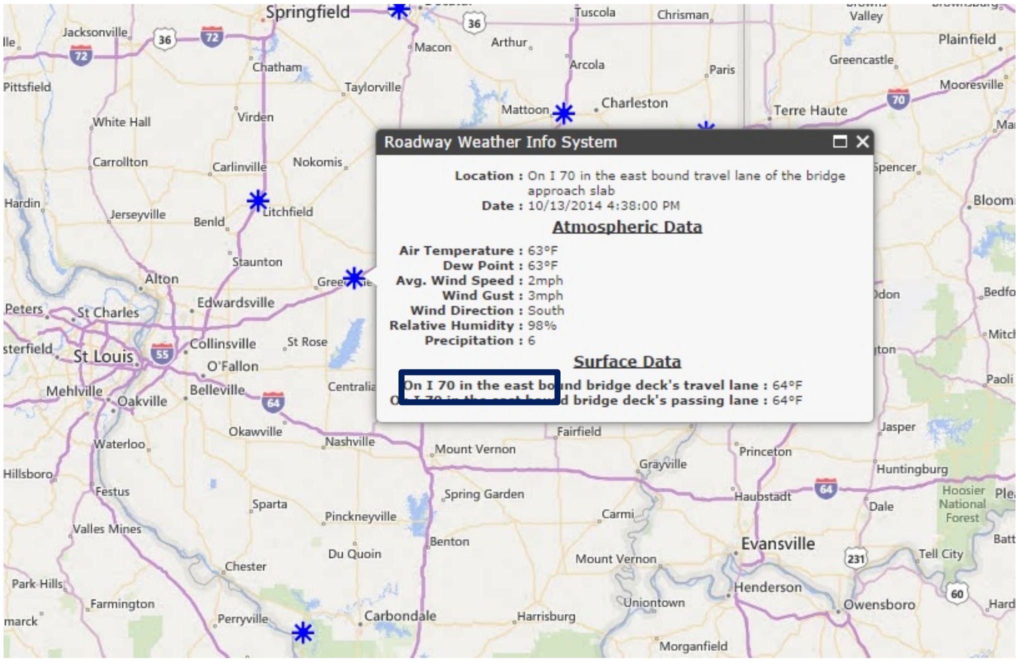


Figure 28. Reported weather information (IDOT, 2014).


Figure 29. Baseline weather information (AccuWeather, Inc., 2014).

### 5.4.4 Weather-Related Recommendations

The current practices observed by the research team suggest that after implementing a method for evaluating accuracy and availability, IDOT will be in compliance with the weather-related requirements set forth by 23 CFR 511. To continue improving the reporting of this information, the following recommendations are proposed:

1. IDOT should streamline the communication path through which weather information is reported. The Travel Midwest or the Getting Around Illinois website could serve as a central hub for reporting weather and other travel information to the public, simplifying reporting needs and website maintenance. Weather information reported via this website should be archived for use with an annual accuracy and availability review.
2. IDOT should select a publicly available weather information source, such as the National Weather Service. Information from the selected source should be collected using automated means, reported to the public via a common travel information platform such as the Getting Around Illinois website (within 20 minutes), and archived for use during annual evaluations.
3. IDOT should formalize the process of reporting road flooding and fog presence. Currently, there are no established practices for reporting these events to a specific place or within certain timeliness criteria.

## 5.5 IMPLEMENTATION

To support the implementation of these recommendations, the research team has created two resources for IDOT personnel or contractors. First, an implementation plan details the practices that are recommended for meeting the details of 23 CFR 511 (see Appendix A). Additionally, a narrated presentation was created to support annual evaluation of real-time traveler information accuracy, availability, and timeliness. This presentation details how compliance with these criteria should be measured.

# CHAPTER 6 INTELLIGENT TRANSPORTATION SYSTEMS ARCHITECTURE RECOMMENDATIONS

The last aspect of our stakeholder meetings involved identifying information-sharing needs and possible changes and updates to ITS architectures. The Illinois state and regional architectures were published between 2005 and 2007. A detailed review of the existing Illinois state and regional ITS architectures was required to identify the planning and deployment needs for meeting the final rule. Each ITS architecture was reviewed to identify missing connections or entities. The descriptions and terms used throughout this chapter are from the U.S. National ITS Architecture (FHWA, 2014). Readers should also reference the U.S. National ITS Architecture for details about any of the listed service packages, architecture flows, data flows, subdata flows, or standards development activities. The information in this chapter is intended for those updating these architectures and includes recommendations on how to accomplish the communications between stakeholders in Illinois and the traveler information services for supporting the 23 CFR 511.

The subheadings of this chapter are organized starting with real-time incident information, and followed by real-time construction lane closure information, real-time road closure information due to weather, and travel-time information. These recommendations are also summarized in a table for each architecture.

## 6.1 RECOMMENDATIONS FOR REVISING THE ILLINOIS STATEWIDE ITS ARCHITECTURE

For the Illinois Statewide ITS Architecture to help planning for 23 CFR 511, five new connections need to be included. Within each connection, several key pieces of information should be shared. These details are summarized in Table 14 and described further in the subsequent text.

Table 14. Summary of Illinois Statewide ITS Architecture Recommended Changes

| Service Package | Architecture Flow | Entities Connecting | Data Flows | Subdata Flow |
|---|---|---|---|---|
| ATMS08—Traffic Incident Management System | Incident information | Illinois State Police and IDOT District Traffic Management Centers | Incident details | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| | | Traffic Management Centers and Station 1 | Current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| ATMS07—Regional Traffic Management | Road network conditions | District Traffic Management Centers and Station 1 | Roadway detours and closures | No subdata flow (primitive element) |
| EM08—Disaster Response and Recovery | Road network conditions | Traffic Management subsystem to Emergency Management subsystem | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | Traffic Management subsystem to Emergency Management subsystem | Network status from traffic for disaster | No subdata flow (primitive element) |
| ATMS21—Roadway Closure Management | Road closure notification | Illinois district hubs and the Illinois statewide hub subsystem | Roadway closure from emergency | No subdata flow (primitive element) |

### 6.1.1 Real-Time Incident Information

The 2005 Illinois statewide ITS architecture did not include real-time incident information flowing between the Illinois State Police and IDOT District Traffic Management Centers (TMCs) (also known as Communications Centers). To add this functionality as part of service package ATMS08—Traffic Incident Management System, future updates to this architecture should add the "incident_information" architecture flow from the Emergency Management subsystem to the Traffic Management subsystem. The connection between these two entities is noted at a high level in Figure 2 of the 2005 statewide ITS architecture concept of operations. The "incident_information" architecture flow should include the data flow "incident_details," which should include the subdata flows "incident_location," "incident_start_time," and "incident_response_clear." The most recent standards work by the Institute of Electrical and Electronics Engineers (IEEE) IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, the ITE TMDD: Traffic Management Data Dictionary (TMDD) Standards, and the Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

The current architecture includes a connection between district TMCs and Station 1, but there is no detail about the type of information that flows between them. The architecture should specify that incident information flow between district TMCs and Station 1 as part of service package ATMS08—Traffic Incident Management System. Specifically, this service package should add the "incident_information" architecture flow from the Traffic Management subsystem to the Other Traffic Management terminator (Station 1). The "incident_information" architecture flow should include the data flow "totm-current_event_data," which should include the subdata flows "incident_location," "incident_start_time," and "incident_response_clear." The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

To enable future incident information flow from county sheriffs and local police, a connection must be included between incident command and local police. This data flow should include "alert notification coordination," "emergency plan coordination," "evacuation coordination," "incident command information coordination," "incident report," and "incident response coordination." The service package related to this flow can be found in the first paragraph on page 35 of the 2005 Illinois statewide ITS architecture.

### 6.1.2 Real-Time Construction Lane Closure Information

The architecture specifies the service package MC08–Work Zone Management. The architecture flow "work zone information" that connects the Maintenance and Construction Management subsystem should be explicitly noted with respect to the need for real-time lane closure information.

To facilitate the real-time reporting of lane-closing construction activities from district TMCs to Station 1, a new architecture flow is proposed. Service package ATMS 07–Regional Traffic Management is recommended for use in sending roadway closure information between district TMCs and Station 1 (Other Traffic Management). It should include the "road_network_conditions" architecture flow. The architecture flow should include the "totm-roadway_detours_and_closures" data flow. The most recent ITE TMDD: Traffic Management Data Dictionary (TMDD) Standards, the Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards, and the NTCIP C2C: NTCIP Center-to-Center Standards Group work should be included when specifying these connections.

### 6.1.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08—Disaster Response and Recovery. As part of this service package, the architecture should specify that weather and flood information be included and that the architecture flow “road_network_condition” should be added from the Traffic Management subsystem to the Emergency Management subsystem.

Regional architectures should be guided to specify the data flow “traffic_data_for_emergency_services,” which should include the subdata flow “link_environment_conditions.” The “road_network_status_assessment” architecture flow should include “roadway_detours_and_closures_for_em_response” data flow, which should include the following subdata flows: “roadway_detours_and_closures,” “highway_closures,” “roadway_closures,” “lane_closure,” and “lane_open.” The most recent ITE TMDD: Traffic Management Data Dictionary (TMDD) Standards, the Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards, and work by the NTCIP C2C: NTCIP Center-to-Center Standards Group should be included when specifying these connections.

As part of the existing service package ATMS21—Roadway Closure Management, the “road_closure_notification” architecture flow from Illinois district hubs (TMCs) to the Illinois Statewide Hub subsystem (Other TMC) should be added. The connection between these two entities is noted at a high level in Figure 2 of the 2005 statewide ITS architecture concept of operations. Regional architectures should include this connection and also include the data flow “roadway_closure_from_emergency.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, as well as the ITE TMDD: Traffic Management Data Dictionary (TMDD) Standards and the Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.1.4 Travel Times from TMCs to the Public

The architecture specifies a connection between the Illinois statewide hub and 511, which provides travel times, RWIS data, planned construction information, and known traffic incidents to the public. Because Illinois does not operate a 511 system and instead operates travel websites, these connections should be revised to match existing practices, but the connection for disseminating travel times to the public through websites and roadside devices should be maintained.

## 6.2 RECOMMENDATIONS FOR REVISING THE CHAMPAIGN–URBANA–SAVOY ITS ARCHITECTURE

For the Champaign–Urbana–Savoy ITS architecture to comply with 23 CFR 511, four new connections need to be included. Within each connection, several key pieces of information should be shared. Although Champaign-Urbana-Savoy is under the jurisdiction of IDOT District 5, the recommendations include District 4 because their traffic management center operates 24 hours. The details of these recommendations are summarized in Table 15 and described in the subsequent text.

Table 15. Summary of Recommended Changes to the Champaign–Urbana–Savoy Regional ITS Architecture

| Service Package | Architecture Flow | Entities Connecting | Data Flows | Subdata Flow |
|---|---|---|---|---|
| ATMS08—Traffic Incident Management System | Incident information | Champaign Police Department, City of Champaign Public Works, Illinois State Police and IDOT District 5 | Incident details | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| | | IDOT District 5, District 4, and Station 1 | Current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| ATMS07—Regional Traffic Management | Road network conditions | IDOT District 5, District 4, and Station 1 | Roadway detours and closures | No subdata flow (primitive element) |
| EM08—Disaster Response and Recovery | Road network conditions | Illinois State Police and IDOT District 5 | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | Illinois State Police and IDOT District 5 | Network status from traffic for disaster | No subdata flow (primitive element) |
| ATMS21—Roadway Closure Management | Road closure notification | IDOT District 5, District 4, and Station 1 | Roadway closure from emergency | No subdata flow (primitive element) |
| | Road network conditions | | Roadway detours and closures | Lane closure |
| | | | | Lane open |

### 6.2.1 Real-Time Incident Information

The 2005 Champaign–Urbana–Savoy regional ITS architecture needs to facilitate the reporting of incident information from the Emergency Management subsystem to the Traffic Management subsystem. Service package ATMS08—Traffic Incident Management System is available with the coordination between the Champaign Police Department and City of Champaign Public Works, but the Illinois State Police and IDOT District 4 are not included. The "incident_information" architecture flow from the Emergency Management subsystem (Champaign Police Department and Urbana Police Department) to the Traffic Management subsystem (IDOT District 4) should be available and should include the data flow "incident_details." The "incident_details" data flow should include the subdata flow "incident_location," "incident_start_time," and "incident_response_clear." The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, in addition to the ITE TMDD: Traffic Management Data Dictionary (TMDD) Standards and the Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

In addition, this architecture should also enable the communication of incident information from regional TMCs to IDOT Station 1. To support this functionality to service package ATMS08—Traffic Incident Management System, the "incident_information" architecture flow from the Traffic Management subsystem (IDOT District 4) to the Other Traffic Management subsystem (IDOT headquarters, also known as Station 1) should be added. Because there is no connection between IDOT District 4 and the City of Champaign Public Works or the City of Urbana Public Works, it should be considered in future updates. The "incident_information" architecture flow should include the data flow "totm-current_event_data," which should include the subdata flows "incident_location," "incident_start_time," and "incident_response_clear." The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group as well as the ITE TMDD: Traffic Management Data Dictionary (TMDD) Standards and the Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

Last, planned efforts should include a path for local police to report lane-closing traffic incidents to IDOT. The current architecture does not specify these responsibilities. these entities should be included in the architecture's definition of either the Emergency Management subsystem or the Other Emergency Management subsystem. If the latter is chosen, "incident_information" should be communicated to the Emergency Management subsystem, including the data flows "alert_ notification_coordination," "emergency_plan_coordination," "evacuation_coordination," "incident_command_information_coordination," "incident_report," and "incident_response_ coordination."

### 6.2.2 Real-Time Construction Lane Closure Information

The existing architecture flows do not specify service package ATMS 21—Roadway Closure Management; therefore, it is recommended to add this functionality to future updates of this architecture. When implementing this service package, the "road_network_conditions" architecture flow from the Traffic Management subsystem (IDOT District 4) to the Other Traffic Management subsystem (Station 1) should be added. The "road_network_conditions" architecture flow should include the data flow "roadway_detours_and_closures," which should include the subdata flows "lane_closure" and "lane_open." The most recent standards work by the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards and the NTCIP C2C: NTCIP Center-to-Center Standards Group should be included when specifying these connections.

Every public works department shares its maintenance schedules with each other and IDOT District 4. To comply with 23 CFR 511, IDOT District 4 should share construction lane closure information with Station 1. Currently, the construction lane closure information is not provided by IDOT District 4 to IDOT headquarters (Station 1). It is recommended that service package ATMS 07—Regional Traffic Management sends the roadway closure information to IDOT District 4 (Traffic Management) and IDOT headquarters (Other Traffic Management). It should include the "road_network_conditions" architecture flow. The architecture flow should include the "totm-roadway_detours_and_closures" data flow. The most recent ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards and work from the NTCIP C2C: NTCIP Center-to-Center Standards Group should be included when specifying these connections.

### 6.2.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08—Disaster Response and Recovery. As part of service package EM08—Disaster Response and Recovery, the architecture flow from Emergency Management (Illinois State Police) to Traffic Management (IDOT District 4) should include "road_network_conditions" and "road_network_status_assessment." The "road_network_conditions" architecture flow should include the data flow "traffic_data_for_emergency_services," which should include the subdata flow "link_environment_conditions." The "road_network_status_assessment" architecture flow should include "roadway_detours_and_closures_for_em_response" data flow, and that should include the following subdata flows: "roadway_detours_and_closures," "highway_closures," "roadway_closures," "lane_closure," and "lane_open." The most recent standards work by the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards and the NTCIP C2C: NTCIP Center-to-Center Standards Group should be included when specifying these connections.

Service package ATMS 21—Roadway Closure Management should be added to future updates of this architecture. When implementing this service package, the “road_closure_notification” architecture flow from TMCs (IDOT District 4) to Station 1 (Other TMC) should be added. This architecture flow should include the data flow “roadway_closure_from_emergency.” The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

## 6.3 RECOMMENDATIONS FOR REVISING THE DEKALB–SYCAMORE ITS ARCHITECTURE

For the DeKalb–Sycamore architecture to comply with 23 CFR 511, six connections need to be added or revised. Within each connection, several key pieces of information should be shared. These details are summarized in Table 16 and described in the subsequent text.

Table 16. Summary of DeKalb–Sycamore Regional ITS Architecture Recommended Changes

| Service Package | Architecture Flow | Entities Connecting | Data Flow | Subdata Flow |
|---|---|---|---|---|
| **ATMS08—Traffic Incident Management System** | Incident information | Illinois State Police and IDOT District Traffic Management Centers | Incident details | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| | | IDOT District 2 and Station 1 | Current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| **MC08—Work Zone Management** | Work zone Information | Maintenance and Construction Management terminator and Maintenance and Construction Management subsystem | Work zone information | Work zone data for status |
| **ATMS07—Regional Traffic Management** | Road network conditions | IDOT District 2 and Station 1 | Roadway detours and closures | No subdata flow (primitive element) |
| **EM08—Disaster Response and Recovery** | Road network conditions | Illinois State Police and IDOT District 2 | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | Illinois State Police and IDOT District 2 | Network status from traffic for disaster | No subdata flow (primitive element) |
| **ATMS21—Roadway Closure Management** | Road closure notification | Illinois State Police and IDOT District 2 | Roadway closure from emergency | No subdata flow (primitive element) |

### 6.3.1 Real-Time Incident Information

The 2006 DeKalb–Sycamore architecture does not currently include a real-time incident information flow between the Illinois State Police and IDOT district TMCs. Service package ATMS08–Traffic Incident Management System was listed as planned. When implementing this service package, the “incident_information” architecture flow from the Emergency Management subsystem to the Traffic Management subsystem should be added. The “incident_information” architecture flow should include the data flow “incident_details,” which should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

The updated architecture should also enable the communication of incident information from regional TMCs to IDOT Station 1. To support this functionality in service package ATMS08–Traffic Incident Management System, the “incident_information” architecture flow from the Traffic Management subsystem to the Other Traffic Management terminator should be added. The “incident_information” architecture flow should include the data flow “totm-current_event_data,” which should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

There is an existing connection between the City of DeKalb Police Department and the City of DeKalb traffic center. Also, there is a planned connection between the DeKalb County Sheriff’s Department and the City of DeKalb Traffic Center. However, the current architecture does not specify a connection between the local police and the district TMC. In an updated architecture, the data flows should include “alert notification coordination,” “emergency_plan_coordination,” “evacuation_coordination,” “incident command_information_coordination,” incident_report,” and “incident_response_coordination.” The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.3.2 Real-Time Construction Lane Closure Information

The architecture currently includes the service package MC08—Work Zone Management, but there is no explanation of the lane closure information exchange. To add this functionality as part of service package MC08— Work Zone Management, the “work_zone_information” architecture flow from the Other Maintenance subsystem and the Construction Management terminator to the Maintenance and Construction Management subsystem should be added, and vice versa. The “work_zone_information” architecture flow should include the data flow “tomcm-work_zone_info,” which should include the subdata flow “work_zone_data_for_status.” The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

To facilitate the real-time reporting of lane-closing construction activities from district TMCs to Station 1, an additional connection is proposed. IDOT District 2 should share the construction lane closure information with Station 1. It is recommended that service package ATMS 07—Regional Traffic Management share the roadway closure information between IDOT District 2 (Traffic Management) and IDOT headquarters (Other Traffic Management). It should include the “road_network_conditions” architecture flow. The architecture flow should include the “totm-roadway_detours_and_closures” and “fotm-roadway_detours_and_closures” data flows. The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards and the should be included when specifying these connections.

### 6.3.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08–Disaster Response and Recovery; however, it doesn't specify responsibilities. The architecture flows "road_network_conditions" and "road_network_status_assessment" should be added as architecture flows from the Emergency Management subsystem to the Traffic Management subsystem (IDOT District 2). The "road_network_conditions" architecture flow should include the data flow "traffic_data_for_emergency_services," which should include the subdata flow "link_environment_conditions." The "road_network_status_assessment" architecture flow should include the "roadway_detours_and_closures_for_em_response" data flow, and that should include the following subdata flows: "roadway_detours_and_closures," "highway_closures," "roadway_closures," "lane_closure," and "lane_open." The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards and should be included when specifying these connections.

Service package ATMS 21—Roadway Closure Management should be added to future updates of this architecture. When this service package is implemented, the "road_closure_notification" architecture flow from TMCs (IDOT District 2) to Station 1 (Other TMC) should be added. This architecture flow should include the data flow "roadway_closure_from_emergency." The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

## 6.4 RECOMMENDATIONS FOR REVISING THE DUPAGE REGIONAL ITS ARCHITECTURE

For the DuPage regional architecture to comply with 23 CFR 511, seven connections need to be included. Within each connection, several key pieces of information should be shared. These details are summarized in Table 17 17 and described in the subsequent text.

Table 17. Summary of DuPage Regional ITS Architecture Recommended Changes

| Service Package | Architecture Flow | Entities Connecting | Data Flow | Subdata Flow |
|---|---|---|---|---|
| **ATMS08—Traffic Incident Management System** | Incident information | Illinois State Police and IDOT District 1 Communications Center | Incident details | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| | | IDOT District 1 Traffic Management Center and Station 1 | Current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| **MC08—Work Zone Management** | Work zone information | Private Sector Maintenance Contractor Dispatch and IDOT District 1 | Work zone information | Work zone data for status |
| **ATMS07—Regional Traffic Management** | Road network conditions | IDOT District Traffic Management Center and Station 1 | Roadway detours and closures | No subdata flow (primitive element) |
| **EM08-—Disaster Response and Recovery** | Road network conditions | Emergency Management to Traffic Management subsystems | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | Emergency Management to Traffic Management subsystems | Network status from traffic for disaster | No subdata flow (primitive element) |
| **ATMS21—Roadway Closure Management** | Road closure notification | IDOT District 1 Communications Center and Station 1 | Roadway closure from emergency | No subdata flow (primitive element) |
| **ATIS01—Broadcast Traveler Information** | Travel times | IDOT District 1 and public website | Current road network state | Link journey time |

### 6.4.1 Real-Time Incident Information

Service package ATMS08—Traffic Incident Management System already exists. This service package includes the IDOT District 1 Communications Center, Illinois State Police District 2 Dispatch, and Illinois State Police District 15 Dispatch. ISP District 2 covers DuPage County, whereas ISP District 15 serves the Illinois Tollway. When implementing this service package, the "incident_information" architecture flow from the Emergency Management subsystem (ISP) to the Traffic Management subsystem (District 1 Communications Center) should be added with the data flow "incident_details." The "incident_details" data flow should include the subdata flows "incident_location," "incident_start_time," and "incident_ response_clear." In addition, this architecture should also enable the communication of incident information from the regional TMC (District 1) to IDOT Station 1. When implementing this connection, the "incident_information" architecture flow from the Traffic Management to the Other Traffic Management terminator should be added with the data flow "totm-current_event_data," which should include the subdata flows "incident_location," "incident_start_time," and "incident_response_clear." The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C:

NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

During incidents, the DuPage County Sheriff's Communications Center oversees the DuPage Interoperable Radio System, a common emergency communications channel that is a part of the Emergency Management system. In order for the local police to report lane-closing traffic incidents to IDOT, the architecture should include the "incident_information" architecture flow from the Emergency Management subsystem (county sheriff) to the Traffic Management subsystem (District 1 Communications Center). This connection should include the data flows "alert_notification_ coordination," "emergency_plan_coordination," "evacuation_coordination," "incident_command_ information_coordination," incident_report," and "incident_response_coordination." The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.4.2 Real-Time Construction Lane Closure Information

Service package ATMS21—Roadway Closure Management was not available. A similar service package, MC08—Work Zone Management, exists, which includes Private Sector Maintenance Contractor Dispatch and the IDOT District 1 Communications Center. The Private Sector Maintenance Contractor Dispatch performs maintenance on regional signal systems, HAR, DMS, lighting systems, and pumping stations. In order to add lane-closing information exchange between contractors and the district TMC (District 1 Communications Center), the architecture flow "work_zone_information" should connect the Maintenance and Construction Management subsystem to the Traffic Management subsystem. The "work_zone_information" architecture flow should include the data flow "tomcm-work_zone_info," which should include the subdata flow "work_zone_data_for_status." The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

To facilitate the real-time reporting of lane-closing construction activities from district TMCs to Station 1, an additional connection is proposed. IDOT District 1 should share the construction lane closure information with Station 1. Service package ATMS 07—Regional Traffic Management is recommended for sharing the roadway closure information between IDOT District 1 (Traffic Management) and IDOT headquarters (Other Traffic Management). It should include the "road_network_conditions" architecture flow. The architecture flow should include the "totm-roadway_detours_and_closures" data flow. The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.4.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08—Disaster Response and Recovery. As part of service package EM08, the "road_network_conditions" and "road_network_status_assessment" architecture flows from the Emergency Management subsystem to the Traffic Management subsystems should be added. The "road_network_conditions" architecture flow should include the data flow "traffic_data_for_emergency_services," which should include the subdata flow "link_environment_ conditions." The "road_network_status_assessment" architecture flow should include "roadway_ detours_and_closures_for_em_response" data flow, and that should include the following subdata flows: “roadway_detours_and_closures,” “highway_closures,” “roadway_closures,” “lane_closure,” and “lane_open.” The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

Service package ATMS 21—Roadway Closure Management should be added to future updates of this architecture. When implementing this service package, the “road_closure_notification” architecture flow from TMCs (District 1 communication center) to Station 1 (Other TMC) should be added. This architecture flow should include the data flow “roadway_closure_from_emergency.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.4.4 Travel-Time Information

The architecture did not include the dissemination of travel-time information. It is recommended that future updates to this document include either service package ATIS01—Broadcast Traveler Information or ATMS06—Traffic Information Dissemination. Both can be used to disseminate travel-time information to the public from IDOT. For example, ATIS01—Broadcast Traveler Information, broadly disseminates this information through existing infrastructure. This service package does not provide connection between the Traffic Management subsystem (IDOT District 1) and the Other Traffic Management subsystem (IDOT headquarters); therefore, it is recommended to add the subsystem Other Traffic Management to allow this data flow.

## 6.5 RECOMMENDATIONS FOR REVISING THE PEORIA–PEKIN REGIONAL ITS ARCHITECTURE

For the Peoria–Pekin regional ITS architecture to comply with 23 CFR 511, five connections need to be included. Within each connection, several key pieces of information should be shared. These details are summarized in Table 18 and described in the following text.

Table 18. Summary of Peoria–Pekin Regional ITS Architecture Recommended Changes

| Service Package | Architecture Flow | Entities Connecting | Data Flow | Subdata Flow |
|---|---|---|---|---|
| ATMS08—Traffic Incident Management System | Incident information | Illinois State Police and IDOT District 4 Communications Center | Incident details | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| | | IDOT District Traffic Management Center and Station 1 | Current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| MC08—Work Zone Management | Work zone information | Private Sector Maintenance Contractor Dispatch and District Traffic Maintenance Center | Work zone information | Work zone data for status |
| EM08—Disaster Response and Recovery | Road network conditions | Emergency Management to Traffic Management subsystems | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | Emergency Management to Traffic Management subsystems | Network status from traffic for disaster | No subdata flow (primitive element) |
| ATMS21—Roadway Closure Management | Road closure notification | IDOT District 4 Communications Center and Station 1 | Roadway closure from emergency | No subdata flow (primitive element) |

### 6.5.1 Real-Time Incident Information

The 2006 Peoria–Pekin Regional ITS architecture does not include real-time incident information flowing between the Illinois State Police and the IDOT District 4 Communications Center. To incorporate this functionality as part of service package ATMS08—Traffic Incident Management System, the “incident_information” architecture flow from the Emergency Management subsystem (ISP) should be added to the Traffic Management subsystem (District 4 Communications Center). The connection between these two entities is noted at a high level on page 161 of the Peoria/Pekin Urbanized Area Transportation Study. The “incident_information” architecture flow should include the data flow “incident_details,” which should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

The current architecture includes a connection between district TMCs and IDOT headquarters (Station 1), but there is no detail about the type of information that flows between them. The architecture should describe how incident information will flow between district TMCs and Station 1. Specifically, service package ATMS08 should include the “incident_information” architecture flow from the Traffic Management subsystem (District 4 Communications Center) to the Other Traffic Management terminator. The “incident_information” architecture flow should include the data flow “totm-current_event_data,” which should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

Last, planned efforts should include a path for county sheriffs and local police to report lane-closing traffic incidents to IDOT. The current architecture does not specify these responsibilities. These entities should be included in the architecture’s definition of either the Emergency Management subsystem or the Other Emergency Management subsystem. If the latter is chosen, “incident_information” should be communicated to the Emergency Management subsystem, including “alert_notification_coordination,” “emergency_plan_coordination,” “evacuation_coordination,” “incident_command_information_ coordination,” “incident_report,” and “incident_response_coordination.” Incident communication was recently established between IDOT District 4 and Peoria and Tazewell Counties, which should be appropriately noted in future updates of this region’s ITS architecture.

### 6.5.2 Real-Time Construction Lane Closure Information

According to Table 4 of the 2006 Peoria–Pekin Regional ITS Architecture, service package MC08 is included. However, there is no other explanation about lane-closing information exchange between contractors and the district TMC (District 4 Communications Center). To add this functionality as part of service package MC08—Work Zone Management, the architecture flow “work_zone_information” should connect the Maintenance and Construction Management subsystem and the Traffic Management subsystem. The “work_zone_information” architecture flow should include the data flow “tomcm-work_zone_info,” which should include the subdata flow “work_zone_data_for_status.”

A connection should exist for the IDOT District 4 Communications Center to report construction lane closures to IDOT Station 1, when appropriate. The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.5.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08—Disaster Response and Recovery. As part of service package EM08—Disaster Response and Recovery, the “road_network_conditions” and “road_network_status_assessment” architecture flows from the Emergency Management subsystem to the Traffic Management subsystem should be added. The “road_network_conditions” architecture flow should include the data flow “traffic_data_for_emergency_services,” which should include the subdata flow “link_environment_conditions.” The “road_network_status_assessment” architecture flow should include the “roadway_detours_and_closures_for_em_response” data flow, and that should include the following subdata flows: “roadway_detours_and_closures,” “highway_closures,” “roadway_closures,” “lane_closure,” and “lane_open.” The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

As part of the existing service package ATMS21—Roadway Closure Management, the “road_closure_notification” architecture flow from TMCs (District 4 Communications Center) to Station 1 (Other TMC) should be added. This architecture should include this connection and also include the data flow “roadway_closure_from_emergency.” The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

## 6.6 RECOMMENDATIONS FOR REVISING THE SPRINGFIELD–SANGAMON COUNTY REGIONAL INTELLIGENT TRANSPORTATION SYSTEMS (ITS) ARCHITECTURE

The Springfield–Sangamon County regional architecture was reviewed and requires five connections to comply with 23 CFR 511. Within each connection, several key pieces of information should be shared. These are summarized in Table 19 and described in the subsequent text.

Table 19. Summary of Springfield–Sangamon Regional ITS Architecture Recommended Changes

| Service Package | Architecture Flow | Entities Connecting | Data Flows | Subdata Flow |
|---|---|---|---|---|
| **ATMS08—Traffic Incident Management System** | Incident information | Illinois State Police and IDOT District 6 Communications | Incident details and current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| **MC08—Work Zone Management** | Work zone information | IDOT District 6 Maintenance and Construction Dispatch and IDOT District 6 Bureau of Operations | Work zone information | Work zone data for status |
| **EM08—Disaster Response and Recovery** | Road network conditions | Emergency Management to Traffic Management subsystems | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | Emergency Management to Traffic Management subsystems | Network status from traffic for disaster | No subdata flow (primitive element) |
| **ATMS 21—Roadway Closure Management** | Road closure notification | District 6 Dispatch Center and Station 1 | Roadway closure from emergency | No subdata flow (primitive element) |

### 6.6.1 Real-Time Traffic Incident Information

Review of the existing plan suggests that the Illinois State Police is the key agency receiving incident information from law enforcement and emergency response agencies. To ensure the traffic incident information is conveyed to the local IDOT district, the existing interconnect between the Illinois State Police and the IDOT District 6 Communications Center should include the “incident_information” architecture flow, which should include the data flow “incident_details.” The data flow should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the IEEE IM: Incident Management Standards Group, NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.6.2 Real-Time Construction Lane Closure Information

The existing architecture connects IDOT District 6 Maintenance and Construction Dispatch with IDOT District 6 Bureau of Operations, but the connection appears to provide traffic camera images only. To provide the required real-time lane closure information, this connection should also include parts of the service package MC08—Work Zone Management. The architecture flow “work_zone_information” that connects the Maintenance and Construction Management subsystem and the Traffic Management subsystem should be explicitly noted with respect to the need for real-time lane closure information. The “work_zone_information” architecture flow should include the data flow “tomcm-work_zone_info,” which should include the subdata flow “work_zone_data_for_status.” District 6 Dispatch should report this information to IDOT Station 1 when appropriate. The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.6.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08—Disaster Response and Recovery. As part of this service package, the architecture should specify that weather and flood information be included and the architecture flow “road_network_condition” from the Traffic Management subsystem to the Emergency Management subsystem should be added.

The Springfield–Sangamon regional ITS architecture should specify the data flow “traffic_data_for_emergency_services,” which should include the subdata flow “link_environment_conditions.” The “road_network_status_assessment” architecture flow should include the “roadway_detours_and_closures_for_em_response” data flow, and that should include the following subdata flows: “roadway_detours_and_closures,” “highway_closures,” “roadway_closures,” “lane_closure,” and “lane_open.” The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

As part of the existing service package ATMS21—Roadway Closure Management, the “road_closure_notification” architecture flow from the District 6 Dispatch Center or Operations Center to the IDOT statewide hub (Station 1) should be added. In this connection, the architecture should also include the data flow “roadway_closure_from_emergency.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.7 RECOMMENDATIONS FOR REVISING THE ST. LOUIS REGIONAL ITS ARCHITECTURE

For the St. Louis regional ITS architecture to comply with 23 CFR 511, five new connections need to be included. Within each connection, several key pieces of information should be shared. These details are summarized in Table 20 and described in the following text.

Table 20. Summary of Saint Louis Regional ITS Architecture Recommended Changes

| Service Package | Architecture Flow | Entities Connecting | Data Flows | Subdata Flow |
|---|---|---|---|---|
| **ATMS08—Traffic Incident Management System** | Incident information | Emergency Management and Traffic Management | Incident details | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| | | IDOT District 8 and Station 1, county sheriffs, and local police | Current event data | Incident location |
| | | | | Incident start time |
| | | | | Incident response clear |
| **MC08—Work Zone Management** | Work zone information | Maintenance and Construction Management and Traffic Management | Work zone information | Work zone data for status |
| **ATMS07—Regional Traffic Management** | Road network conditions | IDOT District 8 and Station 1 | Roadway detours and closures | No subdata flow (primitive element) |
| | | | Road weather data | Road conditions |
| **EM08—Disaster Response and Recovery** | Road network conditions | Emergency Management and Traffic Management | Traffic data for emergency services | Link environment conditions |
| | Road network status assessment | | Network status from traffic for disaster | No subdata flow (primitive element) |

### 6.7.1 Real-Time Incident Information

The 2005 bi-state St. Louis regional ITS architecture needs to facilitate the reporting of incident information from the Emergency Management subsystem to the Traffic Management subsystem. Thus, as part of the existing service package ATMS08–Traffic Incident Management System, the “incident_ information” architecture flow from the Emergency Management subsystem to the Traffic Management subsystem should include the data flow “incident_details.” The “incident_details” data flow should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

In addition, this architecture should also enable the communication of incident information from regional TMCs (IDOT District 8) to Station 1. To support this functionality in service package ATMS08—Traffic

Incident Management System, the “incident_information” architecture flow from the Traffic Management subsystem to the Other Traffic Management subsystem should be added. The “incident_information” architecture flow should include the data flow “totm-current_event_data,” which should include the subdata flows “incident_location,” “incident_start_time,” and “incident_response_clear.” The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

Last, planned efforts should include a path for county sheriffs and local police to report lane-closing traffic incidents to IDOT. The current architecture does not specify these responsibilities. These entities should be included in the architecture’s definition of either the Emergency Management subsystem or the Other Emergency Management subsystem. If the latter is chosen, “incident_information” should be communicated to the Emergency Management subsystem, including “alert notification coordination,” “emergency plan coordination,” “evacuation coordination,” “incident command information coordination,” incident report,” and “incident response coordination.” The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.7.2 Real-Time Construction Lane Closure Information

The architecture specifies the service package MC08—Work Zone Management. The architecture flow “work zone information” that connects the Maintenance and Construction Management subsystem should be explicitly noted with respect to the need for real-time lane closure information. The architecture flow should connect the Maintenance and Construction Management subsystem and the Traffic Management subsystem to allow construction lane closure information sharing between the district TMC (District 8 TMC) and contractors. The “work_zone_information” architecture flow should include the data flow “tomcm-work_zone_info,” which should include the subdata flow “work_zone_data_for_status.”

To facilitate the real-time reporting of lane-closing construction activities from district TMCs to Station 1, an additional connection is proposed. District 8 should share the construction lane closure information with Station 1. The construction lane closure information is not shared from District 8 to Station 1 in the reviewed architecture documents. Service package ATMS 07—Regional Traffic Management is recommended for use in sending roadway closure information between District 8 (Traffic Management) and IDOT headquarters (Other Traffic Management). It should include the “road_network_conditions” architecture flow. The architecture flow should include the “totm-roadway_detours_and_closures” data flow. The most recent standards work by the NTCIP C2C: NTCIP Center-to-Center Standards Group and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.7.3 Real-Time Road Closure Information Due to Weather

The architecture currently includes the service package EM08—Disaster Response and Recovery. As part of service package EM08—Disaster Response and Recovery, the “road_network_conditions” and “road_network_status_assessment” architecture flows from the Emergency Management subsystem to the Traffic Management subsystem are available but the reverse is not true; therefore, the architecture flows should go from the Emergency Management subsystem to the Traffic Management subsystem. The “road_network_conditions” architecture flow should include the data flow “traffic_data_for_ emergency_services” which should include the subdata flow “link_environment_conditions.” The “road_network_status_assessment” architecture flow should include the “roadway_detours_and_ closures_for_em_response” data flow, and that should include the following subdata flows: “roadway_detours_and_closures,” “highway_closures,” “roadway_closures,” “lane_closure” and “lane_open.” The most recent standards work by the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards and the NTCIP C2C: NTCIP Center-to-Center Standards Group should be included when specifying these connections.

To facilitate the real-time reporting of lane closure information due to weather or floods from District 8 to Station 1, a new connection is proposed. As part of the proposed service package ATMS 07—Regional Traffic Management, the “road_network_conditions” architecture flow from District 8 (Traffic Management) to Station 1 (Other Traffic Management) should be added. This architecture flow should include the data flow “totm-road_weather_data,” which should include the “road_conditions” subdata flow. The most recent standards work by the IEEE IM: Incident Management Standards Group, the NTCIP C2C: NTCIP Center-to-Center Standards Group, and the ITE TMDD: Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) Standards should be included when specifying these connections.

### 6.7.4 Travel-Time Information

In service package ATMS06—Traffic Information Dissemination, which is available in the architecture, the information is disseminated to the public from the IDOT Traffic Management subsystem to the Media, Transit Management, Emergency Management, and Information Service Provider subsystems. This service package does not provide connection between the Traffic Management subsystem (District 8) and Other Traffic Management subsystem (IDOT headquarters); therefore, it is recommended that the subsystem Other Traffic Management be added to facilitate these data flows.

The other service package available is ATIS01—Broadcast Traveler Information, which broadly disseminates this information through existing infrastructures. This package does not provide a connection between Traffic Management(IDOT District Eight) and Other Traffic Management (IDOT Headquarters) subsystems, therefore it is recommended that the subsystem Other Traffic Management be added to allow these data flows.

## 6.8 CONCLUSIONS

The researchers found that many of the Illinois ITS architectures needed updates that will enable new communication interfaces to meet the accuracy and availability of traveler information systems required by 23 CFR 511. These recommendations should be considered during the next ITS architecture update efforts, and it would be beneficial to update the statewide ITS architecture in advance of updating the regional architectures.

To address the need for real-time information about traffic incidents, travel times, and weather; the researchers have identified connections defined in the National ITS Architecture. To support the need for real-time construction information flow, the researchers found that the National ITS Architecture lacked the required connection and proposed a new architecture flow. Specifically, service package ATMS 07—Regional Traffic Management is recommended for use in sending roadway closure information between district TMCs (Traffic Management) and IDOT Station 1 (Other Traffic Management). This proposed interconnect, between district TMCs and IDOT Station 1, should include the “road_network_conditions” architecture flow. The architecture flow should include the “totm-roadway_detours_and_closures” data flow.

To support the implementation of these changes, the researchers plan to meet with stakeholders who are currently updating the St. Louis bi-state regional ITS architecture to discuss their recommendations for supporting 23 CFR 511.

# CHAPTER 7 CONCLUSIONS

The objectives of this research were to collaborate with IDOT to help enhance its real-time information dissemination strategies to meet the requirements of the program as defined in Final Rule 23 CFR Sec. 511.311 (b–d). Consequently, these conclusions include a summary of the progress completed and recommendations about reviewing compliance with 23 CFR 511, archiving data, revising policy documents, updating ITS architectures, and deploying infrastructure, among others.

The activities of this research project will guide IDOT toward meeting several of the requirements for 23 CFR 511 compliance detailed in Sections b–d. Most significantly, IDOT now has methods by which travel information quality can be certified for travelers on Illinois roadways, complying with Section b.

Through this project, IDOT (districts and headquarters), the Illinois State Police, the Illinois Tollway, and several planning agencies participated in shaping a real-time information program for Illinois. This participation included identifying current traveler information practices, establishing responsibilities for around-the-clock communication of traveler information along expressways/freeways throughout Illinois, and recommending changes to current practices—thus working towards complying with 23 CFR 511.311 C.

Last, state and regional ITS architectures were evaluated to identify any updates required to reflect requirements of the Real-Time System Management Information Program in complying with 23 CFR 511.311 D.

The most time-sensitive recommendation developed from this research was that IDOT should begin archiving traveler information (travel time, construction, incident, and weather information) that has been reported to IDOT by its personnel, by the traveling public, or by other agencies. IDOT should also begin archiving the traveler information that IDOT has disseminated to the public so that it will be able to measure its compliance with the availability, accuracy, and timeliness thresholds specified in 23 CFR 511. The methods developed by the research team to measure accuracy and availability of traveler information are endorsed by the Illinois division of the FHWA.

The methods related to incident information requires archiving of the times when IDOT is notified about the presence and removal of a verified traffic incident and the time this information is disseminated to the public. Archived incident information should include the time, road segment, and whether it is a full or partial closure. If available, the number of lanes closed and still available should be reported additionally.

The methods related to weather information requires archiving during inclement conditions. This archived information should include what is disseminated to the public and what a baseline source reports during that time.

Real-time travel-time or construction activities reported to the public need not be archived in order to complete accuracy evaluations. That information can be collected during the time of an evaluation.

All methods require that availability be recorded throughout the year. This availability information should be archived to illustrate how long information dissemination systems, for all types of traveler information, are available.

The next pressing recommendation relates to changes in communication practices for construction and incidents. First, construction activities that close lanes on expressways/freeways must be reported to appropriate personnel in IDOT so that information can be disseminated to the public. Discussions should identify text to be added to Section 701, Work Zone Traffic Control and Protection, of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction to address this need. Because IDOT updates this document on an annual basis, notes should be added to construction plans until these changes are adopted.

Second, there is no policy requiring that state police inform IDOT of lane-closing traffic incidents. Although a revision to the existing IDOT/ISP Joint Operational Policy Statement will address IDOT's incident information need in the long term, a memorandum of understanding could be used to establish the flow of this information in the short term.

Before November 8, 2015, IDOT should complete an annual compliance review of traveler information. The review procedures should be guided by the strategies discussed in Chapter 5. Compliance will be determined by the thresholds of 90% availability and 85% accuracy, and the timeliness limits for metropolitan and non-metropolitan areas as dictated by 23 CFR 511.

The remaining recommendations from this research project should be implemented in the near term. These include upgrading the IDOT District 8 Traffic Management Center; establishing a detector health monitoring program, including traveler information quality requirements into future vendor contracts; and updating state and regional ITS architectures. The District 8 Traffic Management Center requires upgrades and a dedicated budget for maintenance of systems and supporting reliable collection, processing, and dissemination of traveler information. Both the District 1 and 8 management centers require additional infrastructure deployment to monitor travel times on expressways/freeways within the bounds defined for their metropolitan area. Until this deployment and upgrade is complete, vendor data could provide a short-term solution to travel-time information needs.

Next, stakeholder feedback indicated that a detector health program would help IDOT strategically maintain its network of traffic sensors. Future work should explore best practices for establishing a program that helps IDOT with management of its ITS assets. Any further vendor contracts for the collection, processing, or dissemination of traveler information should include requirements on data quality to ensure that provided information meets the requirements of 23 CFR 511.

Other contributions of this research include insight about how version 7.0 of the U.S. national ITS architecture supports implementation of communication required for 23 CFR 511. Specifically, the researchers have identified one additional architecture flow that should be considered for future updates to this national planning tool to support consistent implementation for states with distributed control of their infrastructure, similar to those in Illinois. See Chapter 6 for details.

Overall, this research project identified strategies to guide IDOT toward complying with 23 CFR 511. These strategies will help establish traveler information communication with the public and maintain the quality of the data, thereby enhancing trust and enabling travelers to make informed decisions about their travel-related time, mode, and route choices.

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# APPENDIX A IMPLEMENTATION GUIDE

## A.1 SUMMARY

This implementation guide can assist Illinois Department of Transportation (IDOT) decision makers, operation engineers, and practitioners in considering necessary actions to comply with Final Rule 23 CFR Sec. 511.311 (b–d) that became effective November 8, 2014. The guide provides the tools required for evaluating the traveler information system by measuring the accuracy and availability to meet the thresholds set by the rule. This guide recommends changes required in the short term, such as travel-time reporting, as well as long-term changes, such as those to policies and ITS architectures.

To be in compliance with the rule, IDOT should consider implementing multiple stages of changes.

- Develop and implement practices required for collection and archiving of traveler information.
- Assign responsibilities for 24-hour coverage of districts that do not support the collection and dissemination of traveler information outside of their business hours.
- Revise current policies to include specific requirements in the sections related to traveler information, in the near term (see Section A.5 of this appendix).
- Update the state ITS architecture to reflect the recommended changes required in the rule in the near term.
- Complete recommended upgrades in the near term.

The near-term changes, referred to here as other changes and updates, include improvements to the existing infrastructure to add coverage to travel-time measurements and improve the abilities to archive collected data.

The regional ITS architectures should be updated by adding the data flows and/or service packages that address real-time traveler information requirements.

Additional sections should be added to future contracts with vendors who provide traveler information to IDOT requiring the contactors to share the methods used in measuring the quality of the data provided. This implementation guide addresses these steps in detail. Figure A.1 shows an overview of the recommended implementation process.

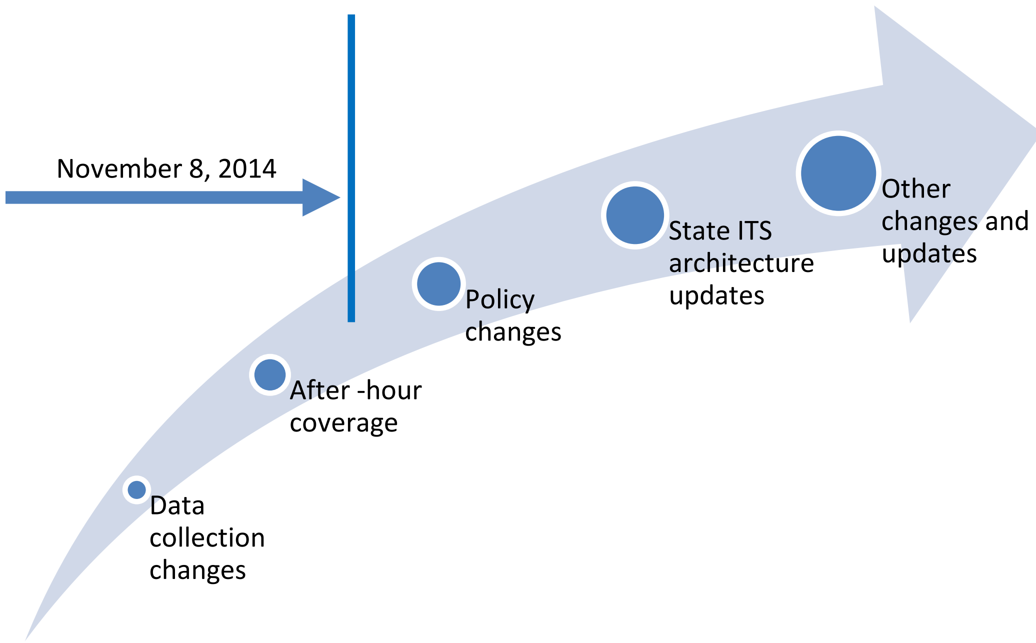


Figure A.1. High-level implementation process.

## A.2 CHANGES TO DATA COLLECTION

IDOT should start applying some changes to the current practices of traveler information data collection to support measurements of accuracy and availability in order to comply with the rule. IDOT upper management and operations personnel, as well as local law enforcement agencies, should receive information about the traveler information requirements of 23 CFR 511 and the importance of timely information reporting to IDOT.

Below are specific changes required for travel-time, incident, and weather information. These changes should be implemented to work towards compliance.

### A.2.1 Travel-Time Data Collection Recommendations

Travel-time requirements are applicable only to District 1 (Chicago metropolitan area) and District 8 (St. Louis metropolitan area). Both districts need to begin reviewing the accuracy and availability of the travel information they report to the public. The following specific changes are suggested:

1. Implement data collection procedures to support estimation of accuracy and availability. Both Districts 1 and 8 should start recording events that cause travel-time information to be unavailable to the public. This information could be found in maintenance logs already used in each Traffic Management Center.
2. Complete the in-progress expansion of travel-time measurement in the Chicago metropolitan area further west along expressway I-80 through Aux Sable Township in Grundy County and further south along I-55 to Lorenzo Road. In addition, further expand travel-time measurement to include I-57 south from the current limit of measurement at I-80 to the Will–Kankakee county line and expand measurement along I-55 from Lorenzo Road to the Will-Grundy County line. Figure A.2 shows the yellow line as boundaries of the counties and townships included in the delineation of the Chicago metropolitan area according to the Chicago Metropolitan Agency for Planning (Chicago Metropolitan Agency for Planning, 2014).

3. Create a system that will record travel-time data reported to the public at the District 8 Traffic Management Center.
4. Expand travel-time measurement in IDOT District 8 further east along Interstates 64 and 70 to Route 4, further north along Interstate 55 to Route 143, and further south along Interstate 255 from Interstate 64 to the Missouri state line. This expansion in coverage could be accomplished by installing traffic sensors or by purchasing the travel times from an external vendor. The yellow line in Figure A.3 illustrates the Illinois boundary of the St. Louis metropolitan area of influence.

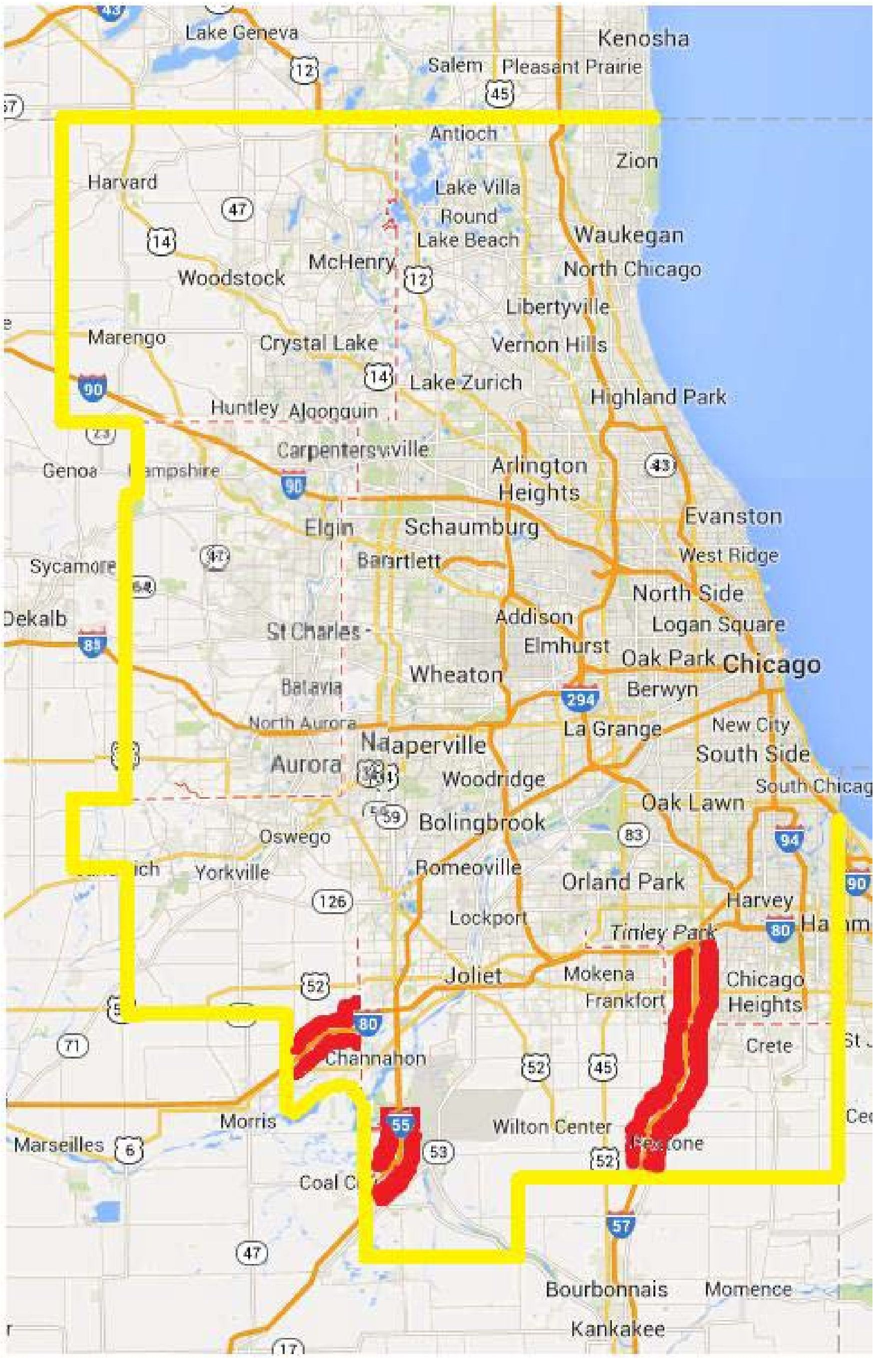


Figure A.2. Chicago metropolitan area of influence (Chicago Metropolitan Agency for Planning, 2014).

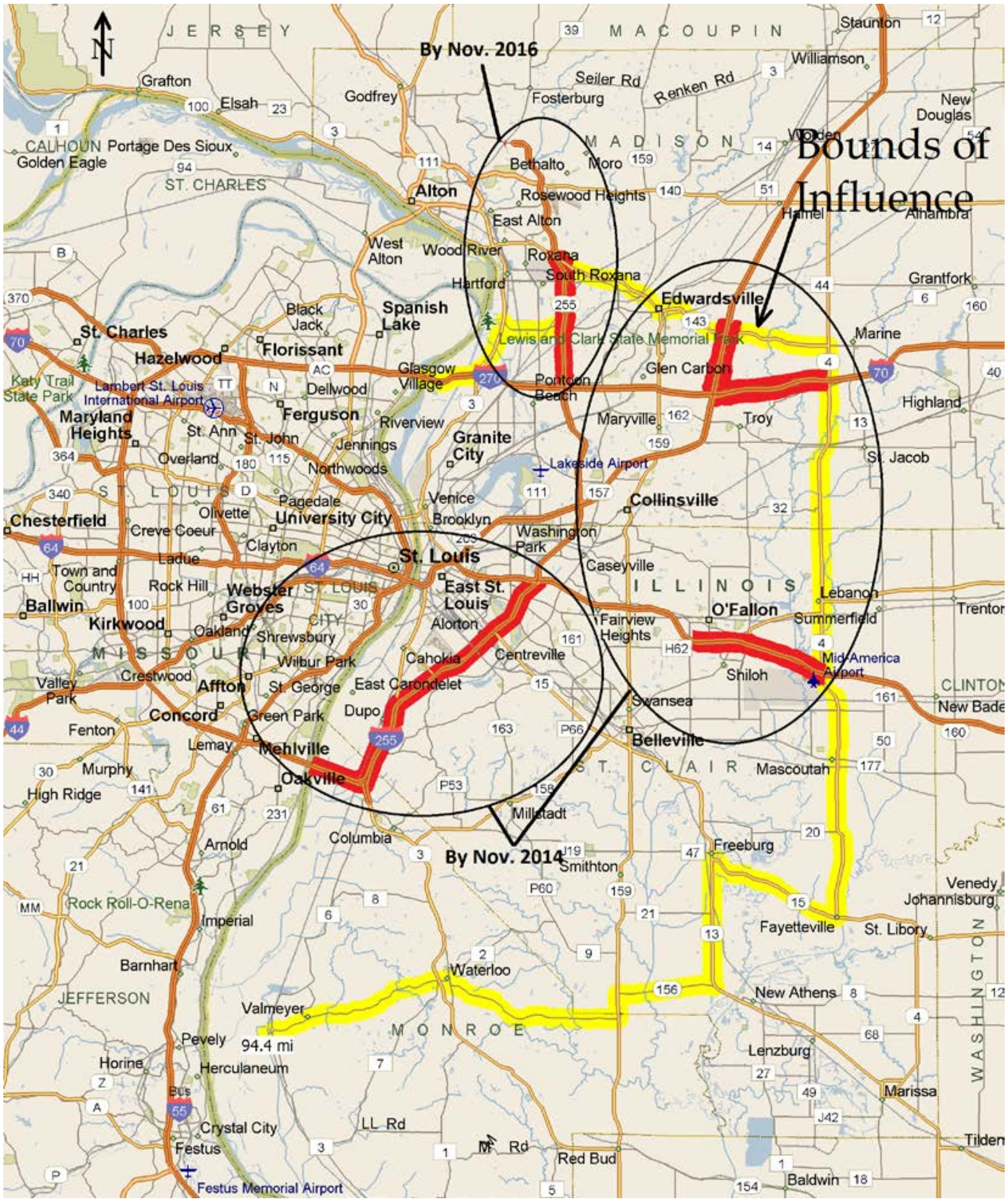


Figure A.3. St. Louis metropolitan area of influence (IDOT, 2014).

### A.2.2 Incident Data Collection Recommendations

IDOT should continue its practice of maintaining communication logs for its Traffic Management Centers/Communications Centers. These logs will be used to evaluate the timeliness of disseminating lane-closing traffic incident information to the public. Additional actions are recommended but are not required to meet the new rule. These actions are described in the following subsections.

### A.2.3 Weather Data Collection Recommendations

A review of the current practices suggests that after a method is implemented for evaluating accuracy and availability, IDOT will be in compliance with the weather-related requirements set forth by 23 CFR 511. To continue improving the reporting of this information, the following recommendations are proposed.

1. Streamline the communication path through which weather information is reported. The Travel Midwest website or the Getting Around Illinois website could serve as a central hub for reporting weather and other travel information to the public, thereby simplifying reporting needs. Weather information reported via the website should be archived for the annual accuracy and availability review.
2. IDOT should select a publicly available weather information source to use in all districts, such as the National Weather Service. Information from the selected source should be collected digitally and reported to the public via a common travel information platform such as the Travel Midwest website (within 20 minutes) and archived for use during annual evaluations. The annual evaluation will require archived data from significant weather events only; therefore, fair weather data need not be archived.
3. IDOT should formalize the process of reporting road flooding and fog presence. Currently there are no established practices for reporting these events to a specific location or within certain timeliness criteria.

## A.3 IMPLEMENTING ANNUAL REVIEW PRACTICES

New methods for evaluating the data quality should be considered when establishing Illinois' Real-Time System Management Information Program. The characteristics of each type of traveler information are different depending on the methods used in collecting, processing, and disseminating, as well as comparison to base data. The following are practices proposed for measuring traveler information (travel time, incident, construction, weather) accuracy and availability. The final report (sections 5.1.4, 5.2.4, 5.3.4, and 5.4.4) includes detailed examples using the recommended methods for calculating the annual quality of each type of traveler information.

### A.3.1 Travel-Time Review Practices

Traffic Management Center personnel can identify whether the reported travel times are accurate within approximately 10%, during congested and non-congested times. These personnel can identify errors either through their daily monitoring of reported travel times and observed traffic conditions or through traveler complaints.

When personnel suspect an inaccurate travel time is being reported, alternative baseline sources should be compared with the reported travel time. Baseline sources could include HERE.com probe vehicle data provided to the metropolitan planning organization from the Federal Highway Administration, Google Maps probe vehicle data, license plate matching tools, or IDOT field probe vehicles.

To ensure the 5-minute data are likely to contain adequate sample sizes, the 5-minute probe vehicle data (provided without a sample size) should be compared with 15-minute monthly probe data (provided with sample sizes). On the basis of meetings with IDOT operations engineers, it is suggested that reported travel times for all routes be compared to a baseline source annually.

When using probe vehicles to measure baseline travel times, the average vehicle method is most appropriate for limited-access roadways. Applying this method requires probe vehicles to traverse the road segment, attempting to maintain the average speed of nearby vehicles (Roess, et al., 2011;

Turner, et al., 1998). The travel times can be collected using a stopwatch and landmarks or with technologies such as global positioning systems (GPS).

In general, travel-time segments should be selected to match information that would be relevant to drivers and traffic managers. Because travel times can change quickly during congested times of the day or just after traffic incidents, IDOT best practices suggest selecting segment lengths less than 15 miles for reporting segment travel times to the public. To be comparable, travel-time runs must be collected when traffic conditions are similar, such as during free flow. If travel-time runs are collected over multiple days, engineering judgment should be used to select the times with similar traffic volumes and other prevailing conditions.

When collecting travel times, it is recommended that the minimum sample size be no less than six runs for each segment and guided by Equation A.1. After six runs have been completed, if *n* is less than the number of runs that have been completed, the data set is significant to a 95% confidence interval and the mean can be accepted for comparison against the baseline. Otherwise, more runs should be conducted until the number of runs is greater than *n*.

**Equation A.1** $$\boldsymbol{n} = \frac{\mathbf{3.84} * \boldsymbol{sd}^{\mathbf{2}}}{\boldsymbol{E}^{\mathbf{2}}}$$

where

$n =$ the required number of travel time measurements collected in the field

$sd =$ standard deviation of travel time measurements (seconds)

$E =$ standard error (seconds)

Equation A.1 assumes that the mean and median of the collected travel times are equal. When evidence suggests otherwise, other statistical techniques are available in the *Traffic Engineering Handbook* (Veeregowda, et al., 2008).

If it is necessary to evaluate travel times during congested periods, it may not be possible for IDOT to perform travel-time runs with similar results. In that case, engineering judgment should be used to determine an appropriate number of travel-time runs, although the finding would not be deemed to have been derived from a statistically significant sample. For example, if IDOT receives repeated calls about erroneous travel times during the peak hour on I-80, travel-time runs could still be conducted.

After collecting the required number of travel times, the accuracy of travel times reported can be evaluated using Equation A.2 as follows:

**Equation A.2** $$\boldsymbol{Accuracy}\ (\%) = \frac{\mathbf{1}}{\boldsymbol{n}} \left\{ \sum_{\boldsymbol{i}=\mathbf{1}}^{\boldsymbol{n}} \mathbf{1} - \left| \frac{x_{i(reported)} - x_{i(collected)}}{x_{i(collected)}} \right| \right\} \boldsymbol{x100}$$

where

$n =$ number of travel time measurements collected in the field

$x_{i(collected)} =$ travel time measured from field tests

$x_{i(reported)} =$ travel time estimated from field devices and reported to the public

$i =$ travel time run number

After the percentage accuracy for each travel-time segment has been determined, an average accuracy should be computed for each district. Engineering judgment should be used to determine whether the lengths of the travel-time segment range widely enough to consider using a weighted average; otherwise, each segment should be considered equal when calculating the district's average accuracy.

To evaluate the availability of travel-time information, an annual review should be conducted to audit the activity and maintenance logs for travel-time dissemination systems, such as websites, in Districts 1 and 8. This audit should identify how many hours the travel-time information was completely unavailable to the public for each road segment. For example, if travel times were not available by any means for 1 hour in July and 2 hours in November, there would be 3 hours of downtime for that segment. Equation A.3 should be used to determine the availability of the travel time for each road segment, and then the travel time should be averaged for each district.

**Equation A.3** $$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr}-T_d}}{\boldsymbol{T_{yr}}}\boldsymbol{x100}$$

where
$Tyr = 8760 \text{ (hours/year)}$
$Td = \text{time that system is unavailable (hours/year)}$

IDOT should be considered in compliance for travel times reporting if both Districts 1 and 8 have average travel-time accuracy equal to or greater than 85% and availability equal to or greater than 90%. After completing each annual review, IDOT should send a report, with summary travel-time accuracy and availability statistics, to the FHWA Illinois Division.

### A.3.2 Construction Review Practices

The Getting Around Illinois website should serve as the central point for construction data, via the Station 1 Traffic Management Center. Construction information is provided to the Getting Around Illinois website by the Gateway Traveler Information System and Travel Midwest website. Districts may still use their own websites in addition to those. The Getting Around Illinois website should store information reported to the public for use in evaluating accuracy and availability as described herein. Accuracy of reported construction activities should be evaluated annually. During an evaluation, IDOT personnel should randomly select a set consisting of 25% of ongoing lane-closing construction projects throughout the state and compare how the following types of information are reported to the public:

- Partial or full closure,
- Road segment with construction activities,
- Start time of lane closure (each lane if different), and
- End time of lane closure (each lane if different).

Evaluation of "partial or full closure" should consider a partial closure as any number of lanes less than the total. IDOT may strive towards providing the number of lanes open and closed when that information is available, but need not provide this information for compliance.

Next, evaluators should verify that the construction activities were reported in the correct direction of travel and on the correct segment of roadway (a segment is defined as the portion of road between two interchanges). IDOT should strive towards providing locations based on mile posts when possible, but need not provide mile post locations for compliance.

23 CFR 511 requires that specific timeliness limits be applied to the reporting of the start and end of lane-closing construction activities. In metropolitan areas, as bounded by a yellow line in Figures A.2 and A.3, these activities must be reported within 10 minutes. Construction lane closures on all other limited-access roadways in Illinois must be reported within 20 minutes. Construction lane closures lasting less than these durations need not be considered.

Construction lane closures can be observed using surveillance equipment or during site visits. If site visits are chosen, it is recommended that they are coordinated with other site visits and activities by resident engineers. For example, IDOT personnel usually visit road construction sites to inspect traffic control devices for compliance with the *Manual on Uniform Traffic Control Devices* (Federal Highway Administration, 2009), as adopted by IDOT.

Construction lane closure reports should be recorded from the appropriate source, such as Travel Midwest or Getting Around Illinois, and compared with those observed in the field. The accuracy percentage should be individually applied to each of the four types of information described. Each IDOT district should measure its accuracy using Equation A.4 as follows:

**Equation A.4**

$$\boldsymbol{Accuracy\ of\ Information\ Type\ X}\ (\%) = \frac{\sum \boldsymbol{Instances\ of\ accurate\ construction\ information\ X}}{\sum \boldsymbol{construction\ projects\ audited\ for\ information\ X}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of construction information, an annual review should be conducted to audit the activity and maintenance logs of the website or websites that report construction information. This audit should identify how many hours the construction information was completely unavailable to the public. For example, if website maintenance requires 30 minutes once a month, there will be 6 hours of downtime per year. Note that information may be unavailable from activities other than website maintenance. Equation A.5 should be used to determine the availability of the construction information for each website individually.

**Equation A.5**

$$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr}} - \boldsymbol{T_d}}{\boldsymbol{T_{yr}}}\boldsymbol{x100}$$

where

$Tyr =$ 8760 (hours/year)

$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for construction information if the construction information accuracy is equal to or greater than 85% and availability is equal to or greater than 90%.

### A.3.3 Incident Review Practices

The accuracy of the reported roadway or lane-blocking traffic incidents should be evaluated annually. IDOT personnel should randomly select 15% of lane-blocking traffic incidents in a year. Engineering judgment should ensure the sample is geographically diverse, including incidents in both rural and urban locations throughout Illinois. During the review, IDOT personnel should compare how the following items are reported to the public:

- Partial or full closure,
- Segment of roads where an incident has occurred,

- Start of incident notice (after incidents are verified), and
- End of incident notice (after all lanes are open to traffic).

Evaluation of “partial or full closure” should consider a partial closure as any number of lanes less than the total. Although IDOT may strive towards providing the number of lanes open and closed, because of the dynamic characteristics of incident management, the number of lanes should not be included in compliance evaluation.

Next, evaluators should verify that the traffic incident was reported in the correct direction of travel and on the correct segment of roadway (a segment is defined as the portion of road between two interchanges). IDOT should strive towards providing locations based on mile posts when information is available, but need not provide mile posts for compliance.

23 CFR 511 requires that specific timeliness limits be applied to the reporting of the start and end of roadway or lane-blocking incidents. In metropolitan areas, as outlined in Figures A.2 and A.3., roadway and lane-blocking traffic incident information must be reported within 10 minutes. Roadway and lane-blocking traffic incidents on all other limited-access roadways in Illinois must be reported within 20 minutes. Lane-blocking traffic incidents lasting less than these durations, respectively, need not be considered.

To evaluate the accuracy of roadway or lane-blocking incidents in Illinois, data logs from Communications Centers/Traffic Management Centers and the Travel Midwest website should be reviewed. The accuracy percentage should be applied to each of the four types of information listed previously in this section. The accuracy of each type should be determined using Equation 5 as follows:

**Equation A.6**

$$\boldsymbol{Accuracy\ of\ Incident\ Information}\ (\%) = \frac{\sum \boldsymbol{Instances\ of\ accurate\ incident\ information}}{\sum \boldsymbol{Number\ of\ incidents\ evaluated}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of incident information, an annual review should be conducted to analyze the activity and maintenance logs of the website or websites that report traffic incident information. This review should identify how many hours the reported incident information was completely unavailable to the public. For example, if website maintenance requires 60 minutes once a month, there will be 12 hours of downtime per year. Note that factors other than website maintenance could cause a loss of availability. Equation A.7 should be used to determine the availability of the incident information for each website individually.

**Equation A.7** $$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr}} - \boldsymbol{T_d}}{\boldsymbol{T_{yr}}} \boldsymbol{x100}$$

where
$Tyr = 8760$ (hours/year)
$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for roadway or lane-blocking incident information reporting if the average accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### A.3.4 Weather Review Practices

The accuracy and availability of weather information can be evaluated annually by reviewing the reported weather conditions during two significant weather events, for a minimum of 12 hours total.

During this review, IDOT Central Office personnel should compare their reported road conditions to a baseline data source, such as the National Weather Service, a road weather information station, or weather vendor such as Schneider Electric. The records for each significant weather event should be divided into time intervals based on the frequency of the weather observation. These time intervals should be no longer than 2 hours but need not be shorter than 20 minutes. Each time interval should be evaluated for accuracy and timeliness (20 minutes). This review should include reporting of road closures and reporting of hazardous conditions such as snow coverage (via the snow coverage map), fog, and flooding. IDOT should measure its overall weather accuracy using Equation A.8 as follows:

**Equation A.8**

$$\boldsymbol{Accuracy}\ (\%) = \frac{\sum \boldsymbol{weather\ time\ intervals\ accurately\ reported}}{\sum \boldsymbol{weather\ time\ intervals\ evaluated}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of weather information, an annual review should be conducted to analyze the activity and maintenance logs of the website(s) that reports weather information. This evaluation should identify how many hours the weather information was completely unavailable to the public. For example, if the website requires maintenance 2 hours per month, there will be 24 hours of downtime per year. Note that information may be unavailable from activities other than website maintenance. Equation A.9 should be used to determine the availability of the weather information for each website, individually.

**Equation A.9**

$$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr}-T_d}}{\boldsymbol{T_{yr}}}\boldsymbol{x100}$$

where
$Tyr = 8760$ (hours/year)
$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for weather information if the accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### A.4 IMPLEMENTING AFTER-HOURS COVERAGE

Districts that do not provide traveler information 24 hours a day are required to coordinate with neighboring districts that run 24-hour Traffic Management Centers for collecting, processing, and disseminating real-time traveler information.

IDOT District 1 will cover sections of I-55 and I-80 within IDOT District 3 jurisdictions after normal business hours. These interstate sections are covered by ISP District 5 (Kendall and Grundy Counties) and District 21 (Kankakee, Iroquois, and Ford Counties).

IDOT District 4 will cover the remaining portions of IDOT District 3 and portions of ISP District 2 (DeKalb County), District 6 (Livingston County), and District 17 (Bureau and LaSalle Counties).

Thus, it was agreed that outside of normal business hours, IDOT Districts 1 and 4 would each support a portion of IDOT District 3 (see Figure A.4 for reference) by receiving and disseminating real-time traveler information. These counties include the following:

**District 1**: DeKalb, Ford, Grundy, Iroquois, Kankakee, and Kendall Counties

**District 4**: Bureau, LaSalle, and Livingston Counties

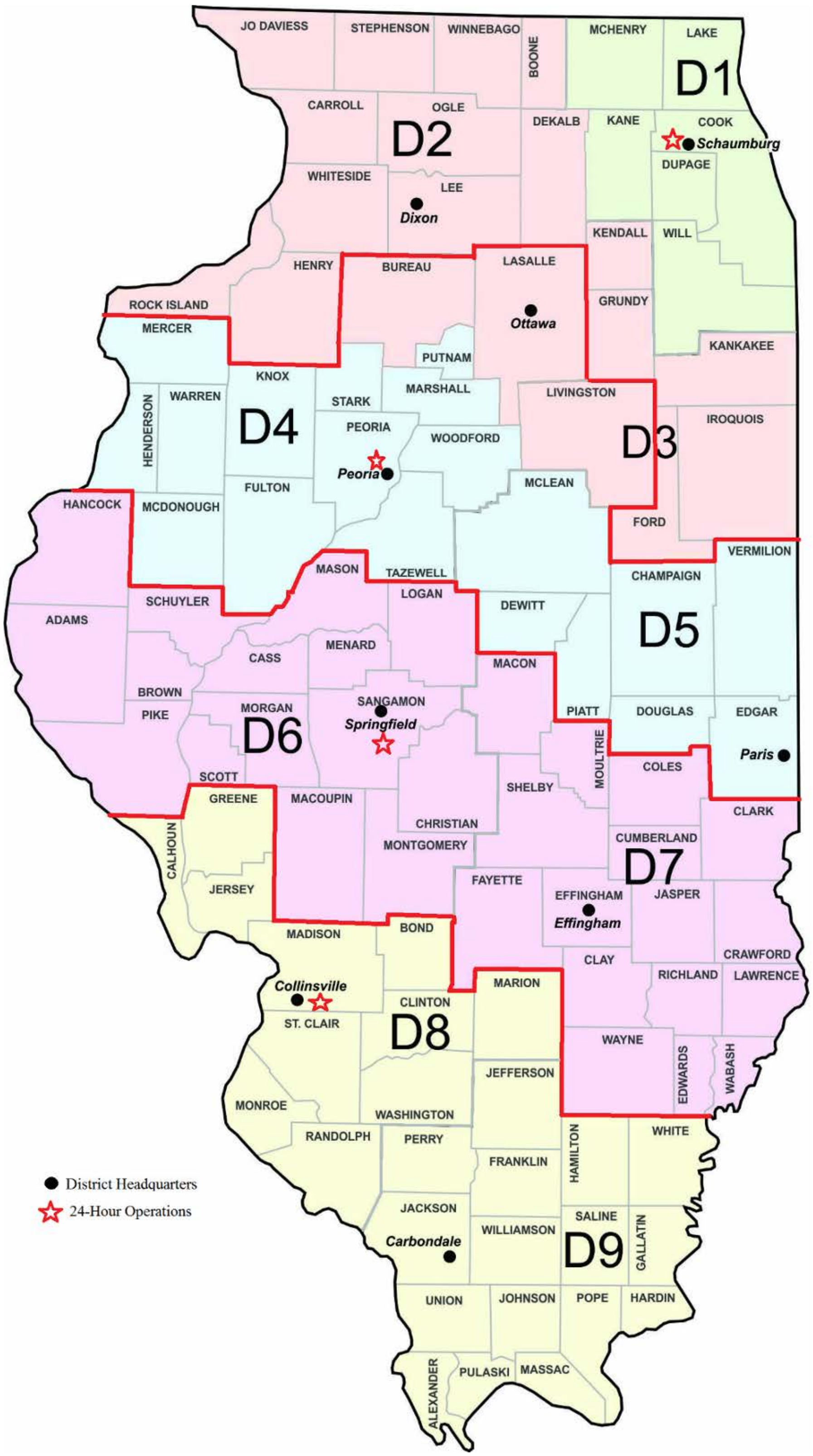


Figure A.4. Illinois Department of Transportation northern districts and counties (IDOT, 2014).

## A.5 CHANGES TO POLICY

In compliance with the rule, some policy modifications can improve the information exchange and reporting. The following were areas identified for revisions to existing policies:

Additional text should be added to Section 701, Work Zone Traffic Control and Protection, of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction. This text should be reflected in district-specific specifications as well. Currently, the standards do not specify freeways/expressways or real-time notification of lane closures and openings.

The additional text should formalize the process of who is responsible for reporting construction activities that close or open travel lanes to IDOT. These activities include a late start, a cancellation, or an early finish. Reporting activities should be discussed during the preconstruction meeting; the contractor's responsible agent for reporting should be identified, including contact information. It should be the contractor's responsibility to update contact information on long-term construction projects. IDOT resident engineers should take responsibility for reporting this information after November 8, 2014, for contracts without these updated specifications.

The IDOT/ISP Joint Operational Policy Statement should include language regarding the timely reporting of roadway or lane-blocking traffic incidents to IDOT. Specifically, the following sentence could be added to the fourth paragraph of Annex B, which describes the responsibilities of IDOT and ISP for the administration of traffic incidents on state highways:

> ISP shall immediately notify the appropriate IDOT district when they 1) verify roadway or lane-blocking traffic incidents, 2) identify a change in the number of travel lanes open at an incident scene, and 3) confirm an incident has been cleared.

Although a revision to the Joint Operational Policy Statement will address IDOT's incident information need in the long term, a memorandum of understanding could be used to establish the flow of this information in the short term.

## A.6 STATE ITS ARCHITECTURE UPDATES

The recommended changes in the methods and practices used in collecting and disseminating traveler information must be reflected in the state ITS architecture. These changes could be implemented through specifying the type of information required to communicate during reporting of travel-time, incident, construction, and weather events. Some of these communication channels are already in place, but others require that specific information be added in order to comply with the rule. In some cases, the information could not be implemented using current channels and would require installation of a new communication infrastructure.

## A.7 OTHER FUTURE CHANGES

### A.7.1 Future Vendor Contract Recommendations

Many IDOT districts depend on contractors to provide some of the traveler information, such as travel time and weather. The districts do not have access to the methods used by these vendors for measuring the quality of the data because the contracts do not require it. To overcome this issue in the future, it is recommended that sections be added to new contracts that require vendors to inform IDOT of the methods they use to determine the accuracy and availability of the information they provide.

### A.7.2 Regional ITS Architecture Updates

The final report (Chapter 6) includes recommended changes in each district's ITS architecture in addition to the state ITS architecture. Following are the most common recommended changes to most of the ITS architectures:

1. Incident information should be added to the Traffic Incident Management System service package (ASTM08). This service package exists in all ITS architectures, but the incident information reporting needs to include all details, such as incident location, start time, and incident response clear. This information should be exchanged within the Traffic Management Center (TMC) and to other TMCs that are affected.
2. Work zone information should be added to the Work Zone Management service package (MC08). This information should report work zone data status to other maintenance and construction management departments.
3. Road network condition and road network status assessment information should be added to the Disaster Response and Recovery service package (EM08). This information includes roadway segment environment conditions, roadway detours and closures, and lane closures and openings.
4. Road closure notification information should be added to the Roadway Closure Management service package (ATMS21). This information includes roadway closures from emergency events.

## A.8 CONCLUSIONS

The Illinois Department of Transportation should promptly implement some of these changes to comply with Federal Rule 23 CFR Sec. 511.311 (b–d); other updates are recommended to achieve the long-term benefit of systems reliability. These changes should be implemented in multiple stages because the rule requires specific areas of compliance by November 8, 2014. Other changes could be implemented by a later date, such as November 8, 2015.

The methods used in measuring accuracy and availability of traveler information must be implemented by November 8, 2014. This step requires IDOT to adopt the methods recommended in this guide in evaluating the quality of traveler information.

Similarly, the after-hour coverage, annual review practices, and data collection procedures should meet the November 8, 2014 deadline. Other steps such as policy changes, ITS architecture updates, infrastructure upgrades, and vendor contract wording should be implemented according to IDOT's plans and policies before the second deadline.

Parallel with these changes, IDOT's operations and resident engineers, as well as staff responsible for traveler information, should be familiarized with the scope of the rule and requirement changes. This training can be facilitated with the narrated presentation developed as part of this project.

# APPENDIX B U.S. INTERSTATE AND POPULATION INFORMATION

The following table lists the center-line miles of interstate highway that each U.S. state (along with Puerto Rico) maintains, as well as the presence of any metropolitan areas larger than 1 million in population. Metropolitan areas are required to meet further requirements as dictated by 23 CFR 511.

Table B.1. Miles of Interstates and Routes of Significance (FHWA, 2013)

| State/Territory | Total Miles | Metro Area >1 Million |
|---|---|---|
| Alabama | 998.77 | Y |
| Alaska | 1082.22 | N |
| Arizona | 1168.64 | Y |
| Arkansas | 647.32 | Y |
| California | 2455.74 | Y |
| Colorado | 952.91 | Y |
| Connecticut | 346.17 | Y |
| Delaware | 40.61 | Y |
| Florida | 1497.58 | Y |
| Georgia | 1243.98 | Y |
| Hawaii | 54.91 | N |
| Idaho | 611.76 | N |
| Illinois | 2182.03 | Y |
| Indiana | 1258.57 | Y |
| Iowa | 781.24 | N |
| Kansas | 874.34 | Y |
| Kentucky | 800.4 | Y |
| Louisiana | 902.84 | Y |
| Maine | 366.54 | N |
| Maryland | 480.45 | Y |
| Massachusetts | 565.63 | Y |
| Michigan | 1240.77 | Y |
| Minnesota | 912.73 | Y |
| Mississippi | 730.64 | Y |
| Missouri | 1384.83 | Y |
| Montana | 1191.23 | N |
| Nebraska | 81.66 | N |
| Nevada | 596.15 | Y |
| New Hampshire | 224.54 | Y |
| New Jersey | 431.36 | Y |
| New Mexico | 999.9 | N |
| New York | 1714.56 | Y |
| North Carolina | 1241.98 | Y |
| North Dakota | 571.13 | N |

| | | |
|---|---|---|
| **Ohio** | 1572.35 | Y |
| **Oklahoma** | 930.16 | Y |
| **Oregon** | 727.41 | Y |
| **Pennsylvania** | 1858.34 | Y |
| **Rhode Island** | 68.53 | Y |
| **South Carolina** | 850.8 | Y |
| **South Dakota** | 678.31 | N |
| **Tennessee** | 1940.34 | Y |
| **Texas** | 3432.95 | Y |
| **Utah** | 938 | Y |
| **Vermont** | 320.22 | N |
| **Virginia** | 1117.23 | Y |
| **Washington** | 763.67 | Y |
| **West Virginia** | 549.05 | Y |
| **Wisconsin** | 741.8 | Y |
| **Wyoming** | 913.6 | N |
| **Washington, D.C.** | 12.27 | Y |
| **Puerto Rico** | 249.77 | Y |
| **Total** | 48298.93 | |

# APPENDIX C APPROVED METHODS FOR MEASURING INFORMATION QUALITY IN ILLINOIS

## C.1 PROPOSED METHOD OF MEASURING TRAVEL-TIME INFORMATION QUALITY IN ILLINOIS

### C.1.1 Introduction

This appendix discusses a proposed method for calculating travel-time information quality to satisfy the 23 CFR 511 travel-time requirements. Several aspects related to travel times are explained, including how travel times are determined, a proposed guideline for travel-time accuracy and availability, and the changes that would be required to bring IDOT's districts into compliance with 23 CFR 511.

The travel-time requirements are applicable only to District 1 (Chicago metropolitan area) and District 8 (St. Louis metropolitan area). Maps of the Chicago and St. Louis metropolitan areas of influence are presented as reference (see Figures C.1 and C.2).

More information about the 23 CFR 511 rule can be found in the literature review (Chapter 2 of this report).

This appendix is intended as a stand-alone reference document.

### C.1.2 Current Practices in Travel-Time Determination

Existing travel-time estimation systems in Illinois use a variety of technologies and software. In some cases, if specific sensors are inoperable, travel times may be reported based on interpolation of data from the upstream and downstream sensors. During periods with low traffic volumes, the last recorded travel times are displayed. Travel times are not reported faster than vehicles can traverse a segment traveling at the speed limit; therefore, when sensors indicate that average travel speeds exceed posted speed limits, standard practice is to report the travel time at the segment's speed limit.

There are several systems that receive and disseminate travel times in Illinois. In particular, it is important to note that the Gateway Traveler Information System and Travel Midwest website is expanding statewide and will serve as the information hub for dissemination of travel time, construction, incident, and weather information on www.gettingaroundillinois.com.

### C.1.3 Proposed Guidelines for Travel-Time Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details proposed practices for measuring travel-time accuracy and availability. Traffic Management Center personnel can identify whether the reported travel times are accurate within approximately 10%, during both congested and non-congested times. Personnel can identify these errors either through daily monitoring of reported travel times and observed traffic conditions or through traveler complaints. When personnel suspect an inaccurate travel time is being reported, alternative baseline sources should be compared with the reported travel time. Baseline sources could include HERE.com probe vehicle data provided to the metropolitan planning organizations and IDOT from the Federal Highway Administration, Google Maps probe vehicle data, license plate matching tools, or IDOT field probe vehicles. Five-minute probe vehicle data (provided without a sample size) should be compared with 15-minute monthly probe data (provided with sample sizes) to ensure the 5-minute data are likely to have adequate sample sizes. On the basis of meetings with IDOT operations engineers, it is recommended that reported travel times for all routes be compared annually with a baseline source.

When using probe vehicles to measure baseline travel times, the average vehicle method is most appropriate for limited-access roadways. Applying this method requires probe vehicles to traverse the road segment, attempting to maintain the average speed of nearby vehicles (Roess, Prassas, &

McShane, 2011; Turner, Eisele, Benz, & Holdener, 1998). Travel times can be collected using a stopwatch and landmarks, or with technologies such as global positioning systems (GPS).

Travel-time segments should be selected to match information that would be relevant to drivers and traffic managers. Because travel times can change quickly during congested times of the day or just after traffic incidents, IDOT best practices suggest selecting the segment lengths less than 15 miles for reporting segment travel times to the public. If travel-time runs are collected over multiple days, engineering judgment should be used to select times with similar traffic volumes and other prevailing conditions. When collecting travel times, it is recommended that the minimum sample size be no less than six runs for each segment and guided by Equation C.1 as follows:

**Equation C.1** $$\boldsymbol{n = \frac{3.84 * sd^2}{E^2}}$$

where

$n =$ the required number of travel time measurements collected in the field

$sd =$ standard deviation of travel time measurements (seconds)

$E =$ standard error (seconds)

Equation C.1 assumes that the mean and median of the collected travel times are equal. When evidence suggests otherwise, other statistical techniques are available in the *Traffic Engineering Handbook* (Veeregowda, Bharalo, & Washington, 2008).

After the required number of travel times have been collected, the accuracy of travel times reported can be evaluated using Equation C.2 as follows:

**Equation C.2** $$\boldsymbol{Accuracy}\ (\%) = \frac{1}{n}\left\{\sum_{i=1}^{n} 1 - \left|\frac{x_{i(reported)} - x_{i(collected)}}{x_{i(collected)}}\right|\right\} x100$$

where
$n =$ number of travel time measurements collected in the field
$x_{i(collected)} =$ travel time measured from field tests
$x_{i(reported)} =$ travel time estimated from field devices and reported to the public
$i =$ travel time run number

After the percentage accuracy for each travel-time segment has been determined, an average accuracy should be computed for each district. Engineering judgment should be used to determine whether the lengths of the travel-time segment range widely enough to consider using a weighted average; otherwise, each segment should be considered equal when calculating the district's average accuracy.

To evaluate the availability of travel-time information, an annual review should be conducted to audit the activity and maintenance logs for travel-time dissemination systems, such as websites, in Districts 1 and 8. This audit should identify how many hours the travel-time information was completely unavailable to the public for each road segment. For example, if travel times were not available by any means for 1 hour in July and 2 hours in November, there would be 3 hours of downtime for that segment. Equation C.3 should be used to determine the availability of the travel time for each road segment, and then averaged for each district.

**Equation C.3** $$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr}-T_d}}{\boldsymbol{T_{yr}}}\boldsymbol{x100}$$

where
$Tyr = $ 8760 (hours/year)
$Td = $ time that system is unavailable (hours/year)

IDOT should be considered in compliance for travel times if both Districts 1 and 8 have average travel-time accuracy equal to or greater than 85% and availability equal to or greater than 90%. After completing each annual review, IDOT should send a report, with summary travel-time accuracy and availability statistics, to the FHWA Illinois Division.

### C.1.4 Travel Time–Related Recommendations

IDOT's District 8 is largely covered by traffic detection sensors that can be used to determine travel times. However, the coverage area should be expanded to the east to the boundaries of the metropolitan area of influence. The required travel-time coverage expansions are under way in District 1. Both districts need to begin a cycle of reviewing the accuracy and availability of the travel information they report to the public. The following specific changes are suggested:

1. Implement data collection procedures to support measurement of accuracy and availability.
2. Complete the in-progress expansion of travel-time measurement in the Chicago metropolitan area further west along expressway I-80 through Aux Sable Township in Grundy County and further south along I-55 to Lorenzo Road. In addition, further expand travel-time measurement to include I-57 south from the current limit of measurement at I-80 to the Will–Kankakee county line and expand measurement along I-55 from Lorenzo Road to the Will-Grundy County line. Figure C.1 shows the counties and townships included in the delineation of the Chicago metropolitan area according to (Chicago Metropolitan Agency for Planning, 2014). The yellow line denotes the boundary.
3. Create a system that will record travel-time data for the District 8 Traffic Management Center.
4. Expand travel-time measurement in IDOT District 8 further east along Interstates 64 and 70 to Route 4, further north along Interstate 55 to Route 143, and further south along Interstate 255 from Interstate 64 to the Missouri state line. This expansion in coverage could be accomplished by installing traffic sensors or by purchasing travel times from a vendor. The yellow line shown in Figure C.2 illustrates the Illinois boundary of the St. Louis metropolitan area of influence. This boundary was agreed on by IDOT District 8 and the East–West Gateway Council of Governments in February 2014.
5. Include requirements on accuracy and availability in future contracts where vendors provide real-time traveler information or software calculating such information.
6. Establish a traffic detector health program that measures the performance of individual detectors. This program should focus on Illinois metropolitan areas with the objective of identifying and scheduling maintenance or replacement of poorly performing detectors. Improving the performance of these detectors will improve the accuracy of travel information recorded in the field and reduce the need for extensive data cleaning by information dissemination and archiving personnel.

### C.1.5 Travel Time–Related Changes Required in the Near Term

To assist with providing accurate and available travel times, the District 8 Traffic Management Center should be upgraded in the near future. Specifically, this system has encountered frequent problems predicting accurate travel times. Further, this TMC lacks a budget for maintenance in the center or in the field, causing many of the components to fail before reaching full design life.

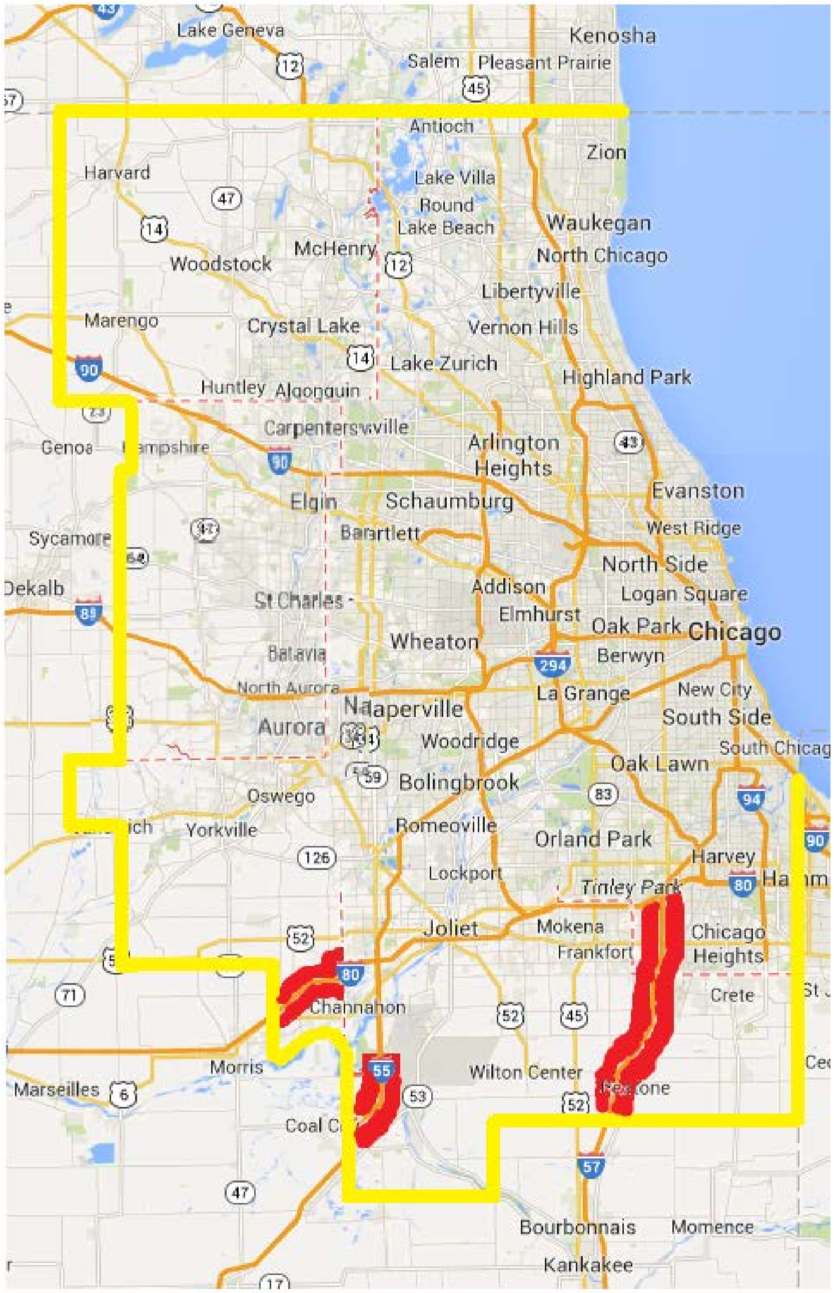


Figure C.1. Chicago metropolitan area of influence (Chicago Metropolitan Agency for Planning, 2014).

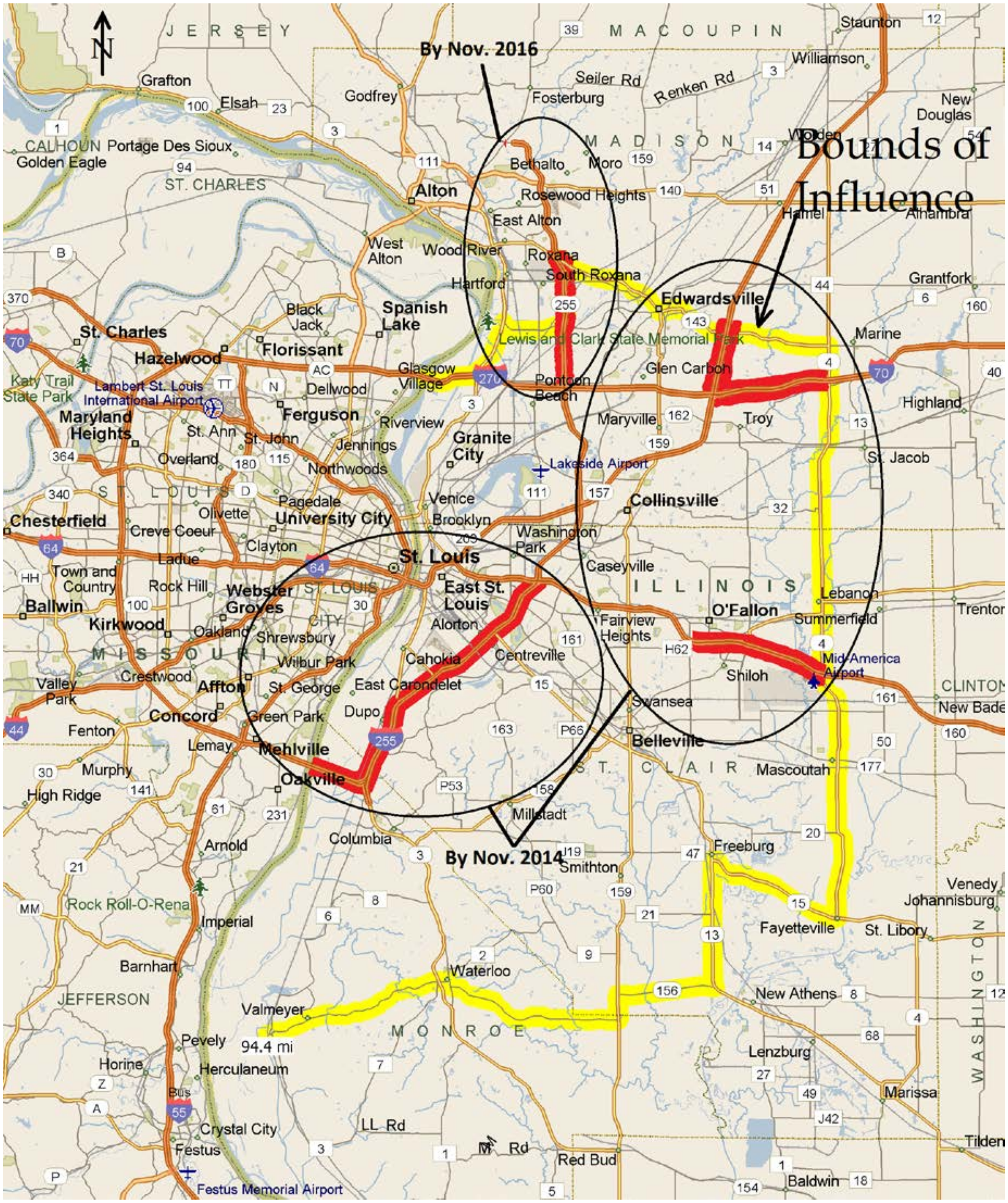


Figure C.2. St. Louis metropolitan area of influence (IDOT, 2014).

## C.2 PROPOSED METHOD FOR MEASURING CONSTRUCTION TRAVEL INFORMATION QUALITY IN ILLINOIS

### C.2.1 Introduction

This section discusses a proposed method for calculating construction travel information data quality to satisfy the 23 CFR 511 travel-time requirements. This document describes how construction information is currently collected and disseminated by IDOT, details a proposed guideline for measuring construction travel information accuracy and availability, and lists the changes that would be required to bring IDOT's Districts into compliance with 23 CFR 511.

This appendix is intended as a stand-alone reference document.

### C.2.2 Current Practices in Construction Travel Information

Practices throughout IDOT require either the contractor or the resident engineer to report planned construction activities that close lanes of traffic. Among IDOT districts, there are a variety of methods that specify how to report construction lane closures and compliance is not consistent. For example, some districts may not be aware whether construction activities end early and reopen lanes ahead of schedule. Currently, there is no formalized requirement throughout the state for real-time reporting of construction lane closures. Current methods of construction activity reporting used by IDOT District 1 are the most formalized and include a special provision and an automated lane closure database system. The special provision, titled "Keeping the Expressway Open to Traffic," effective March 22, 1996 (revised February 13, 2014), states:

> The Contractor shall request and gain approval from the Illinois Department of Transportation's Expressway Traffic Operations Engineer at www.idotlcs.com twenty-four (24) hours in advance of all daily lane, ramp and shoulder closures and one week in advance of all permanent and weekend closures on all Freeways and/or Expressways in District One.

These lane closure requests are reviewed to avoid conflicts and, if approved, will be reported as planned construction. Periodic updates are based on the reports from either contractors or resident engineers. Planned construction activities are currently updated on a daily basis.

A new Web-based lane closure system (LCS) replaced the previous Microsoft Access–based system that had been used by IDOT District 1. Once registered and approved electronically, contractors enter closure requests on the www.iIdotlcsLCS.com website. The requests are reviewed by IDOT staff. Approved, merged, and canceled closure requests are emailed to the contractors, traffic control, and IDOT staff. A summary report of approved closures is also automatically emailed to a list of interested parties, including the media and other agencies. The Travel Midwest daily construction report for short-term and long-term closures is based on this approved list of closures.

After construction activities are approved, many districts use databases to manage these events. For example, District 8 uses "ITS Event Entry," a Microsoft Access database. These events are then reported to the public through websites such as those shown in Table C.1.

Table C.1. Summary of IDOT Traveler Information Websites

| IDOT District | Site Title | Web Address | Managing Center Name |
|---|---|---|---|
| 1 | Travel Midwest | www.travelmidwest.com/lmiga/home.jsp | IDOT D1 Communications Center and Traffic Systems Center |
| 4 | Getting Around Peoria | gettingaroundpeoria.com | IDOT D4 Communications Center |
| 8 | St. Louis Traveler Information | www.stl-traffic.org/ | IDOT D8 Traffic Management Center |
| Headquarters | Getting Around Illinois | www.gettingaroundillinois.com | Station 1, IDOT Headquarters |

Throughout Illinois, travel information is processed and disseminated using a variety of centers with differing names. From here on, these centers will be referred to as Traffic Management Centers, to be consistent with the national ITS architecture (USDOT, 2012).

The accuracy of construction lane closures are checked periodically, but the focus is on proper traffic control devices. In some cases, traffic surveillance systems can detect unreported construction lane closures.

### C.2.3 Proposed Guidelines for Construction Travel Information Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details proposed practices for measuring construction information accuracy and availability. The Getting Around Illinois website should serve as the central point of construction data, via the Station 1 Traffic Management Center.

Construction information is provided to Getting Around Illinois by the Gateway Traveler Information System and Travel Midwest website. In addition, districts may still use their own websites. The Getting Around Illinois website should store information reported to the public for use in evaluating the accuracy and availability as described herein. The accuracy of the reported construction activities should be evaluated annually. During an evaluation, IDOT personnel should randomly select a set consisting of 25% of ongoing lane-closing construction projects throughout the state and compare how the following items are reported to the public:

- Number of lanes closed and available,
- Road segment with construction activities,
- Start time of lane closure (each lane if different), and
- End time of lane closure (each lane if different).

All four of these items must be correct to consider the construction information accurate. Evaluation of "number of lanes closed and available" should include the total count of lanes closed and available for each segment. Next, evaluators should verify that the construction activities were reported on the correct segment of roadway (a segment is defined as the portion of road between two interchanges).

23 CFR 511 requires that specific timeliness limits are applied to the reporting of the start and end of lane-closing construction activities. In metropolitan areas, as bounded by a yellow line in Figures C.1 and C.2, these activities must be reported within 10 minutes. Construction lane closures on all other limited-access roadways in Illinois must be reported within 20 minutes. Construction lane closures lasting less than these durations need not be considered.

Construction lane closures can be observed using surveillance equipment or during site visits. If site visits are chosen, it is recommended that they are coordinated with other site visits and resident engineer activities that already take place. For example, IDOT personnel already visit road construction sites to inspect traffic control devices for compliance with the *Manual on Uniform Traffic Control Devices* (Federal Highway Administration, 2009), as adopted by IDOT.

Construction lane closure reports should be recorded from the appropriate source, such as Travel Midwest or Getting Around Illinois, and compared with those observed in the field. If the start time, end time, and number of lanes are reported within the timeliness requirements, the construction information should be considered accurately reported. Each IDOT district should measure its accuracy using Equation C.4 as follows:

**Equation C.4**

$$\boldsymbol{Accuracy}\ (\%) = \frac{\sum \boldsymbol{construction\ projects\ accurately\ reported}}{\sum \boldsymbol{construction\ projects\ audited}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of construction information, an annual review should be conducted to audit the activity and maintenance logs of the website or websites that report construction information. This audit should identify how many hours the construction information was completely unavailable to the public. For example, if website maintenance requires 30 minutes once a month, there will be 6 hours of downtime per year. Note that information may be unavailable from activities other than website maintenance. Equation C.5 should be used to determine the availability of the construction information for each website individually.

**Equation C.5**

$$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr} - T_d}}{\boldsymbol{T_{yr}}} \boldsymbol{x100}$$

where
$Tyr = 8760$ (hours/year)
$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for construction information if average construction information accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### C.2.4 Construction-Related Changes Recommended

1. IDOT should implement data collection procedures to support measurement of accuracy and availability.
2. IDOT should add text to Section 701, Work Zone Traffic Control and Protection, of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction. This text should be reflected in district-specific specifications as well. Currently, Section 701 does not specify freeways/expressways or real-time notification of lane closures and openings. The additional text should formalize the process of who is responsible for reporting construction activities that close or open travel lanes to IDOT. These activities include a late start, a cancellation, or an early finish. Reporting activities should be discussed during the preconstruction meeting, and the contractor’s responsible agent for reporting should be identified, including contact information. It should be the contractor’s responsibility to update contact information on long-term construction projects. IDOT resident engineers should take responsibility for reporting this information after November 8, 2014 for contracts without these updated specifications.

3. IDOT upper management, construction, and operations personnel should receive information about the requirements of 23 CFR 511 and the importance of information accuracy and availability.
4. IDOT should establish a mechanism to gather real-time construction lane closure information from districts without a 24-hour Traffic Management Center. It is recommended that the existing Traffic Management Centers be leveraged to assist neighboring IDOT districts outside of their normal business hours. Based on a teleconference between the researchers and IDOT officials on September 4, 2014, and subsequent correspondence, the research team recommends that outside of regular business hours, District 1 covers District 2 and the northeastern six counties of District 3. Figure C.3 shows an IDOT district map with the proposed divisions marked with a red line. Similarly, outside of regular business hours, the District 4 Communications Center should support the western four counties of District 3 and all of District 5. The Central Office Traffic Management Center, also known as Station 1, should support Districts 6 and 7 outside of regular business hours. Last, the District 8 Traffic Management Center should support District 9 outside of regular business hours. These districts should support the reporting of real-time construction lane closures to the public. Because regular business hours may differ by district, each should develop a plan to ensure 24-hour coverage for all areas in Illinois.

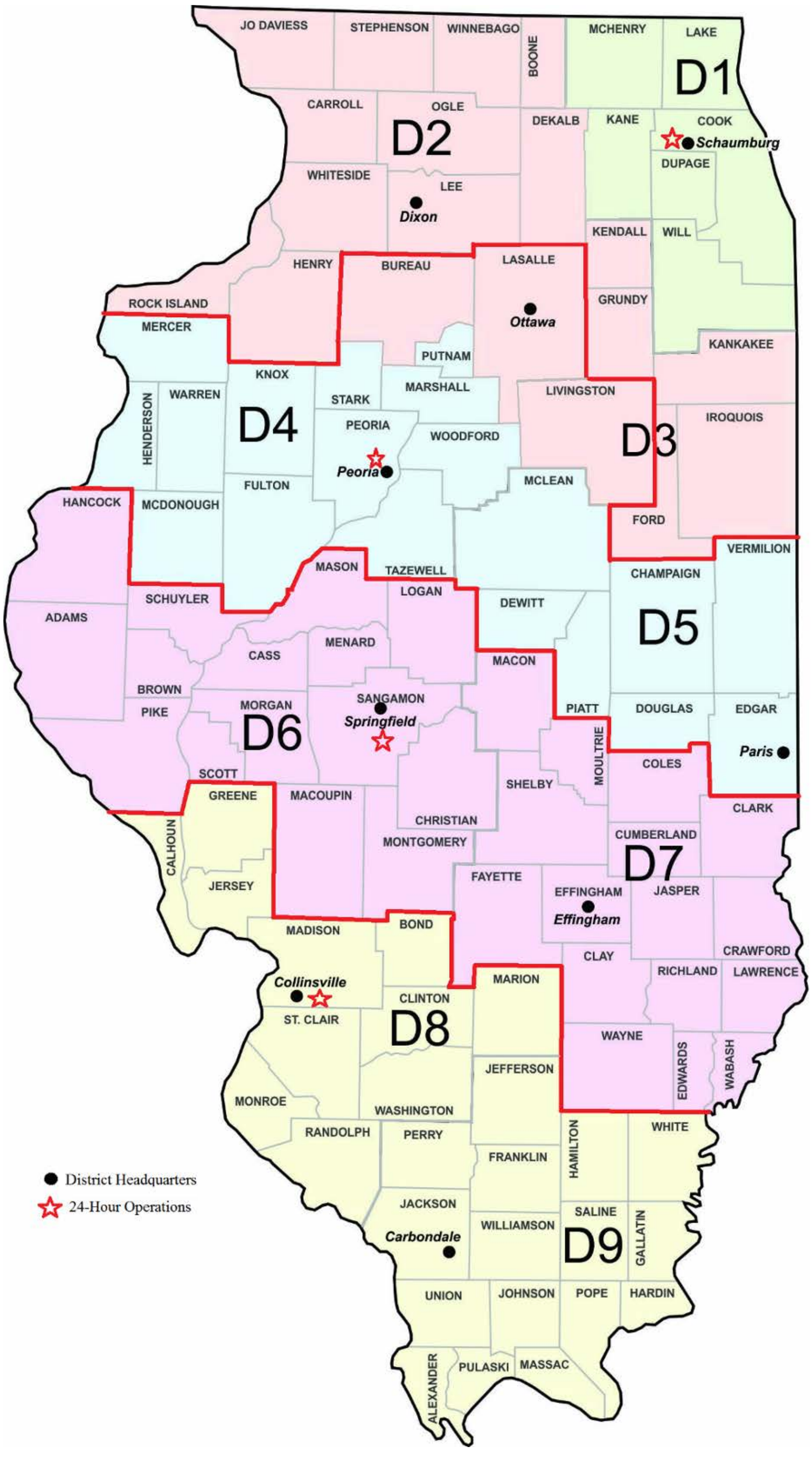


Figure C.3. IDOT district map for 24-hour coverage (IDOT, 2014).

## C.3 PROPOSED METHOD OF MEASURING TRAFFIC INCIDENT TRAVEL INFORMATION QUALITY IN ILLINOIS

### C.3.1 Introduction and Background

This section discusses a proposed method for determining the accuracy and availability of information related to roadway or lane-blocking traffic incidents. This document describes how traffic incident information is currently collected and reported to the public by IDOT, details a proposed guideline for measuring traffic incident information accuracy and availability, and lists the changes that would be required to bring IDOT districts into compliance with 23 CFR 511.

This appendix is intended as a stand-alone reference document.

Figure C.4 illustrates the timeline of a traffic incident. 23 CFR 511 requires that information regarding incidents that block lanes be disseminated after $T_2$ and $T_5$. To ensure the roadway or lane-blocking incident information is available, IDOT must receive information from its field devices, personnel, or other agencies when these incidents are verified ($T_2$) and when these incidents are cleared ($T_5$).

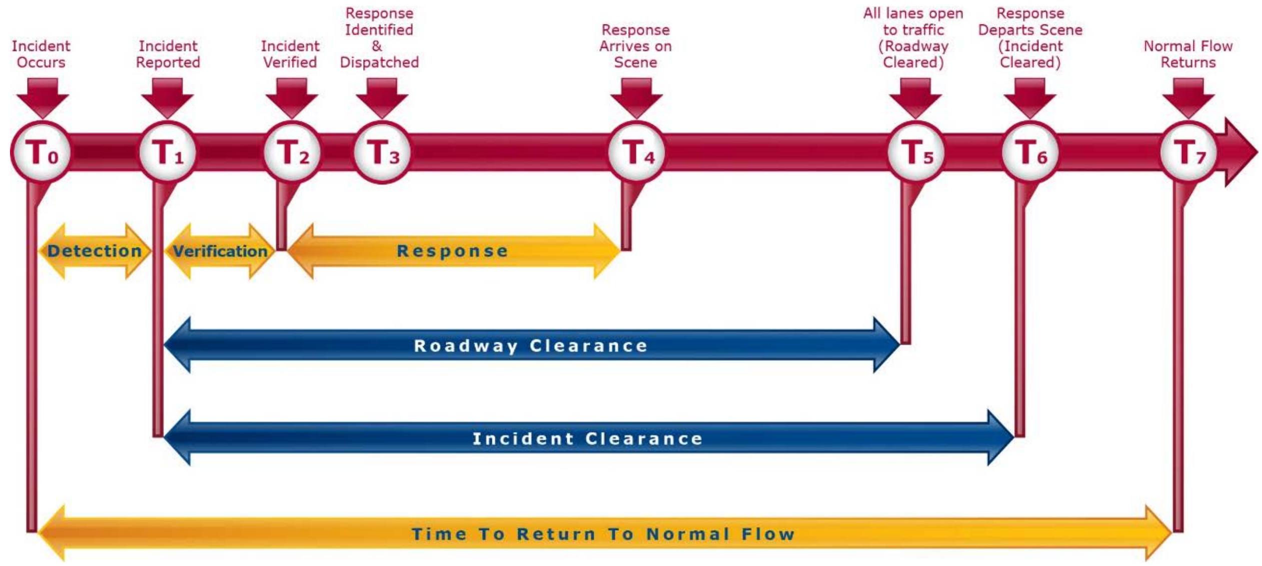


Figure C.4. Traffic incident management (TIM) timeline (SHRP, 2014).

### C.3.2 Current Practices in Traffic Incident Information Reporting

IDOT and the Illinois State Police (ISP) have a Joint Operational Policy Statement, issued in October 2004, for providing a safe and efficient highway transportation system. This statement describes IDOT's and ISP's responsibilities and communication mechanisms for events including traffic incidents, but focuses on ISP reporting infrastructure damage to IDOT (see Annex B of the statement). The statement does not require ISP to report roadway or lane-blocking traffic incidents to IDOT unless infrastructure is damaged.

IDOT has an established method for timely reporting of roadway or lane-blocking traffic incidents to the public in Districts 1 and 8, both of which serve metropolitan areas. These two districts operate 24 hours a day and report roadway or lane-blocking incidents on their own websites as well as to IDOT's Central Office. The Travel Midwest website will report lane-blocking incidents throughout the state with its statewide expansion. Other districts report roadway or lane-blocking traffic incidents to IDOT's Central Office during regular business hours, but they do not operate 24 hours a day. The IDOT/ISP Joint Operational Policy Statement (IDOT/ISP, 2004) says:

The ISP and IDOT district offices shall develop an interdistrict communications network providing for 24-hour contact.

Thus, there is a need to assist non-metropolitan districts in the timely reporting of roadway or lane-blocking traffic incidents.

### C.3.3 Proposed Guidelines for Incident Information Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details practices proposed for measuring incident information accuracy and availability. The accuracy of reported roadway or lane-blocking traffic incidents should be evaluated annually.

After the researchers for this project evaluated a sample data set from CMAP for 2013, they found an acceptable percentage of traffic incidents that would ensure a confident ($\alpha = 0.05$) estimate of accuracy with an error of 10%. Accordingly, to ensure a statistically valid sample, IDOT personnel should randomly select 15% of lane-blocking traffic incidents in a year. Engineering judgment should ensure the sample is geographically diverse, including incidents in both rural and urban locations throughout Illinois. During the review, IDOT personnel should compare how the following items are reported to the public:

- Number of lanes closed and available,
- Segment of road where incident is located,
- Start of incident notice (after incidents are verified), and
- End of incident notice (after all lanes are open to traffic).

All four of these items must be reported correctly for the incident information to be considered accurate. Evaluation of "number of lanes closed and available" should include the total count of lanes closed and the number that remain available, for each segment. Next, evaluators should verify that the traffic incident was reported on the correct segment of roadway (a segment is defined as the portion of road between two interchanges).

23 CFR 511 requires that specific timeliness limits be applied to the reporting of the start and end of roadway or lane-blocking incidents. In metropolitan areas, as outlined in Figures C.5 and C.6, roadway and lane-blocking traffic incident information must be reported within 10 minutes. Roadway and lane-blocking traffic incidents on all other limited-access roadways in Illinois must be reported within 20 minutes. Lane-blocking traffic incidents lasting less than these durations, respectively, need not be considered.

To evaluate the accuracy of roadway or lane-blocking incidents in Illinois, data logs from Communications Centers/Traffic Management Centers and the Travel Midwest website should be reviewed. For each roadway or lane-blocking incident, if the number of lanes reported is correct and the start and end times are within the timeliness requirements, the incident information should be considered reported accurately. Overall accuracy should be determined using Equation C.6 as follows:

**Equation C.6**

$$\boldsymbol{Accuracy}\,(\%) = \frac{\sum \boldsymbol{roadway\ or\ lane\ blocking\ incidents\ accurately\ reported}}{\sum \boldsymbol{roadway\ or\ lane\ blocking\ incidents\ evaluated}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of incident information, an annual review should be conducted to analyze the activity and maintenance logs of the website or websites that report traffic incident information. This review should identify how many hours the reported incident information was completely unavailable to the public. For example, if website maintenance requires 60 minutes once a month, there will be 12 hours of downtime per year. Note that factors other than website maintenance could cause a loss of availability. Equation C.7 should be used to determine the availability of the incident information for each website individually.

**Equation C.7** $$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr} - T_d}}{\boldsymbol{T_{yr}}} \boldsymbol{x100}$$

where
$Tyr =$ 8760 (hours/year)
$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for roadway or lane-blocking incident information if the average accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### C.3.4 Incident-Related Changes Recommended

1. To improve the timeliness of reporting traffic incidents to travelers, the IDOT/ISP Joint Operational Policy Statement should be revised. The revisions should include language regarding the timely reporting of roadway or lane-blocking traffic incidents to IDOT. Specifically, the following sentence could be added to the fourth paragraph of Annex B of the statement, which describes the responsibilities of IDOT and ISP for administration of traffic incidents on state highways:

    > ISP shall immediately notify the appropriate IDOT district when they 1) verify roadway or lane-blocking traffic incidents, 2) identify a change in the number of travel lanes open at an incident scene, and 3) confirm an incident has been cleared.

    Although a revision to the Joint Operational Policy Statement will address IDOT's incident information need in the long-term, a memorandum of understanding could be used to establish the flow of this information in the short-term.

2. Revisions to this policy should also add background information about the requirements of 23 CFR 511. For example, the following sentence should be added to the Annex B section overview:

    > According to the new Rule (23 CFR 511) transportation agencies must inform travelers about reported interstate (and other routes of significance) roadway or lane-blocking traffic incidents within 10 minutes in Chicago (District One) and St. Louis (District Eight) metropolitan areas and within 20 minutes for interstates elsewhere in the state.

3. IDOT upper management and operations personnel, as well as local law enforcement agencies, should receive information about the traffic incident requirements of 23 CFR 511 and the importance of reporting incidents to IDOT with timeliness.
4. IDOT should establish a mechanism to gather roadway and lane-closing traffic incident information from districts without 24-hour operations. It is recommended that existing Traffic Management Centers and Communications Centers be leveraged to assist neighboring IDOT districts outside of their normal business hours. These recommendations will likely require changes in staffing, District policies, and equipment. See section C.2 of this appendix, focusing on construction activities, for recommendations on this mechanism.

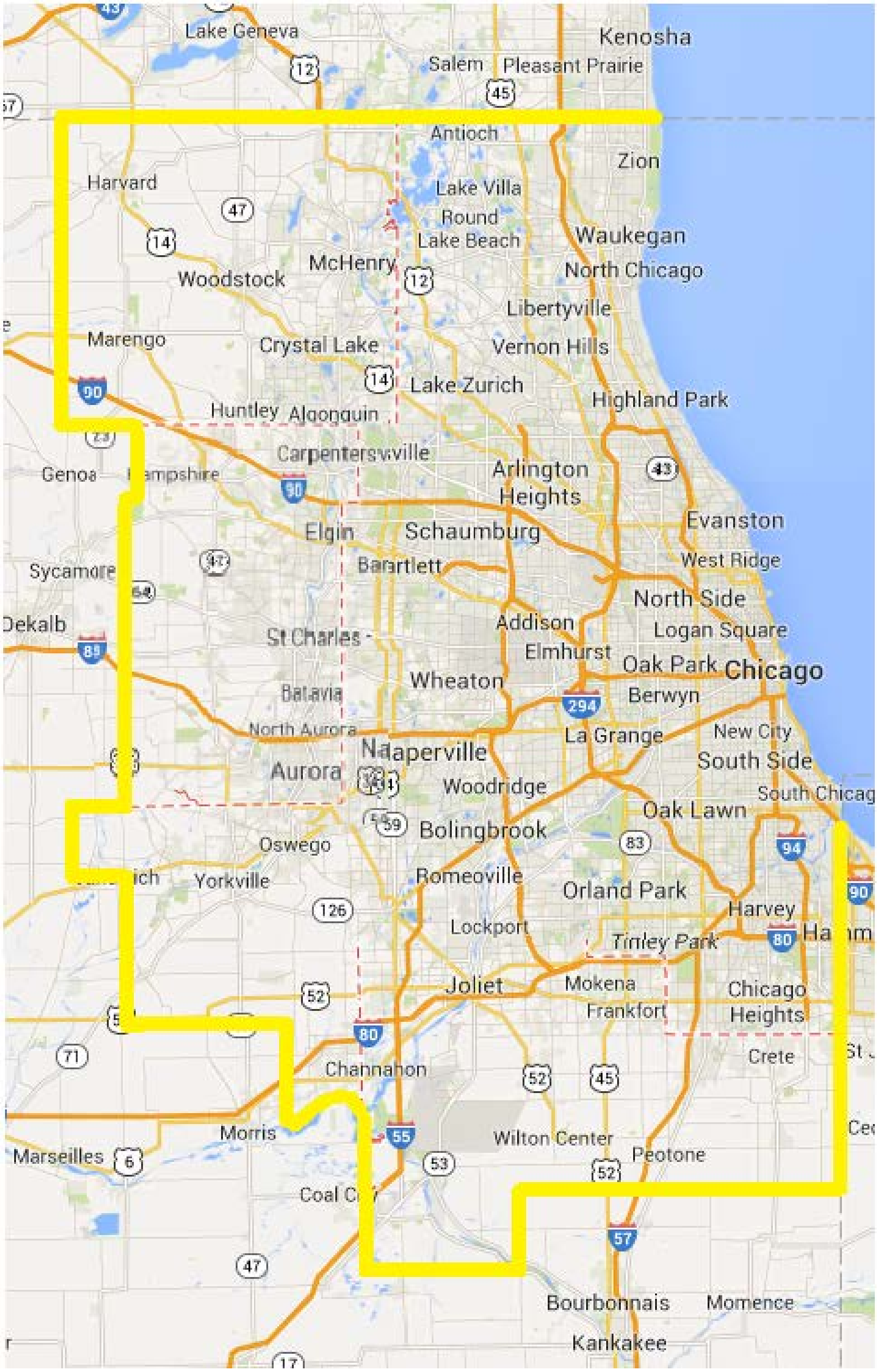


Figure C.5. Chicago metropolitan area of influence (Chicago Metropolitan Agency for Planning, 2014)

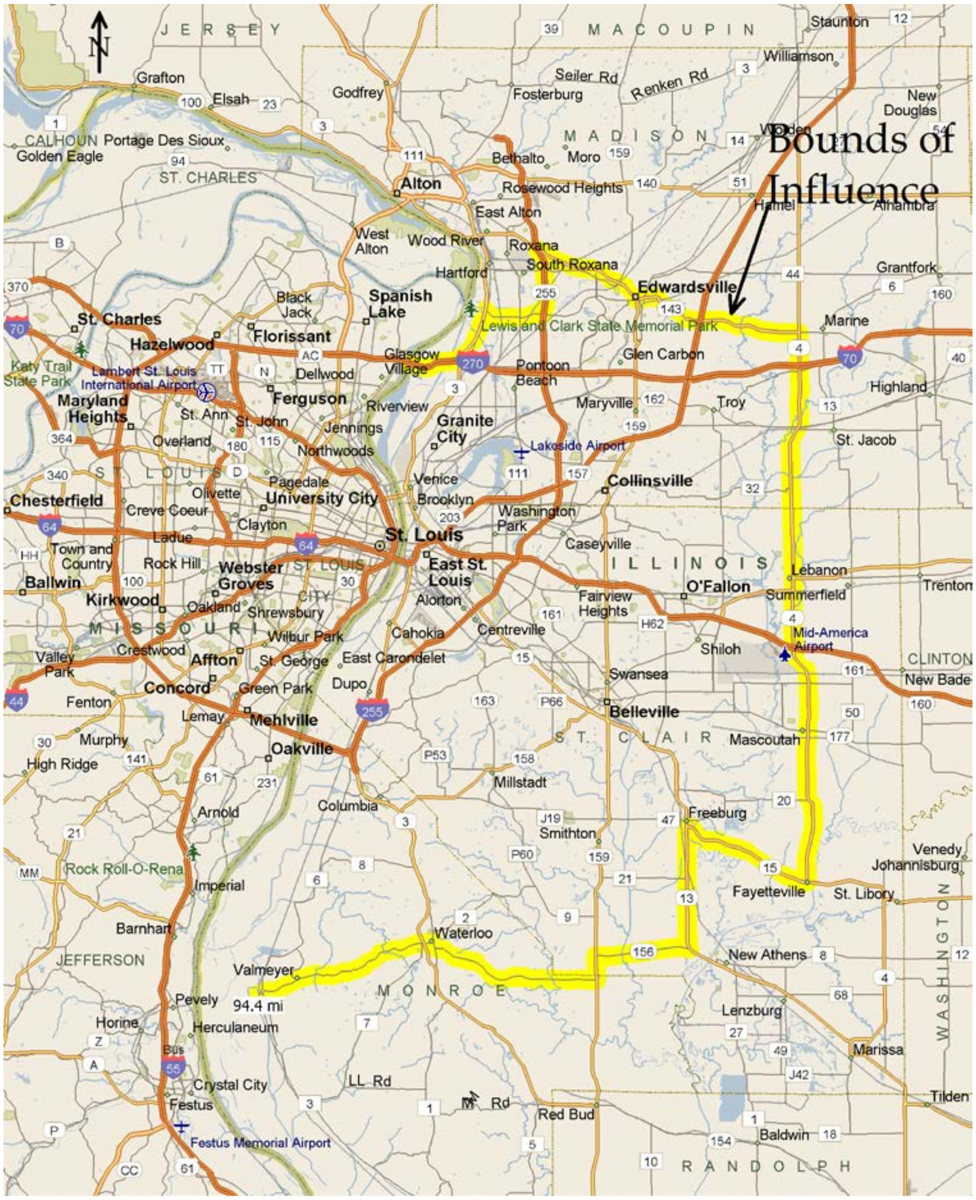


Figure C.6. St. Louis metropolitan area of influence (IDOT, 2014)

## C.4 PROPOSED METHOD OF MEASURING WEATHER INFORMATION QUALITY IN ILLINOIS

### C.4.1 Introduction

This section discusses a proposed method for calculating weather information quality to satisfy the 23 CFR 511 requirements. Several aspects related to weather information are explained, including how information is currently collected, a proposed guideline for measuring weather information accuracy and availability, and the changes that are recommended to assist IDOT districts with reporting weather information.

This appendix is intended as a stand-alone reference document.

### C.4.2 Current Practices in Weather Data Reporting

The most frequent weather information impacting travel in Illinois is winter weather, including snow and ice. Currently, most IDOT districts receive weather information from a vendor, Schneider Electric, solely for the purpose of operations during these events; however, this weather information is not reported to the public. Instead, information collected from IDOT snowplow vehicles during winter weather events is reported to the public every 2 hours, using a website. These vehicles report a numeric code that indicates the road conditions.

Additionally, the Travel Midwest website gathers information from the National Weather Service and overlays this information on its travel information map. Not all areas of Illinois receive weather information besides winter weather operations.

IDOT has already established a Joint Operational Policy Statement with the Illinois State Police that requires timely communication and collaboration for closing roadways due to adverse weather. 23 CFR 511 requires that IDOT report weather information including hazardous conditions, blockage, or closure, within 20 minutes of when it is reported.

### C.4.3 Proposed Guidelines for Weather Information Accuracy and Availability

In establishing Illinois' Real-Time System Management Information Program, the following text details proposed practices for measuring weather information accuracy and availability. The accuracy and availability of weather information can be evaluated annually by reviewing the reported weather conditions during two significant weather events, for a minimum of 12 hours total. During this review, IDOT Central Office personnel should compare their reported road conditions to a baseline data source, such as the National Weather Service, a road weather information station, or weather vendor such as Schneider Electric.

The records for each significant weather event should be divided into time intervals based on the frequency of weather observation. These time intervals should be no longer than 2 hours, but they should be no shorter than 20 minutes. Each time interval should be evaluated for accuracy and timeliness (20 minutes). This review should include reporting of road closures and reporting of hazardous conditions such as snow coverage (via the snow coverage map), fog, and flooding. IDOT should measure its overall weather accuracy using Equation C.8 as follows:

**Equation C.8**

$$\boldsymbol{Accuracy}\,(\%) = \frac{\sum \boldsymbol{weather\ time\ intervals\ accurately\ reported}}{\sum \boldsymbol{weather\ time\ intervals\ evaluated}}\ \boldsymbol{x\ 100}$$

To evaluate the availability of weather information, an annual review should be conducted to analyze the activity and maintenance logs of the website or websites that report weather information. This evaluation should identify how many hours the weather information was completely unavailable to the public. For example, if the website requires maintenance 2 hours per month, there will be 24 hours of downtime per year. Note that information may be unavailable from activities other than website maintenance. Equation C.9 should be used to determine the availability of the weather information for each website individually.

**Equation C.9**

$$\boldsymbol{Availability}(\%) = \frac{\boldsymbol{T_{yr} - T_d}}{\boldsymbol{T_{yr}}}\boldsymbol{x100}$$

where
$Tyr = 8760$ (hours/year)
$Td =$ time that system is unavailable (hours/year)

IDOT should be considered in compliance for weather information if the accuracy is equal to or greater than 85% and availability equal to or greater than 90%.

### C.4.4 Weather-Related Recommendations

The current practices observed by the research team suggest that after implementing a method for evaluating accuracy and availability, IDOT will be in compliance with the weather-related requirements set forth by 23 CFR 511. To continue improving the reporting of this information, the following recommendations are proposed:

1. IDOT should streamline the communication path through which weather information is reported. The Travel Midwest or the Getting Around Illinois website could serve as a central hub for reporting weather and other travel information to the public, simplifying reporting needs and website maintenance. Weather information reported via this website should be archived for use with the annual accuracy and availability review.
2. IDOT should select a publicly available weather information source, such as the National Weather Service. Information from the selected source should be collected using automated means, reported to the public via a common travel information platform such as the Getting Around Illinois website (within 20 minutes), and archived for use during annual evaluations.
3. IDOT should formalize the process of reporting road flooding and fog presence. Currently, there are no established practices for reporting these events to a specific place or within certain timeliness criteria.