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Final Report

North/West Passage Transportation Pooled Fund Phase I

Research

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16. Abstract (Limit: 200 words)

The North/West Passage Transportation Pooled Fund (TPF) Program is a multi-state cooperative program for the coordination, development, and deployment of Intelligent Transportation Systems projects along I-90 and I-94 from the states of Wisconsin to Washington. Individual states along the corridor have developed different systems for collecting, processing and integrating traveler and road maintenance information, and for delivering this information to users. As a result traveler information along the corridor has not been “seamless” or readily integrated and shared across borders.

The objective of this TPF Study Phase I was to influence ongoing standards development; and utilize effective methods for coordinating, integrating, and sharing of traveler information across borders. The Minnesota Department of Transportation (DOT) was the lead agency for this study with North Dakota DOT and Wisconsin DOT also contributing funding for Phase I. A Steering Committee, consisting of members from the eight corridor states (Washington, Idaho, Wyoming, Montana, North Dakota, South Dakota, Minnesota, and Wisconsin), met monthly to coordinate efforts. The Federal Highway Administration served as a monitoring body, providing strategic and technical input. The committee successfully completed eight Phase I corridor projects and approved a Phase II Work Plan focusing on a corridor strategic plan.

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North/West Passage Transportation Pooled Fund Program Phase I

Final Report

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Executive Summary

Purpose of Program

The North/West Passage Transportation Pooled Fund (TPF) Program, TPF-5(093), is a multi-state cooperative program for the coordination, development, and deployment of Intelligent Transportation Systems (ITS) projects along the I-90 and I-94 corridor from the states of Wisconsin to Washington. Individual states along the corridor have developed different systems for collecting, processing and integrating traveler and road maintenance information, and for delivering this information to users. As a result traveler information along the corridor has not been "seamless" or readily integrated and shared across state borders.

Objective

In Phase I of the program the objective was to influence ongoing standards development; and utilize effective methods for coordinating, integrating, and sharing of traveler information across state borders. North Dakota, Minnesota, and Wisconsin began the program by contributing funding for development of Phase I of this Pooled Fund Study. A Steering Committee, consisting of members from the eight corridor states (Washington, Idaho, Wyoming, Montana, North Dakota, South Dakota, Minnesota, and Wisconsin), met monthly to coordinate efforts. The committee initiated and successfully completed eight Phase I corridor projects and approved a Phase II Work Plan focusing on a corridor strategic plan. The projects are summarized in ***Table 1: North/West Passage TPF Study – Phase I Projects Summary***. The Federal Highway Administration (FHWA) served as a monitoring body, providing strategic and technical input.

Results

Phase I of the North/West Passage TPF Study has shown that a limited amount of funding, carefully applied and leveraged, combined with multi-state cooperation, ingenuity, and dedication, can be very effective in solving problems and in meeting traveler information needs. Each of the study projects has a success story to tell that goes beyond the project itself. New contacts, friendships, sharing of knowledge and ideas, leveraging of resources, and the application of new technology to solve problems have all contributed to the overall success of each project in the study. This report and the success of the ongoing projects including Phase II, which provide benefit to the traveling public, are the final products of Phase I.

Examples of projects' success from Phase I include Project 1.1, where Minnesota traveler information is now available via the 511 telephone number to all travelers in North Dakota and at no additional project cost in South Dakota. In Project 1.2 the operational capabilities of a 511 reporting system via the web was successfully demonstrated in Wisconsin. In Project 1.4 North Dakota upgraded and integrated their Dynamic Message Signs (DMS) to National Transportation Communications for ITS Protocol (NTCIP) compliance, based on new-shared technology information and with funding from an alternative source other than the TPF study. Project 1.5 developed a Concept of Operations for DMS Deployment on each side of the North Dakota/Minnesota border. Project 1.6 for DMS deployment at Tomah, Wisconsin has been studied and folded into a statewide Transportation Operations Plan. Project 1.7 successfully developed and managed a North/West Passage website to allow worldwide web users to benefit from the North/West Passage multi-state project ideas and lessons learned. The website can be accessed at: http://www.nwpassage.info. Project 1.8 focused on developing integrated multi-state communications plans and requests for proposals, for bridge anti-icing on the I-94 bridges

between North Dakota and Minnesota. Project 1.9 studied the requirements and limited deployment of a reporting system in Wisconsin (Project 1.2), Meridian's Reporting system in South Dakota, and other selected statewide road/traveler information system experiences to identify typical requirements, and develop a Lessons Learned document that can be used by other states.

Note: The North/West Passage Phase I projects and this Final Report, were essentially completed before the passage of the new federal transportation funding bill SAFETEA-LU. The new SAFETEA-LU bill does provide new options and addresses some of the recommendations made during development of the North/West Passage Pooled Fund Program.

Recommendations

While the North/West Passage TPF Study was not set up as a research program, there are some clear conclusions and recommendations that can be made from its success. Four major conclusions and recommendations have been identified for the success of future TPF Study projects focusing on multi-state corridor programs. The recommendations shown below include support for multi-state program integration, multi-state corridor organization development, project initiation, and development of Phase II of the North/West Passage TPF Study.

Recommendation 1: The North/West Passage Program will continue to work towards and support development of multi-state program integration efforts especially those relating to center-to-center communications.

Recommendation 2: An appropriate set of national programs that are designed to encourage multi-state coalitions would be beneficial. This could be a national level-planning program or a program similar to or under American Association of State Highway and Transportation Officials (AASHTO).

Recommendation 3: Based on the success of the project initiation activities (recognizing a need, creating an interest, and initiating early action activities to jump-start projects) in Phase I, and where appropriate during Phase II, the concept of project initiation will be utilized to develop high payoff project ideas.

Recommendation 4: The Steering Committee will pursue a Pooled Fund Study, Phase II of the North/West Passage Program, that focuses on development of an ITS Integrated Corridor Strategic Plan.

While Phase I of the study concentrated on early success projects, Phase II will concentrate on an expanded ITS Integrated Corridor Strategic Plan for the North/West Passage Corridor. It is anticipated that development of the ITS Corridor Strategic Plan will help the states to coordinate integrated corridor efforts between state borders and identify future projects to pursue. The plan will focus on center-to-center opportunities and include a high-level architecture for the corridor, an inventory of communication coverage, and a coordinated deployment/concept of operations for traveler information. The North/West Passage Phase II Study will be developed and reported separately.

Chapter 1: Introduction

Phase I History

On February 25, 2002 representatives of the North/West Passage states met in Bloomington, Minnesota to discuss the potential of forming a multi-state coalition along the I-90 and I-94 corridor from the states of Wisconsin to Washington. The focus of the proposed coalition was the development of coordinated Intelligent Transportation System (ITS) projects along the corridor. A Steering Committee was formed and the name North/West Passage Corridor Coalition was selected. Each state along the corridor was asked to submit ideas for potential corridor projects. A first draft list of potential project ideas was then developed.

During the 2002 ITS America Conference in Long Beach, California, the Steering Committee developed a list of problems and needs along the corridor to help sort Potential ITS Priority Programs for the corridor. It was determined that the number one need was consistent and adequate traveler information across state borders. Along with project selection, the Steering Committee began to develop a coalition Memorandum of Understanding for its members to sign. The Steering Committee continued to meet with telecommunications and technical support of the Federal Highway Administration (FHWA). Legal council rejected the draft Memorandum of Understanding and it was decided on June 13, 2002 that the best way to pursue the coalition objectives was through a Transportation Pooled Fund (TPF) Study.

The North/West Passage Program was posted as Pooled Fund Study, TPF-5(093) in October 2003, and three state Department of Transportations (DOTs), Minnesota, North Dakota, and Wisconsin, committed funding totaling $100,000 to Phase I. In addition, Minnesota committed funding for management of the Pooled Fund Study Phase I and became the sponsoring organization. URS Corporation, coordinating with the International Idea Institute Inc., was selected to manage and sub-contract with other consultants and vendors for work on Phase I of the Pooled Fund Study.

A Work Plan for Phase I projects was approved by the Steering Committee on December 5, 2003. Based on the funding commitments from North Dakota, Wisconsin, and Minnesota, the initial geographic focus of the projects became I-94 through these states. All of the North/West Passage corridor states were invited to participate in the Steering Committee meetings and were provided documentation as the individual projects moved forward.

Purpose

As stated in the Work Plan, the purpose of the Phase I Projects was to implement and evaluate integrated traveler information systems and coordinate maintenance operations across state borders. Using appropriate delivery systems, traveler information would be made available to internal staff and the traveling public via 511, Dynamic Message Signs (DMS) and other systems. The long-term vision of the North/West Passage Corridor states is to influence ongoing standards development, operate database systems that can transmit and receive multiple data streams, and utilize effective methods for sharing, coordinating, and seamless integration of traveler information across state borders for the benefit of the traveling public.

Planning and Project Development
Corridor Steering Committee members selected nine projects as potential early success projects that could benefit the traveling public and validate the North/West Passage multi-state corridor concept. All of the Phase I projects are in essence study projects and were therefore subject to being modified, molded, and revised to achieve the most effective results. Early in the project development process one project, Project 1.3 – Deploy Automated Road Conditioning Reporting System, was set aside because another Pooled Fund Study, TPF-5(054), was already working on developing an automated reporting system. The other eight projects have successfully been completed.

The Phase I Work Plan identified the following projects for initial development:

- ***Project 1.1****- Integrate North Dakota, Wisconsin, and Minnesota Reporting Systems*
- ***Project 1.2*** *- Deploy Limited CARS Study Application for Wisconsin*
- ***Project 1.3*** *- Develop Automated Road Condition Reporting System*
- ***Project 1.4*** *- Provide Integrated Communications Capabilities for North Dakota DMS*
- ***Project 1.5*** *- Preliminary Design for DMS Deployment on I-94 Eastbound in North Dakota*
- ***Project 1.6*** *- Preliminary Design for DMS Deployment at the I-94 Split in Tomah, Wisconsin*
- ***Project 1.7*** *- Develop a North/West Passage Website*
- ***Project 1.8*** *- Develop a Communication Plan for an Anti-Icing System at I-94, Red River Bridge*
- ***Project 1.9*** *- Develop a Lessons Learned Document Comparing Reporting Systems in Wisconsin and North Dakota*

Table 1: North/West Passage TPF Study – Phase I Projects Summary provides additional details on the nine selected projects.

Work on each project began with the designation of a Project Champion as outlined in *Figure 1: Phase I Organizational Structure*. Project team members were selected, deliverables determined, funding needs finalized, and project development meetings began.

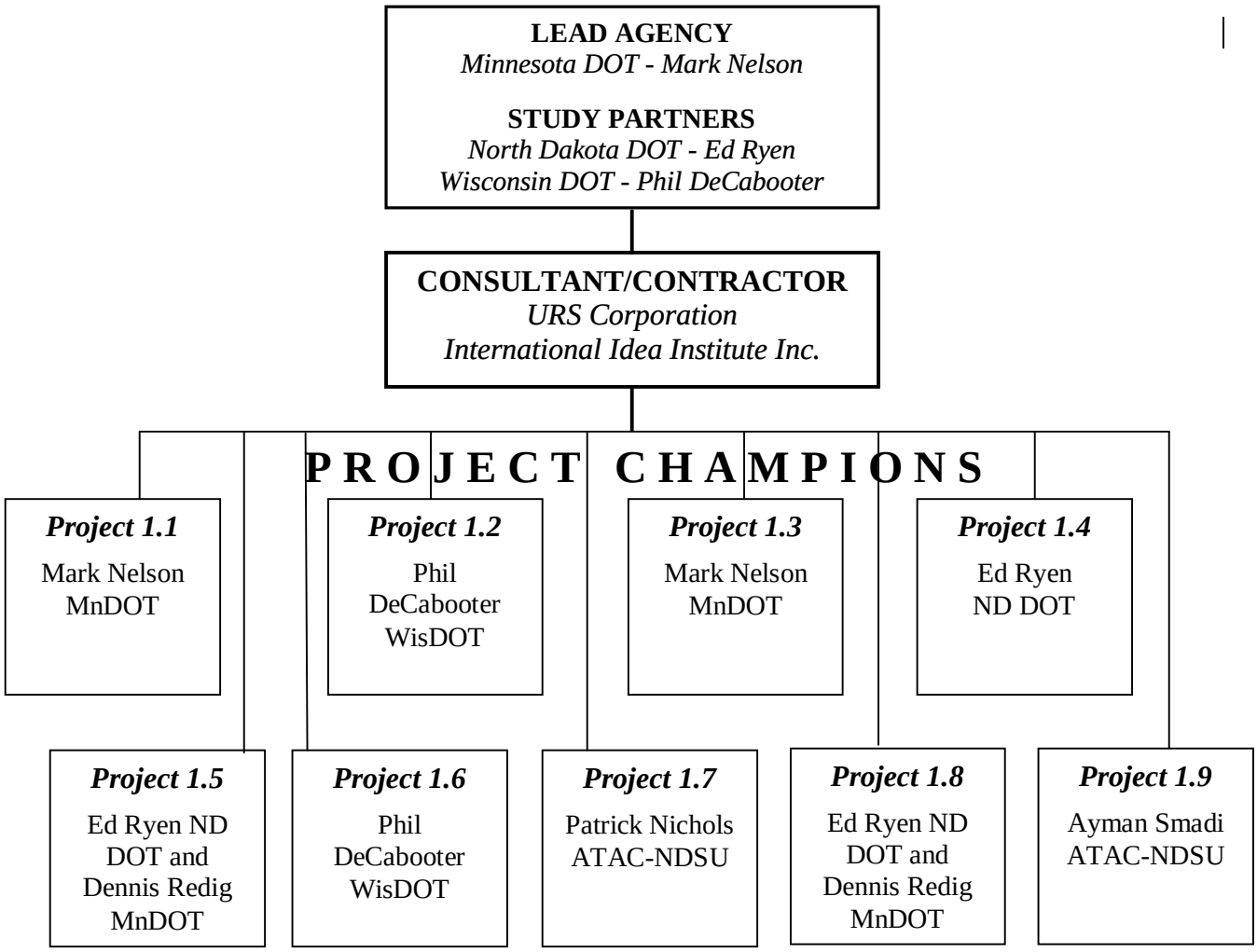

Figure 1: Phase I Organizational Structure

Project Details

Development of each Phase I project has been documented and details for each project are included in Chapters 2 through 10 of this report. Included in the chapter reports are the Project Title, Objective, Results, Champion, and Cost. The Results sections provides an overview of the success of each project, the lessons learned, and other key factors in moving the project from an idea into a successful program. *Appendix A: Summary of Phase I Work Teams and Highlights* focuses on a month-by-month summary related to the development process for each project. The Highlights section can be especially valuable to other pooled fund project managers since it shows the activities and steps that each team followed and their thought process as they made decisions, modified the projects, and brought the project to a successful conclusion. Meeting minutes from each Phase I Work Team Meeting along with the Steering Committee can be accessed on the North/West Passage Website (*http://nwpassage.info*).

Chapter 11, Major Findings and Observations, includes a discussion on the success of the pooled fund projects, and major findings of the study. Also included are observations on what has been accomplished in this pooled fund study and how the lessons learned can be applied to benefit other multi-state corridor programs. It also sets the stage for development of a Phase II program.

While the North/West Passage Pooled Fund Program was not set up as a research specific program there are some clear conclusions and recommendations that can be made from its success; these are summarized in *Chapter 12, Conclusions and Recommendations.*

Table 1: North/West Passage TPF Study - Phase I Projects Summary

Phase I Project Name	*Project Champion*	*Comments*	*North/West Passage Cost*
Project 1.1 - Integrate North Dakota, Wisconsin, and Minnesota Reporting Systems	*Mark Nelson* Mn/DOT	Travelers in North Dakota can now select to receive Minnesota's 511 traveler information. For no additional project cost, Minnesota data is also now available in South Dakota.	$29,500
Project 1.2 - Deploy Limited CARS Study Application for Wisconsin	*Phil DeCabooter* WisDOT	A four-week trial demonstrated the value achieved when a reporting system is operational within the state and alleviated fears about the time demands for operators to input data.	$7,500
Project 1.3 - Develop Automated Road Condition Reporting System	*Mark Nelson* Mn/DOT	Early in the project it was learned that a more extensive Maintenance Decision Support System (MDSS) TPF-5(054) program is already underway. This project was then set aside.	$00
Project 1.4 - Provide Integrated Communications Capabilities for North Dakota DMS	*Ed Ryen* NDDOT	This project succeeded early by using new communications technology to upgrade all 19 of North Dakota's DMS to NTCIP compliance and by leveraging Amber Alert grant funding.	$00
Project 1.5 - Preliminary Design for DMS Deployment on I-94 Eastbound in North Dakota	*Ed Ryen* NDDOT and Dennis Redig Mn/DOT	The Steering Committee agreed to refocus the project by developing a Concept of Operations for DMS Deployment on I-94 Eastbound in ND and I-94 Westbound in Minnesota.	$12,000
Project 1.6 - Preliminary Design for DMS Deployment at the I-94 and I-90 Split at Tomah, Wisconsin	*Phil DeCabooter* WisDOT	This project successfully shifted focus when it was determined that a Concept of Transportation Operations was the first priority to coordinate with Wisconsin's statewide Concept of Operations.	$12,000
Project 1.7 - Develop a North/West Passage Program Web Site	*Patrick Nichols* ATAC-NDSU	The North/West Passage website (http://nwpassage.info) was successfully launched on August 20, 2004 as an outreach tool, for internal and external communications.	$4,000
Project 1.8 - Develop a Communications Plan for the Anti-icing System to be Installed on the I-94 Bridges at Red River	*Ed Ryen* NDDOT *and Dennis Redig* Mn/DOT	An anti-icing communications plan and preliminary design layouts were developed for the anti-icing system RFP.	$20,000
Project 1.9 - Develop a Lessons Learned Document Comparing Reporting Systems in North Dakota and Wisconsin	*Ayman Smadi* ATAC-NDSU	This project shifted focus to develop a lessons learned document to identify typical requirements for reporting systems throughout the country	$15,000
Total Cost of Phase I Projects *(not including administration, travel, or consultant support services)*			**$100,000**

Chapter 2

Project 1.1 - Integrate North Dakota, Wisconsin, and Minnesota Reporting Systems

Project Objective
The objective of Project 1.1 was to integrate the North Dakota, Wisconsin, and Minnesota traveler information reporting systems such that seamless access to traveler information, including both road conditions and weather information, would be provided via the 511 telephone number.

Project Results
During the planning for Project 1.1, Wisconsin was in the beginning planning stages for a 511 reporting system and it had not yet been deployed. Therefore the project focus shifted to integrating North Dakota and Minnesota's traveler information reporting systems.

Project 1.1 was successfully completed and travelers in North Dakota can now select from North Dakota's 511 system to receive Minnesota's 511 traveler information. For no additional cost, this project was also able to provide travelers in South Dakota with the option to receive Minnesota's 511 traveler information. An Interface Control Document (ICD) was also created to identify the process that would allow the North Dakota condition reporting system to send data to Minnesota's reporting system, so that travelers in Minnesota could select to receive North Dakota's traveler information. For other North/West Passage states using different condition reporting systems, this document offers a significant step towards defining the specifics of the exchange standards. For example, should another North/West Passage state using a different condition reporting system wish to make use of the ICD, a simple edit of the specific interpretations and data mapping (to suit the local system) should be all that would be needed to convert the ICD to one that specifically supports exchanges with the other system. The ICD is included in *Appendix B: State to State Data Exchange Interface Control Document.*

Completion Date
March 31, 2005

Project Champion
Mark Nelson, Minnesota DOT

NWP Project Cost
$29,500

Project Deliverables
Project 1.1 State to State Data Exchange Interface Control Document (included in *Appendix B*)

The data feed from Minnesota's reporting system to North Dakota's reporting system was completed, so North Dakota travelers have the option to select Minnesota's 511 system. For no additional cost, this project was also able to provide travelers in South Dakota the option of receiving Minnesota's 511 traveler information.

Chapter 3

Project 1.2 - Deploy Limited CARS Study Application for Wisconsin

Project Objective
The goal of this project was to deploy a limited Condition Acquisition Reporting System (CARS) along I-94 in Wisconsin District 6 to demonstrate the capabilities of a traveler information reporting system in order to study the inputting of road condition, construction, incident, special event information, and possibly Amber Alert and assess the results.

Project Results
At the start of Project 1.2 there was concern about the amount of time a manual condition reporting system would require from operators to keep the data updated and accurate. Wisconsin State Police agreed to conduct a trial of CARS for incident and travel condition management. The intent of this trial was not to evaluate a particular software or approach towards condition reporting, but rather to give State Patrol dispatchers an idea of the level of effort that would be required to enter events into a condition reporting system. Further, it was envisioned that State Patrol dispatchers would have an opportunity to see the value in entering this data in one central location as opposed to responding to multiple requests for information.

After four weeks of trial use the discussion focused more on "how" would Wisconsin DOT and Wisconsin State Patrol select a vendor or system for deployment of a reporting system. The project demonstrated the value that will be achieved when such a system is operational within the state and alleviated fears about the system time demands. The Recap and Lessons Learned document developed for this project is included as *Appendix C: Project Recap and Lessons Learned.*

Completion Date
March 21, 2005

Project Champion
Phil DeCabooter, Wisconsin DOT

NWP Project Cost
$7,500

Project Deliverable
Project 1.2 Project Recap and Lessons Learned Document (included in *Appendix C*)

Chapter 4

Project 1.3 – Develop Automated Road Condition Reporting System

Project Objective
The objective of this project was to develop, test, and evaluate automated road condition reporting that will reduce the need to manually enter situations in statewide reporting systems.

Project Results
This project was successfully developed in a separate Maintenance Decision Support System (MDSS) TPF study, TPF-5(054). Therefore, planning for this project was set aside in Phase I and will be further addressed in Phase II by reviewing the status and success of the MDSS study.

Project Champion
Mark Nelson, Minnesota DOT

NWP Project Cost
$0

Chapter 5

Project 1.4 – Provide Integrated Communications Capabilities for North Dakota DMS

Project Objective
The objective of this project was to allow district border offices in North Dakota to communicate and remotely operate Dynamic Message Signs (DMS) by integrating central control software.

Project Results
This project succeeded using software called Intelligent Controller from Intelligent Devices Inc. This software was used to upgrade all 19 of North Dakota's portable DMS signs from five different manufacturers to NTCIP compliance. North Dakota DOT is now able to use a single communication interface to communicate to all their DMS signs. To fund the project, North Dakota leveraged funding from their Amber Alert Grant Program. As a result, the objective of this project was successfully accomplished early and without North/West Passage funding.

Completion Date
May 2004

Project Champion
Ed Ryen, North Dakota DOT

NWP Project Cost
$0

Chapter 6

Project 1.5 - Preliminary Design for DMS Deployment on I-94 Eastbound in North Dakota

Project Objective
The goal of project 1.5 was to provide information to travelers eastbound on I-94 as they approach the North Dakota/Minnesota border utilizing a Dynamic Message Sign (DMS). This sign would compliment the I-94 DMS on the Minnesota side for westbound travelers.

Project Results
The kick-off meeting for North/West Passage *Project 1.8 Develop a Communications Plan for the Anti-Icing System to be Installed on the I-94 Bridge at Red River* was scheduled before work on Project 1.5 was started. The objective of Project 1.8 was to develop the communication plan associated with development and deployment of anti-icing technology on I-94 over the Red River Bridge located at the border of North Dakota and Minnesota. Due to location of the proposed DMS in Project 1.5 (eastbound prior to the Red River Bridge) it was agreed to coordinate project efforts.

The anti-icing system and DMS communication plan was completed. However, after considerable discussion it was agreed that the DMS communication would not be included in the Request for Proposals (RFP) for deployment of the anti-icing system and would be addressed separately.

During the planning of Project 1.5, Amber Alert Grand Funds became available and North Dakota DOT decided to use these funds to deploy DMS statewide and include the planned DMS along I-94 eastbound near the North Dakota/Minnesota border in the statewide DMS plan. Therefore, only one RFP would be developed for deploying all of the DMS in North Dakota.

As a result of these revisions, the Project 1.5 Work Team agreed to shift the focus of the project from preliminary design of the DMS to developing a Concept of Operations for DMS deployment on I-94 eastbound in North Dakota and I-94 westbound in Minnesota. The title was revised to *Project 1.5 Concept of Operations for DMS Deployment on I-94 Eastbound in North Dakota and I-94 Westbound in Minnesota*. The Concept of Operations document serves as a reference as North Dakota and Minnesota develop system requirements, design, deployment, operations, and maintenance for the DMS on each side of the border. The document also includes a Draft Memorandum of Understanding for Dynamic Message Sign Operations on I-94 at the North Dakota – Minnesota Border. The Concept of Operations document is included in *Appendix D: Project Summary including a Concept of Operations.*

Completion Date
January 10, 2006

Project Champions
Ed Ryen, North Dakota DOT
Dennis Redig, Minnesota DOT

NWP Project Cost
$12,000 (Project 1.5)

Project Deliverable
Project 1.5 Summary Document including a Concept of Operations (included in *Appendix E*)

Chapter 7

Project 1.6 - Preliminary Design for DMS Deployment at the I-94 and I-90 Split at Tomah, Wisconsin

Project Objective
The goal of Project 1.6 was to provide information to travelers westbound on I-90/94 before the split at Tomah, Wisconsin in order for users to make informed route decisions based on current road/weather conditions.

Project Results
The initial focus of the project was to develop a preliminary design for DMS deployment. However, due to other planning efforts within Wisconsin, the focus of the project shifted to addressing a concept of transportation operations.

Although a preliminary design was not developed for a DMS at the Tomah split in Wisconsin, this project successfully shifted focus to better meet the users' needs. During the planning, the project team determined that a Concept of Transportation Operations should first be developed to identify where a traveler information component could be placed in order to receive buy-in among the stakeholders. At the same time Wisconsin was working on its Statewide Traffic Operations Plan (TOP). The focus then shifted for Project 1.6, to concentrate on developing a Concept of Operations for this project that identifies information to be addressed as Wisconsin moves forward with its statewide TOP. The Project Summary Report including the Concept of Operations that was developed for this project is included as *Appendix E: Summary Report including a Concept of Operations.*

Completion Date
March 31, 2004

Project Champion
Phil DeCabooter, Wisconsin DOT

NWP Project Cost
$12,000

Project Deliverable
Project 1.6 Summary Document including a Concept of Operations (included in *Appendix E*)

Chapter 8

Project 1.7 - Develop a North/West Passage Website

Project Objective
The goal of this project was to create a website for the North/West Passage that can be used as an outreach tool to the general public and an internal communication tool for project committee members.

Project Results
The North/West Passage Program website (http://nwpassage.info) was successfully launched August 20, 2004. The website was developed to communicate project information to the general public and as an internal communications tool for project committee members. Because of the usefulness of the website it was determined that it should be maintained through Phase II of the North/West Passage. A screen shot of the home page is included in *Appendix F: North/West Passage Website Home Page (http://nwpassage.info)*.

Completion Date
August 20, 2004

Project Champion
Patrick Nichols, ATAC-North Dakota State University

NWP Project Cost
$4,000

Project Deliverable
North/West Passage Website (*http://nwpassage.info*) (Screen shot included in *Appendix F*)

Chapter 9

Project 1.8 – Develop a Communications Plan for the Anti-Icing System to be Installed on the I-94 Bridges at Red River

Project Objective
The goal of project 1.8 was to develop the Communications Plan and Project Design Layouts associated with development and deployment of automated anti-icing technology on the I-94 bridges over the Red River between North Dakota and Minnesota.

Project Results
Project 1.8 which focused on developing a Communications Plan and Project Design Layouts for the anti-icing technology on the I-94 bridges over the Red River succeeded. North Dakota and Minnesota have successfully coordinated development of the anti-icing RFP. The RFP including the Communications Plan and Project Design Layouts developed for the anti-icing project are included as *Appendix G: Anti-Icing RFP including the Communication Plan and Preliminary Design Plans.*

Project Champions
Ed Ryen, North Dakota DOT
Dennis Redig, Minnesota DOT

NWP Project Cost
$20,000

Project Deliverable
Communication Plan and Project Design Layouts for inclusion in the RFP for the Anti-Icing Technology over the Red River Bridge on the North Dakota/Minnesota Border (included in *Appendix G*)

Chapter 10

Project 1.9-Develop a Lessons Learned Document Comparing Reporting Systems in North Dakota and Wisconsin

Project Objective
The goal of this project was to develop a lessons learned document based on deployment experiences of statewide condition reporting systems in North Dakota and one in Wisconsin.

Project Results
The initial purpose of this project was to develop a lessons learned document based on deployment experiences of statewide condition reporting systems in North Dakota and one in Wisconsin. The North Dakota NDDOT was exploring the possible deployment of Meridian's statewide condition reporting system (later named IRIS for Incident Reporting Information System) to further expand current traveler information capabilities and support North Dakota's 511 system. Similarly, the Wisconsin DOT was in the initial planning stage of its 511 system with a vision that includes partnering with the Wisconsin State Patrol for operating the underlying statewide condition reporting system that would support 511. Therefore, WisDOT wanted to demonstrate data entry requirements to the Wisconsin State Patrol for any condition reporting system, using the CARS as an example (Project 1.2).

After the start of the project, the NDDOT decided not to proceed with plans to deploy Meridian's statewide condition reporting system in North Dakota. This development greatly reduced ATAC's ability to study North Dakota's deployment as a case study. ATAC staff did, however, participate with demonstrations held for the NDDOT on the Meridian system.

In Wisconsin, plans for a limited CARS deployment were proceeding well. However, CARS itself was undergoing a major update in order to meet new NTCIP protocols. Therefore, the new version of CARS differs from the old version, especially in terms of compatibility with other systems. Nonetheless, some initial data were collected on Wisconsin's experience with CARS limited deployment.

After consulting with the project advisory panel, the following revised scope was developed for this project:

1. Provide a description of new federal requirements for (real-time) statewide information systems
2. Provide general descriptions of CARS, IRIS, and Arizona's HCRS
3. Document Wisconsin's CARS limited deployment
4. Review South Dakota Department of Transportation's (SDDOT) limited Meridian condition reporting system deployment and study on improved road condition reporting

The Lessons Learned document created by Project 1.9 is included in *Appendix H: Lessons Learned Comparing Road Condition Reporting Systems.*

Project Champion
Ayman Smadi, ATAC-North Dakota State University

NWP Project Cost
$15,000

Project Deliverable
Lessons Learned Comparing Road Condition Reporting Systems (included in *Appendix H*)

Chapter 11

Major Findings and Observations

During Phase I of the North/West Passage Transportation Pooled Fund Program, the project work teams focused on developing and implementing nine integrated projects with a potential for early success. Beyond the completed projects the work teams have also learned valuable lessons and findings that can be utilized in similar multi-state corridor programs. These findings are included in this chapter along with general observations on what has been accomplished in this Pooled Fund Study. This chapter could have also been called "Lessons Learned" since that is what the findings and observations are. Particularly important is how the lessons learned may be applied to, or benefit other multi-state corridor programs and the traveling public. It also sets the stage for development of a Phase II program.

With the number of diverse projects that have been undertaken in Phase I it is easy to lose sight of the overall program objective. The stated objective is to influence ongoing standards development, operate database systems that can transmit and receive multiple data streams and utilize effective methods for sharing, coordinating, and seamless integration of traveler information across state borders for the benefit of the traveling public *(For details on the development and positive results of each project that led to the findings and observations listed below please refer to the Project Results section of each project).*

Findings and observations for the development of multi-state corridor programs include:

1. Multi-state coalitions/programs are valuable catalysts for planning and developing programs and projects that provide drivers traveler information along "seamless" corridors for the benefit of the traveling public. These loose, informal coalitions of dedicated people work well especially when the participating states can see the benefits of their efforts. However, participants must be sensitive to the perception that these multi-state initiatives conflict with individual states' internal ITS/traffic operations planning and programming processes. From all 9 projects).

   Observation: Multi-state coalitions like the North/West Passage program that support multi-state program integration, especially communications, do work.

2. Formal coalitions are extremely hard to develop and formalize because of legal issues involving authority, financing, and organizational control. (Legal issues during preliminary development of the North/West Passage Program led to the revamping of the program as a Transportation Pooled Fund.)

3. The development and documentation of system architecture and the identification of applicable standards is an integral part of planning cross-border systems and center-to-center data sharing.

4. Coalitions that have a single project or need to focus their efforts towards will drive a coalition at the beginning; however, that single point of focus needs to be balanced with a

broader corridor-wide strategy and multiple programs to sustain the coalition. (From all 9 projects).

5. Although the FHWA staff has been exceptionally supportive of the North/West Passage multi-state corridor programs, the multi-state corridor concept does not fit neatly into current federal and state funding and development categories or programs. While the Transportation Pooled Fund program has been a vital component to the development of the Corridor, it was not designed as a project development and funding program.

   Observation: An appropriate set of national programs designed to encourage and fund multi-state coalitions would be helpful and would benefit the traveling public.

6. Flexibility is key to managing multi-state programs where some projects need to be dropped, others expanded, some combined, and others refocused. (Each of the projects was modified at least once on its way to success.)

7. Limited funding, judiciously applied, can work wonders to coordinate efforts, stimulate cooperation and innovation on multi-state coalition projects and in helping to overcome obstacles and individual state priorities. The key is open discussion, innovation, and cooperation in the planning and application of the limited funds. Also important is the selection of potential high-payoff projects. For example Projects 1.5 and 1.8 on I-94 at the Red River resulted in savings in planning, in future systems deployment and operations and in development of a single RFP that could be used by both states. (Project 1.1, 1.4, and 1.8 all had very limited or no funding, but the cooperative, innovative efforts of the work teams and the potential benefits to the individual states involved resulted in successful projects.)

8. In some Phase I Projects that involved significant construction or equipment purchases, the North/West Passage TPF Study served as project initiator by recognizing the need, creating an interest and initiating early action activities. By creating an interest in the potential multi-state project the North/West Passage Program was able to bring the work teams together to initiate discussion and planning for the potential project. Although funding for the full project was not available the work teams were able to initiate discussion and action on the project. In Projects 1.5 and 1.8 both North Dakota and Minnesota were able to coordinate communications systems planning resulting in a more effective system design that will be lest costly and more useful in both states. The full project will be completed as part of the regular states construction programs or through other funding sources. (Project 1.1, 1.2, 1.4. 1.5, 1.6, 1.8 are examples of projects that served as initiators to define the need and create an interest in the project).

   Observation: The concept of project initiation was a success in Phase I and will continue in future projects where appropriate and when funding is available.

9. Committed leadership is required for coalition success, both from the states, the FHWA and the coalition teams. State and federal leaders have supported the concept and, despite funding problems, have continued to be involved and help move the North/West Passage

Program forward. North/West Passage projects came together successfully because the team leaders were familiar with the multi-state needs of their project and were committed to the multi-state concept before they joined the program. *(Continued involvement and meeting participation on the part of all the states and FHWA including development of a Phase II Work Plan is an indicator of their interest. Project work teams have successfully revised, modified, and completed their projects and as appropriate issued final reports with suggestions and recommendations for future multi-state programs.)*

10. Observation: It would be helpful for the development and management of multi-state coalitions and programs if there were a national-level planning program. A national level program could showcase the benefits and provide a forum for those states that are striving to build multi-state coalitions that are focused on improving transportation operations.

11. Conclusion: Project 1.9, the North/West Corridor Pooled Fund Study states are well positioned to provide a positive example of how states can work together in streamlining road and weather condition data across their borders. These states recognized the value of coordination and integration long before the passage of SAFETEA-LU and its provisions for real-time system management. They have developed and implemented projects specifically focused on solving problems of data collection, data entry, and multi-state/multi-agency sharing of resources. Further, the output of the strategic plan and corridor architecture to be undertaken in Phase II of the North/West Passage should provide valuable insights to the U.S. DOT and other states.

12. Observation: The Steering Committee agreed that Phase I has been successful and for future success of the North/West Passage Program, additional planning and program development along the corridor is needed. Therefore, there is a need to pursue a second phase (Phase II), of the North/West Passage Program that would focus on Strategic Planning. (The Steering Committee discussions resulted in initial development of a Phase II Strategic Planning program.)

Chapter 12

Conclusions and Recommendations

While the North/West Passage Pooled Fund Program was not set up as a research program there are some clear conclusions and recommendations that can be made from its success. Four major conclusions and recommendations have been identified for the success of future TPF Study projects on multi-state corridor programs. The four recommendations shown below include; support for multi-state program integration, multi-state corridor organization development, project initiation, and for development of Phase II of the North/West Passage Pooled Program.

Multi-State Program Integration
The North/West Passage Program Phase I has shown how necessary and valuable multi-state program cooperation and integration can be in communications, databases and in other areas. Cross-border programs and system integration efforts are especially important for development of multi-state corridor programs that provide "seamless" traveler information to the traveling public. An important finding is the strong need for the development of center-to-center communications systems that are usable across state borders and on a national level. System architecture for center-to-center communications is and will continue to be an important element in the success of multi-state corridor projects. The Interface Control Document developed in Project 1.1 is an excellent example since it addresses the process of sharing information between two different reporting systems. This document will benefit all the North/West Passage states as their statewide 511 systems mature.

Conclusion: Multi-state program integration is critical to the success of future "seamless" traveler information and corridor programs both on a regional and national level.

> Recommendation 1: The North/West Passage Program will continue to work towards and support development of multi-state program integration efforts especially those relating to center-to-center communications.

Multi-State Corridor Organization Development:
Early in the development of the North/West Passage Program, the Steering Committee attempted to develop a Memorandum of Understanding. It was anticipated that all corridor state transportation departments could agree upon and sign this document as the framework for the Program. Legal issues prevented this and ultimately the TPF Study format was adopted and utilized to pursue multi-state programs along the corridor.

Conclusion: An appropriate set of national programs designed to encourage and fund multi-state coalitions would be helpful and would benefit the traveling public.

> Recommendation 2: An appropriate set of national programs that are designed to encourage multi-state coalitions would be beneficial. This could be a national level-planning program or a program similar to or under AASHTO.

Project Initiation
In some Phase I Projects that involved significant construction or equipment purchases, or where there was potential of major benefits, the North/West Passage TPF Study served as project initiator by recognizing a need, creating an interest, and initiating early action activities to jump-start the project. With limited funds provided in Phase I the project teams were able to initiate major benefit projects, then search for alternative methods of project development or funding sources. This was especially demonstrated in Project 1.4 to "Provide Integrated Communications Capabilities for North Dakota DMS" where, after project initiation, alternative technology and funding created a successful project without financing from Phase I.

Conclusion: For program success, all it takes is for an individual or group to develop and define the conceptual idea. Once the idea is initiated, funding and other resources can be pursued.

> Recommendation 3: Based on the success of the project initiation activities (recognizing a need, creating an interest, and initiating early action activities to jump-start projects) in Phase I, and where appropriate during Phase II, the concept of project initiation will be utilized to develop high payoff project ideas.

Development of Phase II of the North/West Passage Program
The Steering Committee agreed that Phase I has been successful and for future success of the North/West Passage Program additional planning and program development along the corridor is needed.

Conclusion: There is a recognized need to pursue a second phase (Phase II) of the North/West Passage Program that focuses on Strategic Planning

> Recommendation 4: The Steering Committee will pursue a Pooled Fund Study, Phase II of the North/West Passage Program that focuses on development of an ITS Integrated Corridor Strategic Plan.

The Recommendation for development of Phase II of the North/West Passage Program was determined mid 2004, which the Steering Committee subsequently pursued. On December 13, 2004 the committee adopted the following Phase II Work Plan. Highlighted below are excerpts from the first two pages of the Phase II Work Plan. The Complete Phase II Work Plan is available on the North/West Passage website, (http://nwpassage.info) and as Appendix H.

North/West Passage Transportation Pooled Fund Study
Phase II Work Plan
December 13, 2004

Purpose

The purpose of Phase II of the North/West Passage Transportation Pooled Fund (TPF) Study Projects is to develop a North/West Passage ITS Integrated Corridor Strategic Plan while continuing to develop, expand implementation, and evaluate integrated traveler information systems. This work will include coordinated maintenance operations across state borders and the development of safety improvement systems. The plan will focus on center-to-center opportunities and include a high-level architecture for the corridor, an inventory of communication coverage, and a coordinated deployment/operations concept for traveler information systems. Suggested projects for the corridor to pursue will be identified.

The long-term vision of the North/West Passage Corridor states (Washington, Idaho, Montana, North Dakota, South Dakota, Minnesota, Wyoming, and Wisconsin) is to influence ongoing standards development; operate database systems that can transmit and receive multiple data streams; and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders.

Based on funding commitments from North Dakota, Wisconsin, and Minnesota, the initial geographic focus of Phase I was I-94 through Wisconsin, Minnesota, and North Dakota. Phase II projects will expand on the initial focus to include additional states and new technological concepts as additional states commit funding.

Strategy

By coordinating efforts to develop an integrated traveler information and maintenance operations network, the North/West Passage states will influence ongoing standards development, operate data base systems that can transmit and receive multiple data streams, and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders. When completed, the systems should appear seamless to users and maintenance operations. This system will benefit users in all connected states by supplying timely and accurate traveler information.

In some Phase I Projects that involved significant construction or equipment purchases, the North/West Passage TPF Study served as project initiator. This concept of project initiation was a success in Phase I and will continue during Phase II where appropriate and when funding is available.

In Phase II, the participants will focus on integrated corridor strategic planning for the development of the traveler information and maintenance network. When funding is available continue development of a series of independent, but closely related projects. These projects will

build on the success of the Phase I program that focused on integrated traveler information systems and coordinated maintenance operations.

Phase II Projects

North/West Passage members submitted project ideas and then voted on projects to pursue for Phase II. The following list ranks these projects as agreed by the membership. It was agreed that the initial focus of Phase II would be project 2.1.

2.1 North/West Passage ITS Integrated Corridor Strategic Plan
- *Corridor ITS Strategic Plan*
- *Corridor High Level Architecture*
- *Integrated Traveler Information Systems Coordinated Deployment Concept*
- *Corridor Communication Coverage Inventory and Alternatives*

2.2 Coordinated Guidelines for Rural DMS Operations and Messages along the Corridor

2.3 Automated Road Condition Reporting System

2.4 North/West Passage Road Weather Info/Net

2.5 North/West Passage Coordination and Partnership with the FHWA Clarus Initiative

2.6 Automated Gate System Demonstration

The Steering Committee also agreed that website maintenance is necessary to continue communication internally and externally and should continue to be funded through Phase II, but not listed as a project.

Appendix A
Summary of Phase I Work Team Meetings and Highlights

Project 1.1
Integrate North Dakota, Wisconsin, and Minnesota Reporting System
Highlights and Work Team Meetings

The following information provides project highlights and a summary of Project 1.1 Work Team Meetings.

March 2005

- Meridian and Castle Rock held a brief conference call to finalize the ICD. Based on the discussion, Castle Rock completed the ICD. This was the last task to complete Project 1.1.

February 2005

- Meridian completed the data feed from Minnesota CARS to North Dakota's reporting system during the third week of February. Travelers now have the option to select Minnesota's 511 systems as an option when they are traveling in North Dakota. Meridian will add Minnesota as a menu option on South Dakota's 511 system if there is no additional cost.
- Under Project 1.1, feeding North Dakota information back to Minnesota will not be completed because North Dakota placed a hold on developing their reporting system. The ICD being developed by Castle Rock will address the technical issues with North Dakota information feeding to Minnesota through a SOAP interface.
- Castle Rock is in the process of completing the ICD, the final task for Project 1.1. CARS is currently being revised. The interface between the next version, which is scheduled to be completed in 2005 and North Dakota's current traveler information system will be mapped in the ICD.

January 2005

- Work continues on the ICD. The decision was made to build an output now with the information North Dakota currently provides, since there is not a timeline of when North Dakota will be implementing a reporting system.

December 2004

- Meridian is still working out a few issues with ingesting Minnesota's data to use in North Dakota's System. However, it should be completed and up and running in the next few weeks.
- North Dakota has put a hold on their statewide 511 project. Part of the original scope of work for Project 1.1 was to build an output program to deliver North Dakota data to Minnesota. The next step is to determine if we build a current output now and then again once RCRS is constructed in North Dakota or wait for RCRS.

October 13, 2004 Work Team Meeting

- Meridian has a few refinements to complete prior to making Minnesota road condition information available to travelers in North Dakota.
- Castle Rock produced a Draft ICD for the group to review. The document addresses how different reporting systems use the recommended standards. The end users of the document will be the developers in each state that would build the standards into their reporting system. This document is a blueprint that each software team would need to develop. The document is 99% generic, meaning that if another reporting system is in use for a state, the document could be easily adapted and modified to fit any state within the North/West Passage Corridor. The next draft of this document will include information on how to get information out of CARS.

August 19, 2004 Work Team Meeting

- Castle Rock is in the process of developing a draft ICD that will address software interfaces between states.

June 11, 2004 Project Kickoff Meeting

- Minnesota's reporting system is CARS.
- North Dakota's reporting system is IRIS.
- Currently in CARS data is updated every minute. However, the CARS consortium is revising their system to meet a new national standard, which will result in data being posted only when status has changed. The Project 1.1 Work Team agreed that the interface between Minnesota and North Dakota should incorporate the new standard. Castle Rock has developed an ICD for sharing and accepting information between states reporting systems in other regions in the country.
- The group agreed that Castle Rock should develop an ICD for the North/West Passage Corridor under Project 1.1 based on the work they have performed in other regions in order to address exchange issues between state agencies now and in years to come.
- Meridian has built and will modify the ingest system that allows Minnesota data to feed into North Dakota's system, so that travelers using North Dakota's 511 system will have the option to receive Minnesota's 511 traveler information.

Project 1.2
Deploy Limited Condition Acquisition Reporting System (CARS) Study Application in Wisconsin
Highlights and Work Team Meetings

The following information provides project highlights and a summary of Project 1.2 Work Team Meetings.

March 21, 2005

- A summary document highlighting lessons learned was developed by Castle Rock and submitted to the Project Work Team as the final deliverable on March 11, 2005. Wisconsin DOT is intending to continue meeting internally to discuss options for proceeding with a reporting system.

February 2005

- This project is complete. A summary document is being developed by Castle Rock.

December 15, 2004 Work Team Recap Meeting

- A recap of Project 1.2 was presented by Castle Rock. The presentation focused on a recap of the project objective, the training, the trial period, and lessons learned with other deployments of condition reporting systems across the country.
- The trial period indicated that the users were unanimous in endorsing a reporting system. Each district would benefit from the time savings.
- The group concluded the meeting indicating that the trial period of CARS was successful and the next step is to meet internally in Wisconsin to begin discussion on moving towards a reporting system or revamping the 1-800-ROADWIS telephone number.
- Castle Rock will develop a summary document of Project 1.2 for the North/West Passage corridor.

November 10, 2004 Work Team Meeting

- The group discussed the training held on November 9, 2004. There was an issue with operators being able to access the system via the web. The Wisconsin DOT staff worked on correcting the problem. The start date of the trial period was pushed back to November 17, 2004.
- The group indicated that based on the feedback from the operators, Wisconsin DOT staff will need to assess recommendation for moving towards a reporting system or revamping the 1-800-ROADWIS telephone number.

November 9, 2004 CARS Training in Eau Claire, Wisconsin

- Two training sessions were held, with a total of 10 operators participating

- A training manual was provided to assist operators as different options and scenarios were stepped through
- The training focused on explaining Project 1.2 of the North/West Passage Project, describing CARS, demonstrating the system, and hands-on entry of the system.

July 27, 2004

- State Patrol representative from Wisconsin's District 6 visited the TOCC in Rochester, Minnesota to observe operational procedures for CARS data entry.

June 24, 2004 Work Team Meeting

- The group identified expectations for the actual trial period of deploying limited CARS in Wisconsin.
    - Timeline – November 13-December 10, 2004 during the hunting season in Wisconsin
    - Location – Minnesota/Wisconsin border to Osseo, Wisconsin on I-94
    - Staff – District 6 State Patrol operators will enter CARS events during the trial period
    - Daily Entries – Minimum of 4 times per day, concurrent with their data entry in 1-800-ROADWIS
    - Training – Mn/DOT staff and Castle Rock will provide training to Wisconsin State Patrol District 6 communications staff in early November.

June 18, 2004 Wisconsin Internal Meeting

- Key individuals met with Wisconsin State Patrol to discuss District 6 State Patrol staff assistance for the CARS pilot project. The group concluded to train staff during the beginning of November and to hold the testing shadow mode pilot project from November 13 – December 10, 2004.

June 4, 2004 Wisconsin Internal Meeting

- Key individuals met with Wisconsin State Patrol to request approval to move forward with Project 1.2. Wisconsin State Patrol approved Project 1.2 using District 6 State Patrol dispatch staff to demonstrate the capabilities of CARS.

May 20, 2004 Work Team Meeting

- A Prospective Wisconsin Reporting System Operational Diagram was developed that outlined one option to accomplish the goals of the project. The diagram explained that the project would operate in a shadow mode, District 6 in Wisconsin would be the trial location, data would be entered by District 6 dispatch at the same time they enter information into the 1-800-ROADWIS system, and training staff would take approximately two hours. The group agreed on moving forward with the information outlined in the diagram, but needed approval from the Wisconsin State Patrol.

April 13, 2004 Wisconsin Internal Meeting

- Key individuals held an Internal Stakeholder Meeting in Wisconsin to discuss feasibility of incorporating CARS application. The group discussed what data would be collected for the project, what staff would be responsible for the data, what CARS training would be needed, etc. The group agreed that a tighter scope was needed. The consensus of the group was to form a smaller group that would develop a detailed road map of training, staff commitment, time, etc. for using CARS.

March 9, 2004 Project Kickoff Meeting

- The group discussed the background of the North/West Passage project and the specifics of Project 1.2. The outcome of the discussion was the decision to hold an internal meeting with Wisconsin staff to determine what Wisconsin would get the most benefit for the $7,500 of funding identified for this project. After a consensus of what the project's focus should be, the project could move forward.

Project 1.3
Develop Automated Road Condition Reporting System
Highlights and Work Team Meetings

This project was set aside July 29, 2003 when it was discovered that a separate Maintenance Decision Support System TPF study TPF-5(054) was already being developed. The status of this project will be reviewed as part Phase II of the North/West Passage Program.

Project 1.4
Provide Integrated Communications Capabilities for North Dakota DMS
Highlights and Work Team Meetings

During an ITS America meeting Ed Ryen from North Dakota DOT discovered a new software technology that would allow them to upgrade and integrate their DMS to NTCIP compliance. About the same time Amber Alert grant funding became available and North Dakota DOT proceeded to upgrade their signs using this funding. North Dakota's system provides a single interface to communicate with all 19 portable DMS from 5 different manufacturers. While North/West Passage helped develop the concepts for this project, it succeeded when North Dakota was able to find appropriate technology and to leverage it with special grant funding to complete the project.

Project 1.5
Preliminary Design for DMS Deployment on I-94 Eastbound in North Dakota
Highlights and Work Team Meetings

The following information provides project highlights and a summary of each team meeting.

November 2, 2005

- In developing the Concept of Operations a number of operational questions developed and the Work Team met to develop answers to these questions. The questions and answers were then used to develop the Concept of Operations and the Draft Memorandum of Understanding for Dynamic Message Sign Operations on I-94 at the North Dakota – Minnesota Border.

September 2005

- Project 1.5 meetings were initially combined with Project 1.8 (see Chapter 9), however to complete the project it was agreed that the project focus would shift to development of a Concept of Operations for DMS Deployment on I-94 Eastbound in North Dakota and I-94 Westbound in Minnesota.

Project 1.6
Preliminary Design for DMS Deployment at the I-94 & I-90 Split at Tomah, Wisconsin
Highlights and Work Team Meetings

The following information provides project highlights and a summary of each team meeting.

March 2005

- URS submitted a wrap-up report of Project 1.6 during the third week of March for approval. This is the final deliverable for Project 1.6

February 2005

- This project is complete. URS is developing a short wrap-up report.

December 9, 2004

- The group discussed the stages of a Concept of Operations in Wisconsin and summarized the project deliverables. The group agreed that Project 1.6 has gone as far as it can go. The next step is to develop a short wrap-up report for Wisconsin to use as work continues on projects such as the TOP project.

October 12, 2004

- The group reviewed the Preliminary Concept of Operations. The revised document is a working document and once key concepts are agreed upon the document will be developed further. The document included high-level purpose of the document, quick project and system overview, a diagram depicting a high-level project concept of operations, descriptions on areas of operational impact, and scenarios. The group commented on the document and it was decided to place this project on hold until further work is completed on the Traffic Operations Plan (TOP) project in order for the two documents to compliment each other.

August 23, 2004 Project Team Meeting

- The purpose of this meeting was to follow up on the discussion from the last Project 1.6 meeting held on Monday, August 16 to further discuss the focus of the Concept of Transportation Operations document and how it fits into the TOP project in Wisconsin. After considerable discussion, the group agreed that focus of the Concept of Transportation Operations document would focus on the Tomah split and address scenarios related to this area of interest. The group also agreed that the Wisconsin TOP project team would monitor the development of the Concept of Operations document to insure that the work complemented the development of the corridor operations template being developed by the TOP project.

August 16, 2004 Project Team Meeting

- Key individuals from Wisconsin involved in other planning efforts participated in this meeting. The meeting focused on addressing how different types of traffic operations and planning documents in Wisconsin should relate to each other. Specifically, how this concept of operations template/document for the North/West Passage relates to the Statewide Traffic Operations Plan and other related documents. The group agreed that the project would focus on developing a Concept of Transportation Operations for the I-90/94 corridor and adjacent areas in Southwest Wisconsin. The next step is to identify a suggested common vocabulary and definitions that could be used in various operations and planning documents in Wisconsin.

August 4, 2004 Project Team Meeting

- The group continued discussion of the revised project level Concept of Operations. The group suggested using I-90/I-94 as the main corridor network but address stretching this out to other areas. Additional information is needed on coordinating efforts with Wisconsin's Statewide Traffic Operations Plan. It was suggested to hold a meeting with those individuals that are involved with the other traffic operations planning efforts.

July 22, 2004 Project Team Meeting

- A revised project level Concept of Operations was developed and reviewed by the group. Suggestions were made to the modify document to include additional information on system architecture, funding options, staffing requirements, and example scenarios.
- The group agreed to hold a follow up meeting on August 4 to continue this discussion

May 20, 2004 Project Team Meeting

- A draft concept of operations was developed and reviewed. The group agreed that the project focus should still first be on a multi-state concept of operations and then on design. The concept of operations should be a roadmap for other similar projects that identifies the information to be placed on the sign, who would control the sign, who is responsible for maintenance, etc. The next step to move forward with the project is to modify the concept of operations to a project level of operations.

March 9, 2004 Project Kickoff Meeting

- The group discussed the initial focus of this project to provide information to travelers through a DMS sign.
- Due to the development of the Wisconsin State Operation Plan the group agreed that focus should include the timeline of the plan.
- The group agreed the focus of this project should shift to a concept of operations that would include a high level template that would be used corridor-wide.

Project 1.7 -Develop a North/West Passage Website
Highlights and Work Team Meetings

The following information provides project highlights and a summary of each team meeting.

August 2004

- The North/West Passage Website was launched on August 20, 2004 (http://www.nwpassage.info). The site contains information on past or future meetings, corridor history, calendar of events, and much more. Meeting minutes and agendas are available to all who visit this website.
- By logging into the website, members have access to meeting agendas and minutes along with all meeting handouts.
- Maintenance of the website will continue.

July 2004

- On July 21, 2004 each of the 3 lead state contacts were emailed a link to the revised website for review. Comments were noted and included in the website. All historic North/West Passage information has been placed on the website. Work continues on development of a member's only section for individuals to download project team materials.

June 10, 2004 Project Team Meeting

- Work group reviewed draft content and format of what to place on the website and agreed the next step is to further develop the website for review by the Steering Committee.

June 4, 2004 Project Kickoff Meeting

- The group reviewed a draft template for the North/West Passage Website and discussed desired website functionality and content
    - Project Schedules
    - Individual Project Pages
    - Members Only Section

Project 1.8
Develop a communications Plan for the Anti-Icing System to be installed on the I-94 Bridges at Red River
Project 1.8 Highlights and Work Team Meetings

The following information provides project highlights and a summary of each team meeting.

March 2005

- The final Anti-Icing RFP was sent to the vendors on February 8, 2005. The proposals are due March 25, 2005.
- The North/West Passage effort for Project 1.8 is complete.

February 1, 2005 Vendor Meeting

- The group held a meeting with potential anti-icing vendors in Fargo, North Dakota. The North/West Passage project was explained and the group went through the draft RFP in detail in order to discuss the necessary information to complete the RFP. The RFP was then revised to incorporate the discussion of the meeting. The RFP will be sent to the vendors in February. Proposals are due March 25.

January 7, 2005

- The group discussed the draft RFP, communications plan, and draft layouts. It was agreed that the DMS would not be included in the Anti-Icing RFP and would be addressed separately by Project 1.5 (see Chapter 6). The communication plan and layouts were revised based on discussion from the meeting. The draft RFP was sent to the potential vendors on January 14, 2005. A meeting will be scheduled with the vendors to discuss the RFP.

December 16, 2004 Project Team Meeting

- The group discussed the Red River Bridge Anti-Icing RFP. NDSU will work to develop text to include regarding the anti-icing communication and DMS communication. A decision document was sent out to the group to assist in identifying how many cameras etc. to specify in the RFP.
- A draft RFP will be finalized the first week in January and sent to the vendors for their input during mid-January. Proposals will be due March 25.
- The group discussed possible anti-icing vendors.
- Work will continue on the architecture as the communication options are finalized.

October 20, 2004

- North Dakota held an internal meeting to review the draft Anti-Icing RFP on October 4, 2004. The draft RFP will be sent out at the beginning of January 2005. North

Dakota will meet with vendors in mid-January to fill in information in the RFP. Proposals are due March 25, 2005. The chosen vendor will design the anti-icing system. The RFP will include communication for the anti-icing system along with communication to the DMS. URS will assist by providing a plan overview of device locations and a plan detail of the bridge deck and structure to include in the RFP.

- The group discussed the architecture for Project 1.5/1.8. North Dakota would like to see a concept of operations for the future Fargo TOC. There is a concern that we proceed with the architecture for this project at the same pace North Dakota DOT is proceeding with their architecture and concept of operations. We are committed to do the design for the DMS, but want to make sure it complements the plan for the TOC in Fargo.

September 15, 2004 Project Team Meeting

- The group reviewed a draft project-level architecture for Project 1.5 and 1.8 and will offer comments prior to the next meeting.
- The group agreed on milestones and a schedule for completing Project 1.5 and 1.8.
- North Dakota will schedule an internal meeting in October to review the Red River Bridge RFP and discuss the communication of the anti-icing system.

August 17, 2004 Project Team Meeting

- A site survey was conducted that included measuring viewing distances for the location of the DMS along I-94 in North Dakota. No concerns were noted.
- Communication options were discussed. The group agreed fiber would be used for both the planned DMS and the bridge deck anti-icing system. (Project 1.5 and Project 1.8.)
- The group concluded that the communication architecture for the DMS and anti-icing system needs to be developed and a description of the communication of the anti-icing system for inclusion in the Red River Bridge Deck Anti-Icing System RFP.

July 29, 2004 Project Team Meeting

- NDSU staff gave a presentation of their VMS Composer. The VMS Composer is software currently in development. It will be used to support the process of generating VMS messages while following state standards.
- The group discussed the scope of Project 1.5 and began answering questions for deploying a DMS on I-94 Eastbound in North Dakota.
    - The location of the sign will be by 5th Street on the south side of I-94 in North Dakota
    - The DMS sign will be a full matrix permanent side mounted sign on the side of the road
    - North Dakota and Minnesota will both be able to operate the sign. An MOU will be developed to formalize the agreement.
- Communication options were discussed, however further research was needed to identify what is currently in place along I-94 in North Dakota and Wisconsin

- The group agreed that Project 1.8 (Communication for the Red River Bridge Anti-Icing) should be considered with the development of communications for the DMS and included in the RFP for the Red River Bridge Project.

July 8, 2004 Project Kickoff Meeting

- The scope of Project 1.5 was discussed. North Dakota will be using Amber Alert Grant funds to fund the deployment of the DMS on eastbound I-94. Communication options between North Dakota and Minnesota were noted.
- It was decided at the conclusion of the meeting to schedule a face-to-face meeting in Fargo to continue discussion of communication options between the states, cost estimates, and developing a memorandum of understanding.

Project 1.9
Develop a Lessons Learned Document Comparing Reporting Systems in North Dakota and Wisconsin
Highlights and Work Team Meetings

1. Project 1.9 deviation from original purpose
    a. Initially was going to look at general requirements for a state to implement a generic statewide information system identifying:
        i. Institutional arrangements
        ii. Resources
        iii. Scope
        iv. Data requirements
    b. Information was to be collected based on two case studies:
        i. Meridians IRIS limited deployment in ND
        (1) NDDOT did not proceed with plans to deploy the system
        ii. CARS limited deployment in Wisconsin
        (1) CARS was undergoing a major update to meet new NTCIP protocols. However, some initial data were collected about Wisconsin's experience with the limited deployment

2. Revised Scope:
    a. Description of new federal requirements for statewide information systems
    b. Descriptions of CARS, IRIS, and Arizona's HCRS
    c. Summary of Wisconsin's questionnaire on CARS limited deployment
    d. Review of SD DOT's report on Improved Road Condition Reporting
    e. A current listing of all available state traveler information sources available online

3. Also contacting selected states for further information about their systems. Surprisingly, many states are still working on their 511 system implementation.

Original project concept was based on the following however the major changes listed above were necessary because of changes to the affected system plans:

Wisconsin is exploring the use of Condition Acquisition Reporting System (CARS) through a limited deployment along the I-94 corridor in Wisconsin. Similarly, North Dakota is looking at possibly deploying South Dakota's system developed by Meridian. Minnesota's CARS is fully operational, however, South Dakota's system is under development.

North Dakota State University will use information generated from pilot deployment of Minnesota's CARS system and South Dakota's DOT (Meridian) system to provide specific requirements. NDSU will then use these requirements to compare the planned CARS system deployment in Wisconsin to Meridian's planned system deployment in North Dakota. The comparison will highlight cost, data, system integration, organization structure, and other relevant issues. The compatibility of the two systems will also be

examined. The product of the comparison will be a Lessons-Learned document that could guide other states in deploying similar systems.

1. Develop general requirements for developing a road condition reporting system
   a. Conduct an inventory of available systems
   b. Obtain documentation/description of systems and their implementation
   c. Summarize requirements (applicable to any state)

2. Illustrate system implementation requirements using Wisconsin and North Dakota as case studies.
   a. Develop a description for the two systems used by Minnesota and South Dakota
   b. Work with consultants (Castle Rocks and Meridian), the North Dakota DOT, and Wisconsin DOT to document the deployment approach in their respective states
   c. Identify agency related issues/requirements
3. Prepare a Lessons-Learned document that will be helpful to other states considering the implementation of similar systems.

   States considering the development of a statewide condition reporting system will benefit from information on the limited (test) deployment of the Minnesota and South Dakota systems.

The following, Chapter 5 Conclusions, are from the Project 1.9 Final Report, dated September 2005 and titled LESSONS LEARNED COMPARING ROAD CONDITION REPORTING SYSTEMS. The Advanced Traffic Analysis Center Upper Great Plains Transportation Institute North Dakota State University, Fargo, North Dakota, prepared this report. The complete Project 1.9 Final Report is included as Appendix G.

5. Conclusions Project 1.9

This study developed information on condition reporting systems from a variety of sources, including review of existing condition reporting systems, available documentations, and interviews with system integrators and agency staff. Below are some of the major observations and findings:

1. There is an increased focus on real-time information as part of a larger emphasis on systems operations and customer service. The traveling public's appetite for information is expected to only grow. With that there is an opportunity for delivering information in a variety of methods as more users have access to the Internet as well as other personal communication devices.
2. Any great information system relies on timely, accurate, and useable data. Our study has found that manual data entry is the general practice for current road condition reporting systems. Manual data entry greatly impacts the level of resources required for successfully operating the system as well as the value to travelers in terms of timeliness and accuracy of information. To increase the number of operators with time-critical data entry privileges, state DOTs should explore sharing the system with other agencies. This is especially true for law enforcement/emergency management agencies which generally have longer

operating hours and are most familiar with incidents and other events affecting system operations.

3. There may yet be great opportunities to expand the use of road condition reporting systems to other agencies, especially law enforcement (which has time-critical data) and with local jurisdictions.
4. Integration of condition reporting systems with other existing state systems continues to be an issue. This not only influences the system's ability to widen its potential users, but also how data are exchanged, including ITS data automation.
5. Database housing, management, and maintenance must be examined prior to system implementation. There could be additional restriction if the database is housed at a state agency by its respective IT department.
6. Integration/coordination between/among neighboring states' condition reporting systems are key to ensure seamless service to the traveler. Of course this requires compatibility among the various systems and protocols for exchanging information. Related to this issue are national ITS standards and possible guidelines through the proposed federal requirements for incident reporting systems.
7. New federal requirements for developing real-time information and management systems were watched closely by the states. The final language in SAFETEA-LU requires the U.S. DOT to develop data exchange formats for these systems no later than August 2007. Additionally, areas developing or updating their regional ITS architectures must explicitly address real-time highway and transit information needs and the systems needed to meet such needs. This legislation should provide additional emphasis on multi-state and multi-agency integration and coordination.
8. North/West Passage states have not only been leaders in developing traveler information systems, but have also developed special projects designed to integrate and coordinate their information systems on a multi-state/multi-agency basis. This places them in a national lead position to implement new system standards, data entry improvements, and multi-state/multi-agency coordination projects

Conclusion Project 1.9

The North/West Corridor Pooled Fund Study states are well positioned to provide a positive example of how states can work together in streamlining road and weather condition data across their borders. These states recognized the value of coordination and integration long before the passage of SAFETEA-LU and its provisions for real-time system management. They have developed and implemented projects specifically focused on solving problems of data collection, data entry, and multi-state/multi-agency sharing of resources. Further, the output of the strategic plan and corridor architecture to be undertaken in Phase II of the North/West Passage should provide valuable insights to the U.S. DOT and other states.

Appendix B

State to State Data Exchange Interface Control Document

Project 1.1 Integrate North Dakota, Wisconsin, and Minnesota Reporting System

North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.1

Integrate North Dakota, Wisconsin, and Minnesota Reporting Systems

State to State Data Exchange Interface Control Document

Prepared by:

CASTLE ROCK

September 29, 2005

North/West Passage

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Document Overview

This document has been prepared on behalf of the North/West Passage Consortium of states. The North/West Passage states have decided to exchange traveler information data between and among states with the intent of one day offering seamless traveler information along the entire corridor.

The Use of Standards for Data Exchange

It is envisioned that the North/West Passage states will not all have the same traveler information systems / condition reporting systems, but rather a collection of several different systems. The use of a message structure based on draft National ITS Standards will facilitate the exchange of data from one system to the next (i.e., from one state to another). This will allow each state's system to be upgraded or modified while still adhering to the same XML interface, and thus promoting continued exchange of data across state boundaries.

What is contained in this document

This interface control document defines the specific use of an XML message based on the Traffic Management Data Dictionary (TMDD)[1] Full Event Update (FEU) draft standard for systems to send data to the Condition Acquisition and Reporting System (CARS) currently in use in the North/West Passage states of Minnesota and Washington, and currently being deployed in Idaho.

This document also outlines two approaches for exchanging data using the standard XML interface, as follows:

- A Web services exchange (using Simple Object Application Protocol – SOAP) is defined for situations where one system will connect to another system and push events to the other system. This offers the most real-time and efficient mechanism for exchanging data, as the receiving system only receives information about those events that have recently been created or modified.

- An XML Direct transfer where the sending system posts either one or two XML web pages and allows one or more receiving systems to pull data from the XML site. This is the most simple to implement, but requires the receiving system to continuously monitor the XML pages for any new or updated events.

The general use of this document

The primary intent of this initial document is to allow the North Dakota condition reporting system (IRIS) to send data using the FEU, and for the Minnesota CARS system to receive the data. For other North/West Passage states using different condition reporting systems, this document offers a significant step towards defining the specifics of the standards exchanges. For example, should another North/West Passage state using a different condition reporting system wish to make use of this document, a simple edit of the specific interpretations and

[1] Strictly, the TMDD message sets are called "Message Sets for External Traffic Management Center Communications" (MS/ETMCC).

data mapping (to suit the local system) should be all that would be needed to convert this document to one that specifically supports exchanges with the other system.

Nomenclature used in the document

This document regularly refers to the interface as the CARS-TMC Data Exchange Interface (or, from the CARS perspective, the CARS Data Import Interface). In this sense, TMC is used in the generic term as this describes center-to-center exchange of data (as opposed to field to center, or center to device).

Concept of Operations

Traffic Management Centers (TMCs) and/or traveler information systems need to collect and share traffic/travel event and road condition information including current, planned and forecasted roadway reports about construction, incidents, obstructions, traffic conditions, special events, evacuations, homeland security alerts, and natural disasters. States use condition reporting systems as reporting tools for these transportation-related event and status reports. These condition reporting systems typically maintain a statewide conditions database and allow the exchange of event information with other centers and subsystems.

The intent of this document it to provide sufficient detail for the exchange of data between the North Dakota condition reporting system (IRIS), and the Minnesota condition reporting system (CARS) so as to allow the software programmers on each system to develop the formal data exchange mechanisms. However, the contents of this report should offer a general enough description of the use of an XML message based on the TMDD Full Event Update FEU draft standard to be tailored to describe the data flows between other condition reporting systems that do or will exist along the North/West Passage corridor.

The CARS-TMC data exchange interface will allow highway and traffic event reports to be imported from external TMCs like the North Dakota IRIS system into the Minnesota, Idaho, or Washington State CARS database. The appendices also define the SOAP and XML Direct methods of exchanging the XML messages. XML Direct publishing of events over http at a known URL can be used by agencies that may prefer not to use the (more complex) SOAP data exchange approach.

The CARS-TMC Data Exchange Interface uses an XML message based on the draft Traffic Management Data Dictionary (TMDD) standard to receive traffic event and condition data from external systems. This document defines the interface from the North Dakota IRIS system into CARS that is needed to meet the requirements of ongoing deployments within Minnesota. While the focus of this document is on traffic event and condition reporting, it is set within the more general context of overall travel event and status reporting based on the draft TMDD standard. The interface described within this document follows approaches used in the existing exchange of data from the New York State Winter Travel Advisory (WTA) system into CARS, as well as from the New York metropolitan area Transcom Regional Architecture data imports into CARS.

Since 1997, CARS deployments used the TMDD Committee's Event Report Message (ERM) as their primary means of importing and exporting event information with other CARS and CARS-related software modules. However, in December 2003 the ERM draft standard was superseded by a new event message set from TMDD. CARS states decided to migrate to the new message set at a Summit Meeting in Orlando, FL, February 2004. The principal message in the new TMDD event message set is called the Full Event Update message (FEU).

In adopting an XML message based on these new TMDD draft standards between condition reporting systems within the North/West Passage states and the CARS systems deployed along the corridor, the goal is to maintain compatibility with other CARS deployments and with the increasing numbers of other states' Conditions Systems in a standards-compliant way. The intention is to adopt those parts of the standards that serve the needs of the North/West Passage states in working with related software applications in various TMCs. There is no intention of implementing any aspects of the standards that are not yet required to support current or proposed functions.

CARS-TMC Data Exchange ICD - Interface Design Requirements

These requirements shall be read in conjunction with the CARS-TMC Data Exchange ICD Concept of Operations, which forms the first part of this document.

1. Approach

Traffic Management Centers need to collect and share event and status information about current, planned, and forecasted circumstances including traffic conditions, incidents, obstructions, road conditions, homeland security events, and natural disasters. An ITS center's area of responsibility may be an entire geographic region (e.g., a metropolitan region; a state; an urban area) or selected facilities within a region (e.g., all state-designated highways; a specific turnpike facility). Centers may delegate some or all of their responsibilities to other centers for specified locations and periods. In the Minnesota system, CARS serves both statewide and regional functions. Similarly, in the North Dakota system, IRIS serves both statewide and regional functions.

In this ICD, the North Dakota IRIS System—an external ITS center, viewed here as a Traffic Management Center—will generate traffic, road conditions and construction information and share these observations and plans with other ITS systems/centers—specifically, CARS—through use of event reports. Roadway-based traffic information may include traffic conditions (e.g., slow traffic, delays) affecting a particular segment of road. Construction information may include lane closures either happening at present or planned to happen in the future. Road conditions may include driving conditions or weather events.

The sending center can best control what information is exchanged. Some event report content may need to be filtered, being only sent to certain types of users. Receiving centers may also need to limit who has access to some types of content, e.g., for events that involve homeland security implications or personal details of injured people. However, road traffic information from ITS systems like IRIS is normally expected to be public domain.

Managing event information exchanges is challenging because events can be complex and may also have complex interrelationships with other events. Also, bandwidth constraints may limit the exchange of event reports, as system user numbers grow and statewide systems come to be used more intensively.[2] For these reasons, both the content and management of event report exchanges needs to be optimized.

The FEU implementation defined for this deployment provides an opportunity to revisit the various functional and standards requirements with a view to further system optimization, relative to earlier ERM deployments. In particular, it is important in SOAP deployments of this revised implementation to optimize event report exchanges by pushing FEU message exchanges only when events are new or updated. XML Direct can similarly be streamlined by publishing all events to one page, and event message *updates* to a separate page on (say) a five minute cycle. These measures serve to prevent the receiving system from having to read in every event each time an update occurs. The receiving system is responsible for monitoring the event duration or end time and for deleting time-expired events without requiring a further message exchange.

[2] Most event reports are exchanged over wire line systems where bandwidth is relatively plentiful. However, some exchanges use wireless links where bandwidth can be a critical factor. Also, XML is now the preferred medium of exchange, because of its great simplicity and ease of application. XML is, however, less bandwidth-efficient than many earlier data formats. It is for these reasons that bandwidth can become a consideration in the design of event exchanges.

1.1 Definition of *Event*

For the purposes of event information exchange, an event includes any travel situation (any set of travel circumstances) that an agency may wish to report. For example, event reports may describe traffic conditions, incidents, construction, maintenance activities, road or weather conditions, sports events, or VIP visits. In Minnesota CARS, traffic condition reports may stand alone or may form part of other event descriptions, such as a construction event or a crash report.

Events include not only disruptions to normal travel conditions caused by construction or traffic delays but also situations that do not immediately impact travel (e.g., planned special events such as major sports events). Also, event reports can simply convey that circumstances have returned to normal, or that delays have cleared and no longer affect travel.

1.2 Structure of Event Reports

Event reports always include the event's description, its expected duration, and its location. Additional information can also be appended to these core data to meet operational needs. In the interests of efficiency, event reports need only include these additional data when operations so require.

1.2.1 Description

Event descriptions shall be built from standard phrases, causes, and related data such as quantities. Use of standard phrases instead of free text supports greater consistency of reporting; permits automated routing and machine-processing of reports; provides for easy translation into other languages such as French or Spanish; and allows the use of pre-recorded speech for dissemination of reports to end users.

FEU messages allow the descriptive phrases and other components to be exchanged and presented to users in any sequence, as specified in the event message.

1.2.2 Duration; start and end times

Each event report must include an expected duration or end time/date. In Full Event Updates, residual durations are measured from the *update time* of each successive update—or from the start time of the event, for events that have not yet started.

Inclusion of start time and date is optional in event reports. These data are only required in future events and future event elements, such as traffic forecasts and planned road construction.

The FEU differs from the ERM in that all times are exchanged as local times. UTC offset values can also be exchanged with event times in FEU, so that message management (which may take place in another time zone) can handle *start, end* and *recurrent* times correctly. By these means, for example, an event may be announced through a national 511 center only when it is in effect locally.

FEU can handle times and dates that are either clearly inside or outside of daylight saving time, so long as the sending system selects the correct UTC offsets. In all states, event times that refer to periods where daylight saving is or is not in effect shall utilize the appropriate UTC offset. For example, an event in Minnesota updated on September 15 shall have an *update time* UTC offset of -0500. If that event's end time is on November 1, 2004, the end time's UTC offset must be -0600.

One problem that remains, however, is that of *recurrent times*, e.g. of roadwork. *Recurrent times* may span a period, part of which is in daylight saving time and part of which is not. The FEU *recurrent times* UTC offset will indicate what time zone is in effect at the start of the recurrent period, but not at the end, should that period extend into or out of daylight savings. Unless affected event messages are always resent when daylight saving changes, the receiving system needs a way of knowing whether an event's location follows daylight saving time, in order to know whether to apply a correction to UTC offset when times are changed. Fully addressing these complexities would require that a receiving system shall be able to decide what time zone the event is in, and whether daylight saving time is observed at that location.

Essentially, three states do not observe daylight saving time (AZ, HI and IN). None of these is in the NW Passage. In states each with two time zones that observe daylight saving time statewide, e.g., North and South Dakota, FEU requires that the sending center must send UTC offsets appropriate to the event's location and season. Thus, event times and dates in western South Dakota require a UTC offset of -0700 in winter and -0600 in summer. Eastern South Dakota events require an offset of -0500 in summer and -0600 in winter. In order to make sense of FEU messages, both the sending and receiving systems must know when daylight saving time starts and ends.

Also, *recurrent times* of events that span a daylight savings time change needs to be adjusted automatically by the receiving system, preferably without requiring a resend of the event information with a corrected offset. In most of the nation, including all the NW Passage states, this can best be done by assuming that daylight saving time observance is the default.

1.2.3 Location

In FEU, locations can be specified in terms of latitude/longitude (geolocation), route designator and linear reference; or by named area, such as a county through use of the Federal Information Processing System (FIPS) number.

In this CARS-TMC Data Exchange ICD, all roadway-based events shall be reported using the appropriate route designator, linear reference(s), and geolocation(s). This provides receiving systems with the ability to validate the route that is (or is expected to be) affected by the traffic event. Area-based condition reports must use the FIPS number to report conditions affecting a county or causing a regional impact.

In some exchanges, the receiving system has access to predefined location tables, which allow precise geolocations and linear references to be related to nearby and easily-described landmarks. In other cases, the event report must include all the required surrounding landmark information. Both approaches are supported in the FEU, but only the former will be supported by

the Northwest Passage data imports at this time. However, the intent of FEU is to add further location information to the basic route designator, geolocation(s), and linear reference(s) when systems such as CARS and IRIS are upgraded.

1.2.4 Quantities

Event reports may include quantities such as the length of road affected by an event; the speed of traffic on the roadway; the visibility distance; the advisory speed limit for the road segment; or the number of people injured in a crash. CARS-TMC Data Exchange–conformant applications can use quantities to provide numerical details of event impacts on the highway.

For standards compliance, FEU units are always metric, although displays to users and the public are typically converted into "English" units and rounded.

1.3 Event Structure

Event reports are structured so that they can describe both simple and complex events. Features that support this requirement include:

1.3.1 Concurrent event elements

Concurrent event elements are distinct components of complex events that may co-exist and overlap in time. Each concurrent element can have its own duration, description, and location; however, they are treated operationally as component parts of a single event. For example, precipitation affecting a roadway might cause travel delays. Some agencies would treat the delays as a separate event, distinct from the precipitation. Drivers would more likely see them as related elements of a single event. FEU supports the creation of these *concurrent event elements*.

1.3.2 Related events

An alternative way of handling concurrent event elements is to treat them as related events. Events can also, of course, be entered as if they are unrelated. Deciding whether two events should be seen as related is a matter for operators' judgment, within the framework of a center's operating practices.

FEU contains pointers that allow two separate events to be treated as related. This would allow for an alternative way of handling concurrent event elements, using a separate event message for each element. However, TMC-CARS exchanges are not expected to use this feature, as it simply replicates the functionality of Section 1.3.1 above. Thus, if complex (multi-element) events are to be exchanged, they shall utilize concurrent event elements as specified in section 1.3.1.

1.3.3 Scheduled elements

Some event reports in condition reporting systems are expected to include schedules of planned or predicted future circumstances. For scheduled future events, each element of an event

schedule shall include its own expected start and end times/dates. Like ERM, FEU supports this functionality.

In CARS-TMC Data Exchange–conformant applications, this functionality may be used to provide expected impacts that planned construction may have on a roadway segment, including lane closures and other scheduled maintenance activities.

1.3.4 Split and merged events

Circumstances initially reported as separate events may turn out to be parts of a larger, single event. Conversely, situations initially reported as one event may need to be split into separate events later. Therefore, events need to be split or merged when necessary, while maintaining histories of the splits and mergers that occur.

FEU contains new provisions for tracking split and merged events using pointers to earlier event reports. However, CARS does not currently support the explicit tracking of splits or mergers. If required for NW Passage (which is thought unlikely), this functionality can be added in the future. At present, no date is scheduled for this possible enhancement.

1.4 Event Updates

Typically, centers that exchange event information undertake to pass on the most recent event details in immediate event report updates, whenever the event report is updated in the originating center. Systems using SOAP should push updates to CARS as soon as they become known. WSDL/SOAP definitions have already been defined and proven by two separate exchanges in New York (the New York Thruway import of IEEE 1512 data into CARS and the Transcom import of FEU data into CARS) for exchanging data between separate systems. A copy of this WSDL/SOAP definition is appended to this document. Where XML Direct is utilized, a regular publication cycle is typically used instead (e.g., every five minutes).

1.4.1 Irregular updates

Events occur, and are reported and updated, at irregular intervals. Therefore, an event report update gives information about a single event. Whenever an event is updated, an event update shall be pushed to subscribing systems. Each FEU message therefore relates to a single event, which typically has unique creation and update times.

1.4.2 Full or partial reporting

Alternative strategies have been proposed for updating events:

- Full reporting is an update strategy in which all details currently known about all the elements of an event are included in the report.

- Partial reports include full details of specified event elements that have been updated. Unchanged event elements are not included in a partial report. Note therefore that partial

reporting only applies to multi-element events such as construction schedules or events with concurrent event elements.

The TMDD Partial Event Update message or PEU is only able to handle one element of a complex event or schedule at a time. Therefore, on its own it is insufficient for existing CARS deployments (which use multi-element schedules and concurrent event elements). If PEU were deployed it would need to be coupled to FEU usage for handling these event types. FEU on the other hand supports both complex and simple events, which is why it has been selected by the seventeen CARS states and provinces for all event report exchanges. Thus, only FEU will be utilized in NW Passage exchanges as well.

FEU allows both full and partial reporting strategies to be used. However, currently, CARS supports only full reporting using FEU. Therefore, initial North Dakota data imports shall use full reporting within the FEU in pushing traffic data to CARS.

1.4.3 Report selection

Update procedures are usually established through face-to-face negotiations and agreements before exchanges begin. In this case, agreements may establish information selection criteria, specifying the kinds of information to be sent, for which locations, and in what level of detail. Therefore, the sending system can select and filter what is sent to particular users.

1.4.4 Exchange initiation

Once exchanges begin, the originating center should initiate an information exchange, without receiving a specific request. The sender is usually in the best position to judge the importance of a particular event, or may choose to send the information for operational reasons. FEU allows event messages to be pushed as soon as changes occur, and this pattern shall be followed in SOAP versions of Northwest Passage data exchanges. XML Direct exchanges are expected to utilize a fixed publication cycle, e.g., every five minutes.

1.4.5 Advanced requests

Optionally, in the future, advanced request procedures (using the new TMDD "Event Filter Request" message) may be used between centers that so agree, supporting requests for information selection criteria to be adjusted in real time. However, no real-time changes in event filtering are currently required in any CARS or CARS-related exchanges. At this time, no currently planned or funded CARS enhancements require use of this new message, which shall therefore not be implemented in the current Northwest Passage deployments.

1.4.6 Event deletion

Once an event report has been received by an external center, it shall be able to be edited or updated using any of these approaches:

- *Event times out:* the event report includes an expected duration or end time for the event, after which—if not updated—the receiving system shall consider the event to have ended.

Receiving systems shall track event durations and delete events automatically when their durations or end times have been reached. Most roadway events (e.g., construction, incidents, and delays) shall use this approach.

Note that with FEU, every update that uses duration must indicate the residual duration that still remains, measured from each successive update time. If an update merely repeated the original duration, the duration countdown begins again.

- *Report times out:* the event report shall specify a period of time within which the report must be reconfirmed. Receiving systems shall track expiration periods and delete events automatically when their reconfirmation period has expired—unless, of course, they were reconfirmed. This method is typically used by NWS in relation to weather predictions such as five day forecasts, and may not be needed for Northwest Passage data imports to CARS.

- *Termination by sender:* the center that created the event can distribute an update to indicate that the event has ended, or that the event report is canceled. This option is available for use in Northwest Passage data imports to CARS where events time out unexpectedly.

- *Updating by sender:* the responsible center can update the event to show that conditions have changed (including return to normal), changing the end time for the new update.

In principle, all these approaches are supported in FEU, and all may be utilized by the North Dakota IRIS system. However, #1, #3 and #4 are considered the most likely to be needed at this time.

1.5 System Needs

Systems exchanging event information have certain functional needs:

1.5.1 Need for new event reports

Originating systems need to be able to distribute reports that describe new events. Receiving systems need to be able to distinguish new event reports from updates, ends or cancellations, e.g. by means of a unique event identifier. FEU also contains an explicit status indicator, which shows whether an event is new, updated, etc. These data fields must be included in all condition reporting system to CARS data imports, labeling each event with a unique ID and flagging when an event is new, updated, cancelled, etc.

1.5.2 Need for event report updates

Originating systems need to be able to issue updates to existing event reports that supersede previous event information. Receiving systems need to be able to distinguish event report updates and ensure that earlier event details are correctly updated. FEU does this with an update counter. This counter must be utilized in NW Passage updates to existing events, including (where necessary) incrementing the counter for planned events that start today—in

which circumstances the planned event that becomes a current event shall keep the same event ID and shall have its update counter incremented.[3]

1.5.3 Need for event-ended indicator

Although most reports stored in receiving systems are ended as a result of timing-out, some events end earlier than expected. Originating systems need an efficient way to indicate that an event has ended. In FEU this can be handled by means of the status indicator, which can be set to *"ended". Event element detail* is optional to avoid the need to resend all event details when an event is ended ahead of timeout, thus minimizing bandwidth use in this scenario. However, use of the status indicator to flag the early end of an event is the *only* way to ensure that it is deleted from a receiving system in a timely fashion and must be supported in CARS data imports.

1.5.4 Need for report cancellation indicator

Originating systems may also need to cancel a report that was distributed in error. FEU contains such provisions – in FEU, using a status of *"cancelled"*. However CARS does not currently support the explicit cancellation of erroneous events, and no plans or funding currently exist for adding this function. It is not expected to be used in NW Passage data imports to CARS. Cancelled events can however be immediately ended, as noted in section 1.5.3 above.

1.5.5 Need for event report recap

A receiving system may need a complete recap of all currently valid events in order to re-synchronize its own internal database. Event recap is a function of the dialogs or "wrappers" that surround the event messages; thus, recap can be handled in the SOAP message wrapper. On-demand recap shall also be handled using an XML Direct page that lists all current events.

1.5.5.1 Current support for event report recap

The following event report recap data exchange scenario shall be supported in SOAP versions of the CARS TMC Data Exchange interface deployment.

On a 24-hour cycle, the sending center shall push an event report recap to the CARS TMC Data Import interface. By default, the recap push shall occur between the hours of midnight and 12:59:59 AM, according to the time zone in which the sending center resides. The recap will contain FEU reports for all currently valid events, including those that are scheduled to start in the future. The recap message shall be time-stamped, and the CARS TMC Data Import Interface shall acknowledge receipt of the recap using standard SOAP response protocols. The recap message shall be distinguishable from real-time event exchange messages by the "Recap" wrapper tag that surrounds it.

[3] Note that when the start time of a planned event is reached, CARS will automatically assume that it has started. It is not necessary to send an update to this effect. An update is only required, in fact, if it didn't start on time; in which case the update would need to revise the start time.

It is the responsibility of the receiving system (i.e., CARS) to synchronize its internal database of events against the contents of the recap upon receipt of the message. Whenever CARS notices a discrepancy between the recap message and its internal database of events, it shall correct the database. Events that do not appear in the recap message but are still open in CARS shall be ended. New events that appear in the recap message but not in the CARS database shall be added, as well as updates that were not previously received. When any of these discrepancies occur, the CARS TMC Data Import Interface shall note the details in an error log. It shall also email those details to system administrators.

If the CARS TMC Data Import Interface does not receive the event report recap during the expected timeframe (default midnight–2:00 AM), it shall email system administrators.

If the sending center cannot reach the receiving system after 3 attempts to send the recap message, it shall email system administrators.

1.5.5.2 Additional support for event report recap on-demand

In future versions of the CARS TMC Data Import Interface, an on-demand event recap model shall be supported. This model will allow the receiving center to receive recaps on an as-needed basis.

In this model, when CARS needs an event report recap, it shall read an XML Direct page published by the sending center.

Note that it is the responsibility of the receiving system (initially, CARS) to buffer all FEU messages that it receives between system startup and its XML Direct read of the remote system. After receiving the database of all currently active events from in the XML Direct page, it shall compare the timestamp of each buffered FEU message to the timestamp of the XML Direct message. FEUs that are timestamped prior the XML Direct timestamp shall be ignored; FEUs that are timestamped after the XML Direct timestamp shall be reconciled against the database of currently active events.

Appendix A

Mapping FEU Messages for CARS-TMC Data Exchanges

Mapping FEU Messages for CARS-TMC Data Exchanges

This section maps the FEU to the data elements necessary for effective traffic event information transfer between condition reporting systems in the NW Passage. Lines shown in gray are optional items that are not initially expected to be used in current systems. They are included here in case a future use is identified in conditions system applications. As the data elements and data frames become necessary, they may be changed from gray to black and implemented in successive system upgrades.

The full event update can be used to exchange information about any event, including both simple and complex events, i.e. events with either single or multiple elements. In the full event update, events are described using standard phrases, causes, advice, qualifiers, quantities, related locations and additional free text. Operator comments can also be added to the full event update. Also, the full text of the event report as presented over one or more dissemination media can be optionally appended.

1. Top Level Data Frame

This frame defines the high-level structure of FEU reports, as follows:

message-header: initial information used at the start of a message (Section 1.1)
event-reference: a unique reference to the event (Section 1.2)
project-references: optionally, references to a project related to the event (Section 1.3)
event-indicators: optionally, indicators like event status, event priority (Section 1.4)
other-references: optional references to other messages (Section 1.5)
headline: the key phrase and reference to its event element (Section 1.6)
details: event description, location, times, etc. for each event element (Section 2).
operator-comments: optional operator comments, not for public use (Section 2.6)
*full-report-text*s: optionally, the full text of the event report as presented over one or more dissemination media (Section 2.7). This data frame is not proposed for implementation in NW Passage at this time.

```
FullEventUpdate::= SEQUENCE
{
    message-header          MessageHeader,
    event-reference         EventReference,
    project-references      SEQUENCE OF ProjectReference OPTIONAL,
    event-indicators        SEQUENCE OF EventIndicator OPTIONAL,
    other-references        SEQUENCE OF OtherReference OPTIONAL,
    headline                EventHeadline,
    details                 SEQUENCE OF EventElementDetail OPTIONAL,
    operator-comments       EventComments OPTIONAL,
    full-report-texts       SEQUENCE OF FullReportText OPTIONAL
}
```

The event element detail frame (which carries most of the essential information about an event) becomes optional in FEU when an event ends (using *"ended"* in the *status* within e*vent-indicators*), so that its details need not be sent again. Otherwise, it must be sent once per event element.

1.1 Message Header

This frame defines the message header for FEU reports. It contains data frames to be used as follows:

sender: the organization sending the message (Section 1.1.1)
recipients: optionally, organizations receiving the message (Section 1.1.1). This data frame is not currently proposed for use in NW Passage exchanges.
responders: optionally, organizations responding to the message (Section 1.1.1). This data frame is not currently proposed for use in NW Passage exchanges.
message-time-stamp: the date/time/zone the message was created (Section 1.1.2).
message-expiry-time: the date/time/zone after which the message content is no longer valid and shall be deleted from recipients' databases (Section 1.1.2).

```
MessageHeader ::= SEQUENCE
{
    sender                  OrganizationInformation,
    recipients              SEQUENCE OF OrganizationInformation OPTIONAL,
    responders              SEQUENCE OF OrganizationInformation OPTIONAL,
    message-type-version    Event-message-type-version,          --3803
    message-number          Event-message-number,                --3804
    message-time-stamp      DateTimeZone,
    message-expiry-time     DateTimeZone OPTIONAL
}
```

Sender uses the data frame OrganizationInformation.

Message type version is implemented for easing the move from older to newer versions of exchange messages. It is used to prevent legacy systems trying to read new versions of the message which they would not understand. It is to be incremented whenever the XML is changed. The initial version to be used here is Version 1.

Message expiry time shall be used to indicate when a particular event no longer applies. One example would be weather forecasts, whose period of validity often ends before the forecasts periods themselves end. For example, a 5-day forecast may be valid only until midnight tonight, by which time it should have been re-issued. The receiving system shall check that the event is still valid before the "renew by" date is exceeded.

1.1.1 Organization Information

This frame *must* be used in FEU to reference the sender agency. It may also be used to reference the original information source. It contains two data frames, to be used as follows:

last-update-time: the last time that the organization information was updated (Section 1.1.2). This data frame is not currently proposed for use in NW Passage exchanges.

contact-details: contact details of the responsible person in the organization (Section 1.1.1.1).

This frame will carry organization and center identifiers in FEU reports:

```
OrganizationInformation::= SEQUENCE
{
    organization-id          Organization-identifier,                    --3343
    organization-name        Organization-name OPTIONAL,                 --3344
    organization-location    Organization-location OPTIONAL,             --3104
    organization-function    Organization-function OPTIONAL,             --3354
    center-id                Organization-center-identifier OPTIONAL,    --3217
    center-name              Organization-center-name OPTIONAL,          --3355
    last-update-time         DateTimeZone OPTIONAL,
    contact-details          ContactDetails OPTIONAL
}
```

While *center-id* is optional in FEU, it is mandatory in CARS applications. So, for example, in CARS FEU messages, *organization-id* could be **NDDOT** and *center-id* could be **CENTER1, CENTER2**, etc., for the various state centers. Most states that deploy a statewide system will likely have only one "virtual" TMC statewide.

ContactDetails will also be needed to carry the *author* information, if data from NW Passage states is entered by a defined TMC operator.

1.1.1.1 Contact Details

This frame is used to carry a *'contact identifier'* in FEU reports. All the other elements are not proposed for use in NW Passage data exchanges at this time.

```
ContactDetails ::= SEQUENCE
{
    contact-id               Contact-identifier,                         --3105
    person-name              Contact-person-name OPTIONAL,               --3206
    person-title             Contact-person-title OPTIONAL,              --3349
    organization-id          Organization-identifier OPTIONAL,           --3343
    organization-name        Organization-name OPTIONAL,                 --3344
    phone-number             Contact-phone-number OPTIONAL,              --3207
    phone-alternate          Contact-phone-alternate OPTIONAL,           --3113
    mobile-number            Contact-mobile-phone-number OPTIONAL,       --3350
    fax-number               Contact-phone-fax OPTIONAL,                 --3205
    pager-id                 Contact-pager-identifier OPTIONAL,          --3346
    pager-number             Contact-pager-number OPTIONAL,              --3347
    email-address            Contact-email-address OPTIONAL,             --3204
    radio-unit               Contact-radio-unit-identifier OPTIONAL,     --3208
    address-line1            Contact-mailing-address-line1 OPTIONAL,     --3339
    address-line2            Contact-mailing-address-line2 OPTIONAL,     --3340
    city                     Contact-mailing-address-city OPTIONAL,      --3338
    state                    Contact-mailing-address-state OPTIONAL,     --3341
    zip-code                 Contact-mailing-address-zip OPTIONAL,       --3342
    country                  Contact-mailing-address-country OPTIONAL,   --3373
}
```

Where this frame occurs in *organization-id* (Frame 1.1.1), it is required to carry *"contact-id"* which references the author of the event report (see Frame 1.2).

1.1.2 DateTimeZone

This frame is required to carry time and date information in all FEU reports. All times are expressed as local times, for the sending center or the event primary location, according to context.

```
DateTimeZone ::= SEQUENCE
{
    date                Time-local-date,            --3398
    time                Time-local-time,            --3397
    utc-offset          Time-utc-offset OPTIONAL    --3376
}
```

OPTIONAL is grayed-out in utc-offset because it is proposed that all NW Passage event exchanges include UTC Offset.

Three FEU times are expected to conform with local time at the sending center, e.g., the DOT headquarters that conceptually hosts the system:

- The *message time stamp* (Section 1.1),
- The *message expiry time* (Section 1.1),
- Where used, *last update time* (Section 1.1.1). However, this data frame is not currently proposed for use in NW Passage exchanges.

For example, in Minnesota, which uses Central Daylight Time in summer, the required UTC offsets must be -0500 (summer) and -0600 (winter).[4]

Example 1.1: First draft representation of FEU XML for Frame 1.1

The message header might look something like this in XML:

```
<full-event-update>
 <message-header>
  <sender>
   <organization-information>
    <organization-id>MNDOT</organization-id>
    <center-id>MNCARS</center-id>
    <contact-details>
     <contact-id>admin</contact-id>
    </contact-details>
   </organization-information>
  </sender>
  <message-type-version>1</message-type-version>
```

[4] Note that the UTC offset of the message time stamp and the UTC offset defaults are determined by the local time in St. Paul, even though the Minnesota CARS system is actually hosted in Atlanta, GA, and Portland, OR.

```
    <message-number>206</message-number>
    <message-time-stamp>
      <date>20040205</date>
      <time>095859</time>
      <utc-offset>-0600</utc-offset>
    </message-time-stamp>
  </message-header>
```

1.2 Event Reference

This frame defines the event reference in FEU reports:

```
EventReference ::= SEQUENCE
{
    event-id            Event-identifier,                          --3215
    update              Event-update,                              --3293
    response-plan-id    Event-response-plan-identifier OPTIONAL    --3269
}
```

Note that the *update* DE is an INTEGER (1 .. 65535). If an event ever reaches 65535, it shall *not* return to zero. Instead, the event must be ended, and a new event created with the same details but a new event ID number. This will ensure that later updates always have higher update numbers than earlier updates.

response-plan-id is an optional DE that is not currently implemented in CARS 3. It may be implemented in CARS 4. Any data received in this field in initial NW Passage data exchanges will be ignored.

Example 1.2: First draft representation of FEU XML for Frame 1.2

```
  <event-reference>
    <event-id>MNCARS-206</event-id>
    <update>1</update>
  </event-reference>
```

1.3 Project Reference

This data frame in FEU reports is generally used to provide information regarding construction and other related projects. This is not used in CARS 3 for traffic events and it will not be used in the initial CARS-TMC Data Exchange Interface. However, it may be implanted in CARS 4. If these data are available from other NW Passage states they can be sent so that they will become available for use in 2005/06. Or, it may be decided that this information does not need to cross state lines.

This data frame references one other data frame as follows:

project-contacts: contains contact details for the project or special event (Section 1.1.1).

```
ProjectReference ::= CHOICE
```

```
{
    project-reference          Event-project-reference,              --3807
    permit-reference           Event-planned-permit-reference,       --3379
    project-contacts           OrganizationInformation,
    project-description        Event-project-description             --3380
}
```

1.4 Event Indicator

This frame defines an event indicator in FEU reports:

```
EventIndicator ::= CHOICE
{
    category                   Event-category,                       --3381
    status                     Event-incident-status,                --3313
    priority                   Event-description-priority-level      --3301
}
```

category is merely a mapping of the headline event type into an enumerated data element. It adds nothing that is not already conveyed elsewhere. This data frame is not currently proposed for use in NW Passage exchanges.

status is a data element that will clarify whether an event is updated, ended, canceled, etc. It must be used for status *"ended"* to signify the unexpected early ending of an event. The other status values are not currently proposed for use in NW Passage exchanges. When CARS receives the status *'ended'* it shall immediately set the end time of the event to the present time, so the event will be terminated.

priority applies to the whole event and not just to an event element (a change from ERM).

Example 1.4: First draft representation of FEU XML for Frame 1.4

```
<event-indicators>
  <status>ended</status>
  <priority>2</priority>
</event-indicators>
```

1.5 Other References

This data frame is not currently proposed for use in NW Passage exchanges. It contains data frames that are used in FEU as follows:

trip-reference: a pointer to a scheduled transit vehicle trip that is referenced by an event (TMDD 3952)
related-event: pointer to another event that can be viewed as part of a larger, compound event (Section 1.2)
responsible-event: a simultaneous or earlier event that can be regarded as the reason for this event (Section 1.2)
previous-event: another event that must end before this event can start, e.g. in an evacuation sequence of a response plan (Section 1.2)

split-event: an earlier event that was split to form this event (Section 1.2)
merged-event: an earlier event that was merged to form this event (Section 1.2)
sibling-event: an event that was created by merging or splitting this event (Section 1.2)
associated-device: a field device such as a DMS or an RWIS, related to the event (Section 1.5.1)
associated-url: a URL at which additional information about the event can be found (e.g., photograph of the event or its impacts; orthophoto; maps of recommended detours).

```
OtherReference ::= CHOICE
{
    trip-reference          SCH-TripID,                     --3952
    related-event           EventReference,
    responsible-event       EventReference,
    previous-event          EventReference,
    split-event             EventReference,
    merged-event            EventReference,
    sibling-event           EventReference,
    associated-device       DeviceReference,
    associated-url          UrlReference
}
```

Northwest Passage states may decide to add some or all of these features to future data exchanges, but this data frame is not currently proposed for use.

1.5.1 Device Reference

This data frame is not currently proposed for use in NW Passage exchanges. It defines a device such as a DMS in an FEU report:

```
DeviceReference ::= SEQUENCE
{
    device-id               Device-identifier,              --3701
    device-type             Device-type OPTIONAL            --3747
}
```

1.5.2 URL Reference

This frame will not be used in the CARS-TMC Data Exchange Interface. For reference, this frame defines a URL in an FEU report:

```
UrlReference ::= SEQUENCE
{
    url                     Url,                            -- new
    url-type                Url-type[5] OPTIONAL            -- new
}
```

[5] Enumerated list: 1= still-image; 2 = video-image; 3 = 511-audio-file; 4 = HAR-audio-file; 5 = other-audio-file; 6 = map-of-suggested-detour; 7 = other-graphics-file.

1.6 Event Headline

This frame defines the headline (key phrase) in FEU reports. In the CARS-TMC Data Exchange Interface, this element must contain a phrase that defines the primary traffic condition that has resulted in the event being reported (e.g., accident).

The *headline element* allows any element within an FEU to be designated as the headline element. However, initially at least, the *headline-element* data element is not proposed for use in NW Passage exchanges.

This data frame uses one other frame, as follows:

headline: the key phrase within the event description (Section 1.6.1).

```
EventHeadline ::= SEQUENCE
{
    headline            EventType,
    headline-element    Event-headline-element OPTIONAL        --3384
}
```

1.6.1 Event Type

In relation to CARS-TMC Data Exchange Interface use, many data elements within the *EventType* data frame provide eligible phrases for use in describing traffic and road construction.

```
EventType ::= CHOICE
{
    traffic-condition       Event-description-type-traffic-conditions,      --3817
    incident                Event-description-type-incident,                --3818
    closure                 Event-description-type-closure,                 --3819
    roadwork                Event-description-type-roadwork,                --3213
    obstruction             Event-description-type-obstruction,             --3822
    delay                   Event-description-type-delay-status-cancellation, --3830
    unusual-driving         Event-description-type-unusual-driving,         --3831
    mobile-situation        Event-description-type-mobile-situation,        --3832
    device-status           Event-description-type-device-status,           --3833
    restriction             Link-restriction-class,                         --3025
    response-status         Event-description-type-incident-response-status, --3885
    disaster                Event-description-type-disaster,                --3880
    disturbance             Event-description-type-disturbances,            --3884
    sporting-event          Event-description-type-sporting-events,         --3886
    special-event           Event-description-type-special-event,           --3214
    parking-information     Event-description-type-parking-information,     --3835
    system-information      Event-description-type-system-information,      --3836
    weather-condition       Event-description-type-weather-condition,       --3299
    precipitation           Event-description-type-precipitation,           --3825
    wind                    Event-description-type-wind,                    --3826
    visibility-air-quality  Event-description-type-visibility-air-quality,  --3827
    temperature             Event-description-type-temperature,             --3828
    pavement-condition      Event-description-type-pavement-condition,      --3298
```

```
    winter-driving-restriction    Event-description-type-winter-driving-restrictions,    --3888
    winter-driving-index          Event-description-type-winter-driving-index            --3823
}
```

Example 1.6: Draft representation of FEU XML for Frame 1.6

```
    <headline>
      <pavement-conditions>surface-water-hazard</pavement-conditions>
 </headline>
```

2. Event Element Detail

Events can have one or more event elements. Simple events have only one element, while complex event descriptions are built up from multiple elements. For example, a roadwork causing delay typically has two elements: a roadwork element that lasts for weeks or months; and a delay element that lasts for minutes or hours. The full event update can be used to describe both complex and simple events.

Element-id is required if:

(1) this is a complex event with more than one concurrent event elements;
(2) this element is part of a schedule (to identify an element of a planned construction schedule).
(3) this element is part of a sequential forecast, presenting the situation as it is predicted to appear at various times into the future.

An element-id in a forecast is a reference to successive, forecast descriptions of the event as it is expected to develop through time. Higher forecast element identifiers describe the event as it is currently predicted to evolve in successively later time periods. For events with only one element, element-id shall equal “1” (the default value).

Event elements that refer to the same moment in time can be identified by their start times (for future elements) and end times or durations (which will define wholly or partly concurrent periods). Elements that refer to successive forecast situation descriptions have start and end times that define consecutive periods, or they have consecutive forecast times. It is also possible to have multiple event elements relating to time period "1", and multiple elements relating to time period "2", etc.

This data frame includes other data frames that are used as follows:

descriptions: what is happening in each event element (Section 2.1)
locations: where it is happening (Section 2.2)
times: when it is happening (Section 2.3)
lanes: optionally, one or more lanes affected (Section 2.4)
source: optionally, the original source of the event information (Section 2.5).

This frame defines an event element in FEU reports. It MUST be used at least once in all event reports except those with a status of *‘ended’* or *‘cancelled’*:

```
EventElementDetail ::= SEQUENCE
{
    element-id              Event-element-identifier DEFAULT 1,              --3378  confidence
                    Event-description-confidence-level OPTIONAL,     --3300
    access                  Event-access-level DEFAULT 1,                    --3815
    descriptions            SEQUENCE OF ElementDescription,
    locations               SEQUENCE OF EventLocation,
    times                   EventTimes,
    lanes                   SEQUENCE OF EventLane OPTIONAL,
    source                  EventSource OPTIONAL
}
```

locations is a sequence of *EventLocation*, allowing one event to span multiple locations. Typically, this is used for multiple counties in road and weather condition reports. (Note however that a 'location' can mean either a single point or a stretch of roadway between two points.)

2.1 Element Description

This FEU frame determines how event descriptions are created in FEU messages. It includes the following data frames:

phrase: part of the description of the event element, using national ITS standard phrases. Each phrase conveys a single concept, e.g. Overturned truck (Section 1.6.1)
cause: a standard phrase that is judged to be the reason (or part of the reason) for the event, e.g. Stopped traffic due to roadwork (Section 1.6.1)
advice: additional information added to a event description for public safety or traveler information reasons, e.g. Dense fog, keep your distance (Section 2.1.2)
qualifier: additional information added to an event description that further qualifies the description, e.g. Accident in the left lane (Section 2.1.3)
quantity: event elements can be quantified by one or more quantities (Section 2.1.4)
landmark: a named location other than that of the event, that forms part of an event description (Section 2.1.5)
detour: an alternative route, either suggested or required, e.g., Detour for traffic traveling towards New York (Section 2.1.6)
additional-text: additional description information can be added through free text for dissemination to end users (Section 2.1.7).

```
ElementDescription ::= CHOICE
{
    phrase                  EventType,
    cause                   EventType,
    advice                  EventAdvice,
    qualifier               EventQualifier,
    quantity                EventQuantity,
    landmark                Landmark,
    detour                  Detour,
    additional-text         AdditionalText
}
```

Quantities can be assigned to any point within a description. Likewise, advice, qualifiers, landmarks, free text, etc., can be used anywhere within a description.

Landmark names (that is, locations off the road network) within event descriptions were not in ERM and are not currently supported in CARS. Currently they cannot be used for data imports into CARS from other NW Passage states.

2.1.1 Event Type

These two instances of event type (in *phrase* and *cause*) are exactly the same as Frame 1.6.1.

2.1.2 Advice

This FEU frame determines how advice is added to descriptions in FEU messages.

```
EventAdvice ::= CHOICE
{
    suggestion              Event-description-advice-suggestion,              --3842
    warning                 Event-description-advice-warning,                 --3840
    recommendation          Event-description-advice-instruction-recommend,   --3843
    instruction             Event-description-advice-instruction-mandatory,   --3882
    alternative-route       Event-description-advice-alternate-route          --3814
}
```

2.1.3 Qualifier

This FEU frame determines how qualifiers are added to descriptions in FEU messages.

```
EventQualifier ::= CHOICE
{
    generic-qualifier       Event-description-type-qualifier-generic,         --3847
    generic-location        Event-description-type-location-generic,          --3846
    lane-roadway            Event-description-type-lane-roadway,              --3844
    transit-mode            Event-description-type-transit-mode,              --3879
    vehicles-affected       Event-description-type-vehicle-group-affected,    --3887
    travelers-affected      Event-description-type-traveler-group-affected,   --3851
    responders-affected     Event-description-type-responder-group-affected,  --3883
    response-equipment      Event-description-type-incident-response-equipment --3881
}
```

Example 2: Draft representation of FEU XML for Frame 2.1

```
<element-description>
  <phrase>
    <eventType>
      <visibility-air-quality>dense-fog</visibility-air-quality>
    </eventType>
  </phrase>
</element-description>
```

2.1.4 Event Quantity

This FEU frame determines how quantities are added to descriptions in FEU messages. CARS currently supports most of these quantities (see below for details).

```
EventQuantity ::= CHOICE
{
    extent                  DataExtent,
    information             DataInformation,
    link-state              DataLinkState,
    incident-details        DataIncidentDetails,
    road-weather            DataRoadWeather,
    parking                 DataParking,
    surface-conditions      DataSurfaceConditions,
    link-restrictions       DataLinkRestrictions
}
```

All quantities must be converted to metric for conformance with data exchange standards.
It should also be noted that while the TMDD units within FEU use a version of metric units, they are not always logical units that field and data entry staff would use. Selection of appropriate GUI units (in both English and Metric systems) must be considered separately from units used in FEU exchanges.

Table 1 summarizes the conversion rules applicable to the units that are used in FEU. To calculate the value to be written in FEU, it is necessary to take the value in English units and insert it into the Condition Reporting System (CRS) variable of the conversion equation. The 'FEU' variable will equate to the quantity expressed in metric units. To convert data from metric units to English units, insert the value into the 'FEU' variable of the conversion equation and the 'CRS' value will provide the quantity in English units. A check for the conversion is also provided.

TABLE 1 Conversion for Quantities within FEU and CRS Systems

Quantity	TMDD / Metric Unit	CRS / English Unit	Conversion CRS to FEU	Conversion FEU to CRS	Conversion Check
Extent					
length-affected	Tenth of a kilometer	miles	FEU = CRS x 16.093	CRS = FEU / 16.093	1mi = 16.09344 1/10 of a km
proportion-affected	Percent	Percent	FEU = CRS	CRS = FEU	-
above-altitude	Tenth of a meter	Feet	FEU = CRS x 3.048	CRS = FEU / 3.048	1 ft = 3.048 1/10 of m
below-altitude	Tenth of a meter	Feet	FEU = CRS x 3.048	CRS = FEU / 3.048	1 ft = 3.048 1/10 of m
Quantity-range	Parts per thousand	Integer *	FEU = CRS	CRS = FEU	-
Data Information					
Frequency-am	Tenths of a kilohertz	hertz *** change to kHz.	FEU = CRS x 10	CRS = FEU x 0.1	1 kHz = 10 Tenths of kHz
Frequency-fm	Megahertz (x10)	hertz *** change to MHz	FEU = CRS x 0.1	CRS = FEU x 10	1 MHz = 0.1 Mhz x(10)
Phone-number	Str upto 32 char	Str upto 32 char	FEU = CRS	CRS = FEU	-

Channel-number	Identifier	channel *	FEU = CRS	CRS = FEU	-
Data Link State					
Delay	seconds	minutes	FEU = CRS x 60	CRS = FEU / 60	1 min = 60 sec
Headway	Seconds	integer *	FEU = CRS	CRS = FEU	-
Travel-time	Seconds	integer *	FEU = CRS	CRS = FEU	-
Capacity	vehicle/hour	Integer	n/a	n/a	-
Capacity-remaining	Percent	Percent	FEU = CRS	CRS = FEU	-
Travel-time-increase	Percent	Percent ****	FEU = CRS	CRS = FEU	-
Speed-average	km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.609344 km/h
Speed-vehicle-estimated	km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.609344 km/h
Data Incident Details					
Vehicles-involved	vehicles	Integer *	FEU = CRS	CRS = FEU	-
Cars involved	Vehicles (cars)	Integer *	FEU = CRS	CRS = FEU	-
Trucks-involved	Vehicles (trucks)	Integer *	FEU = CRS	CRS = FEU	-
Buses-involved	Vehicles (buses)	Integer *	FEU = CRS	CRS = FEU	-
fatalities	Fatalities	People	FEU = CRS	CRS = FEU	-
injuries	Injuries	People	FEU = CRS	CRS = FEU	-
Major-injuries	Persons	People	FEU = CRS	CRS = FEU	-
Minor-injuries	Persons	People	FEU = CRS	CRS = FEU	-
Data Road Weather					
Wind-direction	Degrees	Degrees	FEU = CRS	CRS = FEU	-
Wind-speed	Tenths of m/s	MPH	FEU = CRS x 4.47039	CRS = FEU / 4.47039	1 MPH = 4.4704 1/10 of m/s
Air-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32) / 0.18]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Dewpoint-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32) / 0.18]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Max-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32) / 0.18]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Min-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32) / 0.18]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Relative-humidity	percent	percent	FEU = CRS	CRS = FEU	-
Atmospheric pressure	Tenths of a milibar	Inches (of mercury)	FEU = CRS x 338.639	CRS = FEU / 338.639	1 inch of Hg = 338.639 1/10 of a mb
Precip-rate	tenths of grams per square meter per second (rain = 0.36 mm/hr)	Inches per hour	FEU = CRS x 9.144	CRS = FEU / 9.144	1 Inches/hr = 9.144 1/10 of g/m*m /second
Snowfall-accum-rate	10^7 meters per second (~0.36 mm/hr)	Inches per hour	FEU = CRS x 9.144	CRS = FEU / 9.144	1 Inches/hr = 9.144 1/10 of gr/m2 /second
Visibility	Tenths of meters	feet	FEU = CRS x 3.048	CRS = FEU / 3.048	1 feet = 3.048 1/10 of meters
uv-index	integer	integer	FEU = CRS	CRS = FEU	-

Probability	percent	percent	FEU = CRS	CRS = FEU	-
Data Parking					
Parking-spaces	Parking spaces	spaces	FEU = CRS	CRS = FEU	-
Parking-occupancy	percent	vehicles	FEU = CRS	CRS = FEU	-
Data Surface Conditions					
Water-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Adjacent-snow-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Roadway-snow-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Roadway-snow-pack-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Ice-thickness	millimeter	Inches	FEU = CRS x 25.4	CRS = FEU / 25.4	1 inch = 25.4 mm
Surface-temperature	Tenths of deg Celsius	deg F	FEU = [(CRS-32) * 5.5555]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Pavement-temperature	Tenths of deg Celsius	deg F	FEU = [(CRS-32) * 5.5555]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Surface-water-depth	millimeter	Inches	FEU = CRS x 25.4	CRS = FEU / 25.4	1 inch = 25.4 mm
Surface-salinity	parts per one hundred thousand	percent *	FEU = CRS	CRS = FEU	-
Surface-freeze-point	Tenths of deg Celsius	deg F	FEU = [(CRS-32) * 5.5555]	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Mobile-friction	percent	percent	FEU = CRS	CRS = FEU	-
Data Link Restrictions					
Speed-limit-advisory	Km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.6093 km/h
Speed-limit	Km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.6093 km/h
Speed-limit-truck	Km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.6093 km/h
Restriction-length	centimeters	Feet	FEU = CRS x 30.48	CRS = FEU / 30.48	1 ft = 30.48 cm
Restriction-height	centimeters	Feet	FEU = CRS x 30.48	CRS = FEU / 30.48	1 ft = 30.48 cm
Restriction-width	centimeters	Feet	FEU = CRS x 30.48	CRS = FEU / 30.48	1 ft = 30.48 cm
Restriction-weight-vehicle	kilograms	Pounds	FEU = CRS x 0.4536	CRS = FEU / 0.4536	1 kg = 0.4536 lbs
Restriction-weight-axle	kilograms	Pounds	FEU = CRS x 0.4536	CRS = FEU / 0.4536	1 kg = 0.4536 lbs
Restriction-axle-count	axles	Axles	FEU = CRS	CRS = FEU	-

NOTES:

* CRS units are internal default assigned units. CRS units should be considered same as FEU units. No conversion needed.

** CRS to input wind direction as a bearing in degrees. CRS units would then be same as FEU units. No conversion needed.

2.1.4.1 Extent

The FEU (metric) definition is:

```
DataExtent ::= CHOICE
{
    length-affected          Event-length-affected,                    --3856
    proportion-affected      Event-proportion-affected,                --3857
    above-altitude           Event-location-coordinates-above-altitude, --3858
    below-altitude           Event-location-coordinates-below-altitude, --3859
    quantity-range           Event-quantity-range                      --3276
}
```

2.1.4.2 Data Information

The FEU definition is:

```
DataInformation ::= CHOICE
{
    frequency-am             Event-frequency-am,                       --3873
    frequency-fm             Event-frequency-fm,                       --3874
    phone-number             Contact-phone-number,                     --3207
    channel-number           Event-broadcast-channel-number            --3876
}
```

2.1.4.3 Data Link State

The FEU definition is:

```
DataLinkState ::= CHOICE
{
    delay                    Link-delay,                               --3005
    alternate-route-delay    Link-alternate-route-delay,               --3894
    headway                  Link-headway,                             --3892
    travel-time              Link-travel-time,                         --3038
    capacity                 Link-capacity,                            --3003
    capacity-remaining       Link-capacity-existing,                   --3864
    travel-time-increase     Link-travel-time-increase,                --3861
    speed-average            Link-speed-average,                       --3033
    speed-vehicle-estimated  Event-speed-vehicle-estimated,            --3862
    description-time         Event-description-time,                   --3895
    density                  Link-density,                             --3006
    occupancy                Link-occupancy,                           --3020
    volume                   Link-volume                               --3040
}
```

The grayed-out quantities are not proposed initially for NW Passage data exchanges.

2.1.4.4 Data Incident Details

The FEU definition is:

```
DataIncidentDetails ::= CHOICE
{
    vehicles-involved       Event-incident-vehicles-involved-count,     --3318
    cars-involved           Event-incident-cars-involved-count,         --3890
    trucks-involved         Event-incident-trucks-involved-count,       --3891
    buses-involved          Event-incident-buses-involved-count,        --3889
    fatalities              Event-incident-human-fatalities-count,      --3303
    injuries                Event-incident-human-injuries-count,        --3304
    major-injuries          Event-incident-human-major-injuries-count,  --3865
    minor-injuries          Event-incident-human-minor-injuries-count   --3866
}
```

2.1.4.5 Data Road Weather

The FEU definition is:

```
DataRoadWeather ::= CHOICE
{
   wind-direction          EssAvgWindDirection,                --3910
   wind-speed              EssAvgWindSpeed,                    --3911
   wind-gust-speed         EssMaxWindGustSpeed,  -- see NTCIP ESS section 3.6.6
   air-temp                EssAirTemperature,                  --3908
   dewpoint-temp           EssDewpointTemp,                    --3912
   max-temp                EssMaxTemp,                         --3914
   min-temp                EssMinTemp,                         --3915
   relative-humidity       EssRelativeHumidity,                --3922
   atmospheric-pressure    EssAtmosphericPressure,             --3909
   precip-rate             EssPrecipRate,                      --3920
   snowfall-accum-rate     EssSnowfallAccumRate,               --3925
   visibility              EssVisibility,                      --3932
   uv-index                Ess-uv-index,
   probability             Ess-probability
}
```

2.1.4.6 Data Parking

The FEU definition is:

```
DataParking ::= CHOICE
{
    parking-spaces          Event-parking-number-of-spaces,     --3871
    parking-occupancy       Event-parking-occupancy             --3872
}
```

2.1.4.7 Data Surface Conditions

The FEU definition is:

```
DataSurfaceConditions ::= CHOICE
{
   water-depth                EssWaterDepth,                --3934
   adjacent-snow-depth        EssAdjacentSnowDepth,         --3907
   roadway-snow-depth         EssRoadwaySnowDepth,          --3923
   roadway-snow-pack-depth    EssRoadwaySnowPackDepth,      --3924
   ice-thickness              EssIceThickness,              --3913
   surface-temperature        EssSurfaceTemperature,        --3930
   pavement-temperature       EssPavementTemperature,       --3917
   surface-water-depth        EssSurfaceWaterDepth,         --3931
   surface-salinity           EssSurfaceSalinity,           --3928
   surface-freeze-point       EssSurfaceFreezePoint,        --3927
   mobile-friction            EssMobileFriction             --3916
}
```

2.1.4.8 Data Link Restrictions

The FEU definition is:

```
DataLinkRestrictions ::= CHOICE
{
    speed-limit-advisory       Link-speed-limit-advisory,    --3863
    speed-limit                Link-speed-limit,             --3034
    speed-limit-truck          Link-speed-limit-truck,       --3035
    restriction-length         Link-restriction-length,      --3027
    restriction-height         Link-restriction-height,      --3026
    restriction-width          Link-restriction-width,       --3029
    restriction-weight-vehicle Link-restriction-weight-vehicle, --3028
    restriction-weight-axle    Link-restriction-weight-axle, --3870
    restriction-axle-count     Link-restriction-axle-count   --3024
}
```

2.1.5 Landmark

This data frame references two other data frames, as follows:

Geolocation: a latitude and longitude representative of the landmark (Section 2.1.5.1)
Upward area reference: a pointer to an area location that contains the landmark (Section 2.2.1).

The landmark data frame is not proposed initially for use in NW Passage data exchanges..

```
Landmark ::= SEQUENCE
{
    landmark-type              Event-location-landmark-type,  --3245
    landmark-name              Event-landmark-name,           --3394
    landmark-point-name        Event-landmark-point-name OPTIONAL, --3395
    location-rank              Event-location-rank OPTIONAL,  --3389
    geo-location               GeoLocation OPTIONAL,
    upward-area-reference      AreaLocation OPTIONAL
```

```
}
```

2.1.5.1 Geolocation

For consistency with LRMS (Location Referencing Standards), the FEU defines a frame *Geolocation* as follows:

```
GeoLocation ::= SEQUENCE
{
    latitude            Event-location-coordinates-latitude,    --3226
    longitude           Event-location-coordinates-longitude,   --3227
    datum               HorizontalDatum OPTIONAL,               --3937
}
```

The datum data frame is not proposed initially for use in NW Passage data exchanges.

2.1.5.2 Area Location

See Section 2.2.1 below.

2.1.6 Detour

This data frame references two other data frames, as follows:

Landmark: a latitude and longitude representative of the landmark (Section 2.1.5)
Location-on-detour: a roadway location along the detour (Section 2.2.2).

The detour data frame is not proposed initially for use in NW Passage data exchanges.
For reference, the FEU handles detours as follows:

```
Detour ::= SEQUENCE
{
    detour-type             Event-alternate-route-type,             --3218
    destination             Landmark OPTIONAL,
    location-on-detour      SEQUENCE OF LinkLocation OPTIONAL
}
```

2.1.6.1 Link Location: See Section 2.2.2.

2.1.7 Additional Text

This data frame shall be used in CARS-TMC Data Exchange Interface to carry free text information that amplifies the coded phrases / quantities in the FEU. The default language is English:

```
AdditionalText ::= SEQUENCE
{
    description         Event-description,                  --3209
    language            Event-description-language OPTIONAL --3816
}
```

2.2 Event Location

This data frame references other data frames as follows:

area-location: an area such as a county (Section 2.2.1)
location-on-link: a point on a transportation route, or a defined stretch of a route. Stretches of route are dynamically-defined segments of named or numbered roads bounded by primary and secondary locations. Point events on links occur at a single, primary location (Section 2.2.2)
landmark: a reference to a landmark, e.g. a sports arena (Section 2.1.5). This data frame is not proposed initially for use in NW Passage data exchanges.
geo-location: an event location known only by its GPS coordinates. This location type is ONLY allowed for event exchanges where no other information is available. It shall not be used for event exchanges between other systems or centers (Section 2.1.5.1). This data frame is not proposed initially for use in NW Passage data exchanges.

The FEU defines Event Location as follows:

```
EventLocation ::= CHOICE
{
    area-location           AreaLocation,
    location-on-link        LinkLocation,
    landmark                Landmark,
    geo-location            GeoLocation
}
```

The GeoLocation event location is intended for GPS reporting (e.g. OnStar reports or ferry tracking), where nothing is known except event coordinates. It shall not be used for NW Passage event imports into CARS, which must use *area* or *location on link*.

2.2.1 Area Location

This data frame includes one other (upward area reference) that allows an area to be specified as a subset of a larger area. For example, a county can be specified as a subset of a named region (a collection of counties) within a state. The upward area reference is a pointer to a larger area that contains the area location.

The FEU defines area locations as follows:

```
AreaLocation ::= SEQUENCE
{
    area-id                 Event-location-area-identifier,     --3809
    area-name               Event-area-name OPTIONAL,           --3388
    location-rank           Event-location-rank OPTIONAL,       --3389
    upward-area-reference   AreaLocation OPTIONAL
}
```

In the FEU, area locations may include the area name and other attributes formerly found only in the location database, as well as the area identifier (e.g. FIPS code). The additional information is not proposed initially for use in NW Passage data exchanges. Eventually, the additional attributes may be sent to other systems which may require them.

The *area-id* data element is a set of 2 to 7 numbers which form the FIPS code to uniquely identify all areas within the United States. The FIPS code is generally formed using a 2-digit code to identify the state. Counties are referenced by appending the 2-digit state code to a 3-digit county code, where 000 may be used to indicate a statewide event. Cities are referenced by appending the 2-digit state code to a 5-digit city code.

2.2.2 Link Location

This data frame references two other data frames, as follows:

Point on link: a point location on a roadway (Section 2.2.2.1)
Link-location: a roadway location specified in terms of an alternative route designator (Section 2.2.2). This addresses routes that have multiple designators and mile points, e.g., I-35 and I-80 around Des Moines, IA. This data frame is not proposed initially for use in NW Passage data exchanges.

In FEU, a link location can include the alignment (N, E, S, W) of the positive direction, an alternative route designator, and a link ID. Currently these data are not used in CARS, which *requires direction to be positive, negative, both-directions or non-directional* (relative to the direction of increasing mile points).

```
LinkLocation ::= SEQUENCE
{
    link-ownership              Link-ownership,                                  --3021
    route-designator            Link-route-designator,                           --3030
    link-id                     Link-identifier OPTIONAL,                        --3012
    primary-location            PointOnLink,
    secondary-location          PointOnLink OPTIONAL,
    link-direction              Link-direction,                                  --3008
    link-alignment              Link-alignment OPTIONAL,                         --3391
    linear-reference-version    Link-location-linear-reference-version OPTIONAL, --3854
    alternative-designation     LinkLocation OPTIONAL
}
```

2.2.2.1 Point on Link

This data frame references two other data frames, as follows:

Geolocation: the latitude and longitude of the point (Section 2.1.5.1)
Upward area reference: a pointer to an area location that contains the roadway point (Section 2.2.1). This data frame is not proposed initially for use in NW Passage data exchanges.

In FEU, points on links used to mark the primary and secondary locations are defined using geolocation (required) and linear reference (optional). In the future, additional information can also be

carried that will describe other attributes of the roadway point. These grayed out data fields are not currently exchanged in CARS deployments (being already stored in the location tables):

```
PointOnLink ::= SEQUENCE
{
    geo-location              GeoLocation,
    linear-reference          Link-location-linear-reference OPTIONAL,          --3855
    link-name                 Event-location-roadway-name OPTIONAL,             --3260
    point-name                Event-point-name OPTIONAL,                        --3392
    cross-street-designator   SEQUENCE OF
                              Event-location-cross-street-begin-identifier OPTIONAL, --3231
    cross-street-name         SEQUENCE OF
                              Event-location-cross-street-begin-name OPTIONAL,  --3229
    signed-destination        SEQUENCE OF Event-signed-destination OPTIONAL,
                                                                                --3393
    location-rank             Event-location-rank OPTIONAL,                     --3389
    landmark-type             Event-location-landmark-type OPTIONAL,            --3245
    upward-area-reference     AreaLocation OPTIONAL
}
```

2.3 Event Times

This data frame references several other data frames, as follows:

update-time: the date/time/zone when the event element was validated, i.e. actually observed or calculated, or otherwise confirmed to be correct (Section 1.1.2).
valid-period: the time period during which the event element is valid (Section 2.3.1)
sequence-time: optionally, the date/time/zone for which a forecast has been made, in a predicted event element (Section 1.1.2).
start time: the date/time/zone when an event element is expected to start, or is said to have started. Events without a start time are effective immediately (Section 1.1.2).
alternate start time: an alternative date/time/zone when an event element will start, in the event of postponement (Section 1.1.2). This data frame is not proposed initially for use in NW Passage data exchanges.
alternate end time: an alternative date/time/zone when an event element will end, in the event of postponement (Section 1.1.2). This data frame is not proposed initially for use in NW Passage data exchanges.
recurrent times: time periods during which an event element may recur (Section 2.3.2).

The FEU contains two new elements (*alternate-start-time, alternate-end-time*), which are not planned for inclusion in CARS 3 or 4 at this time. If they are received they will not be used. If the planned start and end time of an event are changed, the new start and end times must be sent in an update message as soon as they become known.

```
EventTimes ::= SEQUENCE
{
    update-time               DateTimeZone,
    valid-period              ValidPeriod,
    sequence-time             DateTimeZone OPTIONAL,
```

```
    start-time              DateTimeZone OPTIONAL,
    alternate-start-time    DateTimeZone OPTIONAL,
    alternate-end-time      DateTimeZone OPTIONAL,
    recurrent-times         SEQUENCE OF RecurrentTime OPTIONAL
}
```

All times are expressed as local times at the primary location of the event. UTC offsets are not required for presenting times to users, as all times will be presented in terms of local time (i.e., exactly as they are exchanged). However, UTC offsets are required for use in message management in the receiving system, and must be valid for the date and time specified in the event time. For example, in the Washington State, any message time stamp that refers to the summer daylight savings period is required to have an offset of -0700 (Pacific Daylight Time).

2.3.1 Valid Period

This data frame references two other data frames, as follows:

end-time: the date/time/zone when the event element is expected to end. At this time the event element shall be deleted or archived, unless the valid period is updated before that time/date (Section 1.1.2).
duration: the expected duration of the event element, starting from the update-time. After this period the event element shall be deleted or archived, unless the valid period is updated before the duration has expired (TMDD 3279).
effective-period: one or more named periods within which the event element applies, e.g. Sunday afternoon. These are often used for weather forecast situations (Section 2.3.2.1).

The FEU definition is:

```
ValidPeriod ::= CHOICE
{
    end-time                DateTimeZone,
    duration                Event-timeline-estimated-duration,      --3279
    effective-periods       SEQUENCE OF EventPeriod
}
```

Note that durations are always measured from the latest *update time.* If an event's duration crosses over a change to or from daylight saving time, the duration should retain its specified value. For example, an event occurs in a state with daylight saving time at midnight on 10/30/2004, having a duration of four hours, will end four hours later, at 3 AM on 10/31/2004—not at 4 AM, as would be the case on any other night.

2.3.2 Recurrent Time

This data frame references one other data frame, as follows:

recurrent-period: one or more named periods within which the event element reoccurs, e.g. Sunday afternoon. These are often used for weather forecast situations (Section 2.3.2.1).

The FEU definition has:

```
RecurrentTime ::= SEQUENCE
{
    recurrent-period        EventPeriod,
    schedule-times          SEQUENCE OF
                                Event-timeline-schedule-times OPTIONAL,     --3280
    utc-offset              Time-utc-offset OPTIONAL                        --3376
}
```

As for all event times, *recurrent times* are expressed in local time for the event's primary location. When daylight saving time begins or ends, *recurrent times* expressed in local time remain unchanged.

2.3.2.1 Event Period

```
EventPeriod ::= SEQUENCE
{
    days-of-the-week        Event-timeline-schedule-days-of-the-week,   --3282
    effective-period-qualifier Event-effective-period-qualifier DEFAULT 1,  --3813
    holiday                 Event-holiday-day OPTIONAL                  --3396
}
```

In FEU, an effective period qualifier is a named period within which the situation element applies (e.g., morning, afternoon, evening). Currently, some of these data elements are not used in CARS ("morning peak," "afternoon peak," and "middayperiods"), but support for them may be added at a later date. Until then, those data elements will be treated as "not specified."

2.4 Event Lane

This data frame adds the capability to indicate lane effects in both directions, on ramps, or on parallel roadways, etc.

```
EventLane ::= SEQUENCE
{
    lanes-type              Event-lanes-type DEFAULT 1,                 --3382
    link-direction          Link-direction OPTIONAL,                    --3008
    lanes-total-original    Event-lanes-total-lanes OPTIONAL,           --3221
    lanes-total-affected    Event-lanes-total-affected OPTIONAL,        --3383
    event-lanes-affected    SEQUENCE OF Event-lanes-affected OPTIONAL   --3219
}
```

2.5 Event Source

This data frame references one other data frame, as follows:

source: the organization originally reporting the event (Section 1.1.1).

This frame defines an event source in FEU reports:

```
EventSource ::= SEQUENCE
{
    source                  OrganizationInformation OPTIONAL,
    detection-method        Event-detection-method OPTIONAL          --3302
}
```

2.5.1 Organization Information

This frame will carry source organization identifier and name in FEU reports:

```
OrganizationInformation::= SEQUENCE
{
    organization-id         Organization-identifier,                 --3343
    organization-name       Organization-name OPTIONAL,              --3344
    organization-location   Organization-location OPTIONAL,          --3104
    organization-function   Organization-function OPTIONAL,          --3354
    center-id               Organization-center-identifier OPTIONAL, --3217
    center-name             Organization-center-name OPTIONAL,       --3355
    last-update-time        DateTimeZone OPTIONAL,
    contact-details         ContactDetails OPTIONAL
}
```

Use of the data frame *ContactDetails* may be needed to carry the *source contact person name.*

2.5.1.1 Contact Details

This frame will be used to carry a *'contact identifier'* and *'person-name"* in FEU source reports. All the other elements will not be used in CARS 3 at this time.

```
ContactDetails ::= SEQUENCE
{
    contact-id              Contact-identifier,                      --3105
    person-name             Contact-person-name OPTIONAL,            --3206
    person-title            Contact-person-title OPTIONAL,           --3349
    organization-id         Organization-identifier OPTIONAL,        --3343
    organization-name       Organization-name OPTIONAL,              --3344
    phone-number            Contact-phone-number OPTIONAL,           --3207
    phone-alternate         Contact-phone-alternate OPTIONAL,        --3113
    mobile-number           Contact-mobile-phone-number OPTIONAL,    --3350
    fax-number              Contact-phone-fax OPTIONAL,              --3205
    pager-id                Contact-pager-identifier OPTIONAL,       --3346
    pager-number            Contact-pager-number OPTIONAL,           --3347
    email-address           Contact-email-address OPTIONAL,          --3204
    radio-unit              Contact-radio-unit-identifier OPTIONAL,  --3208
    address-line1           Contact-mailing-address-line1 OPTIONAL,  --3339
    address-line2           Contact-mailing-address-line2 OPTIONAL,  --3340
    city                    Contact-mailing-address-city OPTIONAL,   --3338
    state                   Contact-mailing-address-state OPTIONAL,  --3341
    zip-code                Contact-mailing-address-zip OPTIONAL,    --3342
    country                 Contact-mailing-address-country OPTIONAL, --3373
```

}

Where this frame occurs in *source/organization-id* (Frame 2.5.1) it is required to carry *contact-person-name*. However, FEU also requires a source contact-id to be sent. Other lines above are currently unused in CARS. Any incoming data in these fields will be dropped. No outgoing data will use these fields.

The implication of the source/organization-id in FEU is that source would be introduced as the login-name in an automated system.

Example 2.5: First draft representation of FEU XML for Frame 2.5

```
<event-source>
 <source>
  <organization-information>
   <organization-id>Mn DPS</organization-id>
   <organization-name>MN State Patrol</organization-name>
   <contact-details>
    <contact-id>CapnLQ</contact-id>
    <person-name>Captain Lindquist</person-name>
   </contact-details>
  <event-detection-method>police-patrol</event-detection-method>
 </source>
</event-source>
```

2.6 Event Comments

The FEU definition is:

```
EventComments ::= SEQUENCE
{
    notes-and-comments      Event-description-notes-and-comments,      --3210
    language                Event-description-language OPTIONAL        --3816
}
```

2.7 Full Report Text

This data frame is not expected to be used in CARS-TMC Data Exchange Interface. However, for reference the FEU has a frame:

```
FullReportText ::= SEQUENCE
{
    report-medium           Event-report-medium,                       --3385
    description             Event-description,                         --3209
    language                Event-description-language OPTIONAL        --3816
}
```

Appendix B

SOAP Transactions

SOAP Transactions

All data transferred between the sending centers and the CARS TMC Data Input Interface should ideally use SOAP Document/Literal messaging over a TCP/IP connection. The SOAP message payloads will consist of string lists and Extensible Markup Language (XML)-formatted messages. This appendix provides additional details about such transactions.

B1 SOAP Background Information

SOAP provides a standardized way to structure and send XML messages. It offers agreed-upon conventions for defining the types of information that shall be exchanged, the expression of the information in XML, and the delivery of the information from one system to another. Specifically:

- SOAP can be transmitted over a variety of transmission protocols (HTTP, FTP, etc.)
- SOAP defines a "wrapper" around the XML that is sent from one system to another, which ensures that the XML is received and interpreted properly by the receiving system. The wrapper consists both of standardized SOAP XML, as well as information specific to the selected transmission protocol (e.g., HTTP, FTP, etc).
- SOAP also defines what shall occur when the receiving system cannot handle the request. In that case, the SOAP server sends a "SOAP fault" back to the caller, which must handle it appropriately.
- There are two main forms of SOAP transmission: RPC/encoded and document/literal. The CARS TMC Data Input Interface shall use document/literal, as it allows for the delivery of XML data that is already in a known format (FEU).

B2 CARS TMC Data Input Transactions

The primary SOAP-based CARS TMC Data Input exchange is outlined in the following steps. Note that CARS is the SOAP Server in this data exchange and the sending system is the SOAP Client.

Step 1: After the two agencies agree to begin the data exchange, the SOAP Server (e.g., CARS) and Client (IRIS) applications are initiated.

Step 2: Whenever it is time to notify subscribers (e.g., CARS) of updates, the SOAP Client sends a SOAP Message to the CARS SOAP Server.

Step 3: The CARS SOAP Server transfers control to a SOAP Action Handler to handle the periodic or event-driven updates that it receives from the sending system.

Step 4: The CARS SOAP Action Handler finishes processing the message.

Step 5: The sending SOAP Client is notified of completion or an error is returned.

Note that the communication between Clients and Servers over HTTP is connectionless.

B3 Authorization, Authentication, and Encryption

The CARS-TMC Data Exchange interface implemented for the Stage 1 integration currently performs no authentication of the clients that connect to it. The server will assume that any SOAP client that is able to send it a correctly formatted FEU message to the appropriate port, on the appropriate IP

address, is a legitimate client. Thus, security in the current system relies only on the ability of authorized clients to connect to the service. This security model can be ensured to some degree by, for instance, setting a firewall to allow only certain trusted IP addresses to connect to the CARS-TMC Data Import server. Still, this system is potentially vulnerable to a packet sent from a "spoofed" IP address.

The following steps propose a more comprehensive security setup for the CARS-TMC server:

- Include the CARS login and password in the sent packet rather than relying on values supplied in a configuration file.
- Encrypt the connection between the sender and the CARS-TMC server (e.g., do not allow anyone "sniffing" network packets to see any of the data being sent in clear text, including the username/passwords)
- Authenticate the connection between the sender and the CARS-TMC server (e.g., ensure that the sender is genuinely authorized to connect to the server, and that their "from" address is not forged.)

The following technical implementations are suggested in order to accomplish those security functions:

- The sender (SOAP Client) shall generate a client-side SSL certificate.
- The sender shall send that certificate to the receiving system (e.g., SOAP Server or CARS) to install on its server.
- The sender shall connect to the server using the encrypted HTTPS protocol instead of the normal HTTP protocol, as it does now. Also, the sender shall pass the certificate to verify its identity, using the standard HTTPS mechanism for doing so.
- The sender shall include a CARS login and password as part of the SOAP header for the message sent.
- The CARS-TMC Data Input server shall be modified to pass the login and password that were specified as part of the SOAP header into CARS.

The following is an example of the proposed SOAP header:
(copied from an example at http://www.developer.com/net/net/article.php/2192901):

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/
envelope/">
  <soap:Header>
    <AuthHeader xmlns="http://tempuri.org/">
      <UserName>jeff</UserName>
      <Password>imbatman</Password>
    </AuthHeader>
  </soap:Header>
  <soap:Body>
    <GetQuote xmlns="http://tempuri.org/">
      <symbol>msft</symbol>
    </GetQuote>
  </soap:Body>
</soap:Envelope>
```

Appendix C

SOAP WSDL

SOAP WSDL

```
<?xml version="1.0" encoding="UTF-8"?>

<definitions name="FEUDefinitions"
   targetNamespace="http://www.crc-corp.com/wsdl/2004-10-01/feu"
   xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
   xmlns:tns="http://www.crc-corp.com/wsdl/2004-10-01/feu"
   xmlns:feu="http://www.dummy-temp-address"
   xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
   xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
   xmlns="http://schemas.xmlsoap.org/wsdl/">

   <wsdl:types>
      <xs:schema targetNamespace="http://www.dummy-temp-address">
         <xs:complexType name="FullEventUpdate">
            <xs:sequence>
               <xs:any minOccurs="0" maxOccurs="unbounded"/>
            </xs:sequence>
         </xs:complexType>
      </xs:schema>
   </wsdl:types>

   <documentation>
   This is the definition for the FEU service.
   This service accepts messages in Full-Event-Update format from an
external
   source, and forwards them on to a CARS instance.
   This service does minimal parsing of its own -- it relies on CARS
to do parsing of FEU.
   </documentation>

   <message name="FEUEvent">
      <part name="full-event-update" type="feu:FullEventUpdate"/>
   </message>

   <message name="FEUResponse">
      <part name="return" type="xs:string"/>
   </message>

   <portType name="FEUPortType">
      <documentation>FEU Port Type</documentation>
      <operation name="acceptFEUEvent" parameterOrder="full-event-
update">
         <input message="tns:FEUEvent"/>
         <output message="tns:FEUResponse"/>
      </operation>
```

```
   </portType>

   <binding name="FEUSoapBinding" type="tns:FEUPortType">
      <documentation>FEU Soap Binding</documentation>
      <soap:binding style="document"
transport="http://schemas.xmlsoap.org/soap/http"/>
      <operation name="acceptFEUEvent">
         <soap:operation soapAction="acceptFEUEventAction"/>
         <input>
            <soap:body namespace="http://www.crc-corp.com/wsdl/2004-
10-01/feu" use="literal"/>
         </input>
         <output>
            <soap:body namespace="http://www.crc-corp.com/wsdl/2004-
10-01/feu" use="literal"/>
         </output>
      </operation>
   </binding>

   <service name="FEUService">
      <documentation>FEU Web Service</documentation>
      <port name="FEUPort" binding="tns:FEUSoapBinding">
         <!--<soap:address
location="http://67.106.3.233:8080/axis/services/FEUPort"/>-->
         <soap:address
location="http://localhost:8080/axis/services/FEUPort"/>
      </port>
   </service>
</definitions>
```

Appendix D

XML Schema Definition for Event Types Defined in the ICD

XML Schema Definition for Event Types Defined in the ICD

```
<!--Element Event-description-type-traffic-conditions FADD_ID=3817-->
    <xs:simpleType name="Event-description-type-traffic-conditions">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value=""/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-incident FADD_ID=3818-->
    <xs:simpleType name="Event-description-type-incident">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="accident"/>
                    <xs:enumeration value="serious-accident"/>
                    <xs:enumeration value="injury-accident"/>
                    <xs:enumeration value="minor-accident"/>
                    <xs:enumeration value="multi-vehicle-accident"/>
                    <xs:enumeration value="numerous-accidents"/>
                    <xs:enumeration value="accident-involving-a-bicycle"/>
                    <xs:enumeration value="accident-involving-a-bus"/>
                    <xs:enumeration value="accident-involving-a-motorcycle"/>
                    <xs:enumeration value="accident-involving-a-pedestrian"/>
                    <xs:enumeration value="accident-involving-a-train"/>
                    <xs:enumeration value="accident-involving-a-truck"/>
                    <xs:enumeration value="accident-involving-hazardous-materials"/>
                    <xs:enumeration value="earlier-accident"/>
                    <xs:enumeration value="medical-emergency"/>
                    <xs:enumeration value="secondary-accident"/>
                    <xs:enumeration value="rescue-and-recovery-work-in-progress"/>
                    <xs:enumeration value="accident-investigation-work"/>
                    <xs:enumeration value="incident"/>
                    <xs:enumeration value="stalled-vehicle"/>
                    <xs:enumeration value="abandoned-vehicle"/>
                    <xs:enumeration value="disabled-vehicle"/>
                    <xs:enumeration value="disabled-truck"/>
                    <xs:enumeration value="disabled-semi-trailer"/>
                    <xs:enumeration value="disabled-bus"/>
                    <xs:enumeration value="disabled-train"/>
                    <xs:enumeration value="vehicle-spun-out"/>
                    <xs:enumeration value="vehicle-on-fire"/>
                    <xs:enumeration value="vehicle-in-water"/>
                    <xs:enumeration value="vehicles-slowing-to-look-at-accident"/>
                    <xs:enumeration value="jackknifed-semi-trailer"/>
                    <xs:enumeration value="jackknifed-trailer-home"/>
                    <xs:enumeration value="jackknifed-trailer"/>
                    <xs:enumeration value="spillage-occurring-from-moving-vehicle"/>
                    <xs:enumeration value="acid-spill"/>
                    <xs:enumeration value="chemical-spill"/>
                    <xs:enumeration value="fuel-spill"/>
```

```
                    <xs:enumeration value="hazardous-materials-spill"/>
                    <xs:enumeration value="oil-spill"/>
                    <xs:enumeration value="spilled-load"/>
                    <xs:enumeration value="toxic-spill"/>
                    <xs:enumeration value="overturned-vehicle"/>
                    <xs:enumeration value="overturned-truck"/>
                    <xs:enumeration value="overturned-semi-trailer"/>
                    <xs:enumeration value="overturned-bus"/>
                    <xs:enumeration value="derailed-train"/>
                    <xs:enumeration value="stuck-vehicle"/>
                    <xs:enumeration value="truck-stuck-under-bridge"/>
                    <xs:enumeration value="bus-stuck-under-bridge"/>
                    <xs:enumeration value="accident-cleared"/>
                    <xs:enumeration value="incident-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-closure FADD_ID=3819-->
    <xs:simpleType name="Event-description-type-closure">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="closed-to-traffic"/>
                    <xs:enumeration value="closed"/>
                    <xs:enumeration value="closed-ahead"/>
                    <xs:enumeration value="closed-intermittently"/>
                    <xs:enumeration value="closed-for-repairs"/>
                    <xs:enumeration value="closed-for-the-season"/>
                    <xs:enumeration value="blocked"/>
                    <xs:enumeration value="blocked-ahead"/>
                    <xs:enumeration value="reduced-to-one-lane"/>
                    <xs:enumeration value="reduced-to-two-lanes"/>
                    <xs:enumeration value="reduced-to-three-lanes"/>
                    <xs:enumeration value="collapse"/>
                    <xs:enumeration value="out"/>
                    <xs:enumeration value="open-to-traffic"/>
                    <xs:enumeration value="open"/>
                    <xs:enumeration value="reopened-to-traffic"/>
                    <xs:enumeration value="clearing"/>
                    <xs:enumeration value="cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-roadwork FADD_ID=3213-->
    <xs:simpleType name="Event-description-type-roadwork">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="road-construction"/>
                    <xs:enumeration value="major-road-construction"/>
                    <xs:enumeration value="long-term-road-construction"/>
                    <xs:enumeration value="construction-work"/>
                    <xs:enumeration value="paving-operations"/>
```

```
                    <xs:enumeration value="work-in-the-median"/>
                    <xs:enumeration value="road-reconstruction"/>
                    <xs:enumeration value="opposing-traffic"/>
                    <xs:enumeration value="narrow-lanes"/>
                    <xs:enumeration value="construction-traffic-merging"/>
                    <xs:enumeration value="single-line-traffic-alternating-directions"/>
                    <xs:enumeration value="road-maintenance-operations"/>
                    <xs:enumeration value="road-marking-operations"/>
                    <xs:enumeration value="bridge-maintenance-operations"/>
                    <xs:enumeration value="bridge-construction"/>
                    <xs:enumeration value="bridge-demolition-work"/>
                    <xs:enumeration value="blasting"/>
                    <xs:enumeration value="avalanche-control-activities"/>
                    <xs:enumeration value="water-main-work"/>
                    <xs:enumeration value="gas-main-work"/>
                    <xs:enumeration value="work-on-underground-cables"/>
                    <xs:enumeration value="work-on-underground-services"/>
                    <xs:enumeration value="new-road-construction-layout"/>
                    <xs:enumeration value="new-road-layout"/>
                    <xs:enumeration value="temporary-lane-markings"/>
                    <xs:enumeration value="temporary-traffic-lights"/>
                    <xs:enumeration value="emergency-maintenance"/>
                    <xs:enumeration value="road-maintenance-cleared"/>
                    <xs:enumeration value="normal-road-layout-restored"/>
                    <xs:enumeration value="road-work-clearance-in-progress"/>
                    <xs:enumeration value="road-construction-cleared"/>
                    <xs:enumeration value="normal-traffic-lanes-restored"/>
                    <xs:enumeration value="road-work-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-obstruction FADD_ID=3822-->
    <xs:simpleType name="Event-description-type-obstruction">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="obstruction-on-roadway"/>
                    <xs:enumeration value="object-on-roadway"/>
                    <xs:enumeration value="objects-falling-from-moving-vehicle"/>
                    <xs:enumeration value="debris-on-roadway"/>
                    <xs:enumeration value="storm-damage"/>
                    <xs:enumeration value="people-on-roadway"/>
                    <xs:enumeration value="bicyclists-on-roadway"/>
                    <xs:enumeration value="sightseers-obstructing-access"/>
                    <xs:enumeration value="large-numbers-of-visitors"/>
                    <xs:enumeration value="animal-on-roadway"/>
                    <xs:enumeration value="large-animal-on-roadway"/>
                    <xs:enumeration value="herd-of-animals-on-roadway"/>
                    <xs:enumeration value="animal-struck"/>
                    <xs:enumeration value="fallen-trees"/>
                    <xs:enumeration value="downed-power-lines"/>
                    <xs:enumeration value="downed-cables"/>
                    <xs:enumeration value="subsidence"/>
                    <xs:enumeration value="road-surface-collapse"/>
                    <xs:enumeration value="pavement-buckled"/>
                    <xs:enumeration value="pothole"/>
                    <xs:enumeration value="flooding"/>
                    <xs:enumeration value="broken-water-main"/>
                    <xs:enumeration value="collapsed-sewer"/>
                    <xs:enumeration value="sewer-overflow"/>
```

```
                    <xs:enumeration value="gas-leak"/>
                    <xs:enumeration value="snowmelt"/>
                    <xs:enumeration value="mudslide"/>
                    <xs:enumeration value="avalanche"/>
                    <xs:enumeration value="rock-fall"/>
                    <xs:enumeration value="landslide"/>
                    <xs:enumeration value="clearance-work"/>
                    <xs:enumeration value="obstruction-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-delay-status-cancellation FADD_ID=3830-->
    <xs:simpleType name="Event-description-type-delay-status-cancellation">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="delays"/>
                    <xs:enumeration value="short-delays"/>
                    <xs:enumeration value="long-delays"/>
                    <xs:enumeration value="very-long-delays"/>
                    <xs:enumeration value="delays-of-uncertain-duration"/>
                    <xs:enumeration value="delayed-until-further-notice"/>
                    <xs:enumeration value="busy"/>
                    <xs:enumeration value="very-busy"/>
                    <xs:enumeration value="crowded"/>
                    <xs:enumeration value="overcrowded"/>
                    <xs:enumeration value="cancellations"/>
                    <xs:enumeration value="route-cancelled-no-replacement"/>
                    <xs:enumeration value="service-cancelled"/>
                    <xs:enumeration value="service-suspended"/>
                    <xs:enumeration value="service-withdrawn"/>
                    <xs:enumeration value="service-fully-booked"/>
                    <xs:enumeration value="all-services-fully-booked"/>
                    <xs:enumeration value="next-departure"/>
                    <xs:enumeration value="next-arrival"/>
                    <xs:enumeration value="very-frequent-service"/>
                    <xs:enumeration value="frequent-service"/>
                    <xs:enumeration value="fairly-frequent-service"/>
                    <xs:enumeration value="regular-service"/>
                    <xs:enumeration value="irregular-service"/>
                    <xs:enumeration value="not-operating"/>
                    <xs:enumeration value="system-busy"/>
                    <xs:enumeration value="system"/>
                    <xs:enumeration value="system-crowded"/>
                    <xs:enumeration value="travel-time"/>
                    <xs:enumeration value="headway"/>
                    <xs:enumeration value="delays-clearing"/>
                    <xs:enumeration value="delays-cleared"/>
                    <xs:enumeration value="normal-services-resumed"/>
                    <xs:enumeration value="operating"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-unusual-driving FADD_ID=3831-->
    <xs:simpleType name="Event-description-type-unusual-driving">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
```

```
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="vehicle-traveling-wrong-way"/>
                    <xs:enumeration value="reckless-driver"/>
                    <xs:enumeration value="prohibited-vehicle-on-roadway"/>
                    <xs:enumeration value="emergency-vehicles"/>
                    <xs:enumeration value="high-speed-emergency-vehicles"/>
                    <xs:enumeration value="high-speed-chase"/>
                    <xs:enumeration value="dangerous-vehicle-warning-cleared"/>
                    <xs:enumeration value="emergency-vehicle-warning-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-mobile-situation FADD_ID=3832-->
    <xs:simpleType name="Event-description-type-mobile-situation">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="abnormal-load"/>
                    <xs:enumeration value="wide-load"/>
                    <xs:enumeration value="long-load"/>
                    <xs:enumeration value="slow-vehicle"/>
                    <xs:enumeration value="farm-equipment"/>
                    <xs:enumeration value="horse-drawn-vehicles"/>
                    <xs:enumeration value="overheight-load"/>
                    <xs:enumeration value="overweight-load"/>
                    <xs:enumeration value="tracked-vehicle"/>
                    <xs:enumeration value="vehicle-carrying-hazardous-materials"/>
                    <xs:enumeration value="slow-moving-maintenance-vehicle"/>
                    <xs:enumeration value="convoy"/>
                    <xs:enumeration value="military-convoy"/>
                    <xs:enumeration value="refugee-convoy"/>
                    <xs:enumeration value="motorcade"/>
                    <xs:enumeration value="mobile-situation-repositioning"/>
                    <xs:enumeration value="winter-maintenance-vehicles"/>
                    <xs:enumeration value="snowplows"/>
                    <xs:enumeration value="slow-moving-maintenance-vehicle-warning-cleared"/>
                    <xs:enumeration value="exceptional-load-warning-cleared"/>
                    <xs:enumeration value="hazardous-load-warning-cleared"/>
                    <xs:enumeration value="convoy-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-device-status FADD_ID=3833-->
    <xs:simpleType name="Event-description-type-device-status">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="lane-control-signs-not-working"/>
                    <xs:enumeration value="lane-control-signs-working-incorrectly"/>
```

```
                    <xs:enumeration value="lane-control-signs-operating"/>
                    <xs:enumeration value="variable-message-signs-not-working"/>
                    <xs:enumeration value="variable-message-signs-working-incorrectly"/>
                    <xs:enumeration value="variable-message-signs-operating"/>
                    <xs:enumeration value="emergency-telephones-not-working"/>
                    <xs:enumeration value="emergency-telephone-number-not-working"/>
                    <xs:enumeration value="traffic-lights-not-working"/>
                    <xs:enumeration value="traffic-lights-working-incorrectly"/>
                    <xs:enumeration value="ramp-control-signals-not-working"/>
                    <xs:enumeration value="ramp-control-signals-working-incorrectly"/>
                    <xs:enumeration value="temporary-traffic-lights-not-working"/>
                    <xs:enumeration value="temporary-traffic-lights-working-incorrectly"/>
                    <xs:enumeration value="traffic-signal-control-computer-not-working"/>
                    <xs:enumeration value="traffic-signal-timings-changed"/>
                    <xs:enumeration value="overheight-warning-system-triggered"/>
                    <xs:enumeration value="equipment-failure"/>
                    <xs:enumeration value="railroad-crossing-equipment-failure"/>
                    <xs:enumeration value="tunnel-ventilation-not-working"/>
                    <xs:enumeration value="power-failure"/>
                    <xs:enumeration value="widespread-power-outages"/>
                    <xs:enumeration value="technical-problems"/>
                    <xs:enumeration value="electronic-signs-repaired"/>
                    <xs:enumeration value="emergency-call-facilities-restored"/>
                    <xs:enumeration value="traffic-signals-repaired"/>
                    <xs:enumeration value="railroad-crossing-equipment-now-working-normally"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Link-restriction-class FADD_ID=3025-->
    <xs:simpleType name="Link-restriction-class">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="restrictions"/>
                    <xs:enumeration value="ramp-restrictions"/>
                    <xs:enumeration value="truck-restriction"/>
                    <xs:enumeration value="speed-restriction"/>
                    <xs:enumeration value="noise-restriction"/>
                    <xs:enumeration value="traffic-regulations-have-been-changed"/>
                    <xs:enumeration value="local-access-only"/>
                    <xs:enumeration value="no-trailers"/>
                    <xs:enumeration value="no-high-profile-vehicles"/>
                    <xs:enumeration value="hazardous-materials-truck-restriction"/>
                    <xs:enumeration value="no-through-traffic"/>
                    <xs:enumeration value="no-motor-vehicles"/>
                    <xs:enumeration value="width-limit"/>
                    <xs:enumeration value="height-limit"/>
                    <xs:enumeration value="length-limit"/>
                    <xs:enumeration value="axle-load-limit"/>
                    <xs:enumeration value="gross-weight-limit"/>
                    <xs:enumeration value="axle-count-limit"/>
                    <xs:enumeration value="carpool-lane-available"/>
                    <xs:enumeration value="carpool-restrictions-changed"/>
                    <xs:enumeration value="HOV 2-no-single-occupant-vehicles"/>
                    <xs:enumeration value="HOV-3-no-vehicles-with-less-than-three-occupants"/>
                    <xs:enumeration value="bus-lane-available-for-all-vehicles"/>
                    <xs:enumeration value="truck-lane-available-for-all-vehicles"/>
                    <xs:enumeration value="permits call in basis"/>
                    <xs:enumeration value="permits temporarily closed"/>
                    <xs:enumeration value="permits closed"/>
```

```
                    <xs:enumeration value="permits open"/>
                    <xs:enumeration value="restrictions-for-high-profile-vehicles-lifted"/>
                    <xs:enumeration value="width-limit-lifted"/>
                    <xs:enumeration value="height-limit-lifted"/>
                    <xs:enumeration value="length-limit-lifted"/>
                    <xs:enumeration value="axle-count-limit-lifted"/>
                    <xs:enumeration value="weight-limit-lifted"/>
                    <xs:enumeration value="axle-count-limit-lifted"/>
                    <xs:enumeration value="carpool-restrictions-lifted"/>
                    <xs:enumeration value="lane-restrictions-lifted"/>
                    <xs:enumeration value="ramp-restrictions-lifted"/>
                    <xs:enumeration value="motor-vehicle-restrictions-lifted"/>
                    <xs:enumeration value="restrictions-lifted"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-incident-response-status FADD_ID=3885-->
    <xs:simpleType name="Event-description-type-incident-response-status">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="unconfirmed-report"/>
                    <xs:enumeration value="initial-response-en-route"/>
                    <xs:enumeration value="follow-up-response-en-route"/>
                    <xs:enumeration value="initial-response-on-scene"/>
                    <xs:enumeration value="follow-up-response-on-scene"/>
                    <xs:enumeration value="confirmed-report"/>
                    <xs:enumeration value="scene-is-unsecured-at-this-time"/>
                    <xs:enumeration value="response-scene-secured"/>
                    <xs:enumeration value="rescue-and-recovery-work-in-progress"/>
                    <xs:enumeration value="extraction-in-progress"/>
                    <xs:enumeration value="clearance-work-in-progress"/>
                    <xs:enumeration value="body-removal-operations"/>
                    <xs:enumeration value="fire-containment-contained"/>
                    <xs:enumeration value="fire-containment-not-contained"/>
                    <xs:enumeration value="event-cleared"/>
                    <xs:enumeration value="traffic-clearing"/>
                    <xs:enumeration value="incident-closed"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-disaster FADD_ID=3880-->
    <xs:simpleType name="Event-description-type-disaster">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="flash-flood"/>
                    <xs:enumeration value="major-flood"/>
                    <xs:enumeration value="reservoir-failure"/>
                    <xs:enumeration value="levee-failure"/>
                    <xs:enumeration value="tsunami"/>
                    <xs:enumeration value="tidal-wave"/>
                    <xs:enumeration value="volcanic-eruption"/>
```

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                    <xs:enumeration value="ash-fall"/>
                    <xs:enumeration value="lava-flow"/>
                    <xs:enumeration value="serious-fire"/>
                    <xs:enumeration value="forest-fire"/>
                    <xs:enumeration value="wildfire"/>
                    <xs:enumeration value="building-fire"/>
                    <xs:enumeration value="brush-fire"/>
                    <xs:enumeration value="grass-fire"/>
                    <xs:enumeration value="fire-danger-extreme"/>
                    <xs:enumeration value="fire-danger-very-high"/>
                    <xs:enumeration value="fire-danger-high"/>
                    <xs:enumeration value="fire-danger-medium"/>
                    <xs:enumeration value="fire-danger-low"/>
                    <xs:enumeration value="earthquake-damage"/>
                    <xs:enumeration value="air-crash"/>
                    <xs:enumeration value="rail-crash"/>
                    <xs:enumeration value="toxic-release"/>
                    <xs:enumeration value="toxic-leak"/>
                    <xs:enumeration value="radioactive-release"/>
                    <xs:enumeration value="radiation-hazard"/>
                    <xs:enumeration value="reactor-leakage"/>
                    <xs:enumeration value="explosion"/>
                    <xs:enumeration value="major-hazardous-materials-fir"/>
                    <xs:enumeration value="major-hazardous-materials-release"/>
                    <xs:enumeration value="disaster-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-disturbances FADD_ID=3884-->
    <xs:simpleType name="Event-description-type-disturbances">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="assault"/>
                    <xs:enumeration value="crime"/>
                    <xs:enumeration value="robbery"/>
                    <xs:enumeration value="fare-dispute"/>
                    <xs:enumeration value="shooting"/>
                    <xs:enumeration value="gunfire-on-roadway"/>
                    <xs:enumeration value="suicide"/>
                    <xs:enumeration value="fight"/>
                    <xs:enumeration value="gang-fight"/>
                    <xs:enumeration value="person-harassment"/>
                    <xs:enumeration value="person-injured"/>
                    <xs:enumeration value="unruly-passenger"/>
                    <xs:enumeration value="person-intoxicated"/>
                    <xs:enumeration value="crowd-control-problem"/>
                    <xs:enumeration value="demonstration"/>
                    <xs:enumeration value="march"/>
                    <xs:enumeration value="public-disturbance"/>
                    <xs:enumeration value="riot"/>
                    <xs:enumeration value="civil-unrest"/>
                    <xs:enumeration value="civil-emergency"/>
                    <xs:enumeration value="strike"/>
                    <xs:enumeration value="public-transit-strike"/>
                    <xs:enumeration value="stampede"/>
                    <xs:enumeration value="teargas-used"/>
                    <xs:enumeration value="security-alert"/>
                    <xs:enumeration value="security-incident"/>
                    <xs:enumeration value="checkpoint"/>
```

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                    <xs:enumeration value="bomb-alert"/>
                    <xs:enumeration value="terrorist-incident"/>
                    <xs:enumeration value="high-velocity-shell-fire"/>
                    <xs:enumeration value="explosives-in-use"/>
                    <xs:enumeration value="air-raid"/>
                    <xs:enumeration value="weapons-of-mass-destruction-threat"/>
                    <xs:enumeration value="military-operations"/>
                    <xs:enumeration value="security-problem-cleared"/>
                    <xs:enumeration value="traffic-disturbance-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-sporting-events FADD_ID=3886-->
    <xs:simpleType name="Event-description-type-sporting-events">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="sports-event"/>
                    <xs:enumeration value="game"/>
                    <xs:enumeration value="tournament"/>
                    <xs:enumeration value="track-and-field-event"/>
                    <xs:enumeration value="baseball-game"/>
                    <xs:enumeration value="basketball-game"/>
                    <xs:enumeration value="boxing-match"/>
                    <xs:enumeration value="football-game"/>
                    <xs:enumeration value="soccer-game"/>
                    <xs:enumeration value="golf-tournament"/>
                    <xs:enumeration value="hockey-game"/>
                    <xs:enumeration value="tennis-tournament"/>
                    <xs:enumeration value="wrestling-match"/>
                    <xs:enumeration value="road-race"/>
                    <xs:enumeration value="automobile-race"/>
                    <xs:enumeration value="bicycle-race"/>
                    <xs:enumeration value="race-event"/>
                    <xs:enumeration value="marathon"/>
                    <xs:enumeration value="horse-show"/>
                    <xs:enumeration value="rodeo"/>
                    <xs:enumeration value="water-sports-event"/>
                    <xs:enumeration value="winter-sports-event"/>
                    <xs:enumeration value="skating-event"/>
                    <xs:enumeration value="sporting-event-ended"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-special-event FADD_ID=3214-->
    <xs:simpleType name="Event-description-type-special-event">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="major-event"/>
                    <xs:enumeration value="airshow"/>
                    <xs:enumeration value="hot-air-ballooning"/>
                    <xs:enumeration value="concert"/>
```

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                    <xs:enumeration value="state-occasion"/>
                    <xs:enumeration value="vip-visit"/>
                    <xs:enumeration value="show"/>
                    <xs:enumeration value="festival"/>
                    <xs:enumeration value="exhibition"/>
                    <xs:enumeration value="performing-arts"/>
                    <xs:enumeration value="outdoor-market"/>
                    <xs:enumeration value="fair"/>
                    <xs:enumeration value="carnival"/>
                    <xs:enumeration value="fireworks-display"/>
                    <xs:enumeration value="trade-expo"/>
                    <xs:enumeration value="movie-filming"/>
                    <xs:enumeration value="presidential-visit"/>
                    <xs:enumeration value="parade"/>
                    <xs:enumeration value="procession"/>
                    <xs:enumeration value="funeral-procession"/>
                    <xs:enumeration value="crowd"/>
                    <xs:enumeration value="holiday-traffic"/>
                    <xs:enumeration value="event-ended"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-parking-information FADD_ID=3835-->
    <xs:simpleType name="Event-description-type-parking-information">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="normal-parking-restrictions-lifted"/>
                    <xs:enumeration value="parking-meter-restrictions-lifted"/>
                    <xs:enumeration value="special-parking-restrictions-in-force"/>
                    <xs:enumeration value="full-parking-lot"/>
                    <xs:enumeration value="full-parking-garage"/>
                    <xs:enumeration value="all-parking-lots-full"/>
                    <xs:enumeration value="no-parking-spaces-available"/>
                    <xs:enumeration value="only-a-few-spaces-available"/>
                    <xs:enumeration value="spaces-available"/>
                    <xs:enumeration value="no-parking"/>
                    <xs:enumeration value="parking-on-one-side-of-street-only"/>
                    <xs:enumeration value="parking-on-both-sides-of-street"/>
                    <xs:enumeration value="parallel-parking-only"/>
                    <xs:enumeration value="parking-meters-not-available"/>
                    <xs:enumeration value="use-of-parking-meters-restricted"/>
                    <xs:enumeration value="event-parking"/>
                    <xs:enumeration value="handicapped-parking"/>
                    <xs:enumeration value="long-term-parking"/>
                    <xs:enumeration value="overnight-parking"/>
                    <xs:enumeration value="short-term-parking"/>
                    <xs:enumeration value="special-parking-restrictions-lifted"/>
                    <xs:enumeration value="no-parking-information-available"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-system-information FADD_ID=3836-->
    <xs:simpleType name="Event-description-type-system-information">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
```

```
            </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
            <xs:restriction base="xs:string">
                <xs:enumeration value="information-available-on-radio"/>
                <xs:enumeration value="information-available-on-TV"/>
                <xs:enumeration value="call-to-get-information"/>
                <xs:enumeration value="information-available-via-Internet"/>
                <xs:enumeration value="test-message"/>
                <xs:enumeration value="no-information-available"/>
                <xs:enumeration value="null-description"/>
                <xs:enumeration value="information-service-is-being-suspended"/>
                <xs:enumeration value="information-service-resumed"/>
                <xs:enumeration value="message-canceled"/>
            </xs:restriction>
        </xs:simpleType>
    </xs:union>
</xs:simpleType>
<!--Element Event-description-type-weather-condition FADD_ID=3299-->
<xs:simpleType name="Event-description-type-weather-condition">
    <xs:union>
        <xs:simpleType>
            <xs:restriction base="xs:integer">
                <xs:maxInclusive value="256"/>
                <xs:minInclusive value="1"/>
            </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
            <xs:restriction base="xs:string">
                <xs:enumeration value="overcast"/>
                <xs:enumeration value="cloudy"/>
                <xs:enumeration value="mostly-cloudy"/>
                <xs:enumeration value="partly-cloudy"/>
                <xs:enumeration value="partly-sunny"/>
                <xs:enumeration value="mostly-sunny"/>
                <xs:enumeration value="sunny"/>
                <xs:enumeration value="fair"/>
                <xs:enumeration value="clear"/>
                <xs:enumeration value="mostly-clear"/>
                <xs:enumeration value="mostly-dry"/>
                <xs:enumeration value="dry"/>
                <xs:enumeration value="uv-index-very-high"/>
                <xs:enumeration value="uv-index-high"/>
                <xs:enumeration value="uv-index-moderate"/>
                <xs:enumeration value="uv-index-low"/>
                <xs:enumeration value="uv-index-very-low"/>
                <xs:enumeration value="barometric-pressure"/>
                <xs:enumeration value="weather-forecast-withdrawn"/>
            </xs:restriction>
        </xs:simpleType>
    </xs:union>
</xs:simpleType>
<!--Element Event-description-type-precipitation FADD_ID=3825-->
<xs:simpleType name="Event-description-type-precipitation">
    <xs:union>
        <xs:simpleType>
            <xs:restriction base="xs:integer">
                <xs:maxInclusive value="256"/>
                <xs:minInclusive value="1"/>
            </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
            <xs:restriction base="xs:string">
                <xs:enumeration value="severe-weather"/>
                <xs:enumeration value="blizzard"/>
                <xs:enumeration value="heavy-snow"/>
                <xs:enumeration value="snow"/>
```

```
                    <xs:enumeration value="light-snow"/>
                    <xs:enumeration value="snow-showers"/>
                    <xs:enumeration value="winter-storm"/>
                    <xs:enumeration value="ice-glaze"/>
                    <xs:enumeration value="heavy-frost"/>
                    <xs:enumeration value="frost"/>
                    <xs:enumeration value="ice-storm"/>
                    <xs:enumeration value="sleet"/>
                    <xs:enumeration value="rain-and-snow-mixed"/>
                    <xs:enumeration value="rain-changing-to-snow"/>
                    <xs:enumeration value="damaging-hail"/>
                    <xs:enumeration value="hail"/>
                    <xs:enumeration value="thunderstorms"/>
                    <xs:enumeration value="thundershowers"/>
                    <xs:enumeration value="extremely-heavy-downpour"/>
                    <xs:enumeration value="heavy-rain"/>
                    <xs:enumeration value="rain"/>
                    <xs:enumeration value="light-rain"/>
                    <xs:enumeration value="drizzle"/>
                    <xs:enumeration value="showers"/>
                    <xs:enumeration value="dew"/>
                    <xs:enumeration value="precipitation-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-wind FADD_ID=3826-->
    <xs:simpleType name="Event-description-type-wind">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="tornado"/>
                    <xs:enumeration value="hurricane"/>
                    <xs:enumeration value="hurricane-force-winds"/>
                    <xs:enumeration value="tropical-storm"/>
                    <xs:enumeration value="gale-force-winds"/>
                    <xs:enumeration value="storm-force-winds"/>
                    <xs:enumeration value="strong-winds"/>
                    <xs:enumeration value="moderate-winds"/>
                    <xs:enumeration value="light-winds"/>
                    <xs:enumeration value="calm"/>
                    <xs:enumeration value="gusty-winds"/>
                    <xs:enumeration value="crosswinds"/>
                    <xs:enumeration value="windy"/>
                    <xs:enumeration value="strong-winds-have-eased"/>
                    <xs:enumeration value="strong-wind-forecast-withdrawn"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-visibility-air-quality FADD_ID=3827-->
    <xs:simpleType name="Event-description-type-visibility-air-quality">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
```

```
                <xs:enumeration value="dense-fog"/>
                <xs:enumeration value="fog"/>
                <xs:enumeration value="patchy-fog"/>
                <xs:enumeration value="freezing-fog"/>
                <xs:enumeration value="mist"/>
                <xs:enumeration value="haze"/>
                <xs:enumeration value="visibility-reduced"/>
                <xs:enumeration value="white-out"/>
                <xs:enumeration value="blowing-snow"/>
                <xs:enumeration value="smoke-hazard"/>
                <xs:enumeration value="spray-hazard"/>
                <xs:enumeration value="low-sun-glare"/>
                <xs:enumeration value="snow-glare"/>
                <xs:enumeration value="blowing-dust"/>
                <xs:enumeration value="blowing-sand"/>
                <xs:enumeration value="dust-storms"/>
                <xs:enumeration value="sandstorms"/>
                <xs:enumeration value="air-quality-good"/>
                <xs:enumeration value="air-quality-fair"/>
                <xs:enumeration value="air-quality-poor"/>
                <xs:enumeration value="air-quality-very-poor"/>
                <xs:enumeration value="severe-exhaust-pollution"/>
                <xs:enumeration value="smog-alert"/>
                <xs:enumeration value="pollen-count-high"/>
                <xs:enumeration value="pollen-count-medium"/>
                <xs:enumeration value="pollen-count-low"/>
                <xs:enumeration value="swarms-of-insects"/>
                <xs:enumeration value="fog-clearing"/>
                <xs:enumeration value="visibility-improved"/>
                <xs:enumeration value="fog-forecast-withdrawn"/>
                <xs:enumeration value="pollution-alert-ended"/>
                <xs:enumeration value="air-quality-improved"/>
            </xs:restriction>
        </xs:simpleType>
    </xs:union>
</xs:simpleType>
<!--Element Event-description-type-temperature FADD_ID=3828-->
<xs:simpleType name="Event-description-type-temperature">
    <xs:union>
        <xs:simpleType>
            <xs:restriction base="xs:integer">
                <xs:maxInclusive value="256"/>
                <xs:minInclusive value="1"/>
            </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
            <xs:restriction base="xs:string">
                <xs:enumeration value="maximum-temperature"/>
                <xs:enumeration value="temperature"/>
                <xs:enumeration value="minimum-temperature"/>
                <xs:enumeration value="current-temperature"/>
                <xs:enumeration value="heat-index"/>
                <xs:enumeration value="extreme-heat"/>
                <xs:enumeration value="hot"/>
                <xs:enumeration value="hotter"/>
                <xs:enumeration value="heat"/>
                <xs:enumeration value="warmer"/>
                <xs:enumeration value="warm"/>
                <xs:enumeration value="mild"/>
                <xs:enumeration value="cool"/>
                <xs:enumeration value="cooler"/>
                <xs:enumeration value="cold"/>
                <xs:enumeration value="colder"/>
                <xs:enumeration value="very-cold"/>
                <xs:enumeration value="extreme-cold"/>
                <xs:enumeration value="wind-chill"/>
                <xs:enumeration value="dewpoint"/>
```

```
                    <xs:enumeration value="relative-humidity"/>
                    <xs:enumeration value="temperatures-close-to-the-seasonal-norm"/>
                    <xs:enumeration value="less-extreme-temperatures"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-pavement-condition FADD_ID=3298-->
    <xs:simpleType name="Event-description-type-pavement-condition">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="impassable"/>
                    <xs:enumeration value="almost-impassable"/>
                    <xs:enumeration value="passable-with-care"/>
                    <xs:enumeration value="passable"/>
                    <xs:enumeration value="surface-water-hazard"/>
                    <xs:enumeration value="danger-of-hydroplaning"/>
                    <xs:enumeration value="wet-pavement"/>
                    <xs:enumeration value="treated-pavement"/>
                    <xs:enumeration value="slippery"/>
                    <xs:enumeration value="mud-on-roadway"/>
                    <xs:enumeration value="leaves-on-roadway"/>
                    <xs:enumeration value="loose-sand-on-roadway"/>
                    <xs:enumeration value="loose-gravel"/>
                    <xs:enumeration value="fuel-on-roadway"/>
                    <xs:enumeration value="oil-on-roadway"/>
                    <xs:enumeration value="road-surface-in-poor-condition"/>
                    <xs:enumeration value="melting-tar"/>
                    <xs:enumeration value="ice"/>
                    <xs:enumeration value="icy-patches"/>
                    <xs:enumeration value="black-ice"/>
                    <xs:enumeration value="ice-pellets-on-roadway"/>
                    <xs:enumeration value="ice-build-up"/>
                    <xs:enumeration value="freezing-rain"/>
                    <xs:enumeration value="wet-and-icy-roads"/>
                    <xs:enumeration value="melting-snow"/>
                    <xs:enumeration value="slush"/>
                    <xs:enumeration value="frozen-slush"/>
                    <xs:enumeration value="snow-on-roadway"/>
                    <xs:enumeration value="packed-snow"/>
                    <xs:enumeration value="packed-snow-patches"/>
                    <xs:enumeration value="plowed-snow"/>
                    <xs:enumeration value="wet-snow"/>
                    <xs:enumeration value="fresh-snow"/>
                    <xs:enumeration value="powder-snow"/>
                    <xs:enumeration value="granular-snow"/>
                    <xs:enumeration value="frozen-snow"/>
                    <xs:enumeration value="crusted-snow"/>
                    <xs:enumeration value="deep-snow"/>
                    <xs:enumeration value="snow-drifts"/>
                    <xs:enumeration value="drifting-snow"/>
                    <xs:enumeration value="expected-snow-accumulation"/>
                    <xs:enumeration value="current-snow-accumulation"/>
                    <xs:enumeration value="dry-pavement"/>
                    <xs:enumeration value="snow-cleared"/>
                    <xs:enumeration value="pavement-conditions-improved"/>
                    <xs:enumeration value="skid-hazard-reduced"/>
                    <xs:enumeration value="pavement-conditions-cleared"/>
                </xs:restriction>
            </xs:simpleType>
```

```
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-winter-driving-restrictions FADD_ID=3888-->
    <xs:simpleType name="Event-description-type-winter-driving-restrictions">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="winter-equipment-recommended"/>
                    <xs:enumeration value="winter-equipment-required"/>
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Appendix C

Project Recap and Lessons Learned

Project 1.2 Deploy Limited Condition Acquisition Reporting System (CARS) Study Application in Wisconsin

North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.2

Deploy Limited CARS Study Application in Wisconsin

Project Recap and Lessons Learned

Prepared by:

CASTLE ROCK

March 10, 2005

North/West Passage

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Introduction

The North/West Passage *Project 1.2 'Deploy a Limited Condition Reporting System for Wisconsin'* was intended to allow Wisconsin State Patrol staff in District 6 to study the inputting of road condition, construction, incident, and special event information into a Condition Acquisition Reporting System (CARS). This study took place along the I-94 corridor near the Minnesota/Wisconsin border to Osseo, Wisconsin and included an assessment of the overall project.

Typically, a condition reporting system allows manual and/or automated entry of events to be assembled in a central database within the state. These events may then be viewed by other operators of the reporting system, disseminated to the traveling public as part of a traveler information system, or exchanged with other neighboring states.

One hurdle of committing to a statewide condition reporting system is the need for operators to regularly enter events into the system. Simply put, the information that comes out of the system is only as good as the information entered into the system. In these days of limited staff resources, the commitment to maintain a statewide system can be daunting.

As part of the North/West Passage Project, Wisconsin State Police agreed to conduct a trial of CARS for incident and travel condition management. The intent of this trial was not to evaluate a particular software or approach towards condition reporting, but rather to give State Patrol dispatchers an idea of the level of effort that would be required to enter events into a condition reporting system. Further, it was envisioned that State Patrol dispatchers would have an opportunity to see the value in entering this data in one central location as opposed to responding to multiple requests for information.

Overview of CARS

CARS is a statewide condition system, maintaining a record of all events and situations entered by operators or automatically ingested. Authorized users may enter, view and edit events that affect travel. These events can include roadwork, crashes, delays, travel times, driving conditions, weather, commercial vehicle restrictions, and special events. The primary user interface to CARS is a map-based Graphical User Interface (GUI) that displays all state-maintained roads throughout the state, including Interstates, US Routes and State Routes.

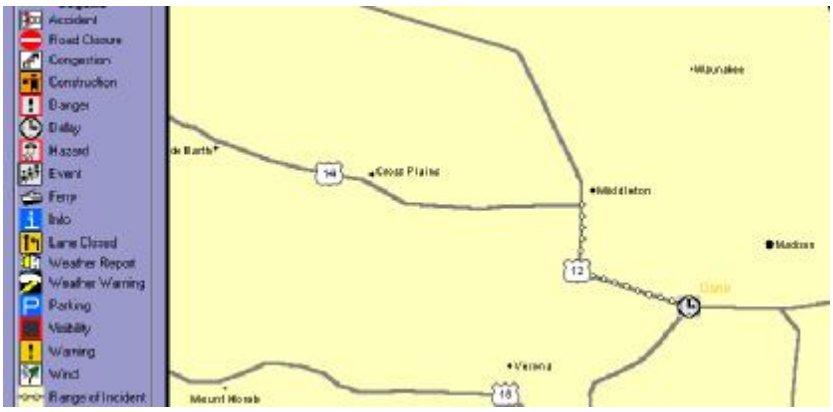

Figure 1 – CARS Map View

Operators click on a route near the reported incident to create a situation report. The situation report entry-screen allows operators to describe the location, description, time/duration, and other details about the event. An event can be entered for a point on a roadway, an extent along a roadway, a county or counties, or statewide. The event remains "active" until its duration or expiration time is reached, or when it is manually canceled by an operator.

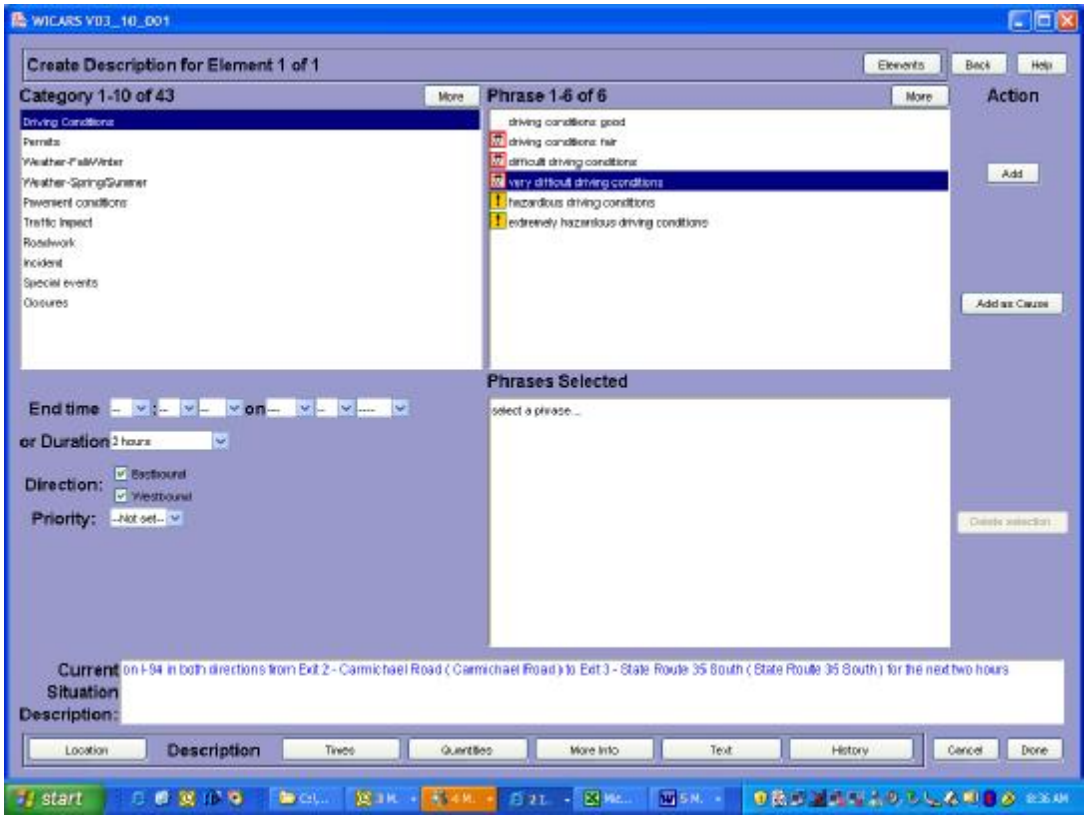

Figure 2 – Example of a CARS Entry Screen

The CARS system provides drop-down "pick-lists" for all descriptions, locations and times. The options available from the pick-lists are defined by national ITS standards, specifically the ITE/AASHTO TMDD (Traffic Management Data Dictionary). Because events are described according to these standards, data entry is uniform and unambiguous. The ITS standards also allow event data to be sent to external systems.

In addition to the map-based GUI, CARS provides an event-list interface for viewing, sorting, and editing events in textual format. The event list allows users to sort active events by various means such as author, time, location or description.

Figure 3 – Example of a CARS Situation Report on WI Route 12

Trial Procedure

The Wisconsin State Patrol (WSP) CARS trial was intended to elicit feedback from WSP regarding the feasibility of radio room operators using such a system as part of their daily routine. A prototype of the CARS system was configured and deployed for the trial. The prototype system included all roads in Wisconsin, however the use by Wisconsin State Patrol only included Region 6, centered around the city of Eau Claire.

Before the trial began, a CARS training session was conducted with Wisconsin State Police. Nine State Patrol dispatchers were trained on how to use the system, including how to view, enter and edit situations in CARS.

The trial began on November 15, 2004 and finished on December 15, 2004. During this period, State Police staff was enabled to enter winter driving conditions, snowfall, crashes and other disruptions to travel on a 24x7 basis.

Throughout the test period, system use was monitored and a trial Internet dissemination site was activated where operators could view how the events could be displayed to the traveling public (however this site was not linked for any live viewing by the traveling public).

Trial Results

After the trial period, members of the North/West Passage Project 1.2 Work Team met in Madison to recap the system usage and to allow feedback and comments from the State Police operators. The following points summarize the thoughts expressed at this meeting:

- Unlike earlier meetings, the general opinion was that a manual input condition reporting system would not be a burden for the dispatchers to enter data;
- The State Patrol noted that operators liked the idea of performing entry into one system and allowing other agencies that need access to view the data (rather than needing to send data to several particular agencies;
- The State Patrol particularly liked the idea that the information input in the condition reporting system could be directly fed to a telephone information system and to an Internet dissemination system;
- The operators reported that the system was quick and easy to use and that using a Condition Reporting System would be entirely feasible for data entry and viewing;
- The State Patrol noted that uptime of the system and the availability of 24X7 support for such a system was an important criteria to be considered if and when WisDOT / WSP pursue such an initiative.

Conclusions

At the start of North/West Passage Project 1.2, there was much concern and debate about the amount of time a manual condition reporting system would require from operators to keep the data updated and accurate. After the four weeks of trial use, the discussion at the table of the trial recap meeting focused more on 'how' would WSDOT and WSP select a vendor or system for deployment. Therefore, the project seems to have alleviated fears about the time demands of such a system, and demonstrated the value that will be achieved when such a system is operational within the state.

Appendix D

Project Summary including a Concept of Operations

Project 1.5 Concept of Operations for Dynamic Message Sign (DMS) Deployment on I-94 Eastbound in North Dakota and I-94 Westbound in Minnesota

North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.5

Concept of Operations for DMS Deployment on I-94 Eastbound in North Dakota and I-94 Westbound in Minnesota

and

Project 1.5 Summary

Prepared by:

URS

January 12, 2006

North/West Passage

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1.0 Introduction and Background

The focus of this document is the project summary for Project 1.5 of Phase I including a Concept of Operations for Dynamic Message Signs (DMS) on I-94 at the Minnesota-North Dakota border.

During Phase I project development, the North/West Passage Steering Committee agreed that to better focus and coordinate efforts they would refine the original focus of Project 1.5 Preliminary Design for DMS Deployment on I-94 Eastbound in North Dakota to develop a Concept of Operations for the DMS to be installed near the border in North Dakota and Minnesota. The project became the current Project 1.5 Concept of Operations for DMS Deployment on I-94 Eastbound in North Dakota and I-94 Westbound in Minnesota. This Concept of Operations document will serve as a reference as North Dakota and Minnesota develop system requirements, design, and deployment plans for the DMS on each side of the border.

History of the decision:
The original purpose of North/West Passage Project 1.5 Preliminary Design for DMS Deployment on I-94 Eastbound in North Dakota was to install a DMS to provide traveler information to travelers eastbound on I-94, as they approach the North Dakota/Minnesota border. The focus of Project 1.5 was to develop a preliminary design, including communication links to stakeholders responsible for system operations for deploying a DMS on I-94 eastbound to complement a DMS being installed I-94 westbound by the Minnesota Department of Transportation (DOT) near the border.

The kick-off meeting for North/West Passage Project 1.8 Develop a Communications Plan for the Anti-Icing System to be Installed on the I-94 Bridge at Red River was scheduled before work on Project 1.5 was started. The objective of Project 1.8 was to develop the communication plan associated with development and deployment of anti-icing technology on I-94 over the Red River Bridge located at the border of North Dakota and Minnesota. Due to location of the proposed DMS in Project 1.5 (eastbound prior to the Red River Bridge) it was agreed at the kick-off meeting to coordinate project efforts.

The anti-icing system and DMS communication plan was completed, however after considerable discussion it was agreed that the DMS communication would not be included in the Request for Proposals (RFP) for deployment of the anti-icing system and would be addressed separately.

During the planning of Project 1.5, Amber Alert Grand Funds became available and North Dakota DOT decided to use these funds to deploy DMS statewide and include the planned DMS along I-94 eastbound near the North Dakota/Minnesota border in the statewide DMS plan. Therefore, only one RFP needed be developed for deploying all of the DMS in North Dakota.

As a result of these revisions, the Project 1.5 Work Team agreed to shift the focus of the project from preliminary design of the DMS to developing a Concept of Operations for DMS deployment on I-94 eastbound in North Dakota and I-94 westbound in Minnesota. The title was revised to Project 1.5 Concept of Operations for DMS Deployment on I-94 Eastbound in North Dakota and I-94 Westbound in Minnesota. The plan is for this Concept of Operations document to serve as a reference as North Dakota and Minnesota develop system requirements, design, deployment, operations, and maintenance for the DMS on each side of the border. The following criteria was then established by the work team to include:

1.1 Purpose and Objectives of the Concept of Operations Document

The purpose of this document is to provide a high level perspective of the DMS System's Concept of Operations, including a definition of key elements and services of each system. A concept of operations is an iterative process of defining the system in non-technical terms so that multiple classes of stakeholders agree on the function and objectives of the system. This plays an invaluable role of accelerating buy-in among stakeholders. With this understanding as a baseline, engineering efforts evolving to design and implementation may commence.

The primary objectives for creating this Concept of Operations are:

- To define goals and objectives
- To clearly describe each DMS system and how it will be managed and operated
- To delineate responsibilities for operations and maintenance
- To identify how each DMS system will work and interface with existing systems
- To advance communication and cooperation among the stakeholders.

1.2 Reference Documents Used to Develop the Concept of Operation

The following documents were referenced for development of this Concept of Operations:

- Project 1.5 Work Team Meeting Minutes from various planning meetings as contained in the Draft North/West Passage Phase 1 Final Report
- North/West Passage Transportation Pooled Fundy Study Phase I – Project 1.6 Summary Document
- MN/DOT District 8 Concept of Operations Technical Memorandum Final Draft November 16, 2005
- Variable Message Sign (VMS) – Local Agency Users Manual, Illinois DOT & Iowa DOT
- Workshop on Changeable Message Sign Usage Sponsored by Illinois and Iowa DOT's 1998
- Mason City Maintenance Area Interstate I-35 Closure Plans 2003-2004
- Interstate Closure - The Procedures for closing the Interstate, Iowa & Minnesota DOT
- North/West Passage Project 1.5 Work Team Meeting minutes, Concept of Operations – DMS, Questions, November 2, 2005
- MN/DOT Message Sign Policy dated October 01, 2003
- MN/DOT Guidelines for Changeable Message Sign (CMS) Use Dated September 15, 2000

1.3 Document Organization

The Concept of Operations document is organized in the following sequence:

2.0 Project and System Overview for Project 1.5
3.0 Concept of Operations - Vision, Goals and Objectives
4.0 Field Devices – Types/Quantities/Locations

5.0 Roles and Responsibilities – Draft MOU & Draft Operations Guidelines
6.0 Outcomes and Benefits
7.0 Staffing, Training, Maintenance and On-going Costs

2.0 Project and System Overview

2.1 Issues and Needs

Eastbound travelers on I-94 in North Dakota and westbound travelers on I-94 in Minnesota lack a seamless, reliable and effective method of obtaining real-time traveler information prior to crossing the Red River Bridge located at the border. Currently in North Dakota and Minnesota, traveler information is available though each state's 511 system. This information is updated district wide a minimum of four times daily, potentially limiting the accuracy of the information presented. Plus drivers are likely to access 511 information only after travel conditions and traffic delays have already developed. This deficiency limits a drivers' ability to make informed route choice decisions as they approach the Red River Bridge.

Both North Dakota DOT and Minnesota DOT have determined they would like to use DMS to provide more seamless, accurate and real-time traveler information for travelers on I-94. The states have developed plans for DMS deployment at the site and have already deployed DMS at other locations along I-94. Filling this void in traveler information could help travelers along I-94 in North Dakota and Minnesota make better route choice decisions.

2.2 Purpose

The purpose of Project 1.5 is to develop a Concept of Operations that provides a high level perspective of the DMS operations. This document includes a Draft MOU that could be used to formalize an agreement between the states for controlling the DMS from each state. The Concept of Operations will help reduce or prevent questions and problems as each state strives to deploy DMS viewable by all vehicles passing through these locations.

2.3 Stakeholders

The primary stakeholders that have responsibility or shared responsibility to maintain and operate the DMS in Minnesota include:

- Minnesota DOT District 4 – Traffic
- Minnesota DOT District 4 – Maintenance
- Minnesota DOT District 4 – Information Technology
- Minnesota State Patrol
- Minnesota DOT Electrical Services Section

The primary stakeholders that have responsibility or shared responsibility to maintain and operate the DMS in North Dakota include:

- North Dakota DOT District 8 – Traffic
- North Dakota DOT District 8 – Maintenance
- North Dakota DOT District 8 – Information Technology
- North Dakota Highway Patrol

- North Dakota DOT Maintenance and Engineering Services Division (MESD)

Specific agency roles are discussed in *Section 5.0 Roles and Responsibilities* of this document.

3.0 Vision, Goals, and Objectives

The vision, goals, and objectives of the Concept of Operations relate specifically to the DMS included in the project. However, it is hoped they can be applied to future projects and to related projects.

3.1 Concept of Operations Vision

The vision of the Minnesota DOT and North Dakota DOT is to use DMS to provide travelers on I-94 seamless, accurate, and real-time traveler information so they can make informed route choice and travel decisions. This Concept of Operations document is being developed to provide a high level perspective of the coordination and operations, of DMS at the borders.

3.2 Concept of Operations Goals and Objectives

The goal of the Concept of Operations for Project 1.5 is to provide system operators and maintainers a high level perspective of the DMS operations, including a definition of key elements and services of each system, communications identification, and contact information resources.

The objective of the Concept of Operations is that it:

- Will facilitate travelers receiving coordinated, accurate, real time information so they can make informed route choice decisions as they approach the Red River Bridge.
- Will provide a clear operational plan for system operators and related information providers as they strive to operate and maintain the system.
- Can facilitate integrate the DMS operations from this project into other state, district and local DMS operational plans.
- Could be used to formalize an agreement between the states for controlling the DMS from each state.
- Can serve as an example and demonstration of multi-state cooperation along the North/West Passage Corridor.

4.0 DMS – Types/ Quantities / Locations

North/West Passage Project 1.5 focused on the deployment of only two DMS located along I-94 specifically for travelers approaching the Minnesota/North Dakota border at the Red River Bridge in Fargo North Dakota and Moorhead in Minnesota. These locations for DMS deployment along I-94 were selected because of the need to provide early warnings to drivers of potential problems and closings of I-94 at locations where they could make informed travel decisions.

In addition these sites were selected because they provide an excellent opportunity for North/West Passage Corridor states to cooperate on a project with mutual need and interest. Separately, two DMS can provide valuable information to motorists; however their value is maximized when they become part of a coordinated deployment and operations program along the entire I-94 corridor.

While North/West Passage Project 1.5 includes only two DMS, the location of these devices was selected so that they are integral parts of the North/West Passage I-94 corridor and integral parts of each states DMS deployment programs.

4.1 DMS Deployment

Eastbound on I-94 one DMS is to be deployed at 5th Street on the South side of I-94 in Fargo, North Dakota. The type, size and other specification details are currently under development and have not been established. This DMS will be owned, operated and maintained by the North Dakota DOT although its messages will primarily benefit travelers entering Minnesota.

Westbound on I-94 one DMS is to be deployed at milepost 1.0 east of the exit to TH-75.The type, size and other specification details are currently under development and have not been established. This DMS will be owned, operated and maintained by the Minnesota DOT although its messages will primarily benefit travelers entering North Dakota.

4.2 DMS Deployment along the I-94 Corridor in Minnesota and North Dakota

As part of their plans to provide drivers real-time travel information, both North Dakota and Minnesota have been and are continuing to deploy additional DMS plus other message and ITS devices.

The Minnesota DOT has DMS operational or in process at the following general locations along I-94:

- Existing westbound MP 6.7 near Moorhead, East of highway 336

The following DMS are listed to show that the DMS included in Project 1.5 are part of a system of DMS providing travelers information. They are activated by staff in the District 4 and District 3 TOCC's.

- Planned westbound at Fergus Falls
- Planned westbound a Alexandria
- Existing westbound MP 128.6, one mile east of highway 71 Sauk Center
- Existing westbound MP 171.7, East of St. Augusta
- Existing westbound MP 180.7, 2.4 miles east of highway 24 Clearwater

- Existing westbound MP 194.8, 1.4 mile east of highway 25 Monticello
- Existing westbound MP 201.5, 1.6 mile west CR 39 at Albertville

North Dakota DOT has portable (semi-permanent) DMS operational or in process at the following general locations in Fargo:

- Existing I-94 westbound near 42nd Street in Fargo
- Existing I-29 northbound between 7th and 12th Ave N. in Fargo.
- Existing I-29 southbound near 32nd Ave. S. in Fargo.

Other public DMS deployments in the Fargo or Moorhead area:

There are no known DMS deployments, including portable DMS deployments in the Fargo or Moorhead area by other public entities including cities or counties. However, on an emergency basis it's reasonable to expect that any of these entities, including Minnesota and North Dakota DOT's, would lease or purchase portable DMS to meet their needs.

4.3 Additional DMS Deployments in Minnesota and North Dakota

In North Dakota, deployment of DMS along I-29, and at various Interstate feeder roads, will be particularly important to the full functioning of the DMS on I-94 since I-29 is both a feeder system and an alternative route for travelers on I-94. North Dakota currently uses 13 portable DMS during winter operations in semi-permanent locations along the Interstate system. Statewide North Dakota has deployed or has plans for DMS deployment at approximately 48 locations.

In Minnesota, deployment of DMS in the Minneapolis/St Paul Metropolitan area and St. Cloud area can also provide travelers information on alternative routes when the DMS are part of a coordinated operational plan. Statewide, Minnesota has deployed or has plans for DMS at numerous locations

4.4 DMS Integration

During the development of this Concept of Operations, it was agreed by the Project 1.5 Work Team that the signs on each side of the border would not be integrated into the other states system at this time. Also that one state would not operate the other states DMS. The MOU developed as part of this document is intended to assist each state with coordination of the signs as needed.

4.5 Communications

In Minnesota the DMS on westbound I-94 at milepost 1 (east of exit to TH-75) will communicate over hardwire phone line.

In North Dakota the DMS on eastbound I-94 at 5th Street will communicate over hardwire phone line.

4.6 Other Systems Communications

North Dakota has deployed a DMS control software for their portable DMS called Intelligent Control provided by Intelligent Devices, Inc. This software was used to upgrade all 19 of North Dakota's portable DMS signs from five different manufacturers to NTCIP compliance. North Dakota is now able to use a single communication interface to communicate to all their DMS.

4.7 Architecture

In Minnesota District 4, as part of the District 4 ITS Scoping Study a Regional Architecture was developed. North Dakota has also developed a state regional architecture that is available at www.atacenter.org/regional/northdakota/). An architecture provides a common framework for planning, defining, and integrating ITS. The architecture defines functions, the physical entities of subsystems, where these functions reside, and the information flows and data flows that connect these functions and physical subsystems together into and integrated system.

5.0 Roles and Responsibilities - DRAFT MOU

The roles and responsibilities for the each DMS of each stakeholder organization are defined in this section. However, no amount of paper or planning can actually facilitate or manage the person-to-person respect, communication, trust, and responsibility that can occur between dedicated people who really want to make a difference. This document will serve as a foundation, but it cannot duplicate or replicate the ongoing arrangements and communication between participants from all the stakeholder organizations as they operate the system. This becomes especially important during emergency conditions when all organizations are stretched to their limit and are operating beyond normal anticipated capabilities. A major disadvantage of informal arrangements is that some stakeholders are left out at critical decisions, and that can become a major factor during emergency situations.

Currently an informal process is in place between North Dakota and Minnesota District Offices that includes calling each other when information is to be shared regarding the border. However, an MOU could be developed to formalize the agreement for controlling the DMS in each state including provisions for after hours or in case of emergencies. It was agreed that as part of Project 1.5 a draft MOU would be developed for use by stakeholders to formalize their operational arrangements (See Section 5.3 Draft MOU for DMS Operations on I-94 Between North Dakota and Minnesota).

A number of factors influence how each state views its roles and responsibilities for the DMS as installed as part of Project 1.5 including:

- An informal process is already in place.
- Future district or statewide DMS operational plans or messages requirements
- Participation by other stakeholders
- Perception and timing of severe weather conditions and emergencies
- Problems and special situations that affect operations and maintenance of the DMS
- Amber Alerts and how they are processed

5.1 Minnesota DOT District 4 & State Patrol

A Concept of Operations for the District 4 Transportation Operations and Communications Center (TOCC) is in draft form as part of on ongoing contract for Districts 2, 3A, 4 and 8. When completed it will formalize operational arrangements for the TOCC between Minnesota DOT District 4, the Minnesota State Patrol, and other stakeholders.

Any multi-state MOU for Project 1.5 will need to be coordinated with this project for development of the TOCC Concept of Operations in District 4.

The following are considered primary stakeholders that have responsibility or shared responsibility for the operations and maintenance of the DMS in Minnesota:

- Minnesota DOT District 4 – Traffic
- Minnesota DOT District 4 – Maintenance
- Minnesota DOT District 4 – Information Technology
- Minnesota State Patrol – Law enforcement and road closures
- Minnesota DOT Electrical Services Section

5.2 North Dakota DOT, District 8 & Highway Patrol

In North Dakota, most emergencies, i.e. road closures, Amber Alerts, etc. are coordinated by NDDOT MESD. They coordinate their operations with the North Dakota Highway Patrol and with the district offices. Non-emergency operations are coordinated though District 8.

The primary stakeholders that have responsibility or shared responsibility for the operations and maintenance of the DMS in North Dakota include:

- North Dakota DOT District 8 – Traffic
- North Dakota DOT District 8 – Maintenance
- North Dakota DOT District 8 – Information Technology
- North Dakota Highway Patrol – Law enforcement and road closures
- North Dakota DOT Maintenance and Engineering Services Division (MESD)

5.3 Draft MOU

The following draft MOU has been prepared as part of Project 1.5 to facilitate involvement of State DOT's, State and Highway Patrol, district offices, and other stakeholders in operations and maintenance of the DMS on I-94 near the Minnesota/North Dakota border. This MOU focuses on the DMS at this particular site, however it was developed so that it could be incorporated in other state operational plans and by other stakeholders as their future plans develop.

Final agreement and signature by key agencies will be an interactive process and while this is a draft MOU it is intended that it can also become a draft or concept document for additional multi-state DMS and other field devices among the North/West Passage Corridor states.

DRAFT DOCUMENT

MEMORANDUM OF UNDERSTANDING

FOR DYNAMIC MESSAGE SIGN OPERATIONS ON I-94

AT THE NORTH DAKOTA - MINNESOTA BORDER

JANUARY 16, 2006

MOU FOR DYNAMIC MESSAGE SIGN OPERATIONS ON I-94 AT THE NORTH DAKOTA – MINNESOTA BORDER

This Memorandum of Understanding is entered into this 16th day of January 2006 by and between the State of Minnesota, Department of Transportation, District 4, hereinafter referred to as MNDOT, the Minnesota State Patrol, hereinafter referred to as MSP, the State of North Dakota, Department of Transportation, Central Maintenance Office, hereinafter referred to as NDDOT, and the North Dakota Highway Patrol hereinafter referred to as NDHP

Whereas, as part of the North/West Passage Pooled Fund Study, Project 1.5, two Dynamic Message Signs (DMS) are to be deployed along I-94 near the border between North Dakota and Minnesota at the following general locations;

- Eastbound on I-94 one DMS on the South side of I-94 at 5th Street in Fargo (NDDOT owned and maintained DMS)

- Westbound on I-94 one DMS on the North side of I-94 at milepost 1, approximately 900 feet east of the TH-75 exit. (MNDOT owned and maintained DMS)

Whereas, as part of the North/West Passage Pooled Fund Study these DMS are to be deployed to advise travelers on I-94 with seamless, real time traveler information, road conditions, and Amber Alerts to the extent possible; and

Whereas, both states recognize that travelers on I-94 need seamless, real time, cross-boarder traveler information on road restrictions, travel conditions, maintenance operations and emergency conditions so they can make informed travel decisions; and

Whereas, westbound travelers on I-94 in Minnesota primarily need information about travel conditions in North Dakota and eastbound travelers on I-94 in North Dakota primarily need information about travel conditions in Minnesota so they can make informed decisions; and

Whereas, each state Department of Transportation (DOT) MSP and NDHP Office operates and maintain the DMS in its respective state independently; and

Whereas, it is recognized between the states that the public need for seamless traveler information, on I-94, can best be served through advanced planning, cooperation and communication between, NDDOT, NDHP, MNDOT, MSP and other stakeholders; and

Whereas, during severe weather conditions and for other public safety reasons, it may become necessary to partially close, fully close or detour traffic on I-94;

Now therefore, based upon mutual understanding, the parties enter into this Memorandum of Understanding (MOU) to establish and implement the following planning, communications and operations procedures for; operating and maintaining the DMS; for determining the need for closing or restricting travel on I-94; for release of public announcements on travel restrictions on I-94 and when necessary for closing or restricting travel on I-94:

1. Each state DOT is primarily responsible for operating and maintaining the above referenced DMS in their state.

2. Each state DOT is primarily responsible for communication between and coordination with their respective State and Highway Patrol Offices and with other stakeholders in their state.

3. Each state DOT is primarily responsible for messages on the DMS in their state. Shared messages i.e. states placing messages on the other states DMS are not planned at this time or included as options in this MOU.

4. FOR GENERAL INFORMATIONAL MESSAGES on the DMS, no multi-state coordination is necessary.

5. FOR ADVISORY MESSAGES, traffic management, information, maintenance operations, construction activities and other messages such as bridge icy, or bridge de-icing, the following will apply; MNDOT will, as soon as a message is determined necessary, communicate that message and timing of it, to NDDOT District 8 Offices at phone number (701) 239-8900, and NDDOT will communicate their advisory messages and their timing to MNDOT TOCC at phone number (218) 846-0450.

6. FOR AMBER ALERT MESSAGES they are coordinated through NDDOT MESD at phone number (701) 328-2545, alternate (701) 328-2517 evening and weekend phone (701) 391-0795, and Minnesota DOT at (218) 846-0450, alternate phone (218) 291-4350. Note: These offices are responsible for coordinating the posting of DMS amber alert messages with their 511 operations so they can be included in 511 phone message sets.

7. FOR I-94 CLOSING, TRAVEL RESTRICTIONS OR EMERGENCY OPERATIONS the first priority is safety and the following procedures will apply:

    A. In Minnesota, MNDOT District 4 Transportation Operations and Communication Center will coordinate discussions with appropriate stakeholders to determine the need to close or restrict travel on I-94.

    B. In North Dakota, NDDOT MESD will coordinate discussions with appropriate stakeholders to determine the need to close or restrict travel on I-94.

    C. Once a determination of need to close or restrict travel appears eminent in either state they will initiate communications with the other state over these conditions and the results of their discussions.

    D. In North Dakota the MESD contact phone numbers for these communications are: daytime phone (701) 328-2545, alternate daytime phone (701) 328-2517 evening and weekend phone (701) 391-0795.

    E. In Minnesota the District 4 Transportation Operations and Communications Center phone number is: (218) 846- 0450, alternate phone (218) 291-4350 These numbers are staffed 24 hours a day, 7 days a week.

F. Additional communications with other stakeholders will be made as appropriate, by each state DOT, so these stakeholders, including County Sheriffs, local police, School Districts, emergency management and the media can prepare for traffic diversion, and other emergency operations.

G. Once a determination, between the states, has been made to close or restrict travel on I-94, and a timeline for closing determined, each state will notify the other appropriate stakeholders of their plans. They will also notify other DOT Districts along I-94 so they can provide a coordinated DMS message to travelers, including 511 messages, and they will notify the appropriate media so that the public is informed of their plans.

H. At the time for closing each state will follow their established procedures for the actual closing, for barricades, traffic coordination, message signs, road maintenance and law enforcement.

I. State DOT's will coordinate messages to be displayed on the DMS so that motorists receive seamless travel information.

J. Finally, and equally important, the same procedures will be followed in reverse as the time for opening I-94 to travel approaches, except that any opening must also be coordinated with maintenance operations on the road.

This MOU is not a legally binding document, but is prepared for the purpose of facilitating DMS operations at the Minnesota – North Dakota border.

IN RECOGNITION OF THE MUTUAL UNDERSTANDINGS DISCUSSED HEREIN THE PARTIES HERETO AFFIX THEIR SIGNATURES ON THIS DOCUMENT, WHICH SHALL BECOME EFFECTIVE ON THE 16TH DAY OF JANUARY 2006

North Dakota Department of Transportation

_____

North Dakota Highway Patrol

_____

Minnesota Department of Transportation

_____

Minnesota State Patrol

_____

5.4 Draft Operations Guidelines for Coordinating DMS Messages When Closing I-94 Westbound at Fargo/Moorhead

In addition to the Draft MOU a one page quick reference OPERTIONS GUIDELINES FOR COORDINATING DMS MESSAGES WHEN CLOSING 1-94 WESTBOUND AT FARGO/MOORHEAD has been prepared in draft form. The purpose of this document is to provide a one-page set of directions for North Dakota MESD staff on who to call, and on messages to be displayed on the DMS across the border in Minnesota.

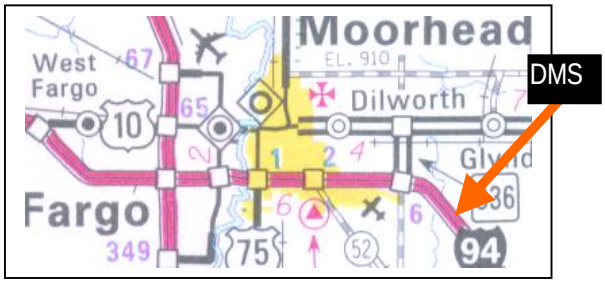
DRAFT DOCUMENT

OPERATIONS GUIDELINES FOR COORDINATING DMS MESSAGES WHEN CLOSING I-94 WESTBOUND AT FARGO/MOORHEAD

JANUARY 16, 2006

– NORTH DAKOTA DOT CENTRAL MAINTENANCE –

OPERATIONS GUIDELINES FOR COORDINATING DMS MESSAGES WHEN CLOSING I-94 WESTBOUND AT FARGO/MOORHEAD



These guidelines are intended to help dispatchers quickly choose and display appropriate messages on the I-94 westbound Dynamic Message Sign (DMS) at Fargo/Moorhead. The messages are used when North Dakota DOT determines it necessary to close I-94 westbound at Fargo/Moorhead because of severe weather conditions or for emergency purposes. They are general guidelines and therefore do not cover every possible situation, or special operational condition that may arise.

1. **Determine the need to close I-94 to all westbound traffic at Fargo, at which exit and at what time.**
2. **Call Minnesota State Patrol (District 4 TOCC) at (218) 846-0450 to request activation of the DMS with time and exit number.**
3. **Follow established procedures for closing of I-94.**
4. **The following DMS messages are considered appropriate to request:**

Note: The DMS on I-94 westbound at exit 6 (County Road 11) is a Dual Phase sign and can display two messages on 3 lines on an alternating basis.

For closings at westbound exit 6 the following messages can be used -

I-94 CLOSED AT EXIT 6 ONE MILE

ALL TRAFFIC MUST EXIT ONE MILE

For closing at westbound North Dakota exits 348, 349, 350 & 351, or at other exits further west, the following can be used (insert correct exit and mileage) -

I-94 CLOSED AT EXIT 349 NINE MILES

ALL TRAFFIC MUST EXIT NINE MILES

Key
Exit - Miles
1 - 5
351 - 7
350 - 8
349 - 9
346 - 12
342 - 16
340 - 18
338 - 20

In addition to closures, the sign can be used for other purposes, such as notifying drivers of upcoming lane closures, resulting from either road work or crashes, to warn of hazardous road conditions, and to post Amber Alerts.

5. **Log message and time displayed in log book**
6. **Coordinate opening of I-94 to traffic following established procedures.**

6.0 Outcomes and Benefits

There are two outcomes and benefits to be considered as part of this Concept of Operations.

6.1 Actual performance and operations of the DMS as a real-time, seamless traveler information system

This Concept of Operations document does not attempt to quantify or qualify actual performance and operations benefits of these DMS. Partially because these are new DMS and their specifications, operations and maintenance have not yet be specified.

In addition these signs will be individual DMS within statewide networks of DMS and other informational signing. Trying to determine the performance benefits of an individual DMS does not appear to be easy exercise, or provide valuable beneficial information. At this time the overall need, benefits and operations characteristics is based on a "judgment' and mutual determination of the participants in the program.

6.2 Usefulness of the coordination efforts, the project experiences and documentation for the overall North/West Passage Pooled Fund Study

The basic question here is are the experiences gained and documentation prepared in this project useful on other North/West Passage Corridor projects. On the experiences gained, each state has gained a better understanding of the others planning and operations plus numerous "contacts" between persons performing similar functions have been established. These contacts and better communications on planning, operations and maintenance will continue as each organization manages its future programs.

Preparing a totally new Concept of Operations for multi-state sharing of DMS has been a learning process for each state. Many of the informal communications links have been refined and documented for the future so that in emergency situations a firm line of communications has been established. It is also expected that as each state develops its future DMS operations plans that these cross-state communications links and this document will be valuable assets to the process.

With a Concept of Operations completed each state along the North/West Passage Corridor has a document format and example that can serve as a starting point for developing additional multi-state programs.

7.0 Staffing, Training, Maintenance, and On-going Costs

7.1 Staffing

At both the North Dakota DOT and the Minnesota DOT the DMS will be additional tools available for staff to perform their day-to-day activities. No additional staff requirements are anticipated as a result of Project 1.5 although they may be called in as part of regular preparations for severe weather or other emergency conditions.

7.2 Training

Both Minnesota and North Dakota already have operational DMS and their staff has experience in operating DMS. However, the following additional training is anticipated as appropriate:

- Training specific to the operational characteristics of the new DMS installed in each state will be provided by the field installation contractors.
- Additional staff training in coordination and operation DMS is anticipated as each state develops additional statewide standard procedures for DMS operations and or messages. Minnesota DOT currently has a Guidelines for CMS Use document dated September 15, 2000, that was used as a reference document in developing this Concept of Operations.
- At a time when a state, route, or site-specific operational plan for interstate closures is developed that affect I-94 at the Minnesota/North Dakota border additional training will be necessary.

7.3 On-Going Operation and Maintenance Costs

Although it is recognized that the messages on each sign will primarily benefit the traveler as they cross the border and travel in the other state, the operational and maintenance costs for each DMS will be born by the state owning the sign.

Individual DMS communications, operational and maintenance costs estimates will be determined as part of the detailed specifications for each DMS.

In Minnesota, MNDOT District 4 Traffic Operations will own and maintain the DMS.

In North Dakota, NDDOT District 8 Traffic will own the DMS, and they will maintain the DMS with support from the NDDOT IT Division.

Appendix E

Project Summary including a Concept of Operations

Project 1.6 Preliminary Design for DMS Deployment at the I-94 and I-90 Split in Tomah, Wisconsin

North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.6

Preliminary Design for DMS Deployment at the I-94 and I-90 Split in Tomah, Wisconsin

Project Summary

Prepared by:

URS

March 17, 2005

North/West Passage

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Introduction

The purpose of the North/West Passage Project 1.6 – *Preliminary Design for Dynamic Message Sign (DMS) Deployment at the I-94 and I-90 Split in Tomah, Wisconsin* was to supply westbound travelers with en-route road weather condition information to Minnesota, North Dakota, and South Dakota in order to make early and safer travel decisions. Currently, travelers receive only limited information via weather broadcasts.

The initial focus of Project 1.6 was to focus on developing a preliminary design for deploying a DMS on I-90 and I-94 southeast of Tomah, Wisconsin including communication links to stakeholders responsible for system operation, in order for road weather condition information on I-94 and I-90 to be communicated early to travelers on these routes.

After considerable discussion at the Project 1.6 Work Team Kick-Off Meeting in March 2004, it was agreed that the first step to achieving the goal of deploying a DMS was developing a Concept of Transportation Operations for the project. Concurrent with the development of Project 1.6, Wisconsin was developing a Traffic Operations Plan (TOP). There was a need to coordinate efforts between these projects due to their close relationship.

Therefore, the focus of Project 1.6 shifted to developing a Concept of Transportation Operations document. The group proceeded with the development of this document, focusing on providing traveler information at the Tomah split not specifically a DMS. However as the project progressed in December 2004 it was determined that the deliverable for this project would be this working document for Wisconsin to use as work continues on projects such as the TOP.

The following sections identify information presented and discussed at Project 1.6 Work Team meetings for inclusion in a Concept of Transportation Operations document.

1.0 Concept of Transportation Operations Purpose and Objective

The purpose of this Concept of Transportation Operations document is to provide a high level perspective of providing traveler information, including a definition of key elements and services of the system, and sample scenarios of how the system will work. A concept of operations is an iterative process of defining the system in non-technical terms so that multiple classes of stakeholders agree on the function and objectives of the system. This plays an invaluable role of accelerating buy-in among stakeholders. With this understanding as a baseline, engineering efforts for evolving to a design and implementation could commence.

The primary objectives for creating a Concept of Transportation Operations is to:

- To make a broad-brush attempt at defining goals and objectives
- To clearly describe a traveler information system and how it will be managed and operated
- To identify and address common institutional issues; and
- To advance communication and cooperation among the stakeholders.

The following sections address the information for Wisconsin to consider in providing traveler information to individuals traveling along the I-90/94 corridor in central and western Wisconsin, in particularly near the Tomah split.

2.0 Project/System Overview

2.1 Need

Although traffic delays are much more common in metropolitan areas, they can be more lengthy and disruptive in rural areas. Unlike metropolitan areas, obstructions to free flow of traffic on rural segments of highway are usually unexpected. When motorists come upon road construction, incidents, or deteriorating driving conditions in rural areas, their options are limited. With fewer exits, fewer alternative routes, and fewer lanes, motorists are less able to minimize delay.

Travelers on I-90/94 in central and western Wisconsin lack a reliable and effective method of obtaining real-time traveler information. Currently in Wisconsin, traveler information is available though the 1-800-ROADWIS telephone number. This number is Wisconsin specific and is not regional traveler information telephone number. This information is currently updated at a minimum of 4 times daily, limiting the accuracy of the information presented. This deficiency limits a drivers' ability to make informed route choice decisions as they approach major decision points along I-90 and I-94.

2.2 Project Purpose

The purpose of this project is to provide accurate and real-time traveler information for travelers on I-90/94 in central and western Wisconsin. Filling this void in traveler information will aid route choice decisions in Wisconsin and throughout the upper Midwest.

2.3 Stakeholders

In order for traveler information to be available to the public, primary stakeholders need to be identified that will have responsibility or shared responsibility to operate the traveler information system. Stakeholders would include Wisconsin Districts along with Minnesota's Regional Traffic Management Center.

Other stakeholders within the areas of operational impact (defined in Section 4.2) may have supporting roles in traveler information operations by means of providing information to and coordinating with the primary stakeholders. Those secondary stakeholders include county and city transportation agencies and emergency responders within the areas of operational impact

2.4 Project Concept

The concept of this project is to provide traveler information along I-90/94 in central and western Wisconsin. Particularly, this project focuses on providing real-time travel information to travelers on westbound I-90/94 at a location southeast of Tomah, Wisconsin prior to the split of the Interstates. The information would be used to provide travelers accurate and useful real-time information pertaining to road closures, incidents, construction, or weather related concerns within both the local area of influence itself and downstream locations throughout the corridors. This information would be available prior to the

split between the two Interstates to provide adequate time for drivers to process the information and make their route choice decision.

In order to provide accurate traveler information various stakeholders mentioned in the previous section will share responsibility of providing information. The primary responsibility would lie in the district the traveler information component is placed during normal business hours. Other districts throughout the state and corridor would share control of providing the traveler information. Additional responsibilities would also be placed on the Wisconsin State Patrol during off hours. Local agencies including county sheriff's departments, local polices and fire, emergency management agencies, county highway departments, and city highway/public works departments, may coordinate with District 5 and the State Patrol during off hours.

3.0 Vision, Goals, and Objectives

3.1 Project Vision

The vision of Project 1.6 is to improve the quality of life for people living in or attending events within the city of Tomah, Wisconsin and surrounding areas or traveling through West-Central Wisconsin, and the upper Midwest on I-90/94 by providing safe, efficient movement of people, goods, and services.

3.2 Project Goals and Objectives

The overall goal of this project is to provide travelers with accurate, timely, and coordinated regional and local traffic and traveler information to enable informed route choice decisions before the split between I-90 and I-94. Specifically, the goals and objectives of this project are:

Goal	Objective
Enhance Mobility and Accessibility	§ Improve accessibility and availability of travel information to the traveling public and other users
Enhance Productivity	§ Reduce travel delay and increase the reliability and predictability of moving people and goods for transportation users § Improve the ability of the traveling public and other users to perform travel planning and make route choice decisions using real-time travel information
Improve Safety	§ To improve the ability to identify, respond, remove, and mitigate the effects of incidents
Increase Efficiency	§ Reduce time delay and costs associated with congestion § Improve the operational efficiency of goods and people movement

In addition, the project will promote the realization of the following benefits:

- § Address and promote sharing of operations of ITS assets between WisDOT Districts and between WisDOT and MnDOT

- Capture the links between this Concept of Transportation Operations Document and other planning and operations documents within the State of Wisconsin
- Promote agency coordination and cooperation within Wisconsin, the Gary-Chicago-Milwaukee Corridor, and the North/West Passage Corridor
- Establish common vocabulary and terminology to be used across agencies and jurisdictions in the State of Wisconsin

4.0 System Architecture and Operational Capability

4.1 System Architecture

This project represents an application of the National ITS Architecture at a project level and implements the vision by providing the following user services:

- En-route Driver Information
- Traffic Control
- Incident Management

The following market packages are closely related to the system:

- ATMS06 – Traffic Information Dissemination
- ATMS07 – Regional Traffic Control

Brief descriptions of the associated with the system are provided in the following.

Traffic Information Dissemination: This market package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road/bridge closures due to maintenance and construction activities to be disseminated.

Regional Traffic Control: This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. This market package provides the communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

4.2 Areas of Operational Impact

Four distinct areas of operational impact centered at the location of the I-90/04 split are defined as:

- The local area of operational impact is defined as the area generally within 10-mile radius of the Tomah Split. The operational authorities within this local area include WisDOT District 5 and WisDOT State Patrol District 5. Other agencies that may support traveler information include Monroe County Highway Department, Emergency Management Department, and Sheriff's Department, and public works, fire and policy departments of cities and local communities within the area.
- The extended local area of operational impact is defined generally as the area between 10 and 20 miles from the Tomah Split. The operational authorities within the area include WisDOT District 4, WisDOT District 5, and WisDOT State Patrol District 5. Other agencies within the area that may support the use of the DMS include Monroe County, Jackson County, Juneau County, and other cities within the area.
- The regional area of operational impact is generally defined as the area within 20 miles of the I-90 and I-94 west of the Tomah Split in Western Wisconsin. The operational authorities within this regional area include WisDOT Districts 5 and 6, and WisDOT State Patrol Districts 5 and 6. Other agencies that may support traveler information within this area include the highway, sheriff's, and emergency management departments of the following counties: Monroe, Jackson, Clark, Eau Claire, Chippewa, Pepin, Buffalo, Pierce, Dunn, St. Croix, Trempealeau, La Crosse, and Vernon.
- The multi-state area of operational impact is any location along the I-90 and I-94 Corridors outside of the regional area of operational impact in Wisconsin, Minnesota, and Eastern North Dakota.

The areas of operational impact include I-90 and/or I-94, and other routes within these four distinct regions. The traveler information provided will not be limited to events on the interstates only but will also include other traveler information deemed important to travelers at this location in central Wisconsin.

4.3 Operational Capability

Operational capabilities for this project should be considered based on the areas of operational impact as defined in the above, in conjunction with the consideration of areas of operational authority. Four operational capability categories are defined:

- Local Functions – Those functions are the responsibility of WisDOT District 2, WisDOT State Patrol District 5, and WisDOT District 5.
- Extended Local Functions – Those can be carried out by the WisDOT District 2, WisDOT District 5, and WisDOT State Patrol District 5 without interagency collaboration but would benefit the local agencies and the region if done with a regional perspective.
- Regional Functions – Those are performed for the regional and local benefit and should be performed with regional cooperation and collaboration between agencies.
- Multi-State Functions – Those functions are performed for the regional and multi-state benefit and regional and multi-state regional coordination and collaboration is required.

4.3.1 Local Functions

WisDOT District 2 Traffic Operations Center (TOC) will be responsible for disseminating traveler information during the regular operating hours. WisDOT District 2 TOC processes information related to any events taking place within this local area of operational impact. The information may be received internally from other divisions within WisDOT District 2 or from other agencies within the local area of operational impact. WisDOT District 5 analyzes the magnitude of the events and the area of influence, and determines appropriate actions for disseminating the information to travelers. If it is determined the traveler information systems are used, WisDOT District 2 TOC Operator then follows the WisDOT policy and disseminates appropriate information via roadway equipment (i.e, DMS and HAR) and/or other travel information systems (i.e. 511, internet website). For pre-scheduled events such as work zone activities and planned special events where the lengths of the events are known, the TOC Operator determines the length of the information that will be disseminated. WisDOT District 2 TOC continues monitoring the events and/or receiving updated information related to the events. Other agencies, that are responsible for or involved with the events and providing the information to WisDOT District 2 TOC for activation of the sign, continue providing updated information to the TOC throughout the length of the events. Upon receiving updated information, the Operator evaluates the scenario and alters or removes information content as appropriate.

4.3.2 Extended Local Functions

Similar to the local functions, agencies within the extended local area of operational impact inform WisDOT District 2 TOC with information significant to travelers on I-90/94. The TOC Operator analyzes the magnitude of the events and the impact area and determines appropriate actions. If traveler information systems are used, the Operator then follows the WisDOT policy and determines and disseminates appropriate information. WisDOT District 2 TOC continues monitoring the events and/or receiving updated information related to the events. Upon receiving updated information, the TOC Operator evaluates the scenario and alters or removes information content as appropriate.

4.3.3 Regional Functions

Coordination amongst WisDOT District 2 and agencies within the regional area of operational impact takes place to inform travelers of events further downstream along I-90 and I-94 Corridors. WisDOT District 2 TOC Operator analyzes and determines the events with regional significance based on the information related to the events. Such information is obtained either internally within the District or is provided by other WisDOT Districts or other agencies within the area of operational impact. The Operator then, based on the WisDOT policies and guidelines, determines if the events warrant the use of travel information systems. A contingency plan must be in place regarding traffic re-routing and suggested alternate routes if conditions require such an action.

4.3.4 Multi-State Functions

Coordination amongst WisDOT District 1, WisDOT District 2, WisDOT District 5, WisDOT State Patrol District 5, MnDOT Regional Transportation Management Center (RTMC), and/or North Dakota DOT, as well as other operational authorities within the multi-state area of operational impact takes place to inform travelers of events further downstream of the I-90 and I-94 Corridors. When an event occurs

further downstream of the corridors that impact the normal operations, MnDOT RTMC may share the operation of the roadway traveler information equipment with WisDOT District 2 TOC and WisDOT District 5. Coordination and information sharing among the three agencies take place when shared control is required.

WisDOT District 2 TOC Operator analyzes and determines the events with greater regional or multi-state significance based on the information related to the events. Such information is obtained either internally within WisDOT or is provided by other agencies within the area of operational impact. The Operator then based on the WisDOT policies and guidelines, determines if the events warrant the use of traveler information systems.

The multi-state operational capabilities will function similarly to the regional capabilities. Agreements will need to be in place between states to facilitate the exchange of information between different state's agencies and provide protocols to create real-time information exchanges.

The vision for this project is to allow all travelers to make route choices based on accurate and real-time traveler information. Traveler information coordination within Wisconsin agencies and with other state agencies is an attainable goal to provide seamless, real-time information to all travelers. The performance of the system can be measured by a variety of sources. One method may include calculating the average time it takes to disseminate the traveler information after the authorities have been notified of the event. Another measure of performance could include calculating the amount of traffic diversion due to the information provided to the traveler.

5.0 Operational and Support Environment

As a traveler information component is identified, it is necessary to describe the facilities, equipment, technologies, computing hardware, software, services, personnel, operational procedures, and support that may be necessary to operate the system and to achieve the project/system performance goals and objectives.

The operational and support environment may include:

- Facilities: identify physical facilities necessary to meet the needs of the fully functional system through high-level descriptions.
- Equipment: High-level descriptions identify the equipment necessary for the system to be operational.
- Hardware: Typically, this refers to the physical information systems that the users of the system access.
- Software: A high-level description of the information system applications necessary for system operations.
- Personnel: Describes the personnel necessary to staff all facilities needed for the system to be operational. This typically includes a concise subset of the system users identified in the User-Oriented Operational Description.
- Operational Procedures: A description of what, and when, the users and system components are performing under specific conditions.
- Support Necessary to Operate the Deployed System: This includes all other supporting labor that is not specifically designated by the operations of the system. This support could include facility management, accounting/finance, human resources, etc.

6.0 Staffing and Training

After a system is defined for providing traveler information, staffing and hours of operations need to be defined. Another component would be to define training requirements in order to familiarize staff with the system.

7.0 Operational Scenarios

A main component in identifying how the system would work for providing information to travelers includes the development of operational scenarios. The following list highlights suggested scenarios to address as a component for providing traveler information is determined.

- Traffic Incident on Westbound I-90 West of Tomah
- Traffic Incident on US Highway 53 Near Bloomer, Wisconsin
- Road Closure at I-94 Bridge Over St. Croix River Near Hudson, Wisconsin
- Truck with Hazardous Material Overturn on I-94 Near Eau Claire
- A Major Winter Strom in Southeastern Minnesota
- Amber Alert

8.0 Roles and Responsibilities

Within each operation scenario suggested above, there is a need to identify the roles and responsibilities of staff within each identified stakeholder.

Conclusion

The goal of Project 1.6 is to provide information to travelers westbound on I-90 and I-94 before the Tomah split, so users can make informed route decisions based on the conditions. Although a preliminary design was not developed for a DMS, the project was successful in identifying that a Concept of Transportation Operations should first be developed to identify where a traveler information component should be placed in order to receive buy-in among stakeholders. Due to Wisconsin's TOP project occurring at the same time as Project 1.6, the group learned that the documents need to compliment each other by addressing the Concept of Operations. The information presented above identifies information to address as a Concept of Transportation Operations document is developed within in Wisconsin.

During the duration of this project the following stages were identified for developing a Concept of Operations for Wisconsin. Please note the stages were suggested and discussed with the Project 1.6 Work Team and were never formally approved.

Stage 1: Regional Concept of Transportation Operations

- This stage would not identify technology. It would look at what is needed from an operational perspective. The effort would consider various operational/ incident related scenarios (6 – 10). The effort would help answer questions about:

- What do we do with traffic?
- How do we manage it?
- What do the travelers need to know?
- Where do travelers need to know this information?

Identify different locations. This effort is independent from what tools or technology will be used but you could identify strategic decision making points or different locations that are critical to the various scenarios.

Stage 2: Corridor Infrastructure Concept of Operations (ITS Plans/Architectures)

§ This stage looks at what system capabilities and tools will need to be implemented throughout the corridor to meet the needs related to the scenarios identified in Stage 1. Technologies and tools such as DMS, communication systems, Public Safety Communication Centers, surveillance, detection, more intensive subsystems for weather information, etc. could be considered. This effort would identify site-specific locations to deploy the tools.

Stage 3: Corridor Operations Plan (Systems Engineering Concept of Operations)

§ This stage takes the next step if you want to implement the infrastructure identified in Stage 2. Here is where you consider things like who operates the tools, who maintains, what information is shared, what gets integrated, on-going operations/maintenance, how the technology is administered institutionally, how does the system evolve over time, etc.

Concept of Corridor Operations Planning Guide (Template)

§ The concept of corridor operations planning guide/template developed under the Wisconsin Transportation Operations Plan (TOP) would precede the three about stages. It would provide the framework to link the three stages together as well as help break the state into specific corridors. The guidelines would facilitate and help tell how you apply the three stages/ tools above.

In addition to discussing the stages for developing a Concept of Operations in Wisconsin, mapping the current Wisconsin efforts to the stages of Concept of Operations was developed as follows.

Concept of Corridor Operations Planning Guide
- § Status: Developed under TOP

Stage 1: Regional Concept of Transportation Operations
- § Apply Corridor Operations Planning Guide to IH94 Tomah Split
  - o Status: To be determined

Stage 2: Corridor Infrastructure Concept of Operations (ITS Plans/Architecture)
- § Completed efforts:
  - o IH90/94 Intercity Corridor Study – Strategic Deployment Plan, Dec. 1996
  - o IH90/94 ITS Corridor Program – Corridor ITS Architecture, March 2002
  - o ITRAM (Madison and Surrounding Area Design Study Report) – established statewide vision for CCTV and DMS.

- Statewide ITS Architecture – effort broke state into corridors and developed a statewide architecture utilizing Turbo.
- TOC Focus Groups

Stage 3: Corridor Operations Plans (Systems Engineering Concept of Operations)

- Completed efforts:
  - ITRAM (Madison and Surrounding Area Design Study Report) – developed very high-level scenarios and concept of corridor centers.
  - Statewide ITS Architecture – effort created very high level concept of operations for corridors throughout the State.
- Other Efforts:
  - North/West Passage Corridor Project 1.6 – DMS Deployment at IH94 Split at Tomah, Wisconsin

Appendix F

North/West Passage Website Home Page (http://nwpassage.info)

Project 1.7 Develop a North/West Passage Program Web Site

North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.7

Develop a North/West Passage Program Website

Homepage

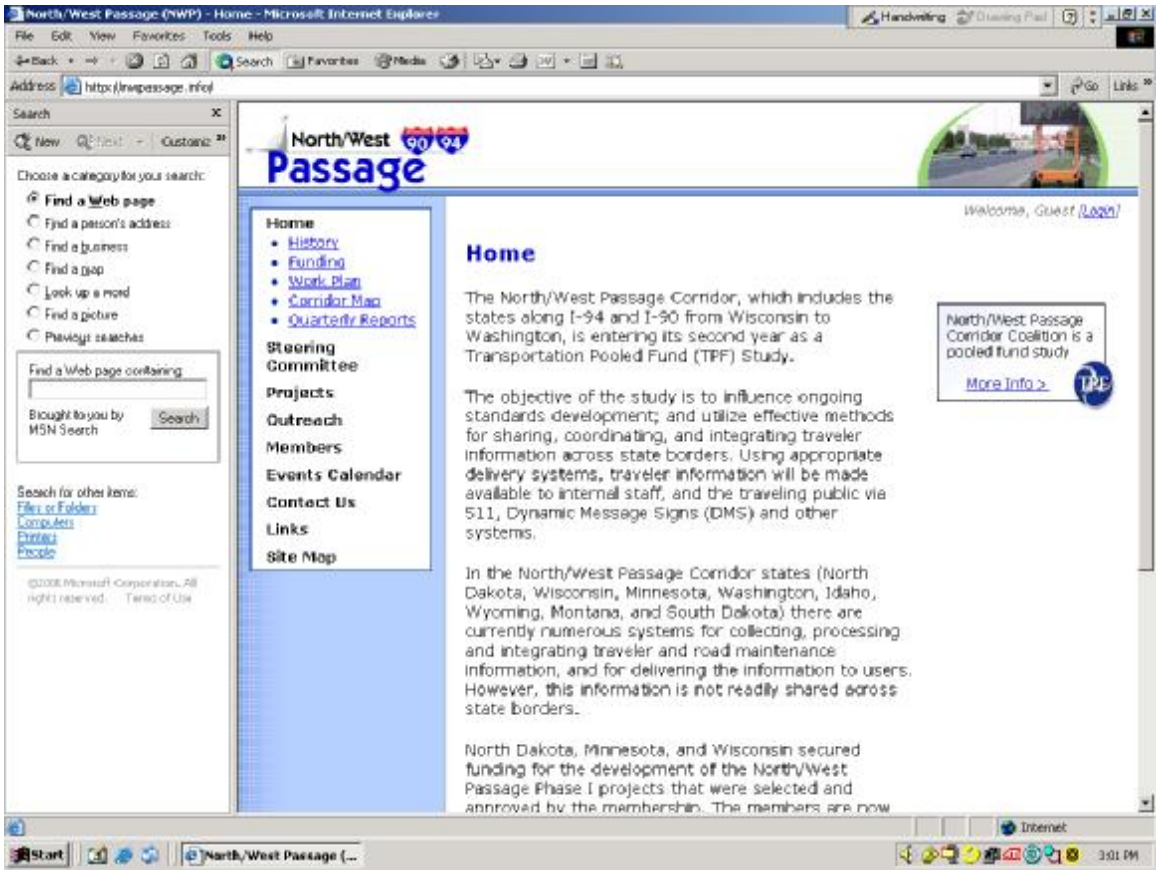
Prepared by:

Advanced Traffic Analysis Center
North Dakota State University
Fargo, North Dakota

August 20, 2004

NORTH/WEST PASSAGE TRANSPORTATION POOLED FUND STUDY: PROJECT 1.7 WEBSITE HOMEPAGE

The objective of North/West Passage Transportation Pooled Fund (TPF) study Project 1.7 was to develop a website for the North/West Passage Corridor. This website (http://www.nwpassage.info/) was developed and launched on August 20, 2004 to allow easy access to North/West Passage information worldwide and to communicate and educate users about the North/West Passage TPF study. The website provides easier communications for those persons working on the North/West Passage Project. Following is a screenshot of the website.



Appendix G

Communication Plan and Preliminary Design Plans

Project 1.8 Develop a Communications Plan for the Anti-Icing System to be installed on the 1-94 Bridges at Red River

Request for Proposal

Fixed Automated
Anti-icing Spray System

Red River Bridge Crossing
Located on I-94 between
North Dakota and Minnesota

ND Bridge Nos. 94-352.453R and 94-352.457L
MN Bridge Nos. 9066 and 9067

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
Bismarck, North Dakota
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DIRECTOR
David A. Sprynczynatyk, P.E.

MAINTENANCE AND ENGINEERING SERVICES DIVISION
Jerome Horner

February 2005

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North Dakota Department of Transportation
Red River of the North I-94 Fixed Automated Spray Technology
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PROJECT SPECIFIC INFORMATION

Project Overview

The North Dakota Department of Transportation (NDDOT) in partnership with the Minnesota Department of Transportation (MnDOT) request proposals for a Fixed Automated Spray Technology (F.A.S.T.) fully automated bridge/roadway anti-icing system. NDDOT Bridge Numbers 94-352.453R/457L and MnDOT Bridge Numbers 9066/9067 has a potential for many vehicle accidents due to traffic congestion on the bridge, “black ice” formation due to freezing vehicle exhaust moisture on the bridge surface and unique meteorological conditions at the bridge. This automated anti-icing project is intended for the purpose of prolonging life expectancies of bridge structures, and to greatly reduce the number of vehicle accidents on the bridge and related property damages and threats to public health and safety and further demonstrate the technical, operational, and economic feasibility of fully automated bridge anti-icing technology.

Project Goal

It is the goal of this project that the Vendor, starting on or about May 11, 2005, will provide all necessary equipment, labor, parts, supplies, engineering, and materials (except anti-icing chemicals which will be provided by the respective Department of Transportations) for a fully automated anti-icing system to be located on the roadway of I-94, across the I-94 Bridge over the Red River or the North, on the North Dakota/Minnesota border, in the cities of Fargo, ND and Moorhead, MN. The Vendor will also provide for Project Management, Furnish and Install Automated Bridge Anti-icing, Interact the control software into the existing NDDOT and MnDOT system software interface or purpose alternate control, complete system check out, onsite and offsite system training, system documentation, warranty and support periods, permits and as-built plans. Installation and checkout of all project features will be completed by October 15, 2005.

This work will consist of the design, construction, testing, and maintenance of a fixed automated anti-icing system for the bridge and roadway approaches, if applicable. The proposal will include all equipment, and services necessary to perform all the tasks to complete the design, installation, testing, start-up, training, and maintenance of the anti-icing system.

The anti-icing system must be a fixed automated system that allows automatic treatment of the traffic lanes and other targeted areas. The anti-icing system shall be capable of utilizing a variety of anti-icing and de-icing chemicals by pumping the chemicals through a series of solenoid-controlled valves to nozzles mounted in the roadway (if applicable) and bridge deck. (The DOT’s have specified that a

potassium acetate based product will be used with the installation.) Upon actuation, a remote processing unit, or RPU, controller opens solenoid valves in an automated sequence to spray the anti-icing liquid over the targeted area. The anti-icing cycle will be initiated automatically, requiring no human activation, based on information provided by active and passive sensors mounted in the bridge deck, and atmospheric sensors. The anti-icing cycle will also be capable of initiation by remote access by cell phone/radio, Internet web, and by manual activation from the pump house. The system must also be accessible remotely by the vendor for the purposes of trouble shooting the system. The system will be capable of dispensing varying quantities of liquid anti-icing agent in variable spray sequences depending on road surface conditions at the site, for example, black ice, snow, or freezing rain.

The system will operate with constant pressure throughout the system to supply a localized pressure boost to the spray nozzles. The liquid will flow through a pressurized piping system that is designed to permit the isolation of individual nozzles or groups of nozzles, while continuing to supply fully pressurized liquid to all remaining operational spray nozzles. The complete anti-icing system will be a fully integrated system, with individual components designed, manufactured, and tested to operate specifically as part of the anti-icing spray system. The system will be a proven design and shall not be a prototype.

The system and its operation will be completely independent of the NDDOT and MnDOT existing or planned road weather information system network. The system will be connected to each DOT anti-icing computer located at each District headquarters in Fargo, ND and Moorhead, MN, from which the system will be capable of remote control operation and monitoring. The system shall be capable individual lane control, i.e.; NDDOT will have manual control over the East Bound lanes and MnDOT will have manual control over the West Bound lanes. Refer to Appendix B, Communications.

Scope of Work and Deliverables

Project Management

- Supervision and coordination of any and all subcontractors
- Coordination with each State
- Bi-weekly written status reports and meetings

Installation of fully automated bridge anti-icing project

- Develop and deliver all contract drawings, specifications, and documents.
- Deliver equipment and material resources.
- Prepare work area, storage and staging area
- Provide electrical power, lighting, telephone, water supply and sanitation facilities for project duration.
- Provide traffic control
- Furnish and install all materials and equipment needed for the anti-icing system

System demonstration

- Complete check of all materials, hardware and software, fully tested

Training – operation and maintenance and repair

- On-site system operation
- Remote operations
- Operation software

System Documentation

- Manuals – System and training

Warranty and Support

- Warranty for 2 years after completion and acceptance
- Technical support for 30 months after warranty

See Appendix A for a more detailed description of work and deliverables. Vendors are encouraged to propose additional tasks or activities if they will substantially improve the results of the project. These items should be separated from the required items on the cost proposal.

Vendors are to respond to all the requested tasks and services listed in the RFP, no more, no less (basic services). Cost proposals are to be based on those basic services. Additional proposed services, alternative approaches, or services the Vendor does not deem necessary are to be addressed separately. Cost for those additional/alterative/not necessary services are to be itemized as subtractions or additions to the basic service cost. This is to ensure a consistent comparison between proposals.

Proposal Evaluation

All responses received by the deadline will be evaluated by representatives of both Departments of Transportation. In some instances, an interview may be part of the evaluation process. A 100-point scale will be used to create the final evaluation recommendation. The factors and weighting on which proposals will be judged are:

1. Project approach 50%
2. Project team 20%
3. Company Experience 20%
4. Cost detail 10%

Proposals will be evaluated on a best value as 90 percent qualifications and 10 percent on cost considerations. The cost proposal will not be opened by the review committee until after the qualifications points are awarded.

Proposal Submittal

All proposals must be sent to:

Ed Ryen, P.E., Assistant Maintenance Engineer
North Dakota Department of Transportation
Maintenance and Engineering Services Division
608 East Boulevard Avenue
Bismarck, ND 58505-0700

All proposals must be received not later than 2:00 P.M., Central Standard Time, March 24, 2005. All visitors to the building, including couriers, must check in at the first floor mail room. Please allow sufficient time in your delivery schedule to comply with security procedures.
Submit six copies of the proposal. Proposals are to be sealed in mailing envelopes or packages with the Vendor's name and address written on the outside. Each copy of the proposal must be signed, in ink, by an authorized member of the firm.

Proposal Questions
Prospective Vendors who have any questions regarding this request for proposal may contact:

Ed Ryen, P.E.
By E-mail (preferred): eryen@dot.state.nd.us

By Fax: (701) 328-4623
By U.S. Mail: 608 East Boulevard Avenue
Bismarck, ND 58505-0700

All questions must be received by 10:00 A.M. Central Standard Time, on February 25, 2005. All questions and answers will be sent to each prospective Vendor by March 11, 2005.

General Information
Vendors must adhere to all terms of this Request for Proposals.

Late proposals will not be considered.

All costs incurred in responding to this RFP will be borne by the Vendor.

Fax and e-mail responses will not be considered.

1. **Acceptance/rejection**. The right is reserved to accept or reject any or all proposal responses wholly or in part, at no penalty to the NDDOT Maintenance and Engineering Services Division or State of North Dakota.
2. **Addition of Terms and Conditions.** Any conditions submitted with a proposal response and any proposal with any additional terms and conditions may be rejected.
3. **Affirmative Action**. The Vendor will take affirmative action in complying with all Federal and State requirements concerning fair employment and employment of the handicapped, and concerning the treatment of all employees without regard to discrimination by reason of race, color, religion, sex, national origin or physical handicap.
4. **Alternate Proposal(s).** Vendors may submit alternate proposal responses(s) for the items(s) specified in the solicitation. Alternate proposal responses are to be clearly marked 'alternate' and all specifications, brand name, model number or trademark, if any, and/or any other information pertinent to identification must accompany the alternate proposal response.
5. **Alterations and/or Corrections.** The person signing the proposal response must initial any or all alterations and/or corrections (i.e. erasers, whiteouts,

correction tape, etc.) made to the proposal response. Those proposal responses with alterations and/or corrections to the unit or total price that are not initialed will be rejected.

6. **Award**. Proposals are not awarded at the proposal opening. Proposal responses will be firm for 30 days, unless stated otherwise.
7. **Awards, Splitting of;** The state reserves the right to make awards by item, groups of items, or on the total low proposal for all the items specified as indicated in the detailed specifications. Vendor's interested only in the total low proposal for all items are to state 'all or nothing' on their proposal response.
8. **Proposal Summary.** Proposal summaries will be mailed to those vendors who supply a self-addressed, stamped envelope with their proposal response. Proposal summaries are not mailed until the proposal has been awarded. Proposal summaries may be viewed and a copy obtained at the NDDOT Maintenance and Engineering Services Division during normal working hours.
9. **Vendors Must Be Approved Before Contract Award** Proposals will be accepted from vendors that are not currently approved vendors on the State's bidders list; however, the successful offeror will be required to become approved prior to award.
   To become an approved vendor, offerors must: 1) be registered with the North Dakota Secretary of State (fees apply), and 2) submit a completed Bidders List Application to the North Dakota Vendor Registry Office. Prospective offerors may access the Procurement Vendor Database on-line at www.state.nd.us/sec/ to verify whether their firm is currently on the bidders list.
10. **Vendor's Responsibility.** It is the vendor's responsibility to ensure that a proposal response is physically deposited with the NDDOT Maintenance and Engineering Services Division prior to the date and time specified for the date and opening. Late proposal responses will not be opened and will be rejected regardless of the degree of lateness or the reasons. It is the vendor responsibility to comply with the State of North Dakota's laws and regulations.
11. **Changes.** After a binding contract has been entered into, no changes (i.e. substitution of product or a price adjustment) may be made, unless prior approval has been obtained from the NDDOT Maintenance and Engineering Services Division.
12. **Clarifications/Interpretations.** Any and all questions regarding this document must be addressed to the NDDOT Maintenance and Engineering Services Division – Project Manager, listed below. The vendor is cautioned that the requirements of this solicitation can be altered only by written addendum and that verbal communications from whatever source are of no effect.

For information about purchasing procedures, policies and clarification of the bidding documents, hardware and software requirements contact:

Ed Ryen, P.E., Assistant Maintenance Engineer
Maintenance and Engineering Services Division
North Dakota Department of Transportation
608 East Boulevard Avenue
Bismarck, North Dakota 58505-0700
Telephone: 701-328-4274
E-Mail: eryen@state.nd.us

13. **Definitions**:
    - Vendor - any person or firm submitting a competitive proposal in response to a request for proposal
    - Proposal response – the executed document submitted by a vendor in response to a request for proposal
    - Contract – a deliberate written agreement between two or more competent persons to perform specific tasks
    - Vendor - any person or firm having a contract with a governmental body.
14. **Facsimile Proposals.** Proposal responses are not be faxed to the NDDOT Maintenance and Engineering Services Division. **PROPOSAL RESPONSES FAXED TO THIS OFFICE WILL BE REJECTED.** Faxed proposal responses are accepted only, if the proposal is faxed to a third party, who will put it in an envelope and deliver it to the NDDOT Maintenance and Engineering Services Division before the date and time specified in the solicitation.
15. **Review of the Proposals.** Proposals are not available for review until after award is made. After award, those interested in reviewing the proposal file are to make arrangements, with the NDDOT Maintenance and Engineering Services Division. The NDDOT Maintenance and Engineering Services Division hours are between 8:00 a.m. and 12:00 p.m. and 1:00 p.m. and 5:00 p.m. Monday through Friday.
16. **Receipt of Proposals**. All sealed proposals received by the NDDOT Maintenance and Engineering Services Division will be opened and recorded at the place, date, and hour specified in the solicitation. The contents of proposals are not available for public review until after the award is made.
17. **Rejection**. Proposal responses will be rejected if:
    - the proposal response is not legible.
    - the proposal response is not completed as requested.
    - the proposal response is completed and/or signed in pencil.
    - the proposal response is faxed to the NDDOT Maintenance and Engineering Services Division
    - the proposal response is unsigned.
    - the proposal response does not meet the required specifications of the solicitation.
    - changes or corrections to price on the proposal response that are not initialed.
    - the proposal response is received after the time and date specified.

- or a combination of the above.

18. **Signature.** The vendor submitting the proposal response or that vendor's duly authorized agent or representative must sign the proposal response manually in ink. The name and title of the person signing the proposal response must be typed or printed below the signature.
19. **Specifications**. All models shall be new, unused units under current production at the time of submitting response unless otherwise specified.

20. **Taxes**. The State does not pay sales tax or federal excise tax. The state sales tax exemption number is E-2001. The federal tax free transaction number is 45-70-0010K.
21. **Withdrawal or changes to a proposal response prior to the proposal opening date and time.** A vendor may withdraw or make a change to his proposal prior to the proposal opening date and time. The request to make a change or withdraw must be in writing by a representative of the firm. The request to withdraw or change must be signed by the vendor or his designated representatives.
22. **Withdrawls after the proposal opening date and time.** Withdrawals after the proposal opening will be allowed only upon written approval from the NDDOT Maintenance and Engineering Services Division. Vendors continually withdrawing proposals after the proposal opening may be removed from the Vendor Database.
23. **Subcontractors.** Overall the vendor must assume responsibility for the proposal submitted in response to this RFP. The vendor submitting the winning proposal must be the prime Vendor and principal contact during the entire term of the resultant contract. All subcontractors the vendor plans to use in fulfilling the obligations of the resultant contract must be fully identified in the vendor proposal.
24. **Vendor Checklist.** HAVE YOU REMEMBERED TO:
    - Mark envelope as indicated
    - Review General Terms and conditions contained in this solicitation.
    - Sign your proposal on the cover sheet included (SFN 51460)
    - Initial all proposal/pricing changes you made.
    - Proposal responses must be submitted in ink or type written.
    - Review and complete all requirements contained in this solicitation to ensure compliance.
    - Register With the North Dakota Secretary of State Office

General Terms and Conditions

1. **Assignments, Transfers, Etc.** Contracts as a result of this request for proposal are not to be assigned, transferred, conveyed, sublet, or otherwise disposed of without previous consent, in writing, to the NDDOT Maintenance and Engineering Services Division.
2. **Attempt To Influence An Award.** No person on a bidders list or who submits or intends to submit a proposal shall give or offer to give, directly or indirectly, any money, article, or other thing of value to:

a. Any office or employee of the North Dakota Department of Transportation.
b. Any office or employee of any requisitioning agency that has submitted or may submit a requisition for any item sold such person.
c. Any office or employee of the State of North Dakota who is a member of a committee whose duty it is to recommend or adopt specifications for any commodity or equipment to be bought by the state that is sold by such person.

Any person attempting to influence an award, or making (or offers to make) a gift is prohibited. All proposals submitted by this person will be rejected and the firm will be barred from further making proposals for period of time, which will be determined by the North Dakota State Procurement Office. (Also see subsection 3 of section 4-03-13-01). The Office of Management and Budget will notify the Attorney General of any violation of this subsection. For such action as the Attorney General may deem appropriate. 4-03-08-01(6).

3. **Award.** Awards will be made to the responsible, responsive vendor whose proposal is determined to be most advantageous in consideration of price and all other state award criteria. Awards may not be made to any person, firm, or corporation in default of a contract or to any company having as its sales agent or representative, or as a member of the firm, an individual previously in default or guilty of misrepresentation.
4. **Binding Contract.** The acceptance of a proposal response in writing by the NDDOT Maintenance and Engineering Services Division shall constitute a contract between the vendor and the state. Written acceptance from the (State Procurement Office or NDDOT) will be in the form of a purchase order or a notification of award. Any oral agreement or arrangement by a vendor or vendor with an agency or buyer will have no force or effect unless reduced to writing. The successful vendor must perform in accordance with the terms and conditions of the contract and this article and purchasing laws of the state of North Dakota.
5. **Compliance with Laws.** The Vendor must, in performance of work under this contract, fully comply with all applicable federal, state, or local laws, rules and regulations. The Vendors must comply with the provisions of all appropriate federal laws, including title VI of the Civil Rights Act of 1964. Any subletting or subcontracting by the Vendor, subject subcontractors to the same provision.
6. **Cancellation of Contract.** If the contract is canceled for cause by the NDDOT Maintenance and Engineering Services Division, the Vendor is responsible for delivery of all items ordered prior to the cancellation, unless those orders had been cancelled by the ordering agency.
7. **Delivery of Equipment.** 30 days after receipt of purchase order.
8. **Discussions with Vendors.** The state reserves the right to hold discussions with vendors for the purposes of clarification, negotiations, and requesting best and final offers with vendors deemed susceptible for award.
9. **Estimated Volume.** The volume of this contract is estimated as listed in the proposal. Estimates are not to be considered as either a minimum or maximum, but rather an estimate based upon past and anticipated usage.

The Vendor or Vendors will be required to furnish actual requirements upon order. This contract will not include items of a similar nature, which must be bought for emergency use.

10. **Funding-out Clause/Appropriations Clause.** This contract shall become null and void, in total or in part, should the Legislature of the State of North Dakota fail to appropriate funds for any or all agencies, which are committed to the terms of this contract. Any such contract termination shall be at no cost to the state.

    The following clause will appear on all multi-year contracts or agreements: "NDDOT's obligation to pay those amounts due for those fiscal years following the next fiscal year are contingent upon legislative appropriation of funds for that purpose. Should said funds not be appropriated, NDDOT may terminate this agreement with respect to those monthly payments for succeeding fiscal years for which such funds are not appropriated. NDDOT will give the bidder thirty (30) days written notice of such termination and advise the bidder of the location of the equipment. All obligations of NDDOT to make payments after the termination date will cease and all interest of NDDOT in the equipment will terminate."

11. **Hold Harmless/Indemnification.** The Vendor agrees to indemnify the state, its officials, agents, and employees while acting within the scope of their duties as such, harmless from and against all claims, demands, and causes of action of any kind or character, including the cost of defense, arising in favor of the Vendor's employees or third parties on account of bodily or personal injuries, death, or damage to property arising out of services performed, goods or rights to intellectual property provided of omissions of services or in any way resulting from the acts or omission of the Vendor and/or its agents, employees, subcontractors or its representatives under this agreement, all to the extent of the Vendors negligence. The successful bidder must sign a contract that also contains our standard Risk Management Clause, which is attached as Appendix E.
12. **Investigations.** The State reserves the right to make an investigation or investigations of the materials, equipment, supplies, qualifications, or facilities offered by vendor or vendors determined to be susceptible for award. This investigation would be to determine whether or not the apparent low vendor or vendors could meet the requirements set forth in the solicitation.
13. **Material and Workmanship.** All material and workmanship shall be subject to inspection and testing by the state either at: (1) the point of manufacturer, or; (2) place of storage, or; (3) upon receipt.
14. **Rejection of any or all proposals.** The state reserves the right to reject any and all proposals in whole or in part.
15. **Title.** Title to items ordered shall not pass to the state until the items are received and accepted by the state. The Vendor shall be responsible for any loss prior to the actual receipt of the items by the state or it's agent.
16. **Subcontractors.** Overall the vendor must assume responsibility for the proposal submitted in response to this RFP. The vendor submitting the

winning proposal must be the prime Vendor and principal contact during the entire term of the resultant contract. All subcontractors the vendor plans to use in fulfilling the obligations of the resultant contract must be fully identified in the vendors proposal.

17. **Price Reductions.** NDDOT reserves the right to receive the benefit of any manufacturer-announced price reductions that occur prior to the delivery of the system components or maintenance contracts.
18. **Preparation of the Proposal.** Only signed proposals submitted on forms furnished by the NDDOT Maintenance and Engineering Services Division will be considered, and the bidder will be assumed to have familiarized themselves with the requirements of any and all special provisions by reference made a part of these specifications. Any unauthorized changes in or additions to the proposal form, including any reservations, will be considered sufficient grounds for rejection.
19. **Ties and Reservations.** No ties or reservations by the bidders are permitted.
20. **Incurring Costs.** NDDOT will not be liable for any costs associated with the preparation and presentation of a proposal submitted in response to this RFP.
21. **Proprietary Information.** NDDOT will consider all proposals received as public domain material and as such, they will be available for review. Any restrictions on the use of the data contained in the proposal must be clearly stated. Proprietary information submitted in response to this request will be handled in accordance with the statues of the State of North Dakota and the policies of the NDDOT. Innovations developed as, a result of this proposal may not be copyrighted or patented. All data, documentation, and innovations become the property of the NDDOT and will not be returned.
22. **Permits and Regulations.** The vendor shall procure and pay all permits, licenses, and approvals necessary for the execution of the contract. The vendor shall also comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the work.
23. **Payments of Permits, Licenses, Etc.** Except as otherwise provided, all import permits, licenses, and the payment of all United States import duties and custom fees shall be the sole responsibility of the vendor
24. **Mandatory Requirements .** Requirements designated in this proposal as mandatory must be satisfied. Proposals, which do not meet this criterion, may be disqualified from further consideration. The vendor should be aware that when the heading of a section or a paragraph of this RFP proposal and Project Specifications document contains the word “Mandatory,” all requests or requirements of the vendor or the proposed equipment contained therein and statements further qualifying those requests or requirements will constitute mandatory requirements unless otherwise stated.

    Failure to meet a mandatory requirement (grounds for disqualification) shall be established by any of the following conditions:

The vendor states that a mandatory requirement cannot be met and does not propose a satisfactory functional equivalent.

The vendor fails to include information necessary to substantiate that a given mandatory requirement has been met.
The vendor fails to include information requested by a mandatory requirement.
The vendor presents the information requested by this RFP in a manner inconsistent with the instructions as stated by mandatory requirements of this RFP.
The evaluation team establishes reasonable doubt by a review of the available user references as to the vendor's ability to comply with one or more of the mandatory requirements of this RFP.

25. **Scope** This RFP contains the instructions governing the proposal to be submitted and the material to be included therein, mandatory requirements which must be met to be eligible for consideration, bidders' responsibilities, and the requirements to be met by each proposal
26. **Proposal Discrepancies.** In case of difference between written words and figures in the proposal, the amount stated in written words shall govern. In case of unit price differences from an extended figure, the unit price shall govern.
27. **Contract.** The successful vendor will be required to execute a contract satisfactory to NDDOT Maintenance and Engineering Services Division within 7 working days after notification. Preprinted contract forms, which represent the "complete and exclusive statement of agreement", are not acceptable. The contents of this specification, as well as the entire proposal submitted by the selected vendor, will become part of the contract. Preprinted contract forms, which are normally and regularly used by the bidders, may be submitted as addenda to the proposal, for consideration during proposal appraisal.
28. **Award of contracts – Bonds.** . For contracts in excess of $20,000. the successful bidder is required to furnish a suitable bond in at least the amount of the contract and with such surety as may be determined by the NDDOT and as approved by it.
29. **Acceptance of Proposal Content.** By submitting a proposal, the vendor agrees that the contents of the proposal will become part of the contract when accepted by the NDDOT Maintenance and Engineering Services Division in the manner prescribed under the standard contract.
    The selected bidder will be required to assume responsibility for delivery, installation, and maintenance of all equipment and support services proposed.
30. **Prime Bidder Responsibility.** A prime bidder is the bidder who offers the proposal to provide the service and receives payment for that service. NDDOT Maintenance and Engineering Services Division will consider the prime bidder to be the sole point of contact with regard to contractual matters, including the performance of services and the payment of any and all charges resulting from contractual obligations.
31. **Collaborative Proposals.** The firm(s) that will be ultimately responsible for installation (if applicable), warranty service, and maintenance service must be a party to the proposal and the resulting contract. Subcontracting of

maintenance must be with the original manufacturer's authorized service organization.

32. **Demonstration.** Selected top three vendors may be required to run a demonstration. The proposed equipment and system will be run on the vendor's supplied hardware to substantiate vendors claims with NDDOT personnel present. Failure to perform as reported in the proposal may result in disqualification.
    The results of the demonstration and data created during the demonstration will become the property of NDDOT, and NDDOT may distribute or publish any of this data, or grant permission to distribute or publish any of this data at NDDOT's discretion.
33. **Notification of Award.** An apparent successful bidder will be announced immediately following NDDOT management approval. This is expected to be within one month of opening bid proposals. Bidder will be notified
34. **Non-performance** of the vendor in terms of the specifications shall be a basis for the termination of the contract or portions thereof by NDDOT. Cancellation of the contract may be made by NDDOT for reasons of non-performance upon thirty (30) days written notice to the vendor. Further, NDDOT shall not pay for work not done or for work done in an unsatisfactory manner
35. **Down Time Attributions.** Down time shall not be attributed to vendor's equipment if failure of the proposed automated testing system equipment is due to "force majeure." The term "force majeure" as used herein shall mean without limitation; acts of God, strikes, or lockout; acts of public enemies; riots; epidemics; lightning; earthquakes; fire; storms; floods; washouts; droughts; arrests; restraint of government and people; civil disturbances and explosions.
36. **Payment.** NDDOT hereby agrees, in consideration of the covenants and agreements specified to be kept and performed by the vendor, to pay to the vendor when the term and conditions of the contract and specifications have been fully completed and fulfilled on the part of the bidder to the satisfaction of NDDOT, the sum of the individual order amount. Payment under the contract will be made in the manner provided by law for payment of claims against NDDOT.
37. **Bidder Questions.** All questions from vendors regarding the RFP or relating to this project must be submitted to NDDOT for clarification by March 14, 2005. Questions will be answered in writing and mailed, e-mailed, or faxed to all bidders by March 18, 2005. Questions must be in writing and mailed, faxed, or e-mailed to:

    Ed Ryen, P.E., Assistant Maintenance Engineer
    Maintenance and Engineering Services Division
    North Dakota Department of Transportation
    608 East Boulevard Avenue
    Bismarck, North Dakota 58505-0700
    Telephone: 701-328-2545
E-Mail: eryen@state.nd.us

Proposal Format

It is requested that the format and the content adhere to the requirements listed below of this RFP. It should be noted that although the response format is optional, the content is mandatory.

The proposals must be prepared on standard 8 ½ x 11 inch paper (charts and other large forms should be folded to fit the above size) and should be placed in a binder with tabs separating the major sections listed below. Optional extras may be quoted as additions in letterform on separate sheets attached to the proposal.

1. **Multiple Proposals.** Multiple proposals involving alternative methods of meeting the objectives may be submitted and are encouraged. Each proposal must conform to the format specified in these instructions. Each proposal must be clearly marked Proposal # one, Proposal #2, etc. on the cover.
2. **Collaborative Proposals**. The firm(s) that will be ultimately responsible for installation (if applicable), warranty service and maintenance service must be a party to the proposal and the resulting contract. Subcontracting of maintenance must be with the original manufacturer's authorized service organization.
3. **Proposal**. The vendor must agree, in writing, that information contained in all material submitted is valid and will remain so for at least six (6) months form the due date of this RFP.
4. **Proposal Specifics:**
   The vendor shall submit proposals as follows:
   a. The proposal shall be printed in ink or typed
   b. Proposals must be submitted in sealed envelopes or containers, and must be clearly identified as proposals submitted in response to the solicitation.
   c. All proposals are to be submitted complete and in their entirety
   d. One original and six (6) copies of the proposal shall be submitted.
   e. Vendor should provide a table of contents and provide label divider tabs.
   f. Alterations or erasures must be crossed out, and the corrections thereof printed in ink or typewritten adjacent thereto. The person signing the proposal must initial the corrections in ink.
   g. All proposals must comply with and not deviate from the provisions of the Project Specifications and/or other bid or contract documents, if any.
   h. Revisions, or interpretations, made by NDDOT shall be by addendum issued prior to the letting date.
   i. Changes to the language in the proposal may be cause for rejection of said proposal.
   j. Vendors must certify the validity of their proposals by the signature of an officer of the vendor's organization authorized to commit the vendor to the proposal content. It is the NDDOT intention to include the vendor proposal as part of the resulting contract.

5. **Catalogs and Specifications.** Catalogs, specification sheets, or other literature giving detailed information of the item quoted on, shall be filed with the proposal. The items shall be identified in the catalog, specification sheet, or literature by model name or number. Modifications or deviations from printed literature will include a written statement to describe accessory items not covered by printed literature. If any additional information is required to properly evaluate the proposal, it shall be furnished during the evaluation period.

Proposal Content Section Headings

1. **General**. There is no intent to limit the contents of proposals and the proposal format instructions to permit the inclusion of any additional information a bidder deems pertinent. It is the request of the NDDOT that the following section headings be used in the vendor responses to this RFP and that they be arranged in the order listed in this proposal.
2. **Section Headings**

A. Vendor Profile (Mandatory)

You are requested to include in this section facts you wish to present about your company. Keep this section brief. A copy of the vendor's latest annual report, Dunn and Bradstreet's current rating, if available, or other sources of financial information must be provided to permit NDDOT and MnDOT to be satisfied with the financial stability of the bidder.

B. Proposed System (Mandatory)

This section will include a detailed narrative describing the equipment and software being proposed. A response to all items is required based off the project specifications (attached). All equipment prices should be listed by line item with a total project rollup.

C. Maintenance, Service, and Support (Mandatory)

The vendor is requested to provide an explanation of the maintenance bid in response to the mandatory requirements listed in the specifications section. This should include a discussion of your firm's maintenance philosophy and capabilities and how you will meet your responsibilities as the prime vendor. Provide a detailed description of your preventative maintenance program and remedial maintenance plan as well as the Qualifications of the Maintenance Personnel. Details regarding maintenance, service and support are shown in Appendix A.

D. Training and Manual/Documentation Requirements (Mandatory)

The vendor is requested to describe briefly the scope of specific training recommended, the duration of basic training (in hours), training aids required (including manuals, skills of people to be trained, and the cost. Include cost to meet Mandatory Training Requirements listed in the attached project specification.

E. Special Conditions (If appropriate)

Detail any special conditions that apply to your response to this RFP

F. Environmental and Physical Specifications (Mandatory)
In this section the vendor is requested to describe the environmental requirements of the equipment bid.

G. Additional Information (If Appropriate)
The vendor may wish to supply additional information if appropriate. The additional information should be relevant to the bid.

H. Outright Purchase (Mandatory)
NDDOT, at its option, may procure under this RFP, using an outright purchase method of financing for hardware and software. Upon installation, acceptance, and final payment (due after acceptance by NDDOT), NDDOT will receive clear title to hardware and the right to use the licensed software per the bidder's Software License Agreement. The vendor is requested to provide and bid this method of acquisition.

I. Annual Payments – Recurring costs (mandatory)
Vendors are invited to propose annual as well as monthly payments for recurring costs (such as maintenance). NDDOT is prohibited by law from making advance payments for maintenance services unless the maintenance agreement is essentially a warranty providing for repair or replacement in the event of failure. Routine preventive maintenance services are construed to be "services" for which no advance payment is legal. Maintenance charges will begin at the end of any warranty period offered with the product.

J. Price Proposal (Mandatory)
The vendor is requested to quote purchase and maintenance prices which will be firm for one year following the expiration of the warranty period. The vendor shall include all maintenance, service, and repair costs. These would be associated costs after the warranty period has expired.

In the event of a price decrease for purchase or maintenance of the proposed equipment to the general trade during the term of the contract, NDDOT shall have the benefit of any lower prices offered the general trade. The bidder is requested to declare this concurrence with this requirement.

K. Delivery Requirements (Mandatory)
The proposal must stipulate typical delivery times following receipt of NDDOT purchase order and signed contract. The vendor must provide NDDOT Maintenance and Engineering Services Division with proposed installation dates. Early and/ or partial deliveries will not be permitted without express written approval by the NDDOT Maintenance and Engineering Services Division.

L. References (Mandatory)
NDDOT requests references of three installations that are similar to what the NDDOT is requesting. Include names, address, and phone numbers

of the contacts. Of the systems installed, indicate how many are currently installed and operating.

> **NOTE:** The NDDOT reserves the right to contact users of vendor systems other than those supplied and to use the information so gathered in the evaluation

M. Warranty Guarantee (Mandatory)

Provide warranty on labor, equipment and installation.

N. Equipment Standard of Performance and Acceptance (Mandatory)

The vendor shall certify to the NDDOT in writing when the system is installed and ready for use. The performance period shall commence on the first State workday following certification, at which time operational control becomes the responsibility of NDDOT. During the acceptance test period of November 1, 2005 through February 1, 2006, the system shall perform successfully in accordance with all the mandatory requirements specified in this proposal. Should the system fail during this 90-day acceptance period, vendor will be required to correct the issue which caused the failure. This correction shall be made within a commercially reasonable time period. Once the correction has been made, a new acceptance period of thirty days shall commence.

Appendix A – Scope of Services

1. Proposal

The Vendor will provide a proposal and bid to the State for all work set forth in this document. There will be no additional cost to the State over and above the lump sum bid price for items included in this document.

2. Vendor Qualifications

The Vendor shall be experienced in the design, installation, and maintenance of fixed automated anti-icing spray systems for roadways and bridges, and will have been responsible for the complete installation of at least five fully functioning fixed automated anti-icing spray systems.

The Vendor shall be experienced in the installation of the active pavement sensors, to be used on this project, specifically for the automatic control of fixed automated anti-icing spray systems, and will have been responsible for the complete installation of at least five fully functioning systems based on active pavement sensor technology. The Vendor will be approved by the anti-icing system manufacturer for the design, construction, testing, and maintenance of the anti-icing system.

The Vendor's designated superintendent performing the work will have at least four years of experience in this work. The Vendor's personnel and equipment will have the capacity to undertake the work, and will be sufficient to complete the work within the specified contract time.

The Vendor will provide documentation of his qualifications, experience record, prior project references, and the availability of the designated personnel. All prior project references will be currently available personnel who can verify the quality of the Vendor's previous work, and will include name, address, and telephone number. This documentation will reference the experience of the Vendor and his designated superintendent in the complete design, installation, and maintenance of fixed automated anti-icing spray systems for roadways or bridges.

3. Project Schedule

The Vendor will develop and provide plans, drawings and specifications for approval by NDDOT's Project Manager by May 6, 2005 and install the complete system by October 15, 2005.

Failure to complete the installation of the complete system by October 15, 2005 will result in the assessment of liquidated damages according to Specification 108.04 J, Failure to Complete the Work on Time, as outlined in the NDDOT Standard Specifications for Road and Bridge Construction, 2002 Edition.

4. Project Management

Vendor will provide all project management needed to develop and deliver all contract drawings, specifications, and documents to NDDOT's Project Manager, deliver equipment and material resources to the project site, and complete installation and checkout of all project features. The Vendor shall provide a bar graph progress chart prior to beginning the project according to Section 108.01.B of the North Dakota Standard Specifications for Road and Bridge Construction 2002

The work will be performed under the supervision of the Vendor's designated superintendent, who will be on site during **all** phases of the installation, who will be fully knowledgeable and experienced, as defined herein, in the design, installation, and maintenance of similar fixed automated anti-icing spray systems.

Vendor will provide all necessary supervision of subcontractors involved in the provision and installation of system features at the project site.

Vendor will be responsible for coordinating all work on, under, or near the bridge with NDDOT's Project Manager. The Vendor must identify their project manager and support staff and their experience with Fixed Automated Spray Technology (F.A.S.T.) systems.

Vendor will maintain continuous coordination with the NDDOT Project Manager and NDDOT Project Inspector for inspection of the automated bridge anti-icing project.

Vendor will provide bi-weekly written reports and meetings on project status, schedule, and progress to NDDOT's Project Manager at the NDDOT Fargo District headquarters.

5. Design of Fully Automated Bridge Anti-Icing Project

The Vendor will comply with the North Dakota Department of Transportation's Standard Specifications for Road and Bridge Construction, 2002 Edition.

All necessary drawings and specifications must be submitted in English units. Some of the dimensions given in this Request for Proposal are in Metric units. It will be the Vendor's responsibility to convert the Metric measurements to English equivalents and adjust the English units to coincide with the nearest Standard English dimensions for a given item.

All parts of this system will be Standard English Units parts, including, but not limited to gaskets, bolts, fasteners, gauges and piping. Converting a Metric part to English units will not be acceptable. The parts themselves need to be English units parts for future replacement purposes.

The Vendor will provide plans, drawings, and specifications to the NDDOT Project Manager. The Vendor will design and construct a pump and liquid

anti-icing storage building that contains all F.A.S.T. components (electronics, hydraulics, electrical pumps, and tanks at the project site).

5.1. Pumphouse

The pumphouse will consist of a precast concrete panelized building system to be field-erected on a cast-in-place, (CIP) concrete foundation. The foundation shall have 6 inches of Class 5 aggregate base as specified in Section 816 of the North Dakota Standard Specifications for Road and Bridge Construction 2002. The CIP concrete foundation will serve as a secondary containment area for the anti-icing chemical that is to be stored within the pumphouse. The containment area will be capable of holding 110% of the volume of the largest tank. The containment area will have a liner impervious to chemicals that may be used for anti-icing. The containment area will be sloped to one corner and drain into a 4 inch deep by 18-inch square sump area. Installation of electrical components within the pumphouse will be in accordance with the requirements of the National Electrical Code, including clearances.

The CIP concrete will be Class AE-3 concrete according to Section 802 of the North Dakota Standard Specifications for Road and Bridge Construction 2002.

The roof and wall panels will be precast and produced as single component monolithic panels, and no intermediate roof or wall joints are allowed, except at corners. The roof and wall panels shall conform to local building codes.

The precast wall panels will have an exposed aggregate architectural finish on all exterior surfaces.

Interior surfaces of precast roof and wall panels will have a smooth steel form finish. The walls and roof panels will be primed and painted.

The pumphouse building will be designed in accordance with the local building codes.

The Vendor will submit for review and approval of the structural engineering design calculations and working drawings for the pumphouse precast concrete building that have been prepared and sealed by a Professional Engineer registered in North Dakota. The design calculations and working drawings will be submitted for review and approval by NDDOT's Project Manager.

Precast concrete will be Class AE-3 concrete. Precast panels will be reinforced with deformed steel bars.

All joints between panels will be caulked on the exterior and interior surface of the joints using Dow Corning 888 or Syk/Flex or approved equal.

Floor grating will be fiberglass, minimum 1.5 inches thick, grade 304 stainless steel supports, with access to the containment area by stairs or ladder.

The Vendor will submit design calculations and working drawings for the stair or ladder framing, including connections that have been prepared and sealed by a Professional Engineer registered in North Dakota, for review and approval. Structural members will be sized to safely carry a uniform live load.
If the Vendor requires a handrail system, it must meet Federal requirements and must be removable.
Two pumphouses, one on the Minnesota side and one on the North Dakota side will be constructed, at locations approved by each State.
Sealed openings will be provided for all needed power supply and piping connections. Building and exterior piping to bridge spray system will be constructed to meet or exceed local building codes.

5.1.1. Required Pumphouse Features

- Ø A **ventilator fan** sized appropriately for the structure, mounted on a powered shutter with 24 hour timer, painted weather hood and removable filter for storage building ventilation.
- Ø One Built-in commercial grade electric **wall heater** sized appropriately for the structure.
- Ø **heavy duty Industrial fluorescent lighting fixtures** sized appropriately for the structure.
- Ø One **personnel entrance door** 3’ wide x 7’ high made of 18 gauge painted aluminum, the door will have an insulating value of R factor 11. Adjust doors to swing open and shut without binding, and to remain in place at any angle without being moved by gravitational influence. 18 gauge aluminum frame with latch guard threshold weather-strip, stainless steel hinges, locksets keyed as required by NDDOT and MnDOT. Rust proofed hold open arm.
- Ø Two exterior weather proof lights.
- Ø Clear sight glasses installed in the supply and return lines.

5.1.2. Instrumentation in Pumphouse

- Ø Pressure Gauges: Analog type, industrial grade, all Type 316 stainless steel, minimum pressure range = 0 to 300 PSI. Pressure gauge and pressure control regulator for liquid pressure and flow readings.
- Ø Flowmeter Transmitter: senses flow rate in system and sends signal to RPU spray system controller. Flowmeter will be fabricated from durable noncorrosive materials. All metallic parts will be non-corrosive. Minimum flow rate range = 0.3 to 6 meters (feet) per second.
- Ø Pressure Switch Transducer: senses pressure in system and sends signal to RPU spray system controller. All metallic parts will be Type 316 stainless steel. Pressure range = 0 to 2,000 kPa (ft/lbs).

- Ø (Ultrasonic) Level Sensor: ultrasonic device to detect the level of chemical in the storage tanks. The ultrasonic level sensor will be connected to an alarm horn mounted on the exterior of the pumphouse to alert personnel filling the tanks when the tanks are full. The ultrasonic level sensor will also send signals to a digital level display located in the housing for the chemical fill tube on the exterior of the pumphouse.
- Ø Pumps with salt (sodium chloride, calcium chloride, potassium acetate and/or magnesium chloride) tolerant seals and bearings.
- Ø Pressure control device, safety return bypass with control valve, and flow transmitter measuring outflow and connection of pressure pipe
- Ø Two Liquid filters in stainless steel housing pressure rated to 250 PSI, PP25 or better w/pressure gauge on the inlet & output lines.
- Ø Valves to control tank overflow and automatic control of security collection basin
- Ø 2500-gallon cylindrical tanks or larger with NDDOT and MnDOT approval.
- Ø Complete external fill pipe assembly, schedule 80 two-inch PVC pipe with ball valve, swing check valve and locking cap assembly. A 2 inch hose that will remain flexible in extreme cold temperatures, with quick connect couplings, properly length for easy filling of the anti-icing tanks.
- Ø Test water storage tank, (for summer flushing) ND/DOT and MnDOT approved polyethylene tank. 1 ¼" drainage flange and cap and automatic flow level control, adequately sized to flush the system.

The chemical tank will have an entry port through the top and removable cover. The tank will be vented at the top. The tank will be rated for a maximum fluid specific gravity of 1.5 or greater and will be made from polyethylene material. Any metal components of the tank will be type 316 stainless steel. Galvanized steel will not be permitted.

Note: All pump station equipment will be contained within secure pump and liquid anti-icing storage building.

5.2. Spray Disks and Valve Units

The anti-icing spray system will dispense a non-chloride deicing agent such as CF7® as illustrated and described as follows:

- Ø Pavement spray disks installed in bridge deck with power and liquid spray supply connections at bottom of pavement.
- Ø Spray disks sealed in pavement with NDDOT and MnDOT approved sealing compound that is Spec Bond 100, Pro-Poxy 100 or equivalent.
- Ø Pavement spray disks to be installed on the bridge will be spaced according to Vendors specifications. Spray disks to be installed on the approach of the eastbound roadway prior to the bridge at the

recommendation of the Vendor. Spray disks to be installed on the approach of the westbound roadway prior to the bridge at the recommendation of the Vendor.

- Ø The spray disks will be mounted in the bridge deck or roadway surface, with the disk top surface just below the surface of the bridge deck or roadway, and will be capable of withstanding high-volume interstate traffic and snow plowing procedures conducted with maintenance trucks. All metallic components of the spray disk will be non-corrosive. The spray disks mounted in the bridge deck will have piping connections located on the underside of the disk. The spray disks mounted in the roadway approach pavement off the bridge will have side-mounted pipe connections. The spray disks will be fabricated in such a manner that the nozzle directions can be adjusted while the disk is embedded in the bridge deck or roadway surface without removal of the disk assembly. The spray disks will provide uniform coverage of all traffic lanes. The nozzles will be self-cleaning.
- Ø Valve unit with associated electrical connecting cable and liquid supply pipe to be placed by the Vendor in such a manner that access to the valves can be easily achieved for maintenance purposes.
- Ø A non-corrosive fixture must be provided at each valve location to affix valve body to the bridge.
- Ø Valve units will control the flow of anti-icing chemical from the main supply line to each spray disk. Valve units will consist of electronically-controlled solenoid valves.

5.3. Piping and Cables

The tanks, piping and cables will have the following requirements:

- Ø Pressure piping – to spray disk: Plastic pipe, ¾-inch Nylon 11 with non-corrosive connections, joints, elbows, fixed points and pipe clamps. Nylon 11 tube couplings are not permitted in tubing runs between junctions, or in remote, inaccessible locations.
- Ø Pressure piping - valve unit supply line: The chemical pressure pipe will be Nylon 11, or approved equal, tubing. Nylon 11, or approved equal, tube couplings are not permitted in tubing runs between junctions, or in remote, inaccessible locations. All pipe connections, joints, elbows, fixed points, and pipe clamps will be non-corrosive.

Chemical pressure pipe within the pump house will be durable non-corrosive rigid pipe with socket fused or threaded joints, rated for the system pressure.

- Ø Protective pipe - hydraulic pressure lines: Galvanized pipe to fully contain pressure pipe includes connections and elbows, fixed points at pump station, valve assemblies, hot dipped galvanized pipe clamps, and mounting hardware. NOTE: Any fasteners penetrating the deck will be stainless steel. Expansion joints will be installed in appropriate numbers to compensate for all anticipated expansion and contraction associated with this bridge. Chemical pressure piping will be routed within a protective conduit system consisting of non-metallic conduit

where embedded in concrete or buried in the ground and galvanized steel conduit where exposed. Conduit and all fittings, connections, elbow, and mounting hardware will be approved by the Project Manager.

- Ø Protective pipe - electrical cables: Fasteners should be stainless, Clamps should be hot-dipped galvanized. Galvanized pipe for protection of electrical cables. Including connections and elbows, stainless steel fixed points, pipe clamps, mounting hardware and expansion joints. Expansion joints will be installed in appropriate numbers to compensate for all anticipated expansion and contraction associated with this bridge.
- Ø Shielded cable - control cable
- Color coded, with ground, Shielded cable-telephone
- Sensor control cable and power cable for RPU Slave Unit will be routed within a protective conduit system consisting of non-metallic conduit where embedded in concrete, and galvanized steel conduit where buried or exposed. The Project Manager will approve conduit and all fittings, connections, elbow, and mounting hardware.
- Ø All fasteners required to mount conduits shall be hot dipped galvanized steel and any fasteners penetrating the deck will be stainless steel.

5.4. Anti-icing spray control system

The anti-icing spray system will be controlled by a microprocessor with capacity for 256 valves maximum and ability to monitor pump functions and tank fluid levels, and will include the following:

- Ø The anti-icing system will be controlled by a microprocessor-based RPU controller with capacity for this project spray disks and the ability to monitor pump functions, system pressure, flow characteristics, and tank fluid levels.
- Ø The RPU spray system controller will be able to interpret between various signals from sensors to initiate different spray programs to apply measured amounts of liquid anti-icing chemical to the roadway surface.
- Ø The control of the application of anti-icing chemical will be fully automated, with provisions for operator intervention and notification.
- Ø The automated control system will include atmospheric sensor capabilities and active and passive pavement sensor technology.
- Ø The RPU spray system controller will be capable of storing and running different algorithms (scenarios) for automatic spray activation sequences. Algorithms (scenarios) shall be listed in the proposal.
- Ø The RPU spray system controller will have the capability to vary the length of time each solenoid valve is opened, thus varying the quantity of liquid anti-icing agent that is applied to the roadway surface, and will

be capable of changing the length of time for pauses between sprays, according to different conditions on the roadway surface.

- Ø Fully automatic operation will have manual override capability, with the options for manual pushbutton operation from the pumphouse, remote control device with a range of no less than 100 feet, and computer activation from web-based software.
- Ø The system will provide surge protection for the incoming telephone line.
- Ø The RPU will have the capability of detecting failures of system components and initiating automatic system shutdown in the event of a failure.

The RPU spray system controller will be contained within a wetherproof stainless steel or aluminum housing with lockable lid. The Vendor will be able to demonstrate experience in the operation of the RPU spray system controller software in automated liquid anti-icing spray systems.

Requirements are as follows:

- Ø Switch for manual activation of spray system

5.5. Automatic Spreading Control System and Pavement Sensors

Vendor will provide a complete automated spreading system, which will include a complete field measuring station for measuring selected site environmental parameters. This microprocessor controlled station will include the following components:

Active Pavement Sensor: The active pavement sensor will be capable of cooling the sensor surface temperature using an electronic peltier device to a point approximately 2 degrees Fahrenheit below the current pavement temperature, and returning the sensor surface to an above freezing temperature, in a continuous cycle; and will be capable of detecting ice formation on its surface. The sensor will be capable of continually measuring the “freeze point temperature” of the moisture/chemical mixture on the roadway surface. This sensor will be capable of accurately detecting freeze point temperature in the range of 32 degrees to minus 4 degrees Fahrenheit using an electronic peltier device.

Passive Pavement Sensor: The passive pavement sensor will be capable of measuring the passive conductivity reading of the moisture/chemical mixture on the pavement surface to compare the active sensor measurement to the passive conductivity measurement. The passive pavement sensor will measure the pavement surface temperature for comparison with the other pavement sensor measurements.

Air Temperature & Relative Humidity Sensor: Temperature measurement range equal to -40° C to +70° C, temperature sensing accuracy throughout range = ± 0.3° C, relative humidity measurement range 10 percent to 100 percent, with an accuracy of less than ±5 percent in the range from 10 percent to 100 percent RH.

Sensor will have a wind and solar radiation shielded housing. Sensor will be mounted in such a manner as to achieve the optimal readings above bridge deck.

Precipitation Sensor: The precipitation sensor will be able to detect the rate and type of precipitation by sensing falling particles, and will be capable of distinguishing between rain, freezing rain, drizzle, and snow. Operating temperature range will be -50° C to +50° C. False alarm error rate for precipitation will be less than 0.2 percent. Precipitation intensity error rate will be less than 5 percent for the range 10 mm/hour to 100 mm/hour, and less than 10 percent for the range 3 mm/hour to 500 mm/hour. The sensor will be mounted in such a manner as to achieve the optimal readings above bridge deck.

Wind Measurements: The anemometer shall be capable of measuring wind speeds in excess of 100 mph and wind detected from any direction between 0° and 360°.

RWIS Remote Processing Unit: There is an existing RWIS at the bridge location and is not NTCIP compliant. It is preferred the existing RWIS remain and be made a part of the system. The Vendor will have as an option, to update the current RWIS or replace the existing RWIS. The remote processing unit, or RPU, of the RWIS shall be able to collect and store data from the various sensors. The RPU will be part of a standard product line and not custom or specially produced for this project. The RWIS RPU will transmit data to the RPU spray system controller in the required formats when polled. The RWIS RPU will consist of a microprocessor of current manufacture that is capable of performing all of the required functions. The RPU layout will provide the data bus for the microprocessor, and individual components will be replaceable to perform maintenance and repairs. The RPU will include serial ports, analog and digital drivers, and inputs to fully support and correctly interpret the pavement and meteorological sensors. The RPU will be supplied with a host serial port for interfacing to a laptop computer to perform diagnostic and calibration functions. The RPU will have the capability for four future expansions of the number of serial ports, and will be capable of adding digital outputs. Where pavement or meteorological sensors are located more than 350 feet from the main RPU, additional “slave” RPU units will be provided within 350 feet from the subject sensors, to collect and store analog data from the sensors, and to transmit the data in digital form to the main RPU. The “slave” RPU units will be fully compatible with, and meet the same requirements as the main RPU. RWIS RPU and slave RPU units will be contained within heavy-duty durable non-metallic enclosures with lockable lids that are sealed against moisture when closed and protected from snow discharged from snowplow trucks during snow plowing operations.

RWIS Mounting Pole: Existing RWIS equipment and tower will be utilized if possible. New RWIS towers shall be aluminum with fold over capabilities for easy maintenance. Any modifications required for the tower will be made by the Vendor upon approval from NDDOT Project Manager.

5.5.1. Sensor Requirements

- Ø Sensors to be installed on the bridge will be placed to achieve the optimal readings possible in each direction of travel.
- Ø The pavement sensors will be mounted in the bridge deck and roadway with the top surface of the sensor below the surface of the bridge deck, and will be capable of withstanding high-volume interstate traffic and snow plowing procedures conducted with maintenance trucks.
- Ø The pavement sensors mounted in the bridge deck will have electrical side-mounted or bottom mounted connections.
- Ø Pavement sensors will provide the following minimum information:
  - Pavement Surface Temperature Range: -40 degrees C to +85 degrees C;
  - Pavement Surface Temperature Accuracy: ± 0.3° C;
  - Presence of wet surface condition;
  - Presence of moisture on pavement;
  - Presence of frost or ice on pavement;
  - Presence of anti-icing chemical;
  - Freezing point temperature of moisture considering concentration of Anti-icing Chemical measured directly in degrees F by active sensor, and estimated in degrees F by passive sensor. Freezing Point Temperature range: 32° F to -4° F
  - Presence of snow, ice, or wet surface condition when surface temperature is below 32° F.

The RWIS system and associated Remote Processing Units will allow for total flexibility in the selection of meteorological sensors and the system adaptability. The system will include the integration of active and passive pavement sensors.

5.6. Remote Operation of System

The Vendor shall use the existing software currently installed and used by both NDDOT and MnDOT. If the existing system is deemed non-functional for the spray system, the Vendor will provide fully automatic remote control operation with data collection and graphical user interface capability, including the following components: .

5.6.1. Modem

Modems shall be fiber optic capable. Dial-up access will be from the Fargo district office for both systems. NDDOT will provide the analog lines.

5.6.2. Software

Required software:

Existing control software shall be used for control and collecting of data. If the existing system is deemed non-functional for the spray system the Vendor shall supply the necessary software to operate the system and collect data. The software shall use WIN 2000/XP Graphical User Interface to include the

following functions:

- Pull-down menus and icons
- Visualizing of meteorological data, time and alarms in a graphical and numerical format
- Free programmable groups of measuring stations
- Multi windows screen
- Summer and winter scale and visualization of a two and 24 hour history of selected values and periods
- Quitting of alarm messages
- Window for system messages
- Starting of other applications or other RWIS-RPU modules
- Printer driver
- Individual password protection, back-up and restore data
- Complete software description shall be included in the proposal.

The specified software and hardware will provide for DOT system operation from a manual control in the pumphouse, and from NDDOT Fargo District and MnDOT Moorhead District locations. NDDOT will identify the applicable telephone company to be involved in system operations. All software supplied to NDDOT will include installation media (CD).

5.7. Anti-Icing System Operations

Ambient Environment – The system will be able to withstand temperatures in the range of -40° C to +65° C with no permanent loss of function or component failure.

The pavement sensors and nozzles will withstand temperatures up to +85° C.

Operating Environment – The system will accurately apply liquid anti-icing chemicals to a pavement surface in the temperature range of -30° C to +5° C.

Chemical Environment – The system will be able to safely store and apply the commonly encountered liquid anti-icing chemicals. Those liquid chemicals include but are not limited to: Calcium Chloride – CaCl2, Magnesium Chloride – MgCl2, Potassium Acetate – Kac, Sodium Chloride – NaCl, Calcium Magnesium Acetate – CMA, and CMA/KAc blend – CMAK

The entire permanent anti-icing spray system component will consist of materials that are resistant to corrosion from whatever chemical is selected by the Department for use in the system. All metallic valves, connections, elbows, fixed points, and pipe clamps shall be non-corrosive.
Communications and Software – The system communication software will be delivered that meets standard communication protocol specifications and the needs of the DOT's. The system will communicate functions such as automatic system operation and display, the system software programs in the controller, tank level, pressure and fluid flow control along with manual operation of the system. The system data collection software will run as a background service on the central computer. The central computer need not be logged on to each Department's network to continue to log data from the anti-icing system.

Operating System –Microsoft Windows 2000 and server requirements must be Microsoft Windows Server 2003.

Software/Firmware – Client software will not require Windows administrative privilege to operate. Software/Firmware manufacturer will support bug fixes and maintenance upgrades for a minimum of two year after system acceptance.

Software Licensing – Vendor will provide a minimum of five remote access licenses.

Security – All communication to and from the RPU will be verified by user name and password. The system will provide two levels of password security, one with administrative configuration abilities, and the other as read-only access.

1. All passwords will be stored in an encrypted format with no clear text.

2. User accounts names and passwords will be user definable and changeable.

3. The system will support a minimum of two user accounts within the RPU.

Regulatory Requirements – The System will comply with all applicable national, state, and local construction and safety codes.

The System provided will be capable of two-way communication with the users using all of the following methods:

Computer Network: The System provided will be capable of networking with wide area networks. The System provided will utilize a Windows 2003 Server.
The server provided will network with standard computers via modem, network router, and frame relay, etc.
Telephone Modem: The System provided will be capable of supporting conventional telephone modem operation. This capability will include the ability to originate, or receive, calls to remote control sites.
Onsite Hook-up: The System provided will provide the for local on-site connection of a portable computer to the RPU spray controller and RWIS
RPU using the supplied RS-232C serial interface protocol.

5.7.1. User Control Options

The system will allow for the control of the liquid chemical application with full automation.

The system will be capable of the following control modes:

1. Fully Automated: The System operation will be automatic utilizing user defined parameters and the pavement and weather conditions sensed by the RWIS.
2. Manual Override: The System provided will allow for manual override of the automated mode. The system will make this vailable locally at the site, remotely at RTMC.
3. Fully Manual: The System provided will respond only to a user – generated command. Manual control options will include the override ability by networked computers, modem and manual on-site switch.

5.7.2. (This Section Intentionally left Blank.)

5.7.3. Fault Detection and Remediation

The System provided is able to detect problems, compensate for these problems and notify the user of the problems by the following methods:

1. Self-Check: The System provided will be able to detect chemical leakage and restrictions within the spray system. Additionally, the System provided will be capable of detecting hardware failures in all other connecting systems including pavement sensors and alerting the system user of the problem. AS AN OPTION: The Vendors

shall propose an isolation system in the event of a failure or other leakage.

2. Remediation: The System provided will provide for a single push button reset of normal functions upon completed system repairs or inspections. The system will automatically detect system defects and take action without operator intervention to prevent system damage or environmental damage.

3. User Notification: The System will automatically notify system user through the central computer of detected problems including location of abnormalities and actions taken. The notification system will include user-definable and configurable alarms/notifications.

4. Vendor Access: The System set up in a manner to allow the vendor access to the system for trouble shooting purposes.

5.7.4. Inventory Tracking and Control

As part of the software, the system will automatically provide tracking of material used by the anti-icing system. The system will provide inventory control. The system will have the ability to detect and report liquid levels in the tank throughout the range from full tank to empty tank. The status of the tank level will be reported to the user using the communications system. The system also will have alarms for low level requiring refilling, and empty - not sufficient chemical to operate the system, providing an alarm to the operator and system shut-off to prevent system damage. All level alarms will be configurable by system user.

5.7.5. Basic Operating Capabilities

The system will have the following basic operating capabilities as a minimum:

1. Automatic system tests on a preprogrammed and timed basis. The system will measure system pressure and quantity of liquid flow and prevent system operation if parameters exist outside of acceptable operating conditions.

2. The system will monitor and alarm for tank levels for two conditions: low and empty.

3. The system will monitor and alarm for liquid in the containment area.

4. Ability to activate a warning device before the spraying operation commences.

5. The system will be capable of going through a system evaluation before activating the spraying operation. This system evaluation will check for system leaks, low chemical reservoir levels, and other system defects and will not activate the system if any of these conditions exist. During system activation, the system will evaluate if individual spray valves do not activate and will document in system log and alert the operator of these conditions.

6. Autonomous operations based on various weather parameters in the RWIS.

7. The RWIS and pavement sensor technology will include the following:

a. The sensor technology must insure that the sensor will work with any anti-icing chemical, multiple chemicals, varying water depths, oils, dirt, and other remaining residuals on the road surface that can change the freezing point temperature. This includes any potential chemical applied on the surface by maintenance trucks.

b. The technology must allow user definable parameters. The pavement and atmospheric sensors will allow the following detection of the system:

i. Comparison of active and passive pavement sensors utilizing the advantages of each.

ii. Detection of accurate Freeze Point Pavement Temperature on the pavement which does not require re-calibration with each chemical used; can work with multiple chemicals, for example when exposed to various combinations of truck-applied chemicals; allows for system activation at different thresholds before freezing, for example, 1, 2, or 3 degrees before freezing, and provides accurate detection of freeze point temperature to -20 degrees Fahrenheit.

8. The System provided will allow for software logic programs that utilize all of the capabilities of the RWIS remote processor to properly interface with the anti-icing spray system controller. The System provided will have user settable thresholds for adjusting automatic operation of the system:

a. System activation when road moisture is at or near freezing via user settable thresholds;

b. System activation when freeze point temperature sensors detect when pavement surface moisture is near freezing via user settable thresholds;

c. System activation when chemical dilution is occurring via user settable thresholds;

d. System activation and accurate freeze point temperature measurements even when multiple chemicals are used via user settable thresholds;

e. Accurate system activation without calibration of pavement sensors with changing chemicals;

f. Immediate system activation when falling snow or freezing precipitation is detected via user settable thresholds;

g. The ability to include other weather parameters in the system logic such as low pavement temperature lockout according to different anti-icing chemicals for minimum temperature, relative humidity, wind etc. via user settable thresholds.

9. The system will be a double loop system, allowing half of the system loop to be disabled by the operator, while allowing the other half of the loop system to function in its treatment of the roadway and bridge.

10. Manual override of system operation from any of the manual options.

11. Manual operation locally and remotely; system options:

    a. Manual pushbutton at the site;

    b. Activation by web-based software.

5.8. Submittals

The Vendor will submit to the NDDOT's Project Manager for review and approval of the following items:

- Detailed design and installation working drawings for the complete anti-icing spray system with sufficient detail to allow review of all power and communications for compliance with the Specifications. Working drawings will clearly indicate any and all deviations from the contract documents. The working drawings will include specific details and exact locations of all system components including proprietary equipment. The working drawings will be in English units.

- Communications Infrastructure Plan showing routing of electronic communications between devices in the field, between devices and computers, between systems, and between the field computers/systems and remote users.
- Installation schedule that will outline the steps the Vendor intends to make to complete the contract. The installation schedule will be revised and resubmitted if there is a significant change to the schedule.
- Documentation of proven field operation of the active pavement sensors in automated liquid anti-icing spray systems.

- Documentation of proven field operation of the programmable system controller software in automated liquid anti-icing spray systems.
- Structural engineering design calculations and working drawings in English units for the pumphouse precast concrete building prepared and sealed by a Professional Engineer registered in North Dakota.
- Working drawings and product data for doors, louvers, frames and all accessories and hardware for the pumphouse in English units.
- Design calculations and working drawings for the pumphouse stair framing in English units that have been prepared and sealed by a Professional Engineer registered in North Dakota.
- Product data sheets or certificates of conformance with the Specifications, and Quality Assurance reports for the following system components:

  1. Spray disks;
  2. Pavement sensors;
  3. Chemical pressure piping;
  4. Conduit for chemical pressure piping;
  5. Valve units;
  6. System control cable;
  7. Sensor control cable;
  8. Conduit for sensor control cable and RPU slave unit power cable;
  9. Anti-icing chemical storage tanks;
  10. Flush water storage tank;
  11. Pump and motor;
  12. RPU spray system controller;
  13. RWIS RPU and all meteorological sensors;
  14. Modems;
  15. Concrete for precast building;
  16. Epoxy resin waterproofing for exterior concrete surfaces;
  17. Deformed steel reinforcing bars, epoxy-coated;
  18. Silicone sealant and bond breaking tape for building joints;
  19. Floor grating for building;
  20. Removable handrail for building;

- Operations and Maintenance Manual (Four (4))– The Vendor will furnish an Operations and Maintenance Manual, or O&M Manual, for

the anti-icing system in English units. The O&M Manual will include operation and maintenance instructions for all systems and items of equipment provided under the contract. The O&M Manual will be in the form of neatly formatted bound ring binders and electronic format in the form of two (2) CD-ROM disks. Prior to completion of the work, and at least 90 days prior to final payment, the Vendor will furnish for the Engineer's review three O&M Manual draft copies. Prior to completion of the work, and at least 30 day prior to final payment, the Vendor will furnish for the Engineer's review four (4) copies of the final O&M Manual. The final O&M Manual will be approved by the Engineer before a final acceptance of the work. The O&M Manual will consist of product data sheets, brochures, bulletins, charts, schedules, approved working drawings corrected to as-built conditions, assembly drawings, wiring diagrams, operation and maintenance information for equipment, and other information necessary for the Department to establish an effective operating maintenance program. Oversized sheets and working drawings larger than 8 inches by 11 inches will be neatly folded to that size with title block exposed along one edge, and bound or placed in pockets within the Manual. The O&M Manual will include:

1. Title page giving the name and location of the facility, bridge plan numbers, and project numbers;
2. Performance curves for all pumps and equipment;
3. Approved working drawings of each component;
4. Approved product data sheets and dimensioned drawings of each piece of equipment, and details of all replacement parts;
5. Manufacturer's installation, operation, and maintenance instructions for each piece of equipment and complete listing of nameplate data;
6. Complete wiring diagrams of all individual pieces of equipment and systems including one line diagrams, schematic or elementary diagrams, and interconnection diagrams;
7. Complete piping and interconnection drawings;
8. Complete parts list with parts assembly drawing preferably by exploded view, names and addresses of spare parts suppliers, recommended list of spare parts to be kept on hand by the Department, and sample order forms for ordering spare parts. Lead time required for ordering spare parts will be estimated;
9. Instructions with easily understood schematics or diagrams for disassembling and assembling the equipment for overhaul or repair;

Delivery of O&M Manual satisfactory to the NDDOT's Project Manager is an essential part of project delivery. Incomplete or inadequate manuals will be returned to the Vendor for correction and resubmission.

The Vendor will not start construction or installation of any part of the anti-icing system until the complete design and installation working drawings and installation schedule have been received and reviewed, and written approval to begin construction has been issued by the NDDOT's Project Manager. Such approval will not relieve the Vendor of responsibility for results obtained by the use of these designs and drawings or any of the Vendor's other responsibilities under the contract.

6. Installation of Fully Automated Bridge Anti-Icing Project.

Vendor will comply with the North Dakota Department of Transportation's Standard Specifications for Road and Bridge Construction, 2002 Edition.

Vendor will furnish and install all materials and equipment.

Vendor will ensure that all materials, equipment and installation procedures meet all applicable local and state codes. Vendor will also provide all drawings, specifications, parts list with pricing in English units, required for the orderly and accurate installation of project materials, equipment, subsequent operation and maintenance of the project.

6.1. Staging and Construction

The Vendor will prepare a work area, equipment storage area, and project staging area within NDDOT and/or MnDOT rights-of-way at the end of the bridge for secure storage of equipment and materials required for the duration of this Contract. This area will be large enough to include a shipping container and truck access to the container. NDDOT and MnDOT will provide a site boundary map of State owned right-of-way at the project site.

The Vendor will be responsible for providing required electrical power via gasoline-powered generator both underneath and on top of the bridge during duration of project. The Vendor will also be responsible for providing work area lighting, telephone, drinking water supply and sanitation facilities for the duration of this Contract.

6.2. Traffic Control

The Vendor will provide all necessary traffic control (as determined by NDDOT's Project Manager) on or adjacent to the bridge to ensure public and worker safety for the duration of this contract. All traffic control devices and layouts will be in accordance with the Manual of Uniform Traffic Control Devices - MUTCD. All traffic control devices will be removed prior to deck/roadway work closure periods unless specifically approved by NDDOT. **NOTE: Traffic control shall be coordinated with all other projects that may be in the area along I-94.**

The Vendor will obtain approval from NDDOT's Project Manager prior to any lane closures or restrictions. A traffic control plan must be submitted and

approved prior to lane closures or restrictions. Additionally, notification must be given to the NDDOT Project Manager at least 24 hours in advance of lane closures or restrictions so that information can be entered into the NDDOT Traveler Information System. Lane closures will only be permitted as long as there are workers present in the work zone.

Two adjacent through lanes in each direction must be maintained between the hours of 6:00 A.M. and 7 P.M. Monday through Friday.

The Vendor may elect to work on weekends where one adjacent through lane is maintained in one direction and two adjacent through lanes are maintained in the opposite direction for spray disk and pavement sensor installation. The weekend period will be defined as the 59 consecutive hours beginning Friday at 7 P.M. and ending Monday at 6:00 A.M. The Vendor may keep lane restrictions in place for up to 59 hours on the weekends as long as workers are present in the work zone. The Vendor will notify the Project Manager at least a week in advance if the weekend closure option will be utilized. There will be no additional costs to the State if the Vendor elects to utilize this option.
Work, which will restrict or interfere with traffic, will not be performed between 12:00 noon on that day preceding and 9:00 AM on the day following any consecutive combination of a Saturday, Sunday and legal holiday. NDDOT Project Manager will have the right to lengthen, shorten or otherwise modify the foregoing periods of restrictions as project area traffic conditions may warrant. If the Vendor is negligent in adhering to the established time schedule, he will be subject to the hourly charge as defined in the following paragraph.

Ramp restrictions will be dependent on the Anti-Icing System Design.

Vendor will be subject to an hourly charge for failure to remove temporary restrictions outside the permitted hours as set fourth in this document unless authorized by NDDOT's Project Manager. Non- compliance charge, for each incident, will be assessed according to Section 704.03 of the North Dakota Standard Specifications for Road and Bridge Construction 2002 for any portion thereof with which the Project Manager determines that the Vendor has not complied with the work zone schedule.

7. System Checkout (Punch List) October 17th

Vendor will, as accompanied by NDDOT and MnDOT Operations personnel and NDDOT Project Manager, and others as necessary, perform a complete checkout of the complete installation to demonstrate accurate and trouble-free system operation in an on-site manual mode, and remote central desktop (web-based) computer mode from NDDOT's Fargo District and MnDOT Moorhead District. Vendor will replace all and any defective materials, equipment, or structures identified during this system checkout.

Vendor will checkout and demonstrate that all liquid anti-icing delivery systems operate without leaks at prescribed pressures and flow rates at each nozzle location.

Vendor will also demonstrate the following through the Acceptance Period of November 1st, 2005 and February 1st, 2006.

1. That installed road sensors, other environmental sensors, associated algorithms that accurately detect ice formation over the full range of materials and equipment are properly installed and functions as designed during all road surface temperatures between -20ºF (-29ºC) and +35ºF (+2ºC).
2. Vendor will document that the air temperature sensor and the optical precipitation sensor operates accurately as designed over this full design range of operation.

7.1. Deliverables

- A complete checkout of all materials, hardware and software needed to use the system over its full range of operation.
- Replacement of any material, equipment, and software found to be defective and/or inoperable over the specified full range of performance.
- Vendor will provide fully tested and configured software for future NDDOT and Mn/DOT system maintenance.

8. Training

On-site training will be provided by a qualified representative. This training will cover operation, commissioning, seasonal commissioning/decommissioning and maintenance of the permanent automatic anti-icing system.
Vendor will fully train personnel in on-site (manual) system operation, in remote operations and in total system operation capability from the NDDOT Fargo District and MnDOT Moorhead District Offices. This training of Operations District personnel will include the use of all operations software over its full range of capability. Vendor will also provide training for system materials and equipment excluding electronic equipment, wiring, and sensors. Vendor will train up to two NDDOT and up to two Mn/DOT electrical/electronic specialists in the operation, maintenance, and repair of all electrical and electronic equipment, and all wiring and sensors (repair of sensors excluded).

9. System Documentation

Vendor will provide complete documentation of all system components including necessary drawings, charts, tables, and diagrams that describe system operations over its full range of capability (minimum -20ºF to +35ºF). Vendor will also provide complete documentation of all communications and

operating software including system actuation algorithms for full range of system operations.

9.1. Deliverables

- Ø Four (4) complete manuals including complete documentation as outlined above, plus and electronic version of all manuals.

10. Warranty and Support Periods

Warranty Period shall begin upon satisfactory completion of all tasks per the approved Acceptance Test Procedures. Vendor will warranty all parts, materials, and labor for the complete system for a period of two full years after NDDOT and Mn/DOT acceptance of the completed project based on satisfactory Vendor completion of all tasks as determined by NDDOT Project Manager. All necessary replacement parts and materials will be shipped to NDDOT Fargo Districts Headquarters at 503 38th St. S, Fargo, ND 58103-1198 within three days after notification by the NDDOT Project Manager.

Vendor will provide technical support at no charge to NDDOT and MnDOT technical expertise requested by NDDOT or MnDOT for repair and/or replacement of any system component or software. It will include on-site technical support (maximum of two days per occurrence) during system startup in October 2005, and system shut down in April 2006, system startup in October 2006, and system shutdown in April 2007. Technical support questions or actions, must be satisfied within 48 hours of notification of the problem. Software upgrades shall be provided free of charge during the full Acceptance Period and during the two-year warranty period. The vendor shall also submit, as an option, additional maintenance and service options after the warranty period (Extended Warranty).

MNDOT and NDDOT are to provide Traffic Control for any work done during both the Acceptance Period and the Warranty Period.

11. Commissioning, Testing, and Training

A qualified representative will provide for the installation of the automatic anti-icing system including the start up, alignment, and testing of the entire system. The chemical storage tanks and the entire system will be filled to capacity with anti-icing chemical at commissioning of the system. The flush water storage tank will be filled to capacity with clean, potable water at commissioning of the system.

11.1. Testing Requirements

Installation Testing: An installation test of the system will be conducted at the conclusion of installation in the presence of the Project Manager. The installation test will simulate the full range of functions the anti-icing system is intended to provide. A successful installation test is required before the endurance test may begin.

PAYMENT SCHEDULE

DELIVERABLES	FULL PAYMENT*
1. Completion and delivery of all final engineering drawings and detailed specifications.	15% of Total Project Cost
2. Complete installation of liquid spray system including pavement sensors and spray nozzles. Complete construction of pump storage equipment shelter with all pumping and liquid storage facilities completed therein. Receipt of all system control equipment (communications equipment, computers, control panels, and interface hardware) and software.	20 % of Total Project Cost
3. Complete installation of system control equipment and software. Complete system checkout.	30 % of Total Project Cost
4. Completion of all on and off-site training including provision of three system operation and maintenance manuals.	25 % of Total Project Cost
5. Completion of assistance for the bridge system startup and system shutdown in November 2005 and April 2006.	5 % of Total Project Cost
6. Completion of assistance for bridge system startup and system shutdown in October 2006 and April 2007.	5 % of Total Project Cost

***Includes retainage as specified in the** North Dakota Standard Specifications for Road and Bridge Construction 2002 **.**

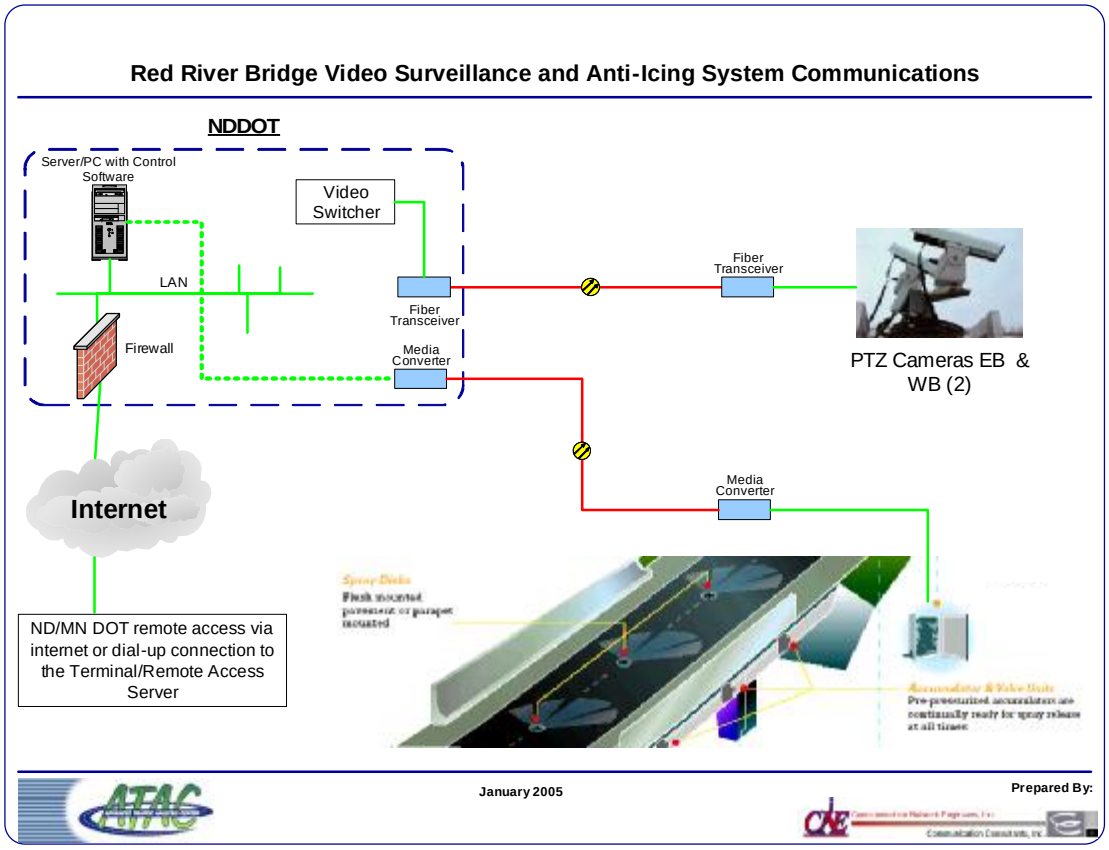
Appendix B - Communications

1. Description

This section covers communications specifications for supporting the following systems:

1. NDDOTand MnDOT Anti-icing system plus video surveillance cameras

Existing Camera/Joystick Software should be utilized. In this section Below is a block diagram showing the concept for the communications system for the Red River Bridge anti-icing and video surveillance systems.



1.1 NDDOT Anti-icing and Video Surveillance System

Both the anti-icing system and the video surveillance camera will be supported by fiber optics communication terminating at the NDDOT Fargo District office. Please note that the fiber specifications are included in Appendix C. The video images and control of the camera should be accessible by the current video switching system (American Dynamics MegaPower 1024) at the Fargo District. It should be noted that the final connection from the last fiber terminal point to the anti-icing system may vary

depending on the vendor specifications for the anti-icing system. However, it is expected that the bridge anti-icing system will provide a web-based interface supported via dial-up communications to allow for remote system operations and checking the status of the system. This access would have to be via a standard internet connection to the server. The web interface will also be used to provide video snapshots from the supplemental video surveillance camera installed with the anti-icing system.

2. Scope

2.1 Anti-Icing System Communications Infrastructure

The anti-icing system communications infrastructure shall consist of the following components:

1. Install, splice, and test fiber cable (28,755 Ft) from the Fargo District Office to the Red River Bridge. This fiber is to be placed in existing conduit. Please reference Appendix C for the fiber specification.
2. Install, splice, and test fiber from the last splice location on the existing conduit to each pump house. This fiber is to be placed in new conduit at a minimum of 36” deep. Please reference Appendix C for the fiber specification.
3. Define, supply, and install all hardware, software, and services needed for designated users to connect to and manually operate the spray controller via the fiber optics communications system. This will at a minimum include media converters to convert the signal from the controller to the fiber, media converters to convert the signal from the fiber to a Terminal/Remote Access Server, and any control software that may be needed for server and/or stand alone machine installation.
4. Define, supply, and install all hardware, software, and services needed to collect and make the RWIS data available for viewing by users via the fiber optics communication system. This will at a minimum include media converters to convert the signal from the controller to the fiber, media converters to convert the signal from the fiber to a Terminal/Remote Access Server, and any control software that may be needed for server and/or stand alone machine installation. (Please note that this may be the same infrastructure as in the above item)

2.2 Video Surveillance Communications Infrastructure

The video surveillance system (NDDOT camera and MnDOT camera) communications infrastructure shall consist of the following components:

1. Install, splice, and test fiber cable per 2.1.1.
2. Install, splice, and test fiber from the last splice location on the existing conduit to the camera locations. This fiber is to be placed in new conduit at a minimum of 36" deep. Please reference Appendix C for the fiber specification.
3. Define, supply, and install all hardware, software, and services needed to connect to the existing video matrix switch / PTZ controller at the Fargo District Office via the fiber optics communications system. The existing system is an American Dynamics MegaPower 1024. This will at a minimum include fiber transceivers to connect the PTZ cameras to the Fargo District Office.

3. System Functional Requirements

3.1 Anti-Icing System Communications Infrastructure

The communications infrastructure shall provide users both directly connected to or remotely connected to the DOT LAN the ability monitor and manually operate the spray controller. The remote connection shall be through a secure connection either via the web or dialup access into the DOT LAN.

3.2 Video Surveillance Communications Infrastructure

The communications infrastructure shall provide for control of the PTZ cameras and view full motion video at the Fargo Traffic Ops Center. This shall be accomplished through the utilization of their current video matrix switch / PTZ controller. The system shall also be capable of providing snapshot images to users via a standard dial-up system.

3.3 Video Camera Specifications

1.0 DESCRIPTION

The NDDOT is installing an automated anti-icing system on the Red Rive Bridge along I-94 in Fargo for the eastbound traffic. A similar system is being installed by Mn/DOT for the west bound traffic. In conjunction with this installation, the NDDOT will install a video surveillance camera to monitor the anti-icing systems operations (for both directions). The camera will send video feed to the NDDOT District office in Fargo. It is also expected that the

surveillance camera will support fiber optics hook up in order to provide real-time and full-motion video at the Fargo District. The new surveillance camera is also expected to be controlled using an existing Sensormatic AD2088 PTZ controller and American Dynamics AD 1024 Video matrix Switch which is currently housed at the Fargo District office.

2.0 SCOPE

Video monitoring and surveillance system, installation hardware, and operating software:

a. One video surveillance camera with PTZ capability, preferably through a built-in PTZ, capable of continuous 360^{o} rotation and minimum of 12X zoom.
b. Supervisor software in Windows NT/2000 capable of supporting system operations.
c. Power supply
d. Additional equipment and supplies required to have a ready-to-operate system.

Hook-ups to remote devices at the NDDOT District in Fargo to operate the system and receive and display video.

Communications devices to support system operations using fiber optics, including required fiber termination points, but not the actual fiber.

On-site training and technical support.

3.0 SYSTEM REQUIREMENTS

Surveillance Camera:

1. Provide full-motion video and work with a PTZ unit to allow remote control of camera operations, including pan, tilt, and zoom.
   a. The camera shall produce NTSC output at no less than 30 frames per second.

2. The camera shall be 1/3-inch color CCD that outputs NTSC video, with a resolution no less than 350 TV lines (horizontal) and 350 TV line (vertical).

3. The camera lens shall be pre-focused at the factory and shall not require field adjustments. The zoom optics shall maintain focus throughout the operating range from 7 to 74 degrees horizontal field of view (5 to 58 degrees vertical field of view).

4. The surveillance camera zoom optics shall provide a minimum of 12X optical zoom.

Environmental Requirements:

1. The video camera shall operate from -40 to 140 degrees F (-40 to 60 degrees C) and a humidity level of up to 95% relative humidity. The camera enclosure shall be waterproof and dust-tight to NEMA-4 specifications.

2. The video cameras shall be equipped with provisions to prevent fogging.

3. The video cameras shall meet FCC class B and CE requirements for electromagnetic interference emissions.

4. The communication panel shall operate under a temperature range of -30 to 166 degrees F (-34 to 74 degrees C) and up to 95% relative humidity, non-condensing.

Power supply

The cameras, heater, and PTZ unit shall operate on 24 VAC at 50/60 Hz or 120 VAC nominal 60 Hz and conform to NEMA 2.1.2 Standard TS2 specifications.

The video output, communication, and power stages of the sensor shall include transient protection to prevent damage to the camera due to voltage transient occurring on the cable leading from the sensor to other field terminations.

Appendix C – Fiber Optic Specification

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

INTERCONNECT CABLE

HSP-8-094(053)352

1. DESCRIPTION

This provision sets forth the minimum requirements for a fiber optic interconnection system to establish communication between ITS equipment as specified.

2. GENERAL

The bid shall include all necessary labor, equipment and material to install the interconnect cable and connections such that the communication link is complete and fully operational.

The fiber optics cable shall be a 36-fiber, single mode optical cable suitable for outside plant operations.

A. Fiber Optic Cable Specification

1. The purpose of this specification is to describe a fiber optic cable for a duct installation application, for the purpose of communication between various ITS devices.

2. Cable Specification

   The optical cable shall be:

   a. Dielectric
   b. Loose-tube
   c. Dry Block
   d. Single polyethylene jacket
   e. Reinforced with aramid yarn (Kevlar)
   f. Suitable for duct installation

3. Optical Specifications shall meet RUS 7 CFR 1755.900 (PE-90) and Telcordia GR-20 standards for single-mode cable. The cable shall also meet the following criteria:

   a. Single-mode, 8.3/125 micrometer, zero water peak.

b. The attenuation shall be less than or equal to 0.4 dB/km at 1310 nm; 0.32 dB/km at 1383 nm and 0.3 dB/km at 1550 nm.

4. Mechanical Specifications

   a. The maximum tensile load rating shall not be greater than 2700 Newtons (600 lbf).
   b. The minimum bend radius shall be 40 times the cable diameter, but not less than 18 inches in diameter, under load and 20 times the cable diameter under no load.
   c. The temperature range shall be -40^{o}C to +70^{o}C Documentation.

5. The cable manufacturer shall provide documentation indicating the attenuation and bandwidth for individual fibers on each reel within five (5) business days after delivery of the cable.

B. Splicing requirements

1. The purpose of this specification is to describe splicing requirements for the installed fiber optic cable.

2. All splicing shall occur in a Coyote Pup splice enclosure or an equivalent splice enclosure. Any alternative splice enclosure must be approved by the DOT prior to installation.

3. Each fusion splice shall be 0.10 dB loss, with a maximum acceptable splice loss of 0.20 dB.

4. For the fiber optic connectors, a 0.50 dB loss for each connectorized junction is allowable. This includes the connector loss and the fusion splice on the connector.

5. All splice losses are assumed to be a bidirectional average.

C. Fiber Optic Connectors

1. The purpose of this specification is to describe single-mode fiber optic connectors for mating the ends of the fiber with other fiber optic devices.

2. The fiber optic connectors shall be single-mode connectors of “ST” Type.

3. The ITS device locations shall be provided with a wall or rack mounted patch panel frame with capacity to terminate all fibers entering or exiting the location. Only fibers to be immediately connected to equipment are required to be terminated.

D. Breakout Cable

1. The purpose of this specification is to describe a single-mode fiber optic cable which shall be sufficiently flexible to connect an ITS device location with the backbone cable, while being sufficiently robust to withstand the most common environmental hazards due to personnel handling and other dangers associated with its environs.

2. The single-mode fiber optic breakout cable shall be a ruggedized cable with six (6) or twelve (12) fibers individually subjacketted for ease in connector installation. The subjackets shall be color coded or numbered for easy identification. The cable shall be manufactured by Corning or OFS.

3. SHOP DRAWINGS

Shop drawing submittals shall be complete and indexed and shall include, but not be limited to the following:

A. Complete details of all components and sections showing all materials.

B. A listing of all applicable North Dakota DOT, UL and AASHTO specification.

C. Name of the manufacturer and supplier.

4. TESTING

End-To-End Conformance Testing using Optical Time Domain Reflectometer (OTDR). The contractor shall test each fiber of each cable run and provide results of the test and the reel packing label test results from the manufacturer to NDDOT. If the individual cable runs do not match the test results of the packing label test results less the connection and splice losses, the cable shall be replaced at the Contractor's expense.

5. INSTALLATION REQUIREMENTS

A. Interconnect shall be installed per the manufacturers recommendation with warning tape placed 12 inches above the cable.

B. The contractor shall include a No.14 AWG 1 unspliced, insulated copper conductor running the full length and parallel to any fiber that is not installed in an existing conduit system with the tracer wire already installed. The purpose of this conductor is for locating the fiber. This is not a separate bid item and the cost shall be included in the price bid for the fiber optic cable.

C. The Contractor shall identify the foot mark of the cable of the incoming and outgoing cable of each hand-hole. The identifying mark shall be recorded and a

label shall be placed in the hand-hole. A summary of all identifying marks shall be provided to NDDOT.

D. The Contractor shall leave a minimum of 50 feet of cable slack in each hand-hole. At strategic locations, additional cable length may be needed. This information will be provided on a case-by-case basis.

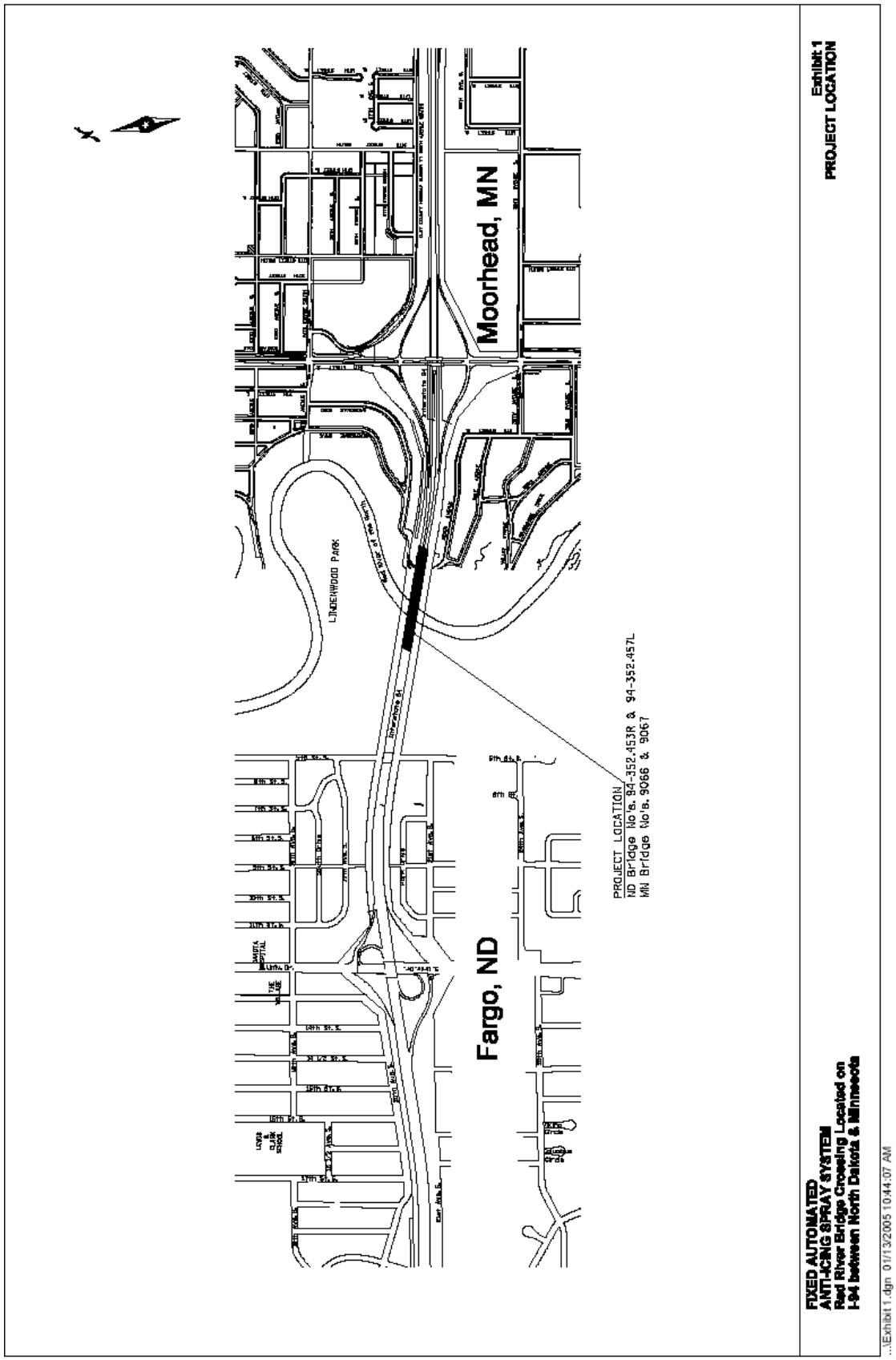
E. Splicing of fiber and breakout cables shall occur in a Coyote Pup enclosure or equivalent. An alternative splice enclosure may be used, but authorized by the DOT prior to installation.

F. The Contractor shall provide 200 feet of cable from each reel to NDDOT District Sign Shop for restoration and maintenance purposes. Attach a tag to each length of cable provided identifying the reel from which the cable was taken.

6. METHOD OF MEASUREMENT

The interconnect cable shall be measured per each linear foot installed. This shall include labor, equipment, and material to install fiber cable. The connectors and breakout cable shall be incidental to the linear feet of fiber cable installed.

Appendix D – Project Layouts


Moorhead, MN
Fargo, ND
LINDENWOOD PARK
PROJECT LOCATION
ND Bridge Nos. 94-352.453R & 94-352.457L
MN Bridge Nos. 9066 & 9067
Exhibit 1
PROJECT LOCATION
FIXED AUTOMATED
ANTI-ICING SPRAY SYSTEM
Red River Bridge Crossing Located on
I-94 between North Dakota & Minnesota
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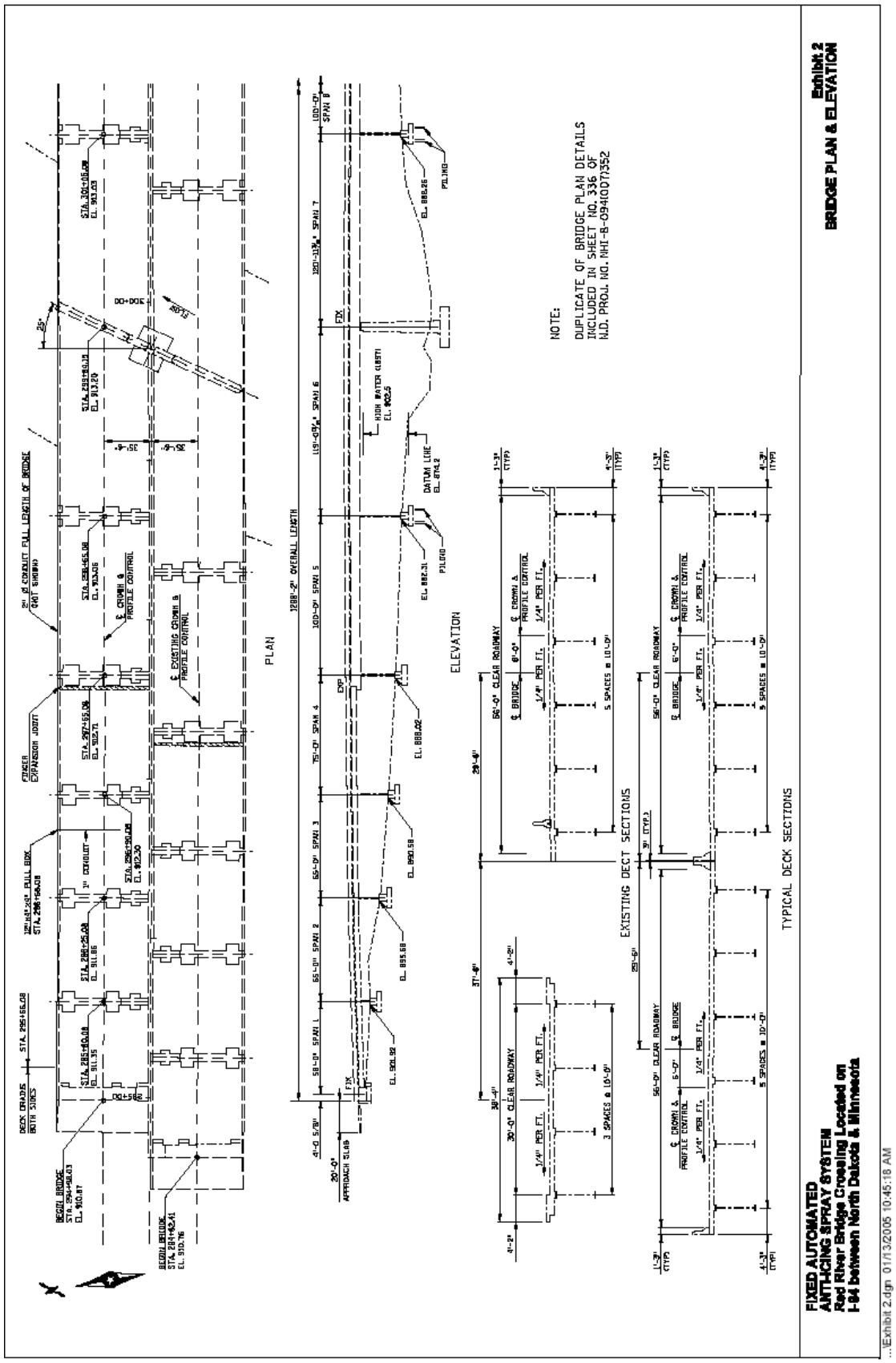
PLAN
ELEVATION
TYPICAL DECK SECTIONS
EXISTING DECT SECTIONS
NOTE:
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INCLUDED IN SHEET NO. 336 OF
N.D. PROJ. NO. NHI-8-094(007)352
FIXED AUTOMATED
ANTI-ICING SPRAY SYSTEM
Red River Bridge Crossing Located on
I-94 between North Dakota & Minnesota
BRIDGE PLAN & ELEVATION
Exhibit 2
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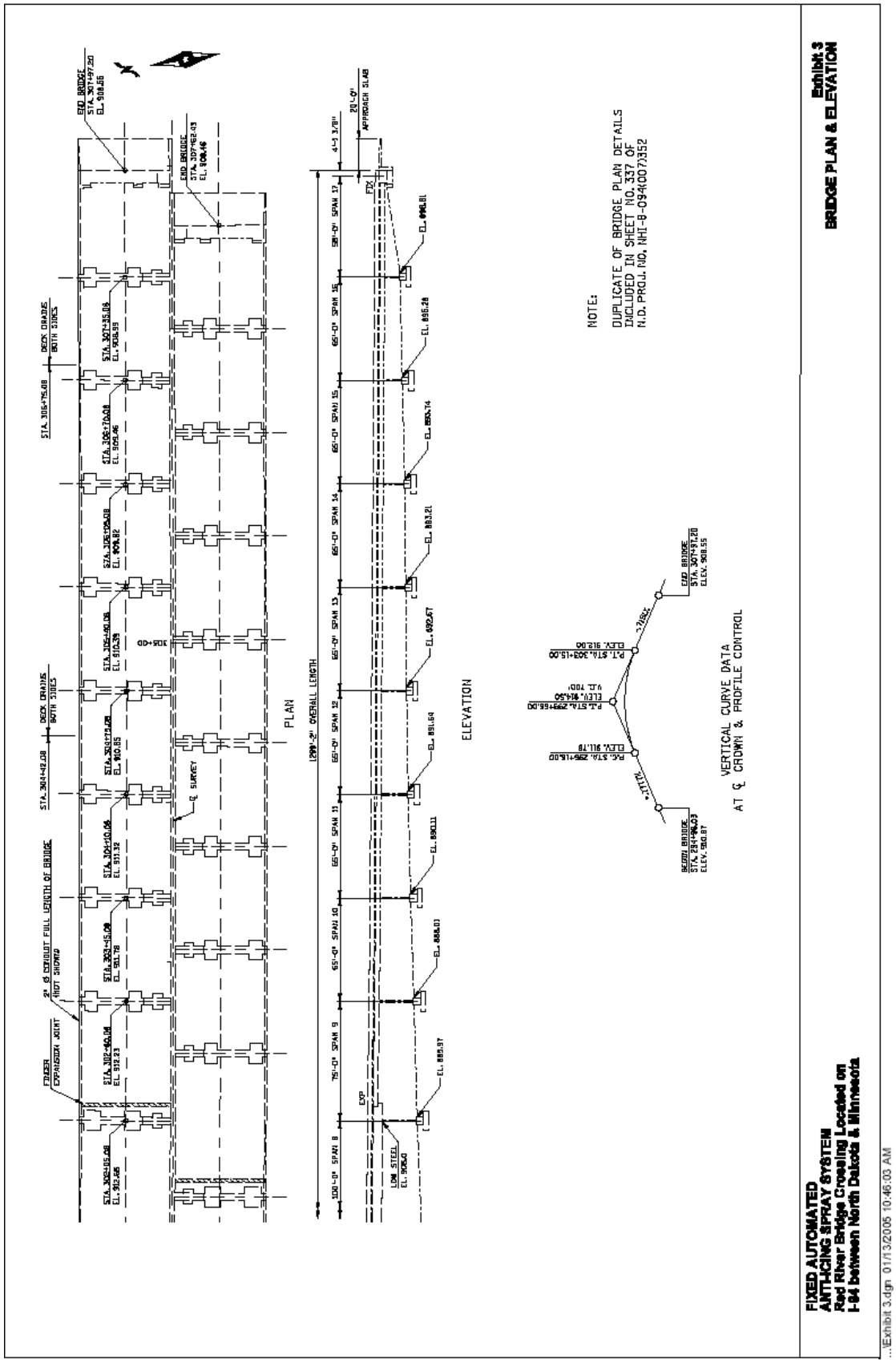
PLAN
ELEVATION
VERTICAL CURVE DATA
AT ℄ CROWN & PROFILE CONTROL
NOTE:
DUPLICATE OF BRIDGE PLAN DETAILS
INCLUDED IN SHEET NO. 337 OF
N.D. PROJ. NO. NHI-0-094(007)352
FIXED AUTOMATED
ANTI-ICING SPRAY SYSTEM
Red River Bridge Crossing Located on
I-94 between North Dakota & Minnesota
BRIDGE PLAN & ELEVATION
Exhibit 3
...\Exhibit 3.dgn 01/13/2005 10:46:03 AM

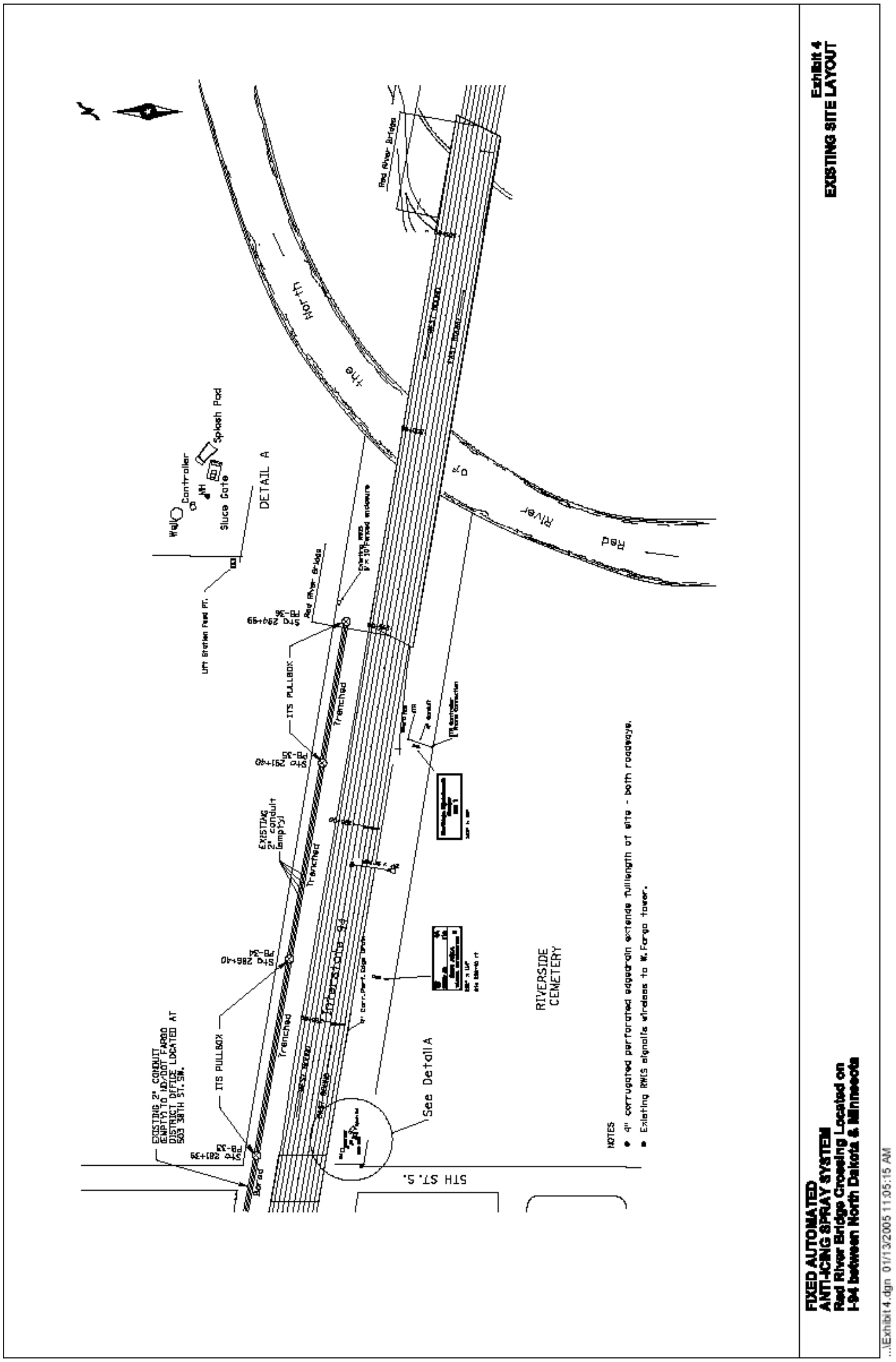
Exhibit 4
EXISTING SITE LAYOUT
FIXED AUTOMATED
ANTI-ICING SPRAY SYSTEM
Red River Bridge Crossing Located on
I-94 between North Dakota & Minnesota
Red River Bridge
North
the
Red River
Interstate 94
DETAIL A
Well
Controller
Splash Pad
Sluice Gate
Lift Station Feed Pt.
ITS PULLBOX
Trenched
EXISTING 2" conduit (empty)
EXISTING 2" CONDUIT (EMPTY) TO ND/DOT FARGO DISTRICT OFFICE LOCATED AT 503 38TH ST. SW.
Sta 281+39 PB-33
Sta 286+40 PB-34
Sta 291+40 PB-35
Sta 294+99 PB-36
Bored
5TH ST. S.
See Detail A
RIVERSIDE CEMETERY
NOTES
4" corrugated perforated edgedrain extends fulllength of site - both roadways.
Existing RWIS signals wireless to W. Fargo tower.
..\Exhibit 4.dgn 01/13/2005 11:05:15 AM

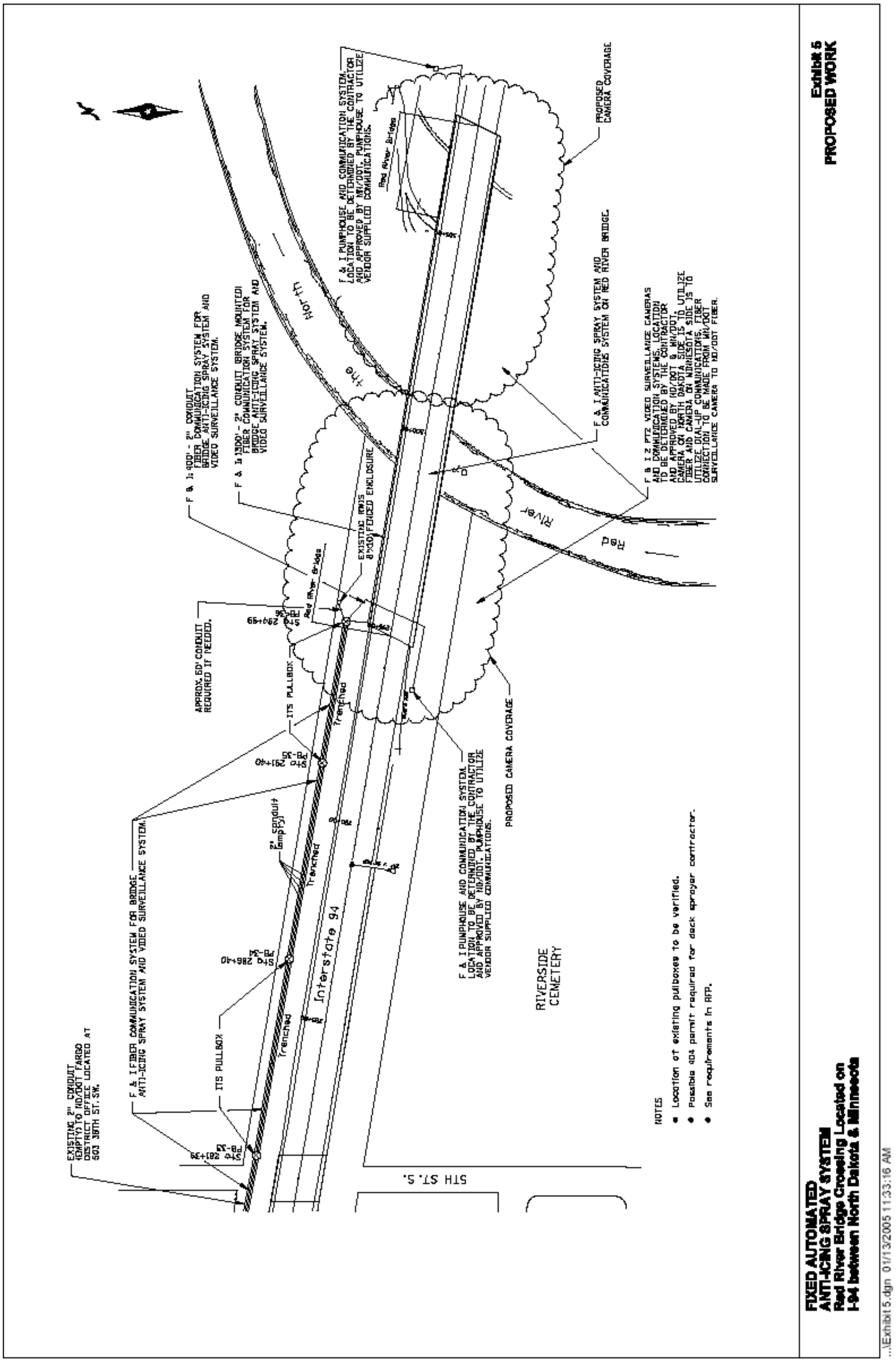
Exhibit 5
PROPOSED WORK
FIXED AUTOMATED
ANTI-ICING SPRAY SYSTEM
Red River Bridge Crossing Located on
I-94 between North Dakota & Minnesota
Interstate 94
Red River
RIVERSIDE CEMETERY
5TH ST. S.
ITS PULLBOX
PROPOSED CAMERA COVERAGE
APPROX. 60' CONDUIT REQUIRED IF NEEDED.
NOTES
Location of existing pullboxes to be verified.
Possible 404 permit required for deck sprayer contractor.
See requirements in RFP.
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Appendix E – Risk Management

Risk Management Appendix

Service Contracts with Private Individuals, Companies, Corporations, Etc.:

Contractor agrees to indemnify, save and hold harmless the state of North Dakota, its agencies, officers and employees (State), from claims resulting from the performance of the Contractor or its agent, including all costs, expenses and attorney's fees, which may in any manner result from or arise out of this agreement. Contractor also agrees to indemnify, save and hold the State harmless for all costs, expenses and attorney's fees incurred in establishing and litigating the indemnification coverage provided herein.

Contractor shall secure and keep in force during the term of this agreement, from insurance companies, government self-insurance pools or government self-retention funds authorized to do business in North Dakota, the following insurance coverages covering the Contractor for any and all claims of any nature which may in any manner arise out of or result from this agreement:

1) **Commercial general liability** and **automobile liability** insurance – minimum limits of liability required are **$250,000 per person** and **$1,000,000 per occurrence.**
2) **Workers compensation** insurance meeting all statutory limits.
3) The State of North Dakota, its agencies, officers, and employees (State) shall be endorsed as an **additional insured** on the commercial general liability and automobile liability policies.
4) Said endorsements shall contain a **"Waiver of Subrogation"** in favor of the state of North Dakota.
5) The policies and endorsements may not be canceled or modified without **thirty (30) days prior written notice** to the undersigned State representative.

Contractor shall furnish a certificate of insurance evidencing the requirements in 1 through 5 above to the undersigned State representative prior to commencement of this agreement.

The State reserves the right to obtain complete, certified copies of all required insurance documents, policies, or endorsements at any time. Any attorney who represents the State under this contract must first qualify as and be appointed by the North Dakota Attorney General as a Special Assistant Attorney General as required under N.D.C.C. Section 54-12-08.

When a portion of a Contract is sublet, the Contractor shall obtain insurance protection (as outlined above) to provide liability coverage to protect the Contractor and the State as a result of work undertaken by the SubContractor. In addition, the Contractor shall ensure that any and all parties performing work under the Contract are covered by public liability insurance as outlined above. All SubContractors performing work under the Contract are required to maintain the same scope of insurance required of the Contractor. The Contractor shall be held responsible for ensuring compliance with those requirements by all SubContractors.

Contractor's insurance coverage shall be primary (i.e., pay first) as respects any insurance, self-insurance or self-retention maintained by the State. Any insurance, self-insurance or self-retention maintained by the State shall be excess of the Contractor's insurance and shall not contribute with it. Any deductible amount or other obligations under the policy(ies) shall be the sole responsibility of the Contractor. This insurance may be in a policy or policies of insurance, primary and excess, including the so-called umbrella or catastrophe form and be placed with insurers rated "A" or better by A.M. Best Company, Inc. The State will be indemnified, saved, and held harmless to the full extent of any coverage actually secured by the Contractor in excess of the minimum requirements set forth above.

RM Consulted 1997
Revised 11-04

Appendix H

Lessons Learned Comparing Road Condition Reporting Systems

Project 1.9 Develop a Lessons Learned Document Comparing Reporting Systems in Wisconsin and North Dakota

North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.9

Lessons Learned Comparing Road Condition Reporting Systems

Final Report

Prepared by:

Advanced Traffic Analysis Center
North Dakota State University
Fargo, North Dakota

September 29, 2005

TABLE OF CONTENTS

1. Introduction

This document is the product of Project 1.9 conducted as part of Phase-1 of the North/West (N/W) Passage Corridor work plan. The N/W Passage corridor promotes seamless traveler information along the I-90 and I-94 corridors from Wisconsin to Washington state by emphasizing the coordination and integration of advanced traveler information systems across state lines. Given the region's long and sometimes severe winter weather, traveler information is critical for ensuring the safety of the traveling public, especially interstate travelers and commercial vehicle drivers.

Background

Several states along the I-90 and I-94 corridors have early on recognized the significant benefits of Intelligent Transportation Systems (ITS) applications to road and weather information delivery. Therefore, these states made modest to moderate investments in weather sensors, traveler information hotlines (and later 511), Dynamic Message Signs (DMS), and more recently; automated roadway/bridge treatment systems. In fact, the roots of 511 could be traced back to a system that was deployed in North Dakota and South Dakota in the late 1990s (#SAFE). Weather was the main focus of these early efforts. Further, given the sporadic availability of ITS infrastructure, these efforts were not always integrated into statewide systems that cover a wide range of traveler information. In addition, there still remain some issues regarding the consistency and compatibility of traveler information across state borders. The need to integrate these systems became apparent as their potential for delivering useful, and often critical, traveler information was better recognized.

Statewide road/weather condition reporting systems provide the means to collect, process, share, and deliver a variety of information in real-time or close to real-time basis. Several vendors developed and marketed early and proprietary road/weather condition reporting systems. One of the first of the state systems was developed under the ITS operational test/model deployment initiatives in Arizona in the mid 1990s. The system initially named Trailmaster, computerized data collection and reporting along major roadways in Arizona. Later the system was renamed as the Highway Condition Reporting System (HCRS). Soon after that, several states initiated a pool fund study to customize the Arizona HCRS to their respective needs. Over the years, other similar systems were developed, including AASHTO's Condition Acquisition and Reporting System (CARS).

While some states did approach the development of statewide condition reporting systems as part of pooled fund studies, there was no single national standard for these systems. Although the ITS Architecture provides a platform for planning these systems, the actual designs were often influenced by the availability of ITS infrastructure (especially communications) in each state. Therefore, vendor-specific (and to some extent, state specific) approaches could best characterize the early development of these systems. This resulted in little or no ability to seamlessly exchange information among different states along the same corridor.

New federal legislation (SAFETEA-LU) has been passed (August 2005) with the stated goal "to provide the nationwide capability to monitor, in real-time, the traffic and travel conditions of our nation's major highways and to widely share that information to improve the security of the surface transportation system, address congestion problems, support improved response to weather events, and facilitate national and regional traveler information." (2) SAFETEA-LU includes provisions that address the development and coordination of real-time system management information through better information exchange formats. This really underlines the importance of multi-state coordination and the increased benefits of having a nation-wide system of condition reporting systems.

Clearly, the N/W Passage Corridor is a significant step in the direction of realizing that national vision. The details of these provisions are discussed in more detail under Section 4 of this report.

Project Purpose/Objective

The initial purpose of this project was to develop a lessons learned document based on deployment experiences of statewide condition reporting systems in North Dakota and one in Wisconsin. The North Dakota Department of Transportation (NDDOT) was exploring the possible deployment of Meridian's statewide condition reporting system (later named IRIS for Incident Reporting Information System) to further expand current traveler information capabilities and support of North Dakota's 511 system. Similarly, the Wisconsin DOT (WisDOT) was in the initial planning stage of its 511 system with a vision that includes partnering with the Wisconsin State Patrol for operating the underlying statewide condition reporting system which would support 511. Therefore, WisDOT wanted to demonstrate data entry requirements to the Wisconsin State Patrol for any condition reporting system, using the CARS as an example. The Advanced Traffic Analysis Center (ATAC) at North Dakota State University was to follow the deployment of the two systems and develop a lessons learned document accordingly. In addition to the two case studies, ATAC planned to develop brief information on other existing statewide condition reporting systems, including their institutional arrangements, general data requirements, resources, etc.

After the start of the project, the NDDOT decided not to proceed with plans to deploy Meridian's statewide condition reporting system in North Dakota. This development greatly reduced ATAC's ability to study North Dakota's deployment as a case study. ATAC staff did, however, participate with demonstrations held for the NDDOT on the Meridian system.

In Wisconsin, plans for a limited CARS deployment were proceeding well. However, CARS itself was undergoing a major update in order to meet new NTCIP protocols. Therefore, the new version of CARS differs from the old version, especially in terms of compatibility with other systems. Nonetheless, some initial data were collected on Wisconsin's experience with CARS limited deployment.

After consulting with the project advisory panel, the following revised scope was developed for this project:

1. Provide a description of new federal requirements for (real-time) statewide information systems
2. Provide general descriptions of CARS, IRIS, and Arizona's HCRS
3. Document Wisconsin's CARS limited deployment
4. Review of South Dakota Department of Transportation's (SDDOT) limited Meridian condition reporting system deployment and study on improved road condition reporting
5. Provide a current listing of state traveler information sources and contact information

Report Organization

The remainder of this report is organized as follows:

Section 2 - Condition Reporting Systems: provides an overview on statewide condition reporting systems, including general components of statewide information systems and brief descriptions of HCRS, CARS, and IRIS.

Section 3 - Lessons Learned: summarizes results from Wisconsin's DOT limited deployment of CARS to illustrate data entry requirements, as well as findings from a South Dakota DOT's study of statewide condition reporting systems and an Arizona DOT study on ITS data integration.

Section 4 - New Federal Requirements: briefly discusses recent provisions on real-time system management information contained in the SAFETEA-LU transportation legislation.

Section 5 - Conclusions: provides a brief summary of findings.

2. Condition Reporting Systems

Information is often referred to as the "I" in ITS. Since the beginning of the ITS program, there has been great emphasis on collecting information relevant to system operations, processing that information, and distributing it. Recipients of this information include a variety of transportation system users, as well as agencies responsible for operating the system and responding to incidents or emergencies.

Traveler information can take a variety of formats and coverage depending on the application and the area (i.e., metropolitan vs. rural or statewide). For statewide and rural applications, these functions are generally included under the Pre-trip Travel Information and En-route Driver Information user services. Pre-trip information is typically provided through a web page or telephone interface. En-route information could be provided through cellular or regular telephone, DMS, Highway Advisory Radio, and Kiosks.

This section provides a general discussion of statewide road condition reporting systems and provides some examples. It discusses the general components of a statewide condition reporting system. It also outlines the features of three existing condition reporting systems, HCRS, CARS, and IRIS.

General Components

Regardless of the method used to deliver the information, the foundation of travel information user services is a system which collects and processes information. Therefore, a road condition reporting system must at least have a method for collecting data from the field, processing the data into deliverable or value-added information, and finally either directly or through an interface with a delivery system, distribute this information to various users.

The scope and complexity of these components largely depend on the application and the location. For large metropolitan areas or corridors with heavy traffic volumes, there is more saturation of sensors, especially video. The availability of broadband communications is not an issue. Information, including road weather conditions, is distributed to a diverse group of users that may include private sector value-added information service providers. Figure 1 provides an illustration of this type of system. An Information Service Provider (ISP) in Figure 1 handles most of value-added traveler information functions.

On the other hand, rural and statewide applications involve less saturation of sensors and they must work with less communications coverage and bandwidth. The focus in these systems emphasizes major incidents, due to weather or traffic crashes, as well as construction activity and other restrictions. Figure 2 shows an illustration of a predominantly weather information system.

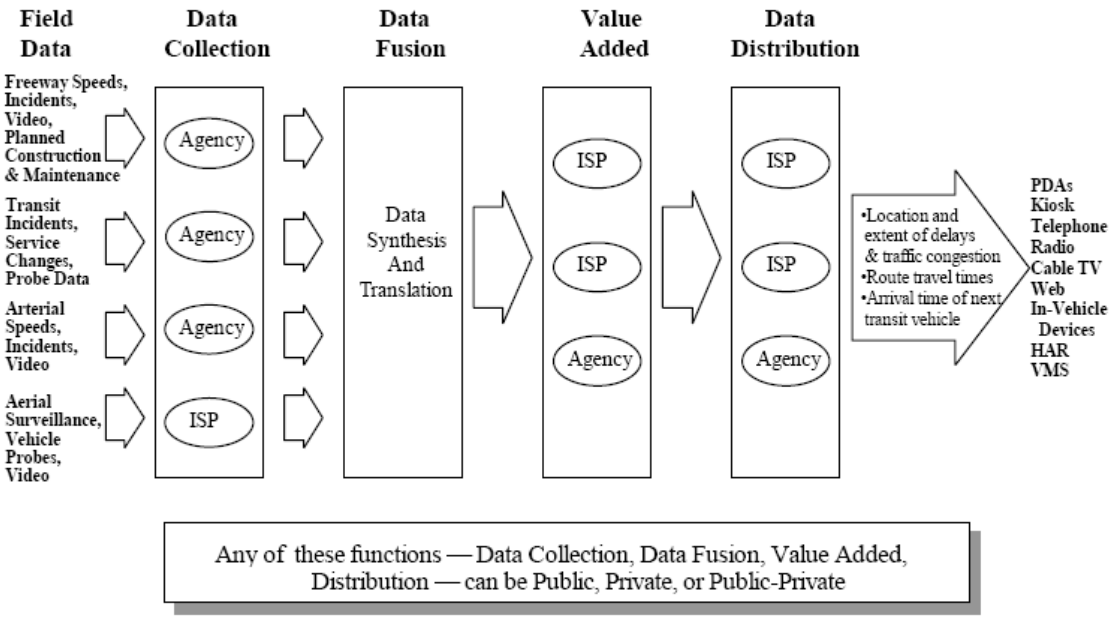

Figure 1 Typical Components of a Travel Information System (1)

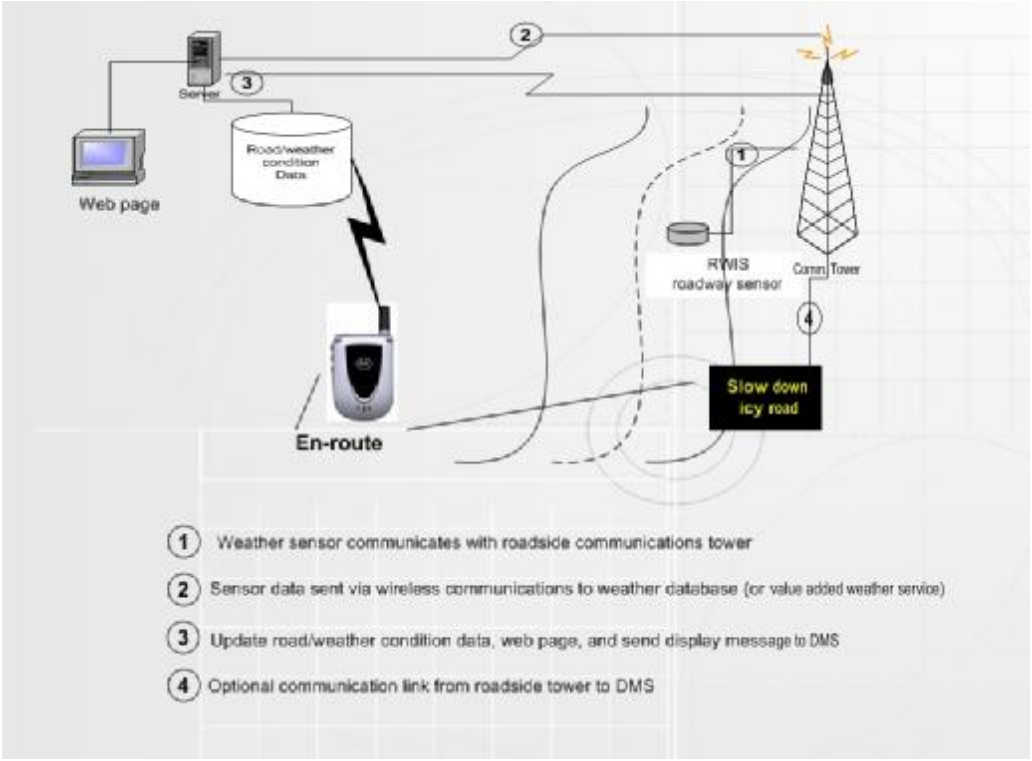

Figure 2 Typical Weather-based Travel Information System

Data Collection

Collecting road condition data provides the foundation for any travel information system, including road condition reporting systems. These condition data may include the operational characteristics of the roadway (traffic), surface conditions and environmental conditions, and incidents. A variety of devices and sensors depending on data types may be used to collect, store, and/or transmit field data. In addition to field sensors, there are other mechanisms to obtain information about the system operations, such as driver cellular calls to 911, DOT crew reports, etc.

Manual data entry is common among various states for entering collected data and other information for processing. However, several current efforts are targeting the automation of these functions to reduce staff requirements, improve accuracy, and most importantly enhance the timeliness of information.

Examples of data collection methods include:

1. Traffic
    a. Loops
    b. Video
    c. Radar
    d. Media
2. Weather
    a. RWIS
    b. Video
    c. Law enforcement
    d. Maintenance personnel
3. Incidents
    a. Law enforcement
    b. Travelers
    c. Video
    d. Homeland security sensors (i.e., HAZMAT detection)

Data Processing

After road and weather condition data are collected in the field, they are transmitted to a processing system. Processing refers to converting raw data and field reports into a usable format to support system operational decisions and to provide information to system users. Depending on the application and the system design, processing may be done automatically at pre-determined frequencies (i.e., update traffic speeds every 30 seconds) or as triggered by certain events or sensor readings (i.e., temperature readings from a RWIS). The National ITS Architecture provides the tools to define various user interfaces and the associated processing required to support their information needs.

Processing may take place on-site in the field without operator or central system intervention to support operations of roadway systems (i.e., RWIS data supports bridge automated anti-icing treatment system and a DMS to warn drivers of icy conditions). A more common arrangement is for field data to be sent to a central database for condition data. Generally, these data exchange formats are covered by established ITS standards, namely National Transportation Communications for ITS Protocol (NTCIP). The condition database may reside at a state agency responsible for operating the system or a private company under contract to operate and support the system.

Information Distribution

After road and weather condition data has been processed, information is distributed to travelers as well as other centers or systems. A variety of methods may be used to deliver information to pertinent users, including 511, web pages, HAR, and DMS. 511 is increasingly becoming a major conduit for delivering information to the travelers and it serves as both a pre-trip and as an en-route traveler information service. However, 511 systems have not been fully implemented in all states. Figure 3 shows a status map of 511 system deployment. All but three of the N/W Passage states have fully operational 511 systems. These systems are generally owned and sponsored by state agencies.

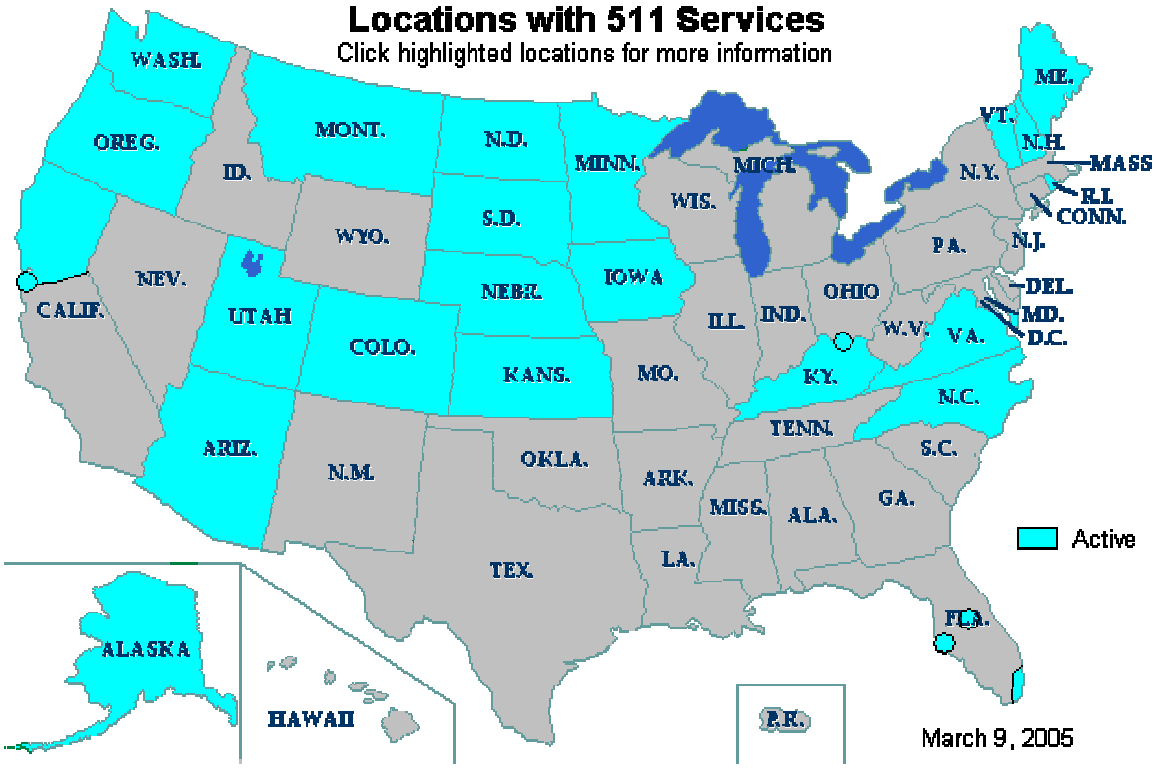

Figure 3 Status of 511 Systems Deployment (Source FHWA)

In addition to the state-sponsored systems, private vendors often provide value-added and tailored traveler information in select markets. They combine road and weather condition information with video, media announcements, advertisements, and other services to specific users and the general public.

Communications

The successful deployment of any travel information system depends on the availability of reliable communication links capable of carrying the required data at the desired frequency. Communications play a major role in influencing statewide condition reporting systems, influencing types of data, data formats, transmission frequency, accuracy, timeliness, and of course deployment and operating costs of these systems. As more data collection and transmission functions are automated and additional data (i.e., video) are added, the need for faster and more reliable communications becomes even more critical. It should also be mentioned that especially for statewide applications, there usually is a mix of communications technologies that are utilized to support desired functions.

Summary
The concept of road condition reporting systems is fairly straightforward, i.e., collect data, process data, and distribute information. However, the proper implementation of these systems is not a trivial task. There are numerous institutional, financial, technological, and technical issues that must be addressed. Given the diversity of sources of data and information and the desire to share information and access among agencies, the development of public-public and public-private partnerships is critical for success. Financial factors influence the ability of the system to cover desired locations and functions. For example, the number of sensors and the type of communications used are greatly influenced by cost considerations. Among the top technological issues are the ability of automating data collection and processing for various field devices and systems and the collection of data from vehicle probes. States can greatly enhance their condition data if they can tap into data from numerous public and private fleets as well as personal vehicles. Finally, technical issues including standardization in order to ensure interoperability and seamless inter-jurisdictional consistency are critical. National ITS Standards (i.e., NTCIP) provide the mechanisms for ensuring such interoperability, while preserving enough flexibility for states to implement systems that meet their unique needs.

To illustrate the impacts of these issues, Figure 4 and Figure 5 show two examples depicting travel information systems in North Dakota and Minnesota. These figures present a schematic illustration of data collection, processing, and distribution in the two states relative to existing systems and users. It should be mentioned that although the two systems look different, both states were successful in integrating their traveler information in order to provide travelers on both sides of the border with relevant road and weather information. This integration was largely possible because of the willingness among the state DOTs and following ITS Standards for data exchange formats.

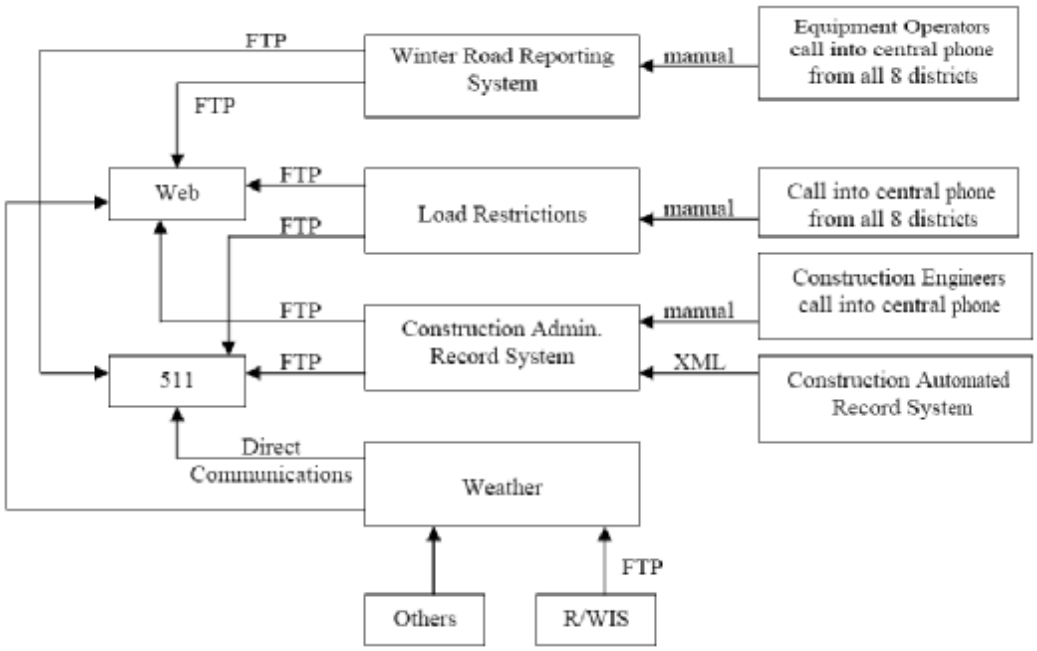

Figure 4 NDDOT Travel Information System (Source: N/W Passage)

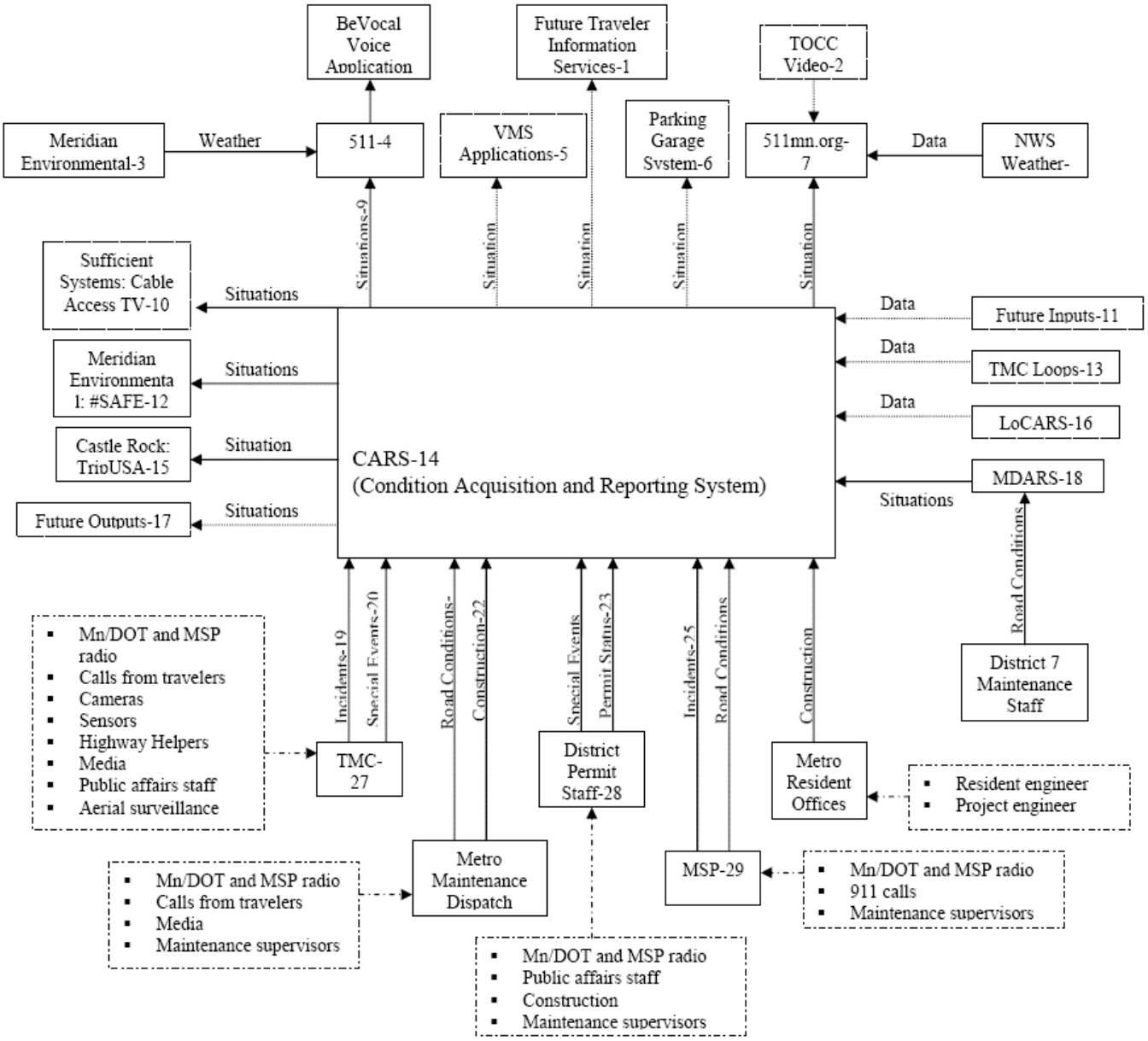

Figure 5 Minnesota DOT Travel Information System (Source: N/W Passage)

Existing Systems

The Highway Condition Reporting System (HCRS) developed in Arizona was among the first statewide condition reporting systems. Soon after that, several states initiated a pool fund study to customize the Arizona HCRS to their respective needs. Over the years, other similar systems were developed, including AASHTO's Condition Acquisition and Reporting System (CARS). A third system was recently developed by Meridian Environmental Technologies under the name Integrated Road Information System (IRIS).

The section provides a brief description of each system. It should be noted that documentation on system components and design was hard to find. Therefore, the researchers relied on documents as well as interviews to develop this information. As such, the level of detail under each system's description varies depending on available information.

HCRS

HCRS is a statewide data fusion system that Arizona Department of Transportation (ADOT) developed in the mid-1990s principally as a means of coordinating the construction and maintenance activities among various ADOT jurisdictions statewide (4). Originally, HCRS stood for Highway Closure and Restriction System and later became Highway Condition Reporting System. The AZDOT realized soon after the HCRS was developed that there was great value in providing this information to the traveling public. Therefore, a web page and an information hot line (prior to 511) were established to provide travelers with access to the system.

HCRS has three main components: data collection, data processing, and data dissemination. The system serves as the central data store for the collection and dissemination of information (3). HCRS is widely and frequently used by ADOT staff. Data is manually entered into HCRS at ADOT offices statewide over the Internet. Currently, information from key fields in the HCRS form are automatically converted to synthesized speech messages by means of a text-to-speech process and made available through the 511system See Figure 6 and Figure 7 for more information on system components.

System Inputs

The HCRS uses traffic and weather information from a network of road/weather information sensors, still-frame video cameras, and construction and maintenance crews and patrols. Information is entered into HCRS via the Internet from HCRS workstations located at ADOT facilities statewide, including in each of the nine ADOT District Offices and field offices within each District (4). Other agencies can also enter information into HCRS, including local traffic agencies and the Arizona Department of Public Safety. As part of the I-40 Traveler and Tourism Information System deployment, other emergency and tourist organizations and private event promoters could enter information in the system.

HCRS data are entered using an Internet-based interface on an electronic on-screen event form. Event data include various event attributes, such as location, type, etc. The system stores the data using International Traveler Information Interchange Standard "category" and "description" information. Recent upgrades to the system enhanced the location field entry by introducing a graphical user interface which allows users to click on mileposts from a map to enter the location (5).

User Interfaces (System Outputs)

The two main outlets for travelers to access information from the HCRS are the Internet and Arizona's 511. The ADOT statewide web site provides real-time roadway condition information. Using a state road map, users can click on a specific route and receive a list of current roadway incident and construction information. Figure 8 shows a sample screen shot of the ADOT web site.

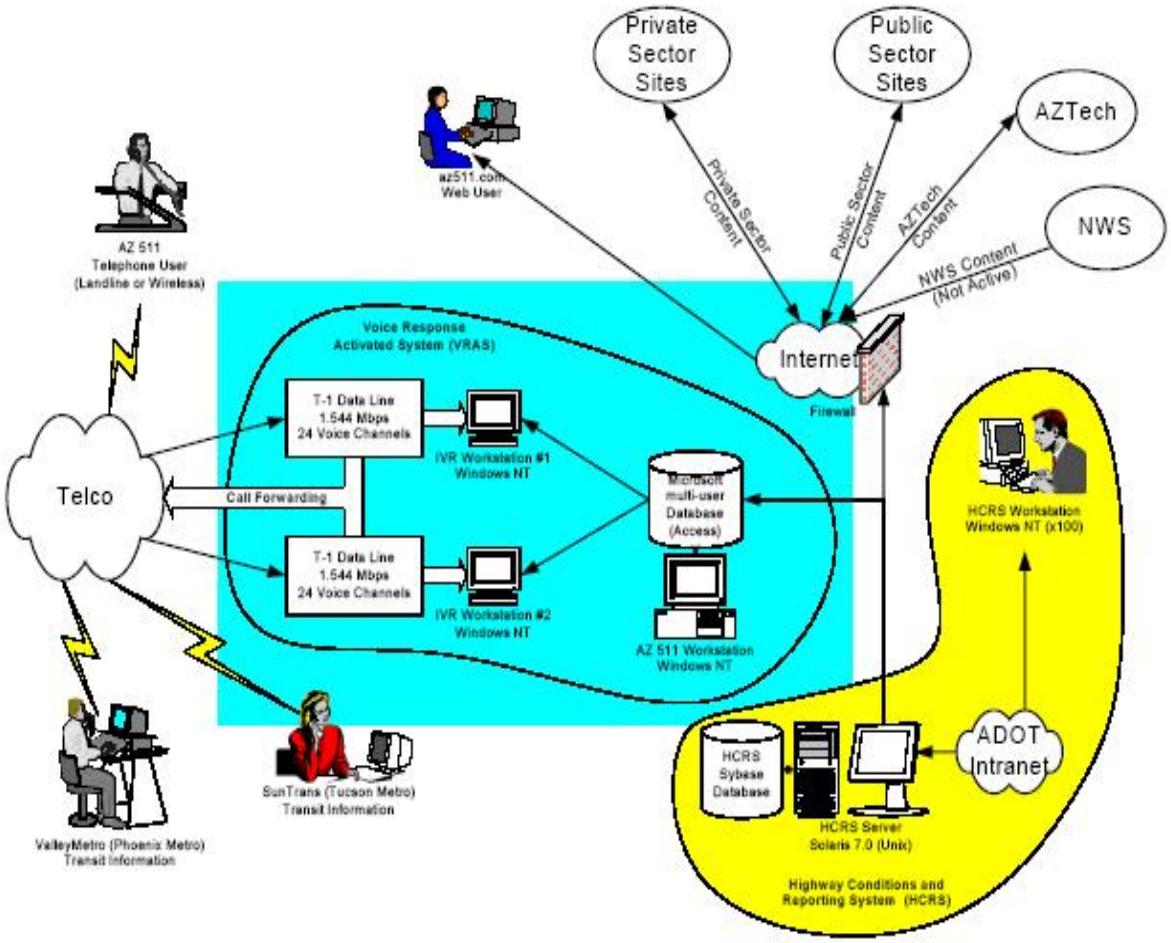

Figure 6 Relationship of HCRS to Arizona's 511 (4)

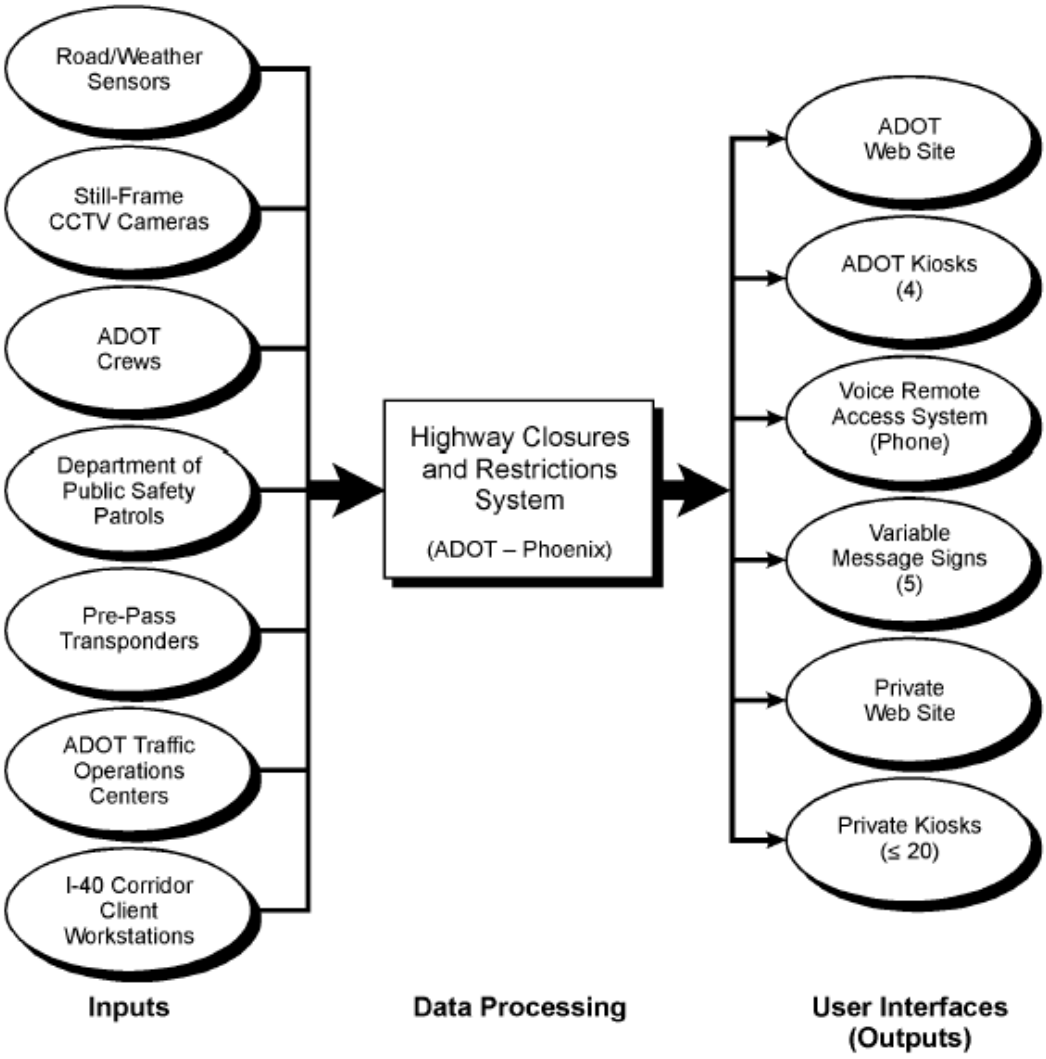

Figure 7 HCRS Components Overview as part of the I-40 ITIS (3)

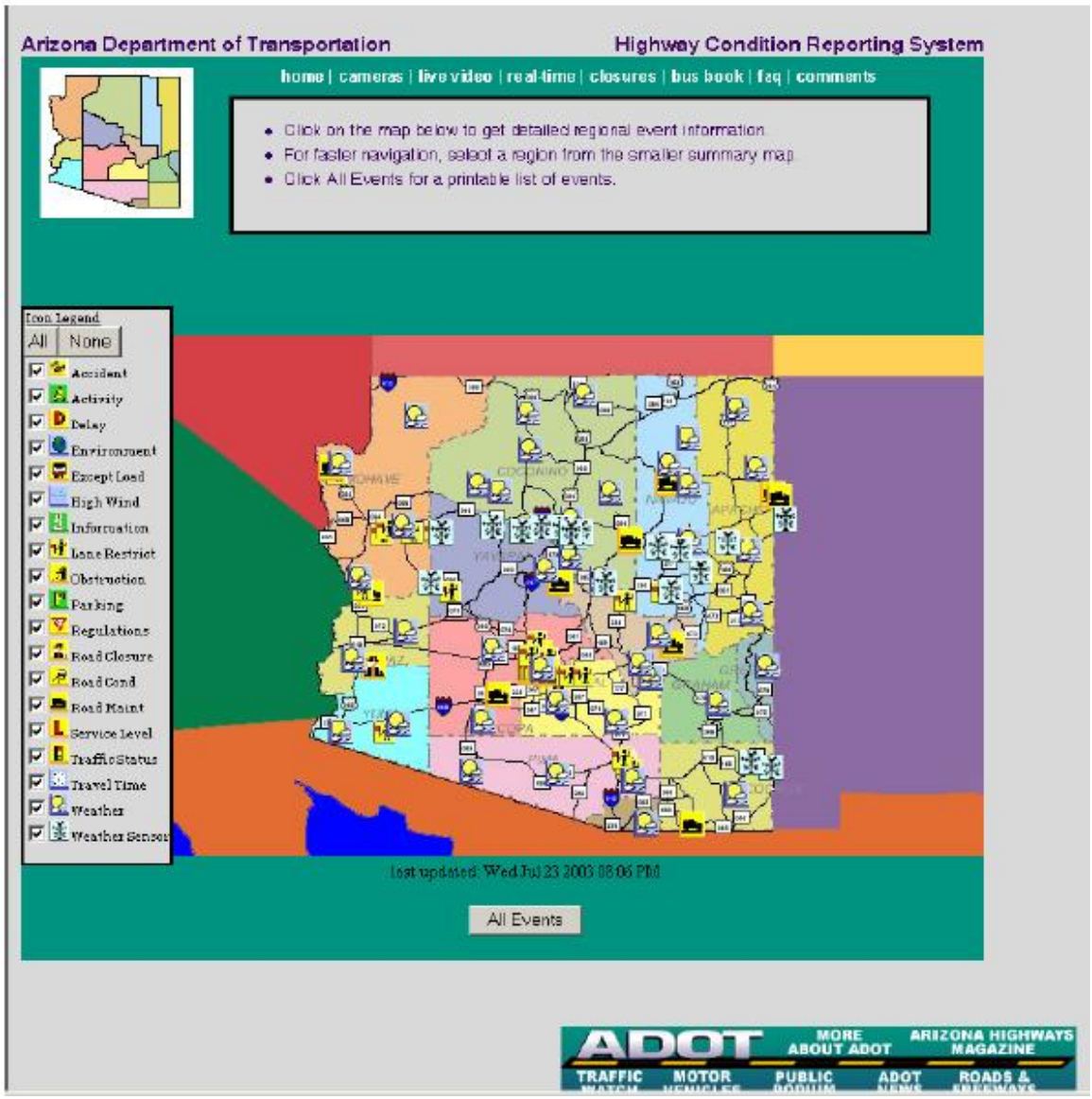

Figure 8 Arizona Traveler Information Web Site Using HCRS Information (4)

CARS

The Condition Acquisition and Reporting System (CARS) was developed as part of a FHWA Pooled Fund Study to customize Arizona's HCRS and turn it into a commercial product. Currently, CARS is non-proprietary and is owned by a consortium of states, including the ten states of Alaska, Iowa, Kentucky, Maine, Minnesota, Missouri, New Hampshire, New Mexico, Vermont, and Washington (6). These states also drive the ongoing improvement and extension of the CARS system based on their needs and budgets.

Authorized users can enter, view and disseminate critical road, travel, weather, and traffic information. CARS users access the system from any location using a standard web browser. This allows users to enter any condition reports or view reports entered by any other users around the state. The system provides for different user groups with different access levels and each user is assigned a login and password. The access/security levels may all be customized by system administrators of the state (7).

In order to keep CARS an open system that can be flexible enough to meet member state needs while being able to interface with other ITS applications, it closely follows national ITS standards. CARS uses Center to Center standards to send or receive incident data. It also uses the national ERM model to transmit and receive data via XML, allowing it to be integrated with other databases and information systems.

System Inputs

CARS data entry is performed manually through a web-based interface. This interface greatly enhanced the system's ability to receive data from as many authorized individuals as possible. Events and situations are formulated according to the National Traffic Management Data Dictionary (TMDD). Users may choose phrases already built intp the system to expedite the data entry process and minimize errors (6). Event data entered into the system include: construction, accidents, traffic, special events, and road weather conditions. The system allows automation of data collection from some ITS devices to reduce data entry costs and time.

Information Display/Graphical Interface

CARS provides several options for displaying system information to travelers and system users. A graphical display using a standard web browser provides a map with zoom options to view a situation's detailed information and location. Additionally, a text-based display is also available. Figures 9 and 10 show examples of the two displays.

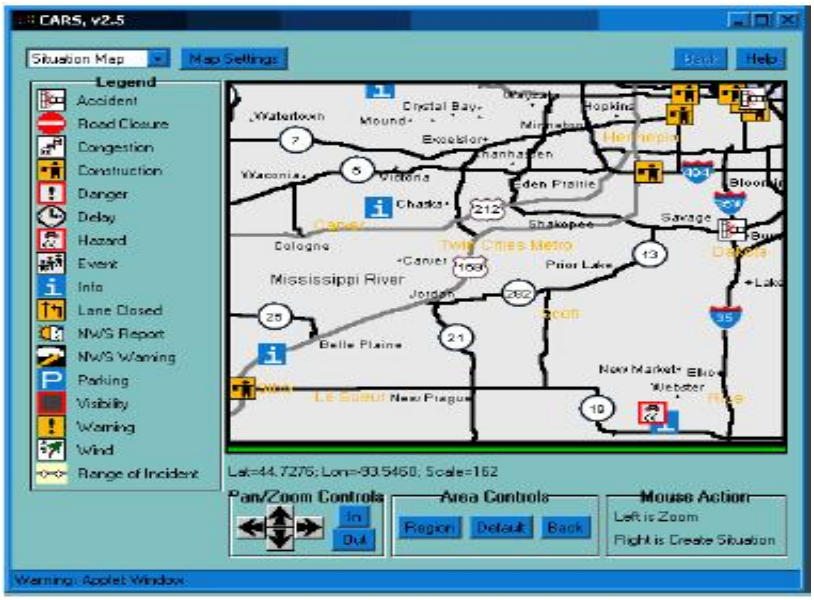

Figure 9 CARS Graphical Situation Display (Source: (6))

Figure 10 CARS Text-Based Display (Source: (6))

IRIS

The Integrated Road Information System (IRIS) was developed by Meridian Environmental Technologies. Meridian has done pioneer work by developing traveler information systems (#SAFE) in the states of North Dakota, Minnesota, and South Dakota in the late 1990s. The development of IRIS came as a product of a study conducted for the SDDOT in 2001 (8). In that study, a review of existing road reporting systems relative to SDDOT requirements revealed the need for a new system. IRIS was therefore developed as an open-design client-server system based on SQL.

The system consists of two major components, winter road conditions and construction information. Information may be entered and accessed from various locations within the state. Based on the organizational structure of the agency, the state may be divided into smaller units. For example, in South Dakota, the state is divided into Regions, Areas, and Shops.

System Inputs

Data entry to the system is accomplished through a graphical user interface for assigning conditions. Winter road condition data include selected highways, conditions, and duration. Construction data include: highway: designate the highway (and direction), restrictions (list of restrictions is configurable and could contain items such as road condition, routing, no passing, width height and weight limitations), and duration (start time and end time for the construction event (9).

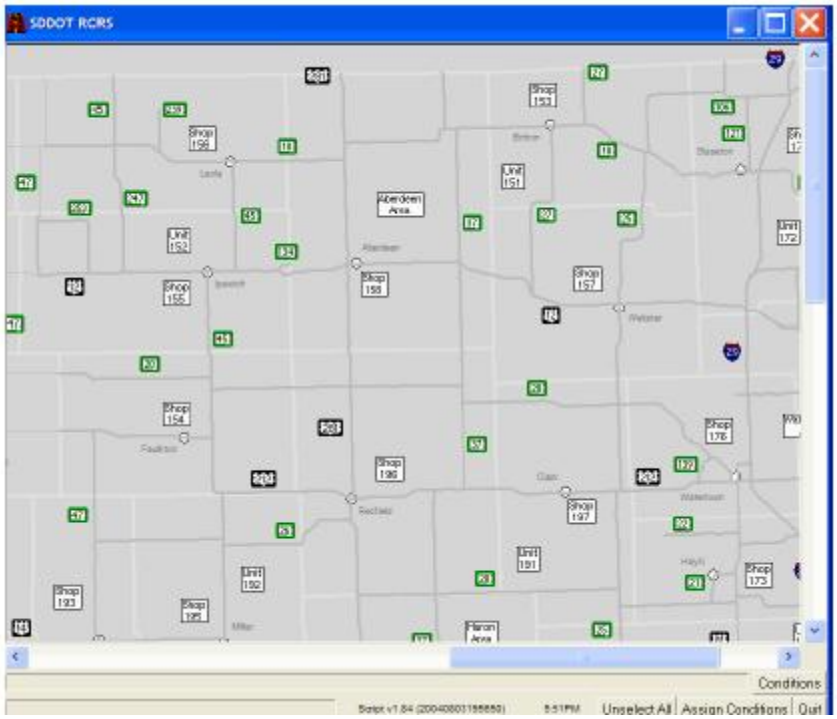

Figure 11 IRIS Graphical Data Entry Interface (8)

The system authenticates the users through a login screen that requires a username and a password. The system allows for a configurable number of user levels, each user level will have different functionality and areas of the system that are available to them. Generally, all users from different levels can view the information, however changing and editing the information requires the user to be authorized (9). IRIS currently handles only manual data input. No data is collected automatically from other systems (such as RWIS).

System Architecture

The system has a central database which can reside at either Meridian or the agency itself. Meridian uses a server with a pulling function where data are pulled from the system every minute. A pushing system is being considered where the data will be transferred to the server only when there is a change in conditions that warrants the transfer. Communication between the clients and the server (database) is done over the internet and some proprietary interface between the client and server. Meridian indicated that bandwidth is not an issue since data are usually only several kilobytes that need to be transferred at a given time and indicated that the system can be run over a dialup modem. Figure 12 shows a general logical architecture of IRIS as it was envisioned for the SDDOT.

Figure 12 IRIS Logical Architecture (8)

3. Lessons Learned

This section provides more detailed information based on Wisconsin's limited deployment of CARS to illustrate data entry requirements, and information obtained from South Dakota DOT 's deployment of IRIS, as well as an Arizona DOT study on ITS data integration. Unfortunately, the IRIS deployment in North Dakota was postponed due to funding issues and uncertainty with the new transportation bill. The NDDOT indicated a desire to wait for federal requirements impacting incident reporting systems before embarking on IRIS's deployment (10). Therefore, information about IRIS is supplemented from a SDDOT study which resulted in the development of the system.

The methodology for obtaining information about both systems relied on a questionnaire developed by the ATAC research team that addressed several deployment aspects. Areas covered in the questionnaire included:

1. System components
    a. User interface:
    b. Functionality:
    c. Output
2. Data collection, entry, and storage
3. System requirements
    a. Technical
    b. Organizational/agency/financial

Figure 13 shows the full questionnaire.

CARS Limited Deployment in Wisconsin

The Project 1.2 of the N/W Passage aimed at testing the CARS system in Wisconsin through a limited deployment. The trial was intended to demonstrate the system's requirements, especially staff requirements for data entry to the Wisconsin DOT (WisDOT) and the Wisconsin State Patrol (WSP). It was envisioned that incident/event data entry into CARS would be handled by WSP (11).

Using the CARS for this demonstration was for illustration purposes, i.e., the intent was to give State Patrol dispatchers an idea of the level of effort that would be required to enter events into any condition reporting system. It was also hoped that the WSP would see the value of a centralized system to handle all incident and road condition information. The demonstration took place along the I-94 corridor near the Minnesota/Wisconsin border at Osseo, Wisconsin.

Questions for Road Condition Reporting Systems
The purpose of these questions is to capture a snapshot of a road condition reporting system. Such information as a description of the general functionality the system provides, a description of the user interface, and system requirements both technical and organizational.

1. The system
    a. User interface:
        i. User Authentication
        ii. Does the system provide for different user groups with different access levels?
        iii. If the system allows different user groups, how many of them?
        iv. Is the number of user groups built into the system or controlled by the end user?
        v. Are the levels of access (the functionally each user group can access) built into the system for the different user groups or customizable by the end user?
    b. Functionality:
        i. Components
            1. Does the system provide for weather/winter road conditions?
            2. What weather conditions are supported? Are they customizable for each agency?
            3. Does the system provide construction information?
            4. Traffic incidents information?
            5. Security information?
        ii. How are road segments identified? Mile posts? Other?
    c. Output
        i. How will the output be provided to the system users?
        ii. How will the output be presented to the traveling public?
        iii. Interfaces with other systems? (511, web, other condition reporting systems)
2. Data
    a. What equipment/methods are used to enter data into the system?
        i. Are Police departments and Highway Patrol mobile data systems supported? Or is communication done through dispatch?
        ii. Does the system support PDA type devices?
    b. Who handles data entry?
    c. Does the system have a mechanism to support getting data from motorists?
    d. Where are the data housed?
        i. Central database?
            1. controlled by agency/ controlled by vendor?
        ii. Distributed database?
        iii. How are entries for the same event handled?
3. Requirements
    a. Technical
        i. What are the communication requirements of the system?
            1. Client/server architecture
            2. Bandwidth requirements
        ii. What are the computing requirements of the system?
            1. CPU speed/Computer memory?
            2. Is the system PC based or other devices are supported?
            3. PDA/Cell phones/Law enforcement mobile data systems?
        iii. What is required before deployment of the system in terms of infrastructure of existing systems or data
    b. Organizational/Agency
        i. What is required in terms of organizational requirement of the agency deploying the system
            1. lead agency
            2. agreements
            3. access
            4. funding
            5. staffing
            6. maintenance/operation

Figure 13 Questionnaire

Mn/DOT staff along with Castle Rock Consulting provided training to WSP dispatchers on the use of CARS, including event data entry, viewing, and editing. A prototype of the CARS system was configured and deployed for the demonstration including all roads in Wisconsin. However, the test activity focused on the Eau Claire region. The trial began on November 15, 2004 and finished on December 15, 2004. During the test period, WSP dispatchers were able to test the system by entering winter driving conditions, snowfall, crashes and other relevant events (11). The system use was monitored during the one-month period, including staff resource requirements, ease of use, and perceived value. System users were able to see CARS output as it would appear to the travelers; however, there was no live broadcast of information during the trial.

The results of the limited deployment were extremely positive, especially in alleviating concerns about data entry resource requirements. The team made the following observations at the conclusion of the trial (11):

1. Manual data entry would not be a burden for WSP dispatchers
2. WSP operators liked the idea of centralizing data entry and information distribution to other agencies that need access to view the data (rather than sending data to several particular agencies)
3. WSP operators felt the system was easy and quick to use
4. The WSP noted that uptime of the system and the availability of 24 hour support was an important criteria to be considered if and when WisDOT/WSP pursue full deployment

SDDOT Study

The SDDOT study on improving road condition reporting systems was not initially part of this project scope (8). However, it was felt that the study's final report provided some valuable insights that could apply to any state and fit well with the lesson-learned theme of this project.

Perhaps one of the first observations from the SDDOT study is the diversity of stakeholders involved in making a decision regarding a state's choice of a condition reporting system. In addition to traditional DOT involvement, state patrol or other law enforcement agencies have an increasing role in supporting condition reporting systems. These agencies provide the much needed operational staff support which may not be available at the DOT. Another agency that could have a crucial role in a condition reporting system implementation is a state IT department. In South Dakota, the Bureau of Information and Telecommunications (SDBIT). The SDBIT had technical requirements in regards to the system design, specifically using SQL Server protocols.

Another observation from the SDDOT experience was that the value of information to travelers and system users was greatly influenced by the timeliness and accuracy of the system. These two system attributes are however impacted by the data collection/entry method. Manual data entry requires more resources and could result in significant delay in entering and displaying event information. This limitation may be addressed by automation and/or by increasing the number of data entry operators by utilizing other agency staff (i.e., law enforcement and emergency management). It should be further noted that automation does not have to be an all-or-nothing provision. There are opportunities to improve system performance by partial automation from ITS devices which could provide automated data.

Finally, the use of ITS standards once again was emphasized as a critical factor of success for the development of any condition reporting systems (and other ITS as well). The SDDOT approach proved effective by developing a criteria based on a wide representation of stakeholders, thus recognizing the unique needs/circumstances of South Dakota, and closely following national ITS standards.

Arizona ITS Data Integration

Although this project was not specific to condition reporting systems, it did address some relevant issues concerning HCRS. The Arizona Department of Transportation (ADOT) recognized the fragmentation of various traffic ITS data and therefore conducted an ITS Traffic Data Consolidation System study (5). ADOT maintains a variety of independent ITS applications to monitor and manage roadway conditions and events across the state. Data from these systems include traffic counts, weather, pavement conditions, signal timing, and DMS text, camera images.

Each of these ITS applications has its own unique user interface, security, output data format, and task initiation timetable. The first phase of this project provided access for HCRS users and website visitors to VMS sign messages, Closed Circuit Television (CCTV) roadway images, sensor data from Road Weather Information Systems (RWIS), and National Weather Service (NWS) forecasts and advisories (5).

The second phase of the project addressed improvements to HCRS's data entry interface. System users are now able to enter highway mileposts graphically, greatly simplifying field data entry and improving location accuracy. In addition, numerous redundant display layers and icons were removed or simplified (15).

Some of the issues identified from this integration project included (5):

1. Difficulty of integrating third-party data (DMS and RWIS)
2. The amount of data archived by the HCRS became an issue Therefore, a storage capacity analysis should have been done prior to system integration
3. There needs to be a process for adding new road sections and integrating these sections into the system's GIS database.
4. Inclusion of more information into the HCRS, including rural travel prediction based on road/weather conditions.

4. New Federal Requirements

The Federal Highway Administration (FHWA) and the USDOT ITS Joint Program Office (IJPO) have long been advocates of advancing travel information to reduce delay and enhance safety. Therefore, Transportation System Management and Operations Information has increasingly been the focus of the national ITS program as a new era following system construction and preservation. ITS is an integral part of this focus labeled "21st Century Operations Using 21st Century Technology." (FHWA)

Real-time information availability is viewed by FHWA and the IJPO as the foundation of system management and operations. As a result, there are several new provisions in the recently passed "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users" (SAFETEA–LU) to promote the development of real-time information systems to support management and operations. Most notable among these provisions is included under Subtitle B Congestion Relief in Sec. 1201 which establishes a Real-Time System Management Information Program. The purpose of this program includes three main components (2):

1. Establish, in all states, a system of basic real-time information for managing and operating the surface transportation system
2. Identify longer range real-time highway and transit monitoring needs and develop plans and strategies for meeting such need
3. Provide the capability and means to share that data with state and local governments and traveling public

This section calls for the U.S. DOT to establish data exchange formats no later than two years of the enactment of TEA LU (i.e., by August 10, 2007). These data formats will ensure that the data provided by highway and transit monitoring systems, including statewide incident reporting systems, can be readily exchanged to facilitate nationwide availability of information. However, this section does not include a specific date for states and local governments to develop new real-time system management information or incorporate data exchange formats into existing systems.

As State and local governments develop or update regional ITS architectures, they must explicitly address real-time highway and transit information needs and the systems needed to meet such needs, including addressing coverage, monitoring systems, data fusion and archiving, and methods of exchanging or sharing highway and transit information (2). Once again, there is no specific date for meeting this requirement since the deadline targeted for the Regional ITS Architecture Conformity Rule expired as of April 2005. Additionally, this rule does not have a specific requirement as to the frequency or scheduling of architecture updates.

No separate funds were allocated for developing and supporting this program. However, states may use their National Highway System (NHS), Congestion Mitigation and Air Quality Improvement (CMAQ), and Surface Transportation Program (STP) funds for these activities.

5. Conclusions

This study developed information on condition reporting systems from a variety of sources, including review of existing condition reporting systems, available documentations, and interviews with system integrators and agency staff. Below are some of the major observations and findings:

1. There is an increased focus on real-time information as part of a larger emphasis on systems operations and customer service. The traveling public's appetite for information is expected to only grow. With that there is an opportunity for delivering information in a variety of methods as more users have access to the Internet as well as other personal communication devices.

2. Any great information system relies on timely, accurate, and useable data. Our study has found that manual data entry is the general practice for current road condition reporting systems. Manual data entry greatly impacts the level of resources required for successfully operating the system as well as the value to travelers in terms of timeliness and accuracy of information. To increase the number of operators with time-critical data entry privileges, state DOTs should explore sharing the system with other agencies. This is especially true for law enforcement/emergency management agencies which generally have longer operating hours and are most familiar with incidents and other events affecting system operations.

3. There may yet be great opportunities to expand the use of road condition reporting systems to other agencies, especially law enforcement (which has time-critical data) and with local jurisdictions.

4. Integration of condition reporting systems with other existing state systems continues to be an issue. This not only influences the system's ability to widen its potential users, but also how data are exchanged, including ITS data automation.

5. Database housing, management, and maintenance must be examined prior to system implementation. There could be additional restriction if the database is housed at a state agency by its respective IT department.

6. Integration/coordination between/among neighboring states' condition reporting systems are key to ensure seamless service to the traveler. Of course this requires compatibility among the various systems and protocols for exchanging information. Related to this issue are national ITS standards and possible guidelines through the proposed federal requirements for incident reporting systems.

7. New federal requirements for developing real-time information and management systems were watched closely by the states. The final language in SAFETEA-LU requires the U.S. DOT to develop data exchange formats for these systems no later than August 2007. Additionally, areas developing or updating their regional ITS architectures must explicitly address real-time highway and transit information needs and the systems needed to meet such needs. This legislation should provide additional emphasis on multi-state and multi-agency integration and coordination.

8. North/West Passage states have not only been leaders in developing traveler information systems, but have also developed special projects designed to integrate and coordinate their information systems on a multi-state/multi-agency basis. This places them in a national lead position to implement new system standards, data entry improvements, and multi-state/multi-agency coordination projects

Conclusion

The North/West Corridor Pooled Fund Study states are well positioned to provide a positive example of how states can work together in streamlining road and weather condition data across their borders. These states recognized the value of coordination and integration long before the passage of SAFETEA-LU and its provisions for real-time system management. They have developed and implemented projects specifically focused on solving problems of data collection, data entry, and multi-state/multi-agency sharing of resources. Further, the output of the strategic plan and corridor architecture to be undertaken in Phase II of the North/West Passage should provide valuable insights to the U.S. DOT and other states.

References

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2. U.S. House of Representatives web page (http://www.house.gov/rules/109textTEALU.htm)

3. Federal Highway Administration, *Evaluation Plan: The I-40 Traveler and Tourist Information System Field Operational Test*, Report # FHWA-JPO-99-028, ITS Joint Program Office, FHWA, U.S. Department of Transportation, 1998

4. Federal Highway Administration, *Interim Analysis Report Model Deployment of a Regional, Multi-Modal 511 Traveler Information System*, ITS Joint Program Office, U.S. Department of Transportation, 2004

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6. CARS program web site: http://www.carsprogram.org/public/overview.htm

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8. South Dakota Department of Transportation, *Improved Road Condition Reporting*, Report # SD2001-15-F, 2004

9. Interview and questionnaire, Mark Owens, Meridian Environmental Technologies, 2004

10. Interview with Ed Ryen, NDDOT, 2005

11. North/West Passage Transportation Pooled Fund Study, *Deploy Limited CARS Study Application in Wisconsin: Project Recap and Lessons Learned*, Phase I Project 1.2, 2005

Appendix I
Phase II Work Plan
North/West Passage Transportation Pooled Fund Study

North/West Passage
Transportation Pooled Fund Study

Phase II Work Plan

December 13, 2004

North/West Passage Transportation Pooled Fund Study
Phase II Work Plan

Phase II Projects – ITS Integrated Corridor Strategic Planning Including Development of Traveler Information and Maintenance Network

Purpose

The purpose of Phase II of the North/West Passage Transportation Pooled Fund (TPF) Study Projects is to develop a North/West Passage ITS Integrated Corridor Strategic Plan while continuing to develop, expand implementation, and evaluate integrated traveler information systems. This work will include coordinated maintenance operations across state borders and the development of safety improvement systems. The plan will focus on center-to-center opportunities and include a high-level architecture for the corridor, an inventory of communication coverage, and a coordinated deployment/operations concept for traveler information systems. Suggested projects for the corridor to pursue will be identified.

The long-term vision of the North/West Passage Corridor states (Washington, Idaho, Montana, North Dakota, South Dakota, Minnesota, Wyoming, and Wisconsin) is to influence ongoing standards development; operate database systems that can transmit and receive multiple data streams; and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders.

Based on funding commitments from North Dakota, Wisconsin, and Minnesota, the initial geographic focus of Phase I was I-94 through Wisconsin, Minnesota, and North Dakota. Phase II projects will expand on this initial geographic area as additional states commit funding.

Status

Currently the North/West Passage states contain numerous systems for collecting, processing, integrating, and delivering transportation data to users. While the information is valuable to users, it is difficult to determine which system can provide the needed information and how accurate and timely the information is. All the states involved have worked on various elements of an integrated traveler information network and have had significant success. However, due to a variety of issues, the current traveler information systems are only beginning to be integrated across state borders. Phase I projects are currently underway along I-94 and are expected to demonstrate capabilities to integrate traveler information systems across state borders.

Strategy

By coordinating efforts to develop an integrated traveler information and maintenance operations network, the North/West Passage states will influence ongoing standards development; operate data base systems that can transmit and receive multiple data streams; and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders. When completed, the systems should appear seamless to users and maintenance operations. This system will benefit users in all connected states by supplying timely and accurate traveler information.

In some Phase I Projects that involved significant construction or equipment purchases, the North/West Passage TPF Study served as project initiator. This concept of project initiation was a

success in Phase I and will continue during Phase II where appropriate and when funding is available.

In Phase II, the participants will focus on integrated corridor strategic planning for the development of the traveler information and maintenance network. And when funding is available continue development of a series of independent, but closely related projects. These projects will build on the success of the Phase I program that focused on integrated traveler information systems and coordinated maintenance operations. One project suggestion from Phase I – Develop Automated Road Condition Reporting System (previously titled 1.3) has been carried forward to Phase II.

Phase II Projects

North/West Passage members submitted project ideas and then voted on projects to pursue for Phase II. The following lists the ranking of as agreed by the membership. It was agreed that the initial focus of Phase II would be Project 2.1.

2.1 North/West Passage ITS Integrated Corridor Strategic Plan
- *Corridor ITS Strategic Plan*
- *Corridor High Level Architecture*
- *Integrated Traveler Information Systems Coordinated Deployment Concept*
- *Corridor Communication Coverage Inventory and Alternatives*

2.2 Coordinated Guidelines for Rural DMS Operations and Messages along the Corridor

2.3 Automated Road Condition Reporting System

2.4 North/West Passage Road Weather Info/Net

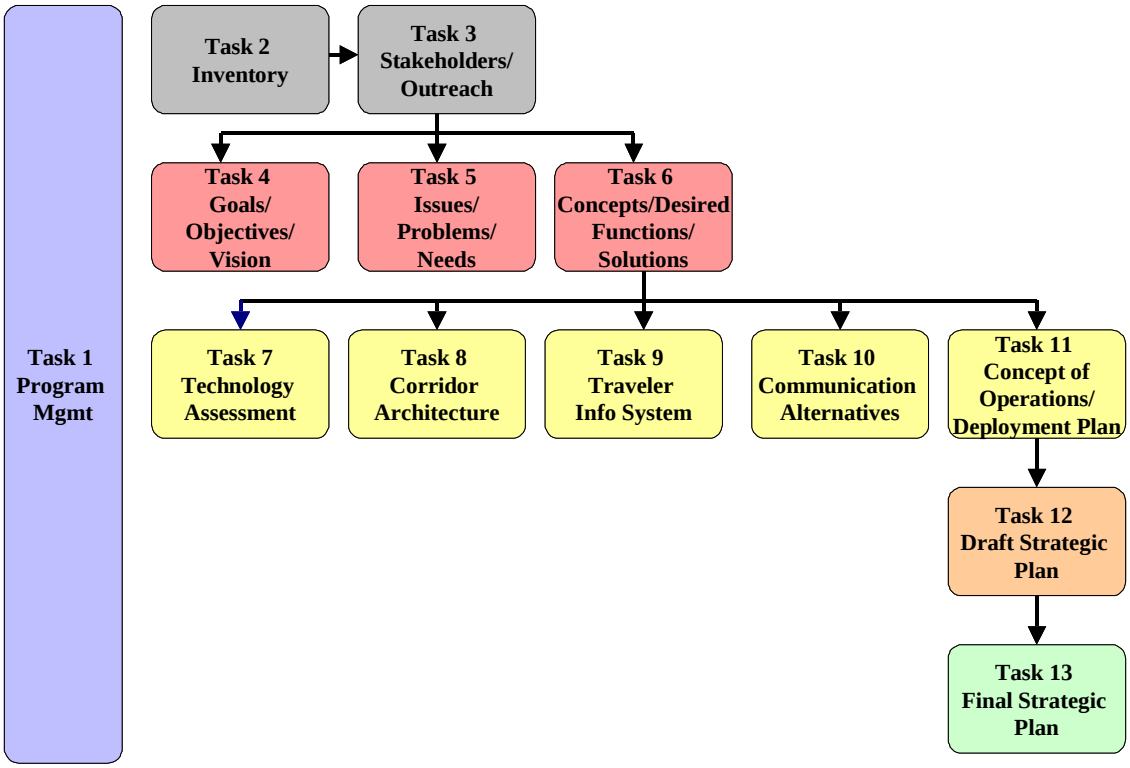
2.5 North/West Passage Coordination and Partnership with the FHWA Clarus Initiative

2.6 Automated Gate System Demonstration

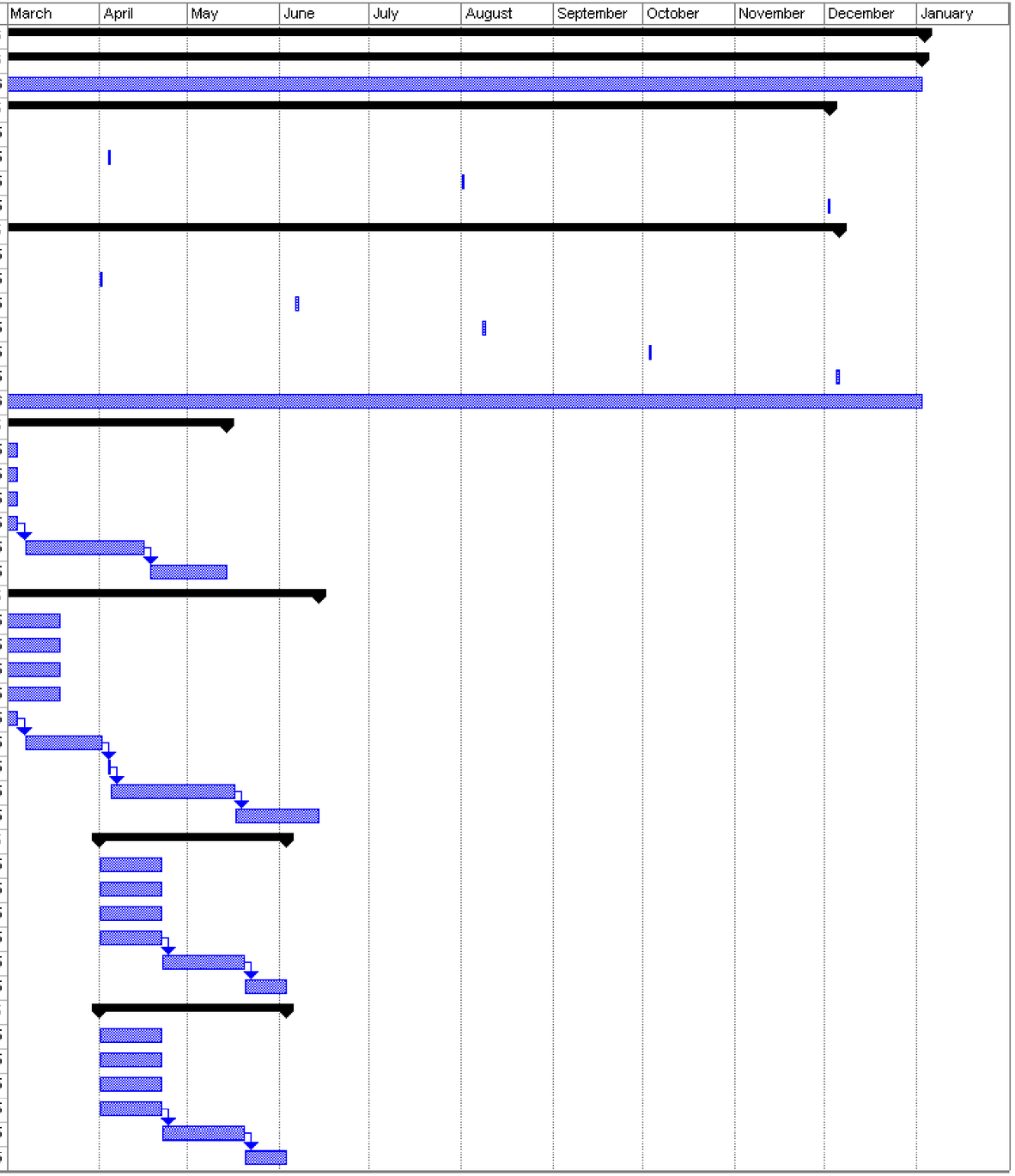
The group agreed website maintenance is necessary to continue communication internally and externally and should continue to be funded through Phase II, but not listed as a project.

Details of projects 2.1 – 2.6 are included on the following pages.

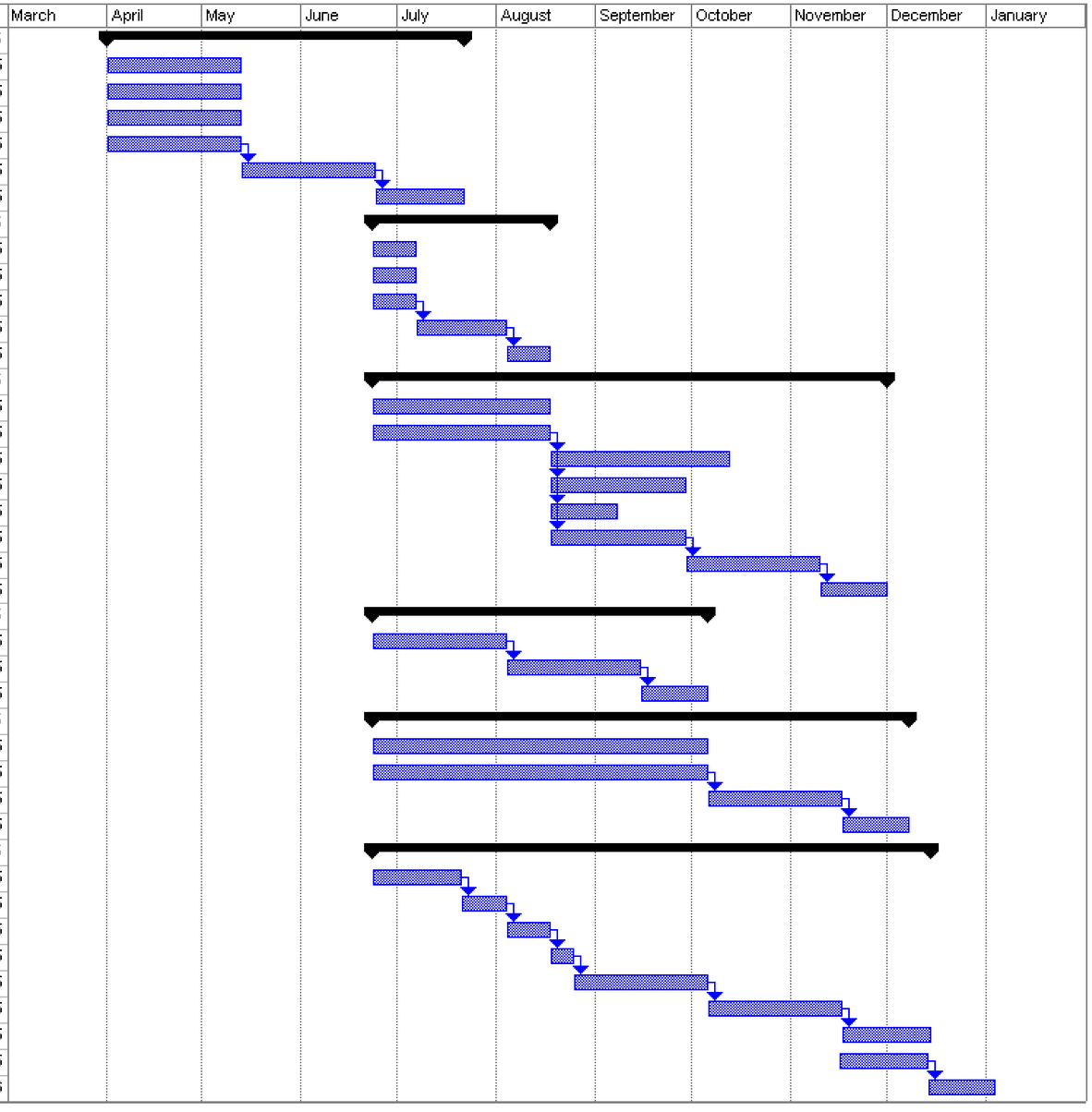
Project Title	**2.1 North/West Passage ITS Integrated Corridor Strategic Plan**
Project Champion	To be determined
Project Objective	To develop an expanded ITS Integrated Corridor Strategic Plan for the North/West Passage Corridor. Development of the ITS Corridor Strategic Plan will help the states to coordinate integrated corridor efforts between state borders and identify future projects to pursue within the North/West Passage Corridor. The plan will focus on center-to-center opportunities and include a high-level architecture for the corridor, an inventory of communication coverage, and a coordinated deployment/concept of operations for traveler information. Suggested projects for the corridor to pursue will be identified.
Current Status	North/West Passage Phase I successfully pursued early deployment of several ITS projects to improve traveler information under the strategic context of the corridor. However, there is a need to develop a solid, corridor wide strategy for planning, programming and development of future integrated corridor projects. North/West Passage states have developed or are developing statewide strategic plans, statewide architectures, state specific traveler information systems, and state specific communication coverage issues. However, the states along the corridor see a need to develop a corridor-wide strategic plan with a high-level architecture, coordinated traveler information system, and an inventory of communication issues for the I-90 and I-94 corridor from Washington to Wisconsin.
Suggested Approach	Following is a suggested approach for developing a North/West Passage Corridor ITS Strategic Plan: § Identify stakeholders to work with to develop an inventory (existing, planned, future) of communication coverage, ITS components, traveler information systems, and architecture for each state and corridor-wide. § Conduct surveys to identify communication coverage, architectures, and existing ITS components. Hold a workshop with identified stakeholders to discuss goals/objectives/vision, issues/problems/needs, and concepts/potential solutions/desired functions for communication coverage, ITS components, traveler information systems, and architectures for the corridor. § Based on the above information gathered from the stakeholders, and working with representatives of each state to develop a corridor architecture, a coordinated deployment concept for traveler information, communication alternatives, and a concept of operations/deployment plan will be created for inclusion in the overall strategic plan. § Special emphasis will be placed on identifying projects that fit within the scope of the North/West Passage charter and that would enhance each states' ability to share information or integrate systems across borders.
Geographic Focus	The geographic focus for Phase II will be the I-90 and I-94 Corridor from Washington to Wisconsin. Additional emphasis within the Strategic Plan will be placed on those states contributing financially to Phase II.
End Users	North/West Passage States - particularly for the planning, coordination, development and operation of integrated programs and projects between the states.
Suggested Outreach	Outreach and education will occur with the identifying of stakeholders and conducting surveys, interviews, and workshops. Progress of the project will also be available on the North/West Passage website (http://www.nwpassage.info).

Benefits	The development of an ITS Corridor Strategic Plan will help the affected states in planning and integration of projects and programs along the corridor. Special emphasis will be placed on providing states with suggested projects for the North/West Passage corridor states to pursue.		
Milestones and Schedule	**Milestone**		**Schedule 1 year**
	1	Project Management, Administration, and Coordination	On-going
	2	Inventory (Exiting/Planned/Future)	Month 1
	3	Identify Stakeholders/Outreach	Month 1
	4	Goals/Objectives/Vision	Month 4
	5	Issues/Problems/Needs	Month 4
	6	Concepts/Potential Solutions/Desired Functions	Month 4
	7	Technology Assessment	Month 6
	8	Corridor Architecture	Month 6
	9	Traveler Information System/511 Assessment/Integration	Month 6
	10	Communication Alternatives	Month 6
	11	Deployment/Concept of Operations Plan	Month 6
	12	Draft Strategic Plan	Month 11
	13	Final Strategic Plan	Month 12
Plan Process	The following figure outlines the Strategic Plan process of the 13 major milestones listed above. 		
Major Task Details and Timeline	The following table indicates the 13 major milestones and details of each task along with graphically depicting the timeline for completing each task.		

ID	Task Name	Duration	Start	Finish
1	**Strategic Plan**	**262 days**	**Mon 1/3/05**	**Tue 1/3/06**
2	**Task 1 Project Management, Administration, and Coordination**	**261 days**	**Mon 1/3/05**	**Mon 1/2/06**
3	Program Management	261 days	Mon 1/3/05	Mon 1/2/06
4	**Strategic Plan Meetings (4)**	**240 days**	**Mon 1/3/05**	**Fri 12/2/05**
5	Strategic Plan Meeting 1	1 day	Mon 1/3/05	Mon 1/3/05
6	Strategic Plan Meeting 2	1 day	Mon 4/4/05	Mon 4/4/05
7	Strategic Plan Meeting 3	1 day	Mon 8/1/05	Mon 8/1/05
8	Strategic Plan Meeting 4	1 day	Fri 12/2/05	Fri 12/2/05
9	**Technical Meetings (6)**	**220 days**	**Tue 2/1/05**	**Mon 12/5/05**
10	Technical Meeting 1	1 day	Tue 2/1/05	Tue 2/1/05
11	Technical Meeting 2	1 day	Fri 4/1/05	Fri 4/1/05
12	Technical Meeting 3	1 day	Mon 6/6/05	Mon 6/6/05
13	Technical Meeting 4	1 day	Mon 8/8/05	Mon 8/8/05
14	Technical Meeting 5	1 day	Mon 10/3/05	Mon 10/3/05
15	Technical Meeting 6	1 day	Mon 12/5/05	Mon 12/5/05
16	Document Development	261 days	Mon 1/3/05	Mon 1/2/06
17	**Task 2 Inventory (Existing/Planned/Future)**	**90 days**	**Mon 1/10/05**	**Fri 5/13/05**
18	ITS Components	40 days	Mon 1/10/05	Fri 3/4/05
19	Traveler Information Systems	40 days	Mon 1/10/05	Fri 3/4/05
20	Communication Coverage	40 days	Mon 1/10/05	Fri 3/4/05
21	Architecture	40 days	Mon 1/10/05	Fri 3/4/05
22	Draft Inventory Chapter	30 days	Mon 3/7/05	Fri 4/15/05
23	Final Inventory Chapter	20 days	Mon 4/18/05	Fri 5/13/05
24	**Task 3 Identify Stakeholders/Outreach**	**101 days**	**Mon 1/24/05**	**Mon 6/13/05**
25	ITS Components	40 days	Mon 1/24/05	Fri 3/18/05
26	Traveler Information Systems	40 days	Mon 1/24/05	Fri 3/18/05
27	Communication Coverage	40 days	Mon 1/24/05	Fri 3/18/05
28	Architecture	40 days	Mon 1/24/05	Fri 3/18/05
29	Stakeholder Surveys	20 days	Mon 2/7/05	Fri 3/4/05
30	Stakeholder Interviews	20 days	Mon 3/7/05	Fri 4/1/05
31	Stakeholder Workshop	1 day	Mon 4/4/05	Mon 4/4/05
32	Draft Stakeholder/Outreach Chapter	30 days	Tue 4/5/05	Mon 5/16/05
33	Final Stakeholder/Outreach Chapter	20 days	Tue 5/17/05	Mon 6/13/05
34	**Task 4 Goals/Objectives/Vision**	**45 days**	**Fri 4/1/05**	**Thu 6/2/05**
35	ITS Components	15 days	Fri 4/1/05	Thu 4/21/05
36	Traveler Information Systems	15 days	Fri 4/1/05	Thu 4/21/05
37	Communication Coverage	15 days	Fri 4/1/05	Thu 4/21/05
38	Architecture	15 days	Fri 4/1/05	Thu 4/21/05
39	Draft Goals/Objectives/Vision Chapter	20 days	Fri 4/22/05	Thu 5/19/05
40	Final Goals/Objectives/Vision Chapter	10 days	Fri 5/20/05	Thu 6/2/05
41	**Task 5 Issues/Problems/Needs**	**45 days**	**Fri 4/1/05**	**Thu 6/2/05**
42	ITS Components	15 days	Fri 4/1/05	Thu 4/21/05
43	Traveler Information Systems	15 days	Fri 4/1/05	Thu 4/21/05
44	Communication Coverage	15 days	Fri 4/1/05	Thu 4/21/05
45	Architecture	15 days	Fri 4/1/05	Thu 4/21/05
46	Draft Issues/Problems/Needs Chapter	20 days	Fri 4/22/05	Thu 5/19/05
47	Final Issues/Problems/Needs Chapter	10 days	Fri 5/20/05	Thu 6/2/05



ID	Task Name	Duration	Start	Finish
48	**Task 6 Concepts/Potential Solutions/Desired Functions**	**80 days**	**Fri 4/1/05**	**Thu 7/21/05**
49	ITS Components	30 days	Fri 4/1/05	Thu 5/12/05
50	Traveler Information Systems	30 days	Fri 4/1/05	Thu 5/12/05
51	Communication Coverage	30 days	Fri 4/1/05	Thu 5/12/05
52	Architecture	30 days	Fri 4/1/05	Thu 5/12/05
53	Draft Concepts/Potential Solutions/Desired Functions Chapter	30 days	Fri 5/13/05	Thu 6/23/05
54	Final Concepts/Potential Solutions/Desired Functions Chapter	20 days	Fri 6/24/05	Thu 7/21/05
55	**Task 7 Technology Assessment**	**40 days**	**Thu 6/23/05**	**Wed 8/17/05**
56	ITS Components	10 days	Thu 6/23/05	Wed 7/6/05
57	Traveler Information Systems	10 days	Thu 6/23/05	Wed 7/6/05
58	Communication Coverage	10 days	Thu 6/23/05	Wed 7/6/05
59	Draft Technology Assessment Chapter	20 days	Thu 7/7/05	Wed 8/3/05
60	Final Technology Assessment Chapter	10 days	Thu 8/4/05	Wed 8/17/05
61	**Task 8 Corridor Architecture**	**115 days**	**Thu 6/23/05**	**Wed 11/30/05**
62	Operational Concept	40 days	Thu 6/23/05	Wed 8/17/05
63	Define Functional Requirements and Interfaces	40 days	Thu 6/23/05	Wed 8/17/05
64	Implementation Plan	40 days	Thu 8/18/05	Wed 10/12/05
65	Agency Agreements	30 days	Thu 8/18/05	Wed 9/28/05
66	ITS Standards	15 days	Thu 8/18/05	Wed 9/7/05
67	Architecture Maintenance Plan	30 days	Thu 8/18/05	Wed 9/28/05
68	Draft Corridor Architecture Report	30 days	Thu 9/29/05	Wed 11/9/05
69	Final Corridor Architecture Report	15 days	Thu 11/10/05	Wed 11/30/05
70	**Task 9 Traveler Information System/511 Assessment/Integration**	**75 days**	**Thu 6/23/05**	**Wed 10/5/05**
71	TIS/511Assessment/Integration Conceptual Design	30 days	Thu 6/23/05	Wed 8/3/05
72	Draft TIS/511 Assessment/Integration Chapter	30 days	Thu 8/4/05	Wed 9/14/05
73	Final TIS/511 Assessment/Integration Chapter	15 days	Thu 9/15/05	Wed 10/5/05
74	**Task 10 Communication Alternatives**	**120 days**	**Thu 6/23/05**	**Wed 12/7/05**
75	Corridor Graphical Information Database	75 days	Thu 6/23/05	Wed 10/5/05
76	Corridor ITS Communications Conceptual Design	75 days	Thu 6/23/05	Wed 10/5/05
77	Draft Communications Alternatives Chapter	30 days	Thu 10/6/05	Wed 11/16/05
78	Final Communications Alternatives Chapter	15 days	Thu 11/17/05	Wed 12/7/05
79	**Task 11 Deployment/Concept of Operations Plan**	**125 days**	**Thu 6/23/05**	**Wed 12/14/05**
80	Priority Project Descriptions	20 days	Thu 6/23/05	Wed 7/20/05
81	Cost Estimates	10 days	Thu 7/21/05	Wed 8/3/05
82	Operation and Maintenance Impacts	10 days	Thu 8/4/05	Wed 8/17/05
83	Schedule for Deployment	5 days	Thu 8/18/05	Wed 8/24/05
84	Concept of Operations	30 days	Thu 8/25/05	Wed 10/5/05
85	Draft Deployment/Concept of Operations Plan Chapter	30 days	Thu 10/6/05	Wed 11/16/05
86	Final Deployment/Concept of Operations Plan Chapter	20 days	Thu 11/17/05	Wed 12/14/05
87	**Task 12 Draft Strategic Plan**	20 days	Wed 11/16/05	Tue 12/13/05
88	**Task 13 Final Strategic Plan**	15 days	Wed 12/14/05	Tue 1/3/06



Project Cost	The project cost for completing a Corridor ITS Strategic Plan is to be determined. The following descriptions identify each milestone as identified in the above timeline. **Task 1** **Program Management, Administration and Coordination** Program Management Strategic Plan Meetings Technical Meetings Document Development **Task 2** **Inventory (Existing/Planned/Future)** ITS Components Traveler Information Systems Communication Coverage Architecture Draft Inventory Chapter Final Inventory Chapter **Task 3** **Identify Stakeholders/Outreach** ITS Components Traveler Information Systems Communication Coverage Architecture Stakeholder Surveys Stakeholder Interviews Stakeholder Workshops Draft Stakeholders/Outreach Chapter Final Stakeholders/Outreach Chapter **Task 4** **Goals/Objectives/Vision** ITS Components Traveler Information Systems Communication Coverage Architecture Draft Goals/Objectives/Vision Chapter Final Goals/Objectives/Vision Chapter

Task 5
Issues/Problems/Needs

ITS Systems
Traveler Information Systems
Communication Coverage
Architecture
Draft Issues/Problems/Needs Chapter
Final Issues/Problems/Needs Chapter

Task 6
Concepts/Potential Solutions/Desired Functions

ITS Components
Traveler Information Systems
Communication Coverage
Architecture
Draft Concepts/Solutions/Functions Chapter
Final Concepts/Solutions/Functions Chapter

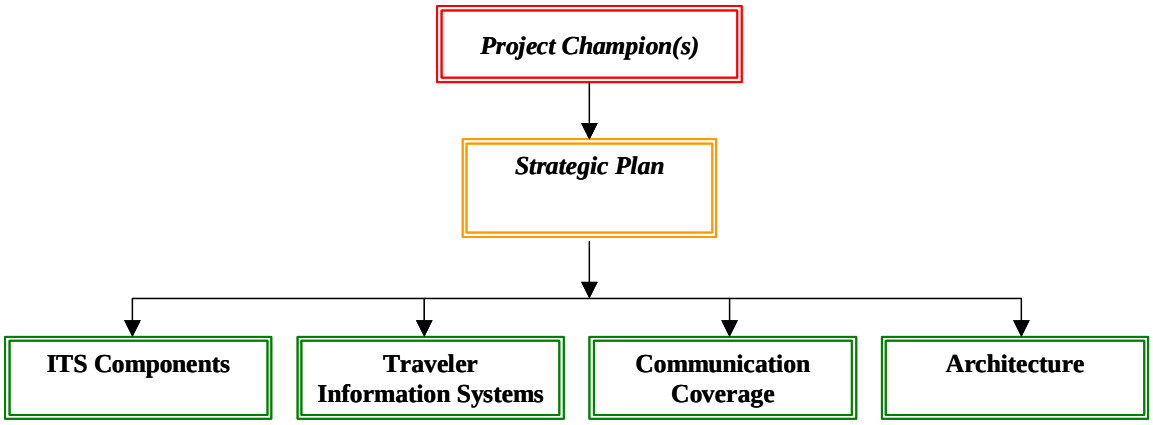
Task 7
Technology Assessment

ITS Components
Traveler Information Systems
Communication Coverage
Draft Technology Assessment Chapter
Final Technology Assessment Chapter

Task 8
Corridor Architecture

Operational Concept
Define Functional Requirements and Interfaces
Implementation Plan
ITS Standards
Architecture Maintenance Plan
Draft Corridor Architecture Chapter
Final Corridor Architecture Chapter

	Task 9 **TIS/511 Assessment/Integration** TIS/511 Assessment/Integration Conceptual Design Draft TIS/511 Assessment/Integration Chapter Final TIS/511 Assessment/Integration Chapter **Task 10** **Communication Alternatives** Corridor Graphical Information Database Corridor ITS Communications Conceptual Design Draft Communication Alternatives Chapter Final Communication Alternatives Chapter **Task 11** **Deployment Plan/Concept of Operations Plan** Priority Project Descriptions Cost Estimates Operation and Maintenance Impacts Schedule for Deployment Concept of Operations Draft Deployment/Concept of Operations Plan Chapter Final Deployment/Concept of Operations Plan Chapter **Task 12** **Draft Strategic Plan** **Task 13** **Final Strategic Plan**
Participants	To be Determined

Organizational Chart	Project 2.1 Organization 
Project Idea Contact Information	North/West Passage Steering Committee
Other Information	North/West Passage Steering Committee members voted on projects to pursue with Phase II funding in October 2004 and agreed to synthesis the top four ranked projects into one project. This project includes the top four ranked projects (Corridor ITS Strategic Plan, Corridor High Level Architecture, Integrated Traveler Information Systems Coordinated Deployment Concept, and Corridor Communication Inventory and Alternatives).

Project Title	**2.2 Coordinated Guidelines for Rural DMS Operations and Messages along the Corridor**
Project Champion	To be determined
Project Purpose/ Objective	To expand on the meetings held in South Dakota pertaining to DMS Operations and Messages. The purpose of this project is to cooperatively develop a recommended set of sign usage guidelines along with specific messages for display to be used on rural DMS along the North/West Passage corridor. Each state could use these recommendations as systems and operations plans are developed. Also, the operations and message sets could be utilized in developing appropriate guidelines for the Manual On Uniform Traffic Control Devices (MUTCD). Coordinate with the High Plains ITS Coalition.
Current Status	South Dakota DOT has sponsored several meetings on DMS operations and messages. However, there is not enough time or resources available to actually develop a proposed set of DMS operations and messages. The project would need to be coordinated with any efforts currently underway to expand or develop DMS operations and message sets for the MUTCD. It is anticipated that other efforts, yet to be determined, are also underway to accomplish the same goal. North Dakota State University-ATAC is developing software that could be used in this project. The High Plains ITS Coalition has developed a Pooled Fund Program in this area.
Suggested Strategy/ Approach	Bring together appropriate staff from all interested states to first determine existing standards, how they are applied, who is working on guidelines for MUTCD, along with any other similar efforts. Step one would be to determine the appropriateness of this project, develop a concept for moving forward, and to hold a series of meetings to develop proposed guidelines. Once a draft set of guidelines were developed, a seminar, or series of seminars would be held to further refine the guidelines and inform others of the proposed guidelines. Finally, the participants would work towards adoption of these guidelines in the MUTCD.
End Users	To be determined
Suggested Outreach and Distribution Plan	High Plains Coalition ITS Coalition
Benefits	States would have an agreed upon set of guidelines for operation and messages on DMS. Travelers along the corridor would receive uniform DMS operations and messages.
Participants	All interested North/West Passage state maintenance, traffic, operations, and law enforcement staff.
Major Milestones and Schedule	Milestone: 1 — To be determined; Schedule: TBD
Project Cost	To be determined
Project Idea Contact Information	North/West Passage Steering Committee
Other Information	Visit: http://www.pooledfund.org/ for further information on the High Plains Coalition

Project Title	**2.3 Automated Road Condition Reporting System**		
Project Champion	Minnesota DOT, Mark Nelson		
Project Purpose/ Objective	To develop, test, and evaluate automated road condition reporting that will reduce the need to manually enter situations in statewide reporting systems.		
Current Status	Currently, 511 traveler information for North Dakota is manually entered into UND/ Meridian #SAFE System and Minnesota road condition data is manually entered into Condition Acquisition Reporting System (CARS). Wisconsin is in the beginning stages of planning for a statewide 511 system, which has not been deployed. Unfortunately, the time when the data is needed most by 511 travelers and users is the time when staff members are busiest with management operations. A separate project through FHWA is addressing some of these needs as part of the Maintenance Decision and Support System (MDSS) project.		
Suggested Strategy/ Approach	The approach will work with and support the MDSS project in developing an approach to automated road condition reporting. The results will be an improved traveler information system. Vendors will develop parameters for generating applicable good/fair/difficult road condition situations based on the weather forecasts. Testing for the reliability, accuracy, and timeliness of automated road condition reporting will also be undertaken. The automated reports should allow for override of reports manually entered by staff in each state.		
End Users	To be determined		
Suggested Outreach and Distribution Plan	To be determined		
Benefits	This project will provide an operational test of automatically generated road condition reports. Automating the reports will save staff time during their busiest operational period, improve accuracy, and reduce delays on making the information available to travelers.		
Participants	North Dakota DOT, Minnesota DOT, Wisconsin DOT, University of North Dakota, and Vendors		
Major Milestones and Schedule		Milestone	Schedule
	1	Study alternatives and planning	TBD
	2	Define concept and develop preliminary parameters	TBD
	3	Preliminary testing of concept	TBD
	4	Develop first generation design for automated road condition reporting	TBD
	5	Operational testing	TBD
	6	Evaluation and assessment	TBD
Project Cost	To be determined		
Project Idea Contact Information	North/West Passage Steering Committee		
Other Information	This project was listed in Phase I Projects, but tabled at the July 29, 2003 Steering Committee meeting, due to the separate and ongoing Maintenance Decision and Support System (MDSS) project.		

Project Title	**2.4 North/West Passage Road Weather InfoNet**
Project Champion	To be determined
Project Purpose/ Objective	To inventory existing road weather data sources and develop a conceptual InfoNet. This InfoNet would streamline currently available road weather data from various DOTs' RWIS sites, National Weather Service, MesoWest, Bureau of Land Management, USDA Forest Service, Dept. of Water Resources, Dept. of Agriculture, and other sources available in the North/West Passage (I-90 & I-94 from Washington to Wisconsin) into one single gateway in a manner that is easily accessible by incident responders and the traveling public. The DOTs and other authorized users will be able to customize their user interface, which will map display a compilation of road weather information to meet their needs.
Current Status	Currently, a variety of agencies operate weather stations of their own and there is a great lack of data integration and interagency collaboration. The information must be accessed through separate sources (DOT, Agriculture, BLM, Forest Service, etc.), making it inefficient and time-consuming to assess road and weather conditions in the region. In addition, the user interfaces are not designed to meet the specific needs of information users. The use of road weather data has not yet reached its full potential, leaving room for improvement in integrating existing data from various sources and enabling easier access to the information.
Suggested Strategy/ Approach	The proposed research will take a phased approach. Phase I: A vision will be developed for the NWP Road Weather InfoNet system, an outreach plan will be developed, and the key players/stakeholders will be identified and meet to draft a Concept of Operations and a Risk Management plan. In light of user service requirements defined in the National ITS Architecture, high-level system requirements will identified as a starting point. Through focus groups, site visits, interviews, and brainstorming workshops, a list of preliminary system requirements will be gathered from the end users. Phase II: A prototype application with basic functionality will be developed, tested, and deployed in order to further identify future functionality of the final system for delivery. A questionnaire along with a simple user guide for the prototype application will be sent to the end users to gather/rank the system requirements. Then, the stakeholders and the research team will meet together to walk through the documented system requirements. The desired requirements will be compared against available budget, and the project oversight committee will work with the research team to select the requirements that should be included. The Concept of Operations will be updated and the list of system requirements will be finalized. Phase III: The final system will be developed by upgrading the original prototype application. First, the list of system requirements will be translated into a high-level definition of functions and then detailed design. Then, the design will be implemented in terms of software modules (data interfaces, data processing, user authentication, user interfaces, etc.), which will then be tested and integrated. Concurrently, a facilities study will be conducted to identify which agency is going to administer and maintain the final system and an Operations and Maintenance plan will be prepared by the research team. After system acceptance, the final system will be deployed at the identified agency. Phase IV: In the final months of the project after installation of the final system, the

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<tr><td></td><td colspan="3">evaluation will be conducted for the final system. It will involve working with end users to determine the success of the final system, determine if it succeeds in meeting the goals and objectives of the project, identify the lessons learned through the project, identifying additional steps, etc.</td></tr>
<tr><td>End Users</td><td colspan="3">All NWP Coalition states, transportation system users in the I-90 and 94 Corridor states, commercial vehicles and system operators.</td></tr>
<tr><td>Suggested Outreach and Distribution Plan</td><td colspan="3">An outreach plan will be developed in the Phase one of this project. Key stakeholder groups will identified and their roles and responsibilities will be documented in the Concept of Operations. If necessary, a business plan will be developed for the NWP Coalition to implement additional steps and to build on the success of this project.</td></tr>
<tr><td>Benefits</td><td colspan="3">The NWP Road Weather InfoNet system will allow users to view a compilation of all available road and weather data from numerous sources, greatly increasing the efficiency of situation assessments for a variety of purposes, including incident management, maintenance and snow removal, homeland security applications, emergency medical services, and general public traveler information. Variations of the user interface will depend on the needs of the different types of users.</td></tr>
<tr><td>Participants</td><td colspan="3">Washington State, Montana, Idaho, Wyoming, North Dakota, South Dakota, Minnesota and Wisconsin DOTs and Tourism Agencies, FHWA, Universities and other stakeholders</td></tr>
<tr><td rowspan="5">Major Milestones and Schedule</td><td colspan="2">Milestone</td><td>Schedule</td></tr>
<tr><td>1</td><td>Finish Phase One: Draft Concept of Operations and preliminary system requirements etc.</td><td>Month 1-9</td></tr>
<tr><td>2</td><td>Finish Phase Two: Install the prototype application and finalize the system requirements</td><td>Month 10-18</td></tr>
<tr><td>3</td><td>Finish Phase Three: Install the final system</td><td>Month 19 - 36</td></tr>
<tr><td>4</td><td>Finish Phase Four: Submit the evaluation report</td><td>Month 37 - 48</td></tr>
<tr><td>Project Cost</td><td colspan="3">To be determined</td></tr>
<tr><td>Project Idea Contact Information</td><td colspan="3">Xianming Shi, Ph.D., Research Scientist
and Steve Albert, Director
Western Transportation Institute (WTI)
Montana State University
P.O. Box 174250, Bozeman, MT 59717-4250
Phone: (406) 994-6114 ; Fax: (406) 994-1697</td></tr>
<tr><td>Other Information</td><td colspan="3">The researchers at WTI are leading a research project entitled WeatherShare to streamline currently available road weather data from Caltrans RWIS, California Dept. of Water Resources, National Weather Service, and other sources available in the Redding area into one accessible source in a manner that is easily accessible by incident responders and potentially the traveling public. Systems engineering methodologies are utilized to gather system requirements from the end users and to ensure that the system is built to work and to meet the user needs.</td></tr>
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Project Title	**2.5 North/West Passage Coordination and Partnership With the FHWA Clarus Initiative**
Project Champion	To be determined
Project Purpose/ Objective	To develop a partnership with the Clarus initiative to coordinate efforts, leverage and share resources and to use the North/West Passage as the Clarus regional corridor for tests, demonstrations and model deployment.
Current Status	The FHWA is funding the Clarus project as one of 9 ITS initiatives. The goal is to demonstrate regional surface transportation observing, forecasting and data management systems, and to establish a partnership to create a Nationwide Surface Transportation Weather Observation System. The objective of Clarus is to reduce the impact of adverse weather for all road and transit users and operators. The project proposes to: • Develop partnerships between transportation and weather communities • Strengthen ties among federal agencies with similar objectives for example FHWA & NOAA • Demonstrate a framework to collect weather and road conditions for advanced weather models as the basis for value-added products contributing to a safer more efficient system. • Establish an instrumented corridor test bed to host new cutting edge technologies for fixed, mobile and remote sensing • Establish a Clarus Interagency Coordination Committee. (Clarus ICC) to guide development. One of the proposed project milestones is demonstration; implement regional multi-state data collection systems with real-time quality control functionality, feedback to State DOT engineers and the creation of an Internet data portal where both current and archived data can be retrieved. Another milestone in Research; provide instrumented corridors to promote and test cutting edge observational technologies from fixed, mobile, and remote sensors.
Suggested Strategy/ Approach	The FHWA has developed a Clarus Roadmap that includes four tracks: 1) Stakeholder Coordination – thru FY09 2) System Design – thru FY 06 3) Multi-State Regional Demonstrations – FY 06 thru FY 08 4) Final Design, Model Deployment – FY 08 thru FY 09 North/West Passage representatives will participate in future meetings on Clarus. Based on feedback from these and other meetings about the Clarus program to develop a proposed strategy for a Clarus – North/West Passage partnership. The partnership would coordinate efforts, leverage and share resources and potentially use the North/West Passage as the Clarus regional corridor for research, tests, demonstrations and model deployment. First step will be for North/West Passage members to participate in meetings including The Clarus ICC Meeting in Norman Okalahoma, September 2004. To participate in Clarus ICC meeting, the ICC and in Clarus Project Task Forces. Note: In developing this project we will need to be careful not to be use federal funds to influence a federal program
End Users	Transportation users and managers, 511, NOAA for forecasting
Suggested Outreach and Distribution	To be determined

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<tr><td>Plan</td><td colspan="3"></td></tr>
<tr><td>Benefits</td><td colspan="3">Clarus benefits are listed as a one-stop internet portal for all surface transportation weather related observations. Also real-time data for incorporation into value-added weather, traffic, and decision support systems</td></tr>
<tr><td>Participants</td><td colspan="3">North/West Passage members, FHWA- Clarus program managers, NOAA and contractors</td></tr>
<tr><td rowspan="5">Major Milestones and Schedule</td><td></td><td>Milestone</td><td>Schedule</td></tr>
<tr><td>1</td><td>Clarus ICC meeting Norman Okalahoma</td><td>9-23-04</td></tr>
<tr><td>2</td><td>Clarus Task Force meetings participation</td><td>Thru 2-05</td></tr>
<tr><td>3</td><td>Develop North/West Passage – Clarus partnership</td><td>2-05</td></tr>
<tr><td>4</td><td>Continued involvement in Stakeholder Coordination & Project Task Forces</td><td>Thru FY 09</td></tr>
<tr><td>Project Cost</td><td colspan="3">To be determined</td></tr>
<tr><td>Project Idea Contact Information</td><td colspan="3">Steve Albert, Western Transportation Institute.</td></tr>
<tr><td>Other Information</td><td colspan="3">CLARUS contact - Paul Pisano – FHWA Road Weather Management Program
Paul.pisano@fhwa.dot.gov or visit: http://www.ops.fhwa.dot.gov/weather</td></tr>
</table>

Project Title	**2.6 Automated Gate System Demonstration**	
Project Champion	To be determined	
Project Purpose/ Objective	To demonstrate the coordination of automated gate systems along the North/West Passage Corridor for development, placement, signing, and operation for future automated gate systems along the corridor.	
Current Status	South Dakota and Wyoming have developed and deployed automated gate systems for road closings. Each system is individually developed, signed, and operated. Other North/West Passage states that are beginning to develop these systems could benefit from communication and coordination of South Dakota and Wyoming's efforts and programs for automated gate systems and their operation.	
Suggested Strategy/ Approach	Start with an automated gate system seminar to discuss the current status of systems development, review operational policies and recommend future actions, including follow-up planning and program development meetings.	
End Users	Traffic engineers, maintenance staff, and state police agencies in the North/West Passage Corridor	
Suggested Outreach and Distribution Plan	Local and state police	
Benefits	Reduced cost of development	
Participants	Traffic Engineers, operations peoples, and police agencies in the North/West Passage Corridor	
Major Milestones and Schedule	Milestone	Schedule
	1 To be determined	TBD
Project Cost	To be determined	
Project Idea Contact Information		
Other Information		