

Final Concept of Operations



prepared by:



Kimley-Horn
of Michigan, Inc.

in association with:



HNTB

May 2010



Michigan Department of Transportation

I-75, US 127, I-94 Triangle ATIS Plan

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List of Acronyms

ADT	Average Daily Traffic
ATIS	Advance Traveler Information System
ATMS	Advance Traffic Management System
CAD	Computer-Aided Dispatch
CCTV	Closed-Circuit Television
ConOps	Concept of Operations
CRC	County Road Commission
DMS	Dynamic Message Signs
EOC	Emergency Operations Center
ESS	Environmental Sensor Stations
FCP	Freeway Courtesy Patrol
GPS	Global Positioning System
HAR	Highway Advisory Radio
ICM	Integrated Corridor Management
IDAS	ITS Deployment Analysis System
ITIP	Intelligent Transportation Infrastructure Program
ITS	Intelligent Transportation System
MDOT	Michigan Department of Transportation
MITSC	Michigan Intelligent Transportation System Center
MSP	Michigan State Police
MSU	Michigan State University
NWS	National Weather Service
PATH	Partners for Advanced Transit and Highways
PSAP	Public Safety Answering Points
PTR	Permanent Traffic Recorder
RCOC	Road Commission for Oakland County
RE	Resident Engineers
RFP	Request for Proposal
RWIS	Road Weather Information System

SE	Systems Engineering
SEMCOG	Southeastern Michigan Council of Governments
TMC	Transportation Management Center
TSC	Transportation Service Center
US DOT	United States Department of Transportation
VMS	Variable Message Signs

1 Introduction

Michigan serves as a vacation destination for many Michiganders and travelers throughout the nation. An array of festivals and recreational opportunities, and Michigan's simple natural beauty draws people to the State. It also has a great deal of international, interstate, and intrastate freight activity. This document identifies the Concept of Operations (ConOps), which will evaluate I-75, US 127, and I-94 on traffic conditions and incident issues. These three corridors make up the boundary of a triangle covering the eastern half of the Lower Peninsula. This area will be referred to as the Triangle Study Area in the remainder of the document. These corridors are major routes for weekend and seasonal traffic. The I-75 corridor provides the best option for travelers traveling to Michigan's northern part of the Lower Peninsula from areas such as Detroit, Flint, and Saginaw.

The I-75 corridor provides sufficient capacity even during moderate incidents and limited adverse weather conditions. However major incidents, construction activities, or adverse weather events occurring during the week or on weekends can cripple the facility and cause major breakdowns in services along the I-75 corridor as well as US 127, a parallel route from Lansing. Due to the length of trips and the percentage of recreational travelers, a comprehensive Advance Traveler Information System (ATIS) deployment is recommended to improve information sharing and traffic management tools for the Triangle Study Area. The ConOps document, along with the High Level Design document will aid the Michigan Department of Transportation (MDOT) in identifying key locations, operational needs, and project identification for implementation of ATIS within the Triangle Study Area.

1.1 Purpose

The purpose of the ConOps is to describes the "what" and the "why" of ATIS solutions, and the "who" will be benefiting from and affecting the ATIS solutions for the Triangle Study Area in the MDOT Metro, Bay, North, and University Regions. The ConOps provides an overview of the methodologies used for the analysis of the corridor practices. It also presents the research and development of approaches and strategies of ATIS solutions. . This document is intended to aid MDOT in identifying elements considered necessary for the establishment of a regional ATIS deployment for the defined Triangle Study Area. It is essentially a guide developed to address the stakeholders' identified needs and document the process in which the solutions were selected.

The development of a ConOps is a fundamental and important step in the Systems Engineering (SE) process. It is the earliest step in developing the project requirements. It identifies all of the stakeholders and their understanding of the project before the design commences. As shown in **Figure 1** the Systems Engineering "V" diagram suggests an interdisciplinary approach to developing systems. It employs a check and balance procedure, ensuring that what is ultimately deployed aligns with the project intent. The SE process is tailored to:

1. Focus on defining the stakeholders and the stakeholder needs;
2. Documenting requirements based on the defined needs; and

3. Proceeding forward with a design and system validation driven by these detailed requirements.

ConOps development follows the approach defined in the United States Department of Transportation (US DOT) Guidebook for Systems Engineering for Intelligent Transportation Systems, 2007. This project will incorporate regional architecture and concept exploration works completed through other projects and continue through a portion of the High-Level Design step as shown in **Figure 1**.

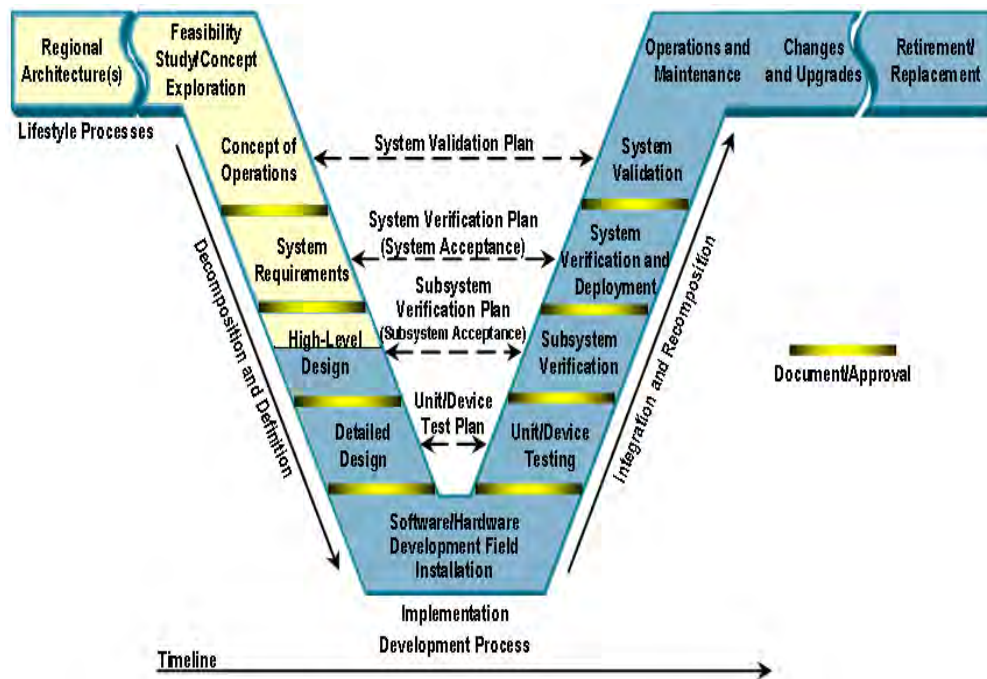


Figure 1. Triangle ATIS Steps of the SE Process

It is important for all stakeholders to review and ensure that the ConOps depicts a reasonable and comprehensive summary of their needs. The needs will be used to identify system requirements that eventually will guide design and implementation of the system.

The ConOps involves four major steps:

1. Identify the key roles associated with ATIS components – what they will and will not do.
2. Describe the environment in which the devices must be built and must operate.
3. Use operational scenarios to describe how the stakeholders should perform under different conditions. In these scenarios, consider all stages of the ATIS design, implementation, operations, and maintenance.
4. From study of the operational scenarios, identify high-level functional requirements for ATIS deployment.

1.2 Project Definition and Scope

Due to a limited ability to gather real-time travel conditions and to transmit those conditions to travelers at a point in their journey where it can affect their experience, the ability to optimize use of this capacity is restricted. Moreover, the lack of real time traffic information also limits the ability of transportation maintenance and operations staff to focus their resources on the best management of the corridor.

This combination of incident and special condition-based congestion with a network of high capacity alternate routes presents a situation extremely conducive to an ITS solution. The power of information will make for a more reliable travel experience for users of the Triangle Study Area. The information also will enhance the ability of MDOT, local transportation management agencies, public safety, and emergency responders to more effectively manage traffic and clear incidents on the entire network.

A key challenge will be how to deploy such a system in a manner that not only fits within MDOT's limited financial resources, but also allows management of the system across multiple lines of responsibilities and agencies. Preliminary research of newer technologies suggests that a non-infrastructure-based data collection and data dissemination method can substantially lower the cost of a comprehensive ITS solution for this corridor; especially, when compared to a traditional infrastructure-based solution.

Fortunately, this project is being studied in the context of several efforts upon which it can build. The MDOT-sponsored Regional ITS Architecture and Deployment Plan processes for the MDOT Southwest (including portions of University), Bay, and North regions as well as the Southeastern Michigan Council of Governments (SEMCOG) (including portions of University and Metro) have been completed. The issue of how to manage the I-75 corridor as well as other key facilities within the Triangle was expressed during the stakeholder outreach process of these plans, and several projects emerged to address them.

The I-75, US 127, and I-94 Triangle ATIS project was developed to identify ITS solutions that could be used to provide traveler information on alternate routes in order to reduce traffic congestion and traffic incidents along the specified corridors. The effort is lead by MDOT and spans over several MDOT regions, including the Metro, Bay, North, and University regions. The project will address several congestion and incident issues that occur along the corridors, especially during the weekends in the summer and winter months when tourism generally is higher. The intent of the project is to develop a high-level design to collect wide area real-time travel data and data dissemination solutions that effectively reach the traveler. Several corridors within the Triangle Study Area already use or plan to use several ATIS devices.

As mentioned previously, the Triangle Study Area forms a triangle in the eastern portion of Michigan's Lower Peninsula. It has vertices in Detroit, Grayling, and Jackson and is bounded by the major corridors of I-75, US 127, and I-94. Unlike many facilities, I-75 is surrounded by a number of viable alternate route options, many with significant capacity. US 127 serves as a primary alternate

route south of Grayling, where I-75 and US 127 diverge. I-94 is the southernmost east-west connector between I-75 and US 127. The Triangle Study Area also includes additional corridors, both Interstate and US routes. They will be examined as connectors for the major corridors and include I-69, I-96, I-275, I-696, US 10, and US 23. Other corridors that will be examined as possible alternates include I-475 in Flint and I-675 in Saginaw. The Triangle Study Area and the numerous internal corridors provide a comprehensive network that connects the eastern half of the Lower Peninsula. **Figure 2** displays the Triangle Study Area, including the major corridors and their connectors.

MDOT is trying to focus on technology that would provide travelers along the Triangle Study Area with trip information they can use to make more informed decisions about their route choices. The Triangle Study Area experiences heavy seasonal and weekend traffic that travels I-75, US 127 and I-94 each year, causing heavy delays and queuing. Pre-trip or real-time information would help the traveler plan alternate routes if congestion increases and trips can be delayed. The most significant issue is a reliable approach to the collection of real-time travel data over a wide area of non-urban roadways which is similar to the corridors in this Triangle Study Area.

The implementation of ATIS within the Triangle Study Area needs to focus on pre-trip traveler information, en-route traveler information, and traveler information dissemination technologies. As mentioned earlier, traveler information may either be static or dynamic (real time). Both will assist the user in making trip preparations and en-route decisions. As mentioned in the US DOT *Developing Traveler Information Systems Using the National ITS Architecture*, characteristics of this information are described as:

- Timely, Accurate, and Available – travel information needs to be current and received in a timely fashion in order to respond to it. The information needs to be correct regardless the type of information displayed. Also, the information needs to be available at any time.
- Cost Effective – Users are willing to pay for information as long as the cost is reasonable, the information will save time, and if it is relevant to the user.
- Provides Route and Decision Guidance – the information must be specific with certain details, such as location, times, and alternate routes.
- Easy to Access and Easy to Use – the user should be able to access the information in any form and from any location. It should be easy to use and easily accessible.
- Safety Implications – the information should help the user avoid dangerous situations such as a bad accident or similar incident.

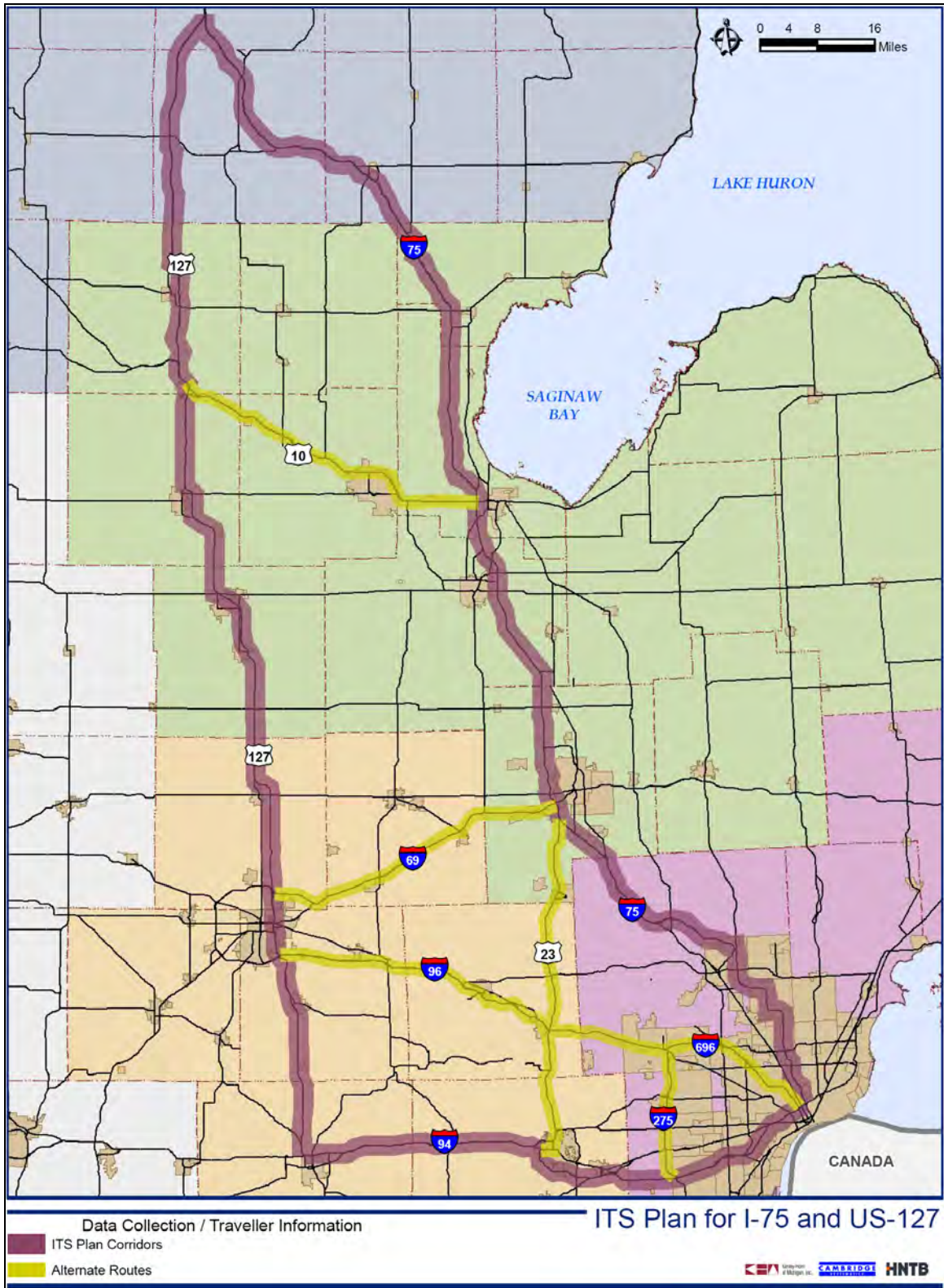


Figure 2. Triangle Study Area

1.3 Corridor Stakeholders and Users

A stakeholder is any person or organization that is responsible for the implementation, operation, or maintenance of the ATIS. Stakeholder support and participation is important to the success of any project so they can firmly establish the foundation and needs of the project. This is especially true in systems engineering projects that span multiple stakeholders with different perspectives. The sustained involvement of stakeholders is required to successfully resolve different perspectives about the roles and responsibilities, user needs, and requirements. As these groups work together to form a common vision, they are able to gain a better understanding of each other’s perspectives and thereby establish stronger relationships that will allow them to overcome institutional boundaries. The stakeholders identified for the Triangle ATIS Plan are listed in **Table 1**.

A user is anyone who will access data available through the ATIS. It is important to identify the various types of users since they will drive many of the needs placed on the system. The users of the proposed ATIS are presented in **Table 1**.

Table 1. Corridor Stakeholders and Use

Stakeholders and Users	Stakeholder	User
MDOT	●	●
County Road Commission (CRC)	●	●
Local Agencies	●	●
Michigan State Police (MSP)	●	●
Local Public Safety Answering Points (PSAPs)	●	●
County Emergency Operations Center (EOC)	●	●
National Weather Service	●	●
Freight/ Trucking Industry		●
Local Users		●
Vacation Travelers		●
Commuters		●
Other States		●

2 Background

The U.S. roadways are becoming increasingly congested, resulting in lost time and wasted fuel. To address the issue, the US DOT launched the *National Strategy to Reduce Congestion on America's Transportation Network*. The program develops several initiatives to promote low-cost operational and technical improvements. One improvement is increasing the use of ATIS either in a regional or even more focused corridor approach. ATIS can have a great impact on the performance of a roadway through reducing travel time and delays for travelers; reducing crash rates; increasing capacity; increasing travel time reliability; and improving consumer satisfaction.

ATIS connects a transportation user with the most up-to-date information specific to their current or planned trip. A comprehensive ATIS includes information about traffic conditions, incidents, transit arrival and departure times, toll costs, and other information that assists the user in making an informed decision in picking the most efficient route to their final destination. The key to a well developed ATIS is a strong foundation of accurate data.

ATIS information includes both static and dynamic information. Static information is updated no more frequently than daily. Static information typically includes route data, tourist or special event information, transit fares and schedules, and emergency service information. Information that is updated more frequently than daily is considered dynamic and is typically updated every few minutes or more often. Dynamic information may include real-time traffic conditions, transit schedule adherence information, incident notifications, etc.

3 Model Development and Analysis

This section describes the methodology for analyzing ITS needs in the Triangle Study Area. An evaluation of travel demand, traffic patterns and safety issues was required in order to establish needs and develop alternatives that address those needs.

This project is heavily focused on seasonal and recreational travel. Tourism is a major element of northern Michigan's economy and I-75 and US 127 are critical links supporting this economic activity. While the greatest level of recreational activity occurs during the summer months, there are significant peaks during fall foliage season, hunting season, and the winter recreation season. Even under free flow conditions, many of the major recreational areas lie between three and five hours of drive time from the Detroit metropolitan region and other major population centers in southern Michigan. According to the Michigan State University (MSU) Extension, approximately 60% of recreational visitors are Michigan residents traveling within the State, while an additional 20% come from Ohio, Indiana, or Illinois. During peak season and holiday weekends, traffic delays can substantially lengthen these trips. There is concern that recurring congestion at peak times could result in reduced visitation and negative impacts for the economy of northern Michigan.

The analysis was conducted using the Michigan statewide travel demand model. This model was developed by the MDOT Bureau of Planning and had been used in five recent Regional ITS Architecture and Strategic Deployment Plans conducted for MDOT. The model represented Average Daily Traffic (ADT), and did not account for the recreational peaks that are found on Friday afternoon/evening in the northbound direction and on Sunday evening in the southbound direction. The traffic analysis task included development of weekend peak models that represented these two conditions during summer months. The analysis task utilized crash data and tourist data collected by MSU Extension to identify critical segments along Triangle Study Area.

The analysis also helped to identify existing and future transportation needs along the corridor and to assess the cost-effectiveness of alternative strategies for addressing these needs. A number of projects have already been proposed as part of the Regional ITS Architecture and Strategic Deployment Plans that had been conducted for the MDOT Southwest, Bay, and North regions as well as SEMCOG. This project refined relevant projects proposed in these plans, as well as identified new projects that may generate positive impacts to the users within the Triangle Study Area.

3.1 Development of Peak Condition Model

The Michigan statewide travel demand model served as the basis for the analysis of peak conditions. The ITS Deployment Analysis System (IDAS), which works in conjunction with the travel demand model, was used to evaluate ITS alternatives, as it has in previous ITS architecture and deployment plan projects. A "base year" of 2010 was modeled along with one future year to be selected in conjunction with the project steering committee. The Friday and Sunday peak season models were developed using the following steps:

Step 1

Models were converted to IDAS and vehicle–miles and vehicle–hours of travel were compared with the statewide travel demand model. Model volumes were compared with traffic counts requested for this project. Adjustments were made as necessary to calibrate the volumes in both models. Minimal adjustment was needed when the statewide model was used in previous studies and the Triangle ATIS Study should warrant a similar level of adjustment.

Step 2

The MSU Extension data provided multiple measures of peak recreational travel demand. One measure of demand was a comparison of “visitor days” to “base population” by county. This provided a rough estimate of the percentage of increase in recreational travel that can be expected in each county. For the Friday peak model, this percentage increase was applied to the destination zones in each county. Base person–days, leisure–days, and the proportion of leisure–days to base person–days are provided by county in Appendix A.

Step 3

The MSU Extension also provided information on the origin of recreational travelers in Michigan. A summary of this information is provided in Appendix B. Not all of this travel was of interest to this project. For example, while recreational travel between the Detroit region and northern Michigan is of interest to this study, recreational travel from suburban Detroit counties to city casinos is not. However, this data source appeared to provide the best measure available and was used to distribute the Friday peak destinations back to their origins. After this allocation was made, the assignment was rerun with the increased trip table.

Step 4

Roadway assignments for peak recreational period models were compared with available traffic counts mentioned from Step 1. Traffic count data was available for the Permanent Traffic Recorder (PTR) locations shown in **Figure 3**.

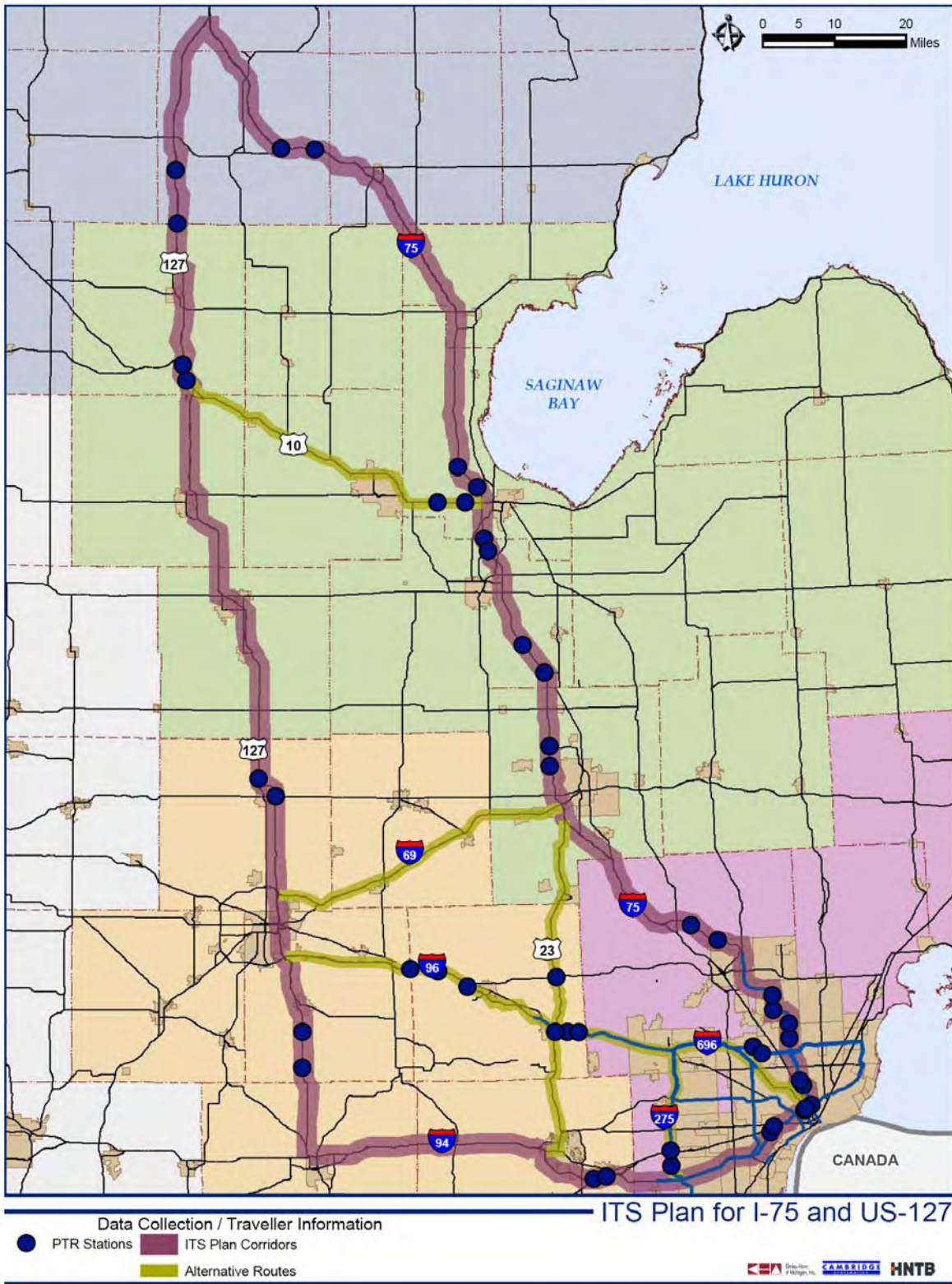


Figure 3. PTR Station Locations

Table 2 includes the peak volume for the PTR stations within the Triangle Study Area for both directions, whether north & south or east & west. The table includes the AADT, peak volume, the variance, and whether or not the peak day was a Friday or Sunday. Those data points that have a “*” represent those stations that have incomplete data collected. Specifically, these stations do not have a full year’s worth of data. However since peak travel time occurs during the summer and station 7029’s peak data was from June, July, and August, its peak day and volume was included in the table even though it does not have a complete years worth of data.

Table 2. Variance in Demand for Sections along the Strategic Corridors

<i>Segment</i>	<i>Station</i>	<i>Direction</i>	<i>AADT</i>	<i>Peak Day</i>	<i>Peak Volume</i>	<i>Variance</i>
I-275 A-B	9209	north	53752	Friday	68173	14421
I-275 B-A	9209	south	53238	Friday	68133	14895
I-69 A-B	6069	east	*	*	*	*
I-69 B-A	6069	west	*	*	*	*
I-69 C-D	6449	east	*	*	*	*
I-69D-C	6449	west	*	*	*	*
I-696 A-B	9829	east	90886		114147	23261
I-696 B-A	9829	west	89777		112746	22969
I-75 A-B	4149	north	6964	Friday	23684	16720
I-75 B-A	4149	South	6872	Sunday	25266	18394
I-75 A-B	6129	north	26763	Friday	65143	38380
I-75 B-A	6129	south	26676		59943	33267
I-75 A-B	6229	northwest	26344	Friday	66709	40365
I-75 B-A	6229	southeast	26406		59883	33477
I-75 A-B	6349	north	34953	Friday	67929	32976
I-75 B-A	6349	south	35873	Sunday	57137	21264
I-75 A-B	6429	north	14066	Friday	45569	31503
I-75 B-A	6429	south	14376		43029	28653
I-75 A-B	8629	north	40471	Friday	60377	19906
I-75 B-A	8629	south	41070		50749	9679
I-75 A-B	9959	north	59199	Friday	73746	14547
I-75 B-A	9959	south	56996	Friday	77358	20362
I-75 A-B	9979	north	56480	Friday	73601	17121
I-75 B-A	9979	south	55997	Friday	70742	14745
I-75 A-B	9989	north	87031	Friday	102421	15390
I-75 B-A	9989	south	83743	Friday	99175	15432
I-94 A-B	7029	east	*	Friday	31140	*
I-94 B-A	7029	west	*	Friday	35314	*
I-94 A-B	8829	east	45618	Friday	57580	11962

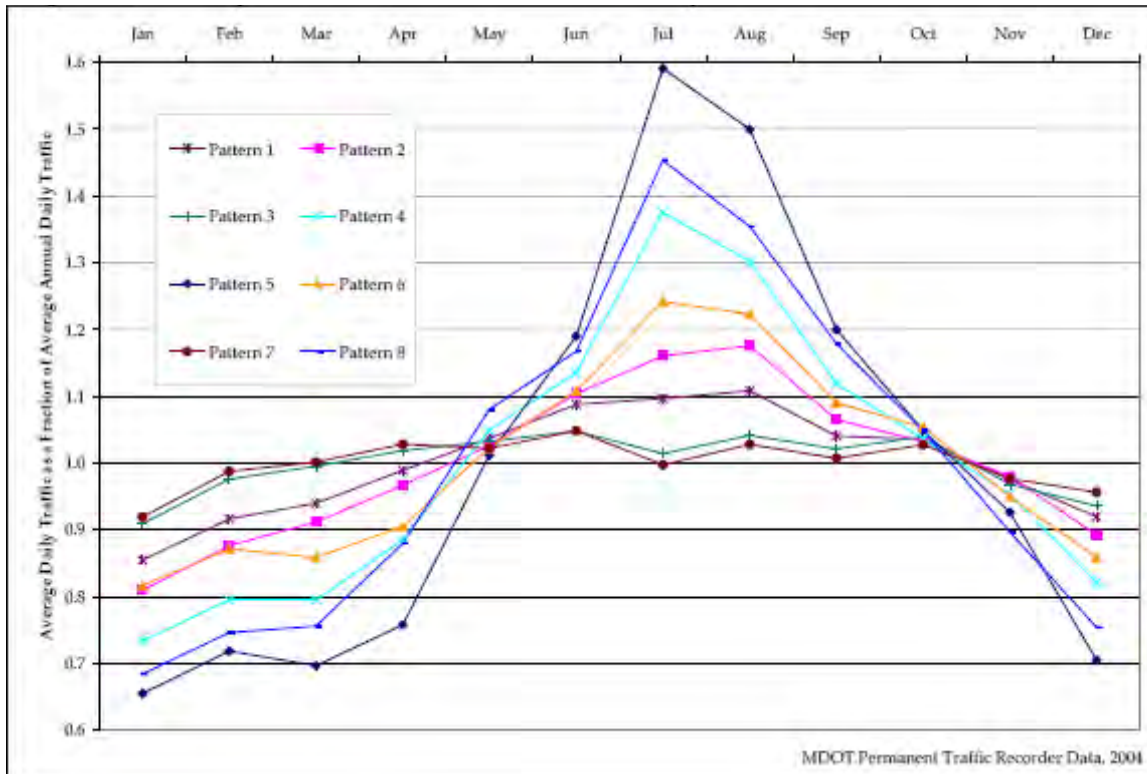
Table 2. Variance in Demand for Sections along the Strategic Corridors

Segment	Station	Direction	AADT	Peak Day	Peak Volume	Variance
I-94 B-A	8829	west	45557	Friday	59475	13918
I-94 A-B	9419	east	68811	Friday	86294	17483
I-94 B-A	9419	west	75187	Friday	91019	15832
I-94 A-B	9489	east	56424		75219	18795
I-94 B-A	9489	west	56066		69870	13804
I-94 A-B	9499	east	77141	Friday	100187	23046
I-94 B-A	9499	west	77547	Friday	94516	16969
I-96 A-B	8049	east	24123		36372	12249
I-96 B-A	8049	west	23605	Friday	35120	11515
I-96 A-B	8209	east	55131		67917	12786
I-96 B-A	8209	west	54908	Friday	72541	17633
I-96 A-B	8219	east	37991		51009	13018
I-96 B-A	8219	west	37478	Friday	51535	14057
US 10 A-B	6479	east	16899	Sunday	20898	3999
US 10 B-A	6479	west	16584	Friday	26549	9965
US 127 A-B	3249	north	11327	Friday	40019	28692
US 127 B-A	3249	south	11680		40353	28673
US 127 A-B	4129	north	4392	Friday	19033	14641
US 127 B-A	4129	south	4430		23465	19035
US 127 A-B	5019	north	9782	Friday	27435	17653
US 127 B-A	5019	south	10241		30313	20072
US 127 A-B	8029	north	11202	Friday	16639	5437
US 127 B-A	8029	south	10967	Friday	16173	5206
US 127 A-B	9049	north	*	*	*	*
US 127 B-A	9049	south	*	*	*	*
US 23 A-B	8229	north	25724	Friday	39962	14238
US 23 B-A	8229	south	25459		31114	5655

**incomplete data gathered from the stations*

Factors documented in the Statewide Long Range Transportation Plan will be used to estimate volumes for comparison with the model. **Figure 4** shows the monthly variation on different types of roadways in the State while **Table 3** describes the general characteristics of the various patterns. **Figure 5** maps the monthly patterns by roadway. Factors will be averaged for July and August and applied to the available count. The Friday day-of-week factor shown in **Figure 5** will be applied as well. **Figure 6** shows the traffic pattern for each segment of trunkline roadway within Michigan. This information also is available in a spreadsheet format and will be utilized to apply the appropriate factors. There is a mix of patterns on the roadways. In the northern portion of the

Triangle Study Area, I-75 and US-127 generally follow Patterns 4 and 5. Roadways in the southern portion of the corridor primarily follow Patterns 1, 2, and 7.



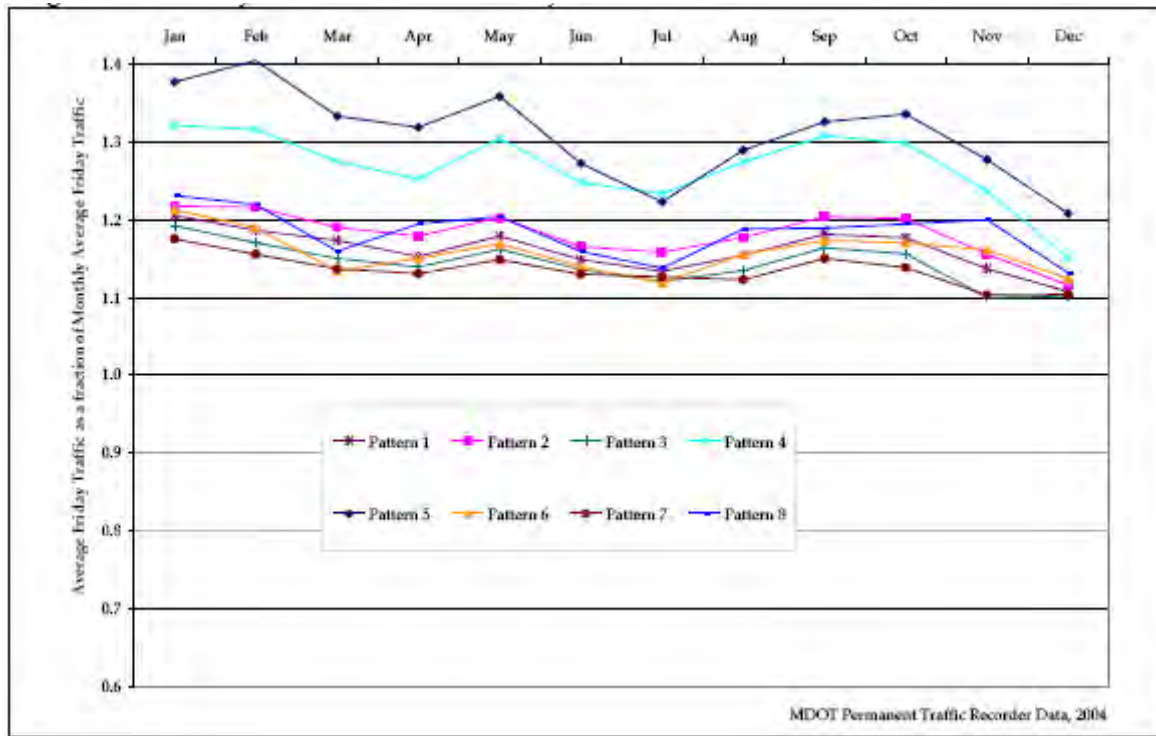
Source: MDOT State Long Range Transportation Plan, Travel Characteristics Report, prepared by MDOT with assistance from Wilbur Smith Associates, August, 2006, p. 48

Figure 4. Monthly Travel Patterns (Seasonal Variability in Traffic)

Table 3. Description of Seasonal Patterns

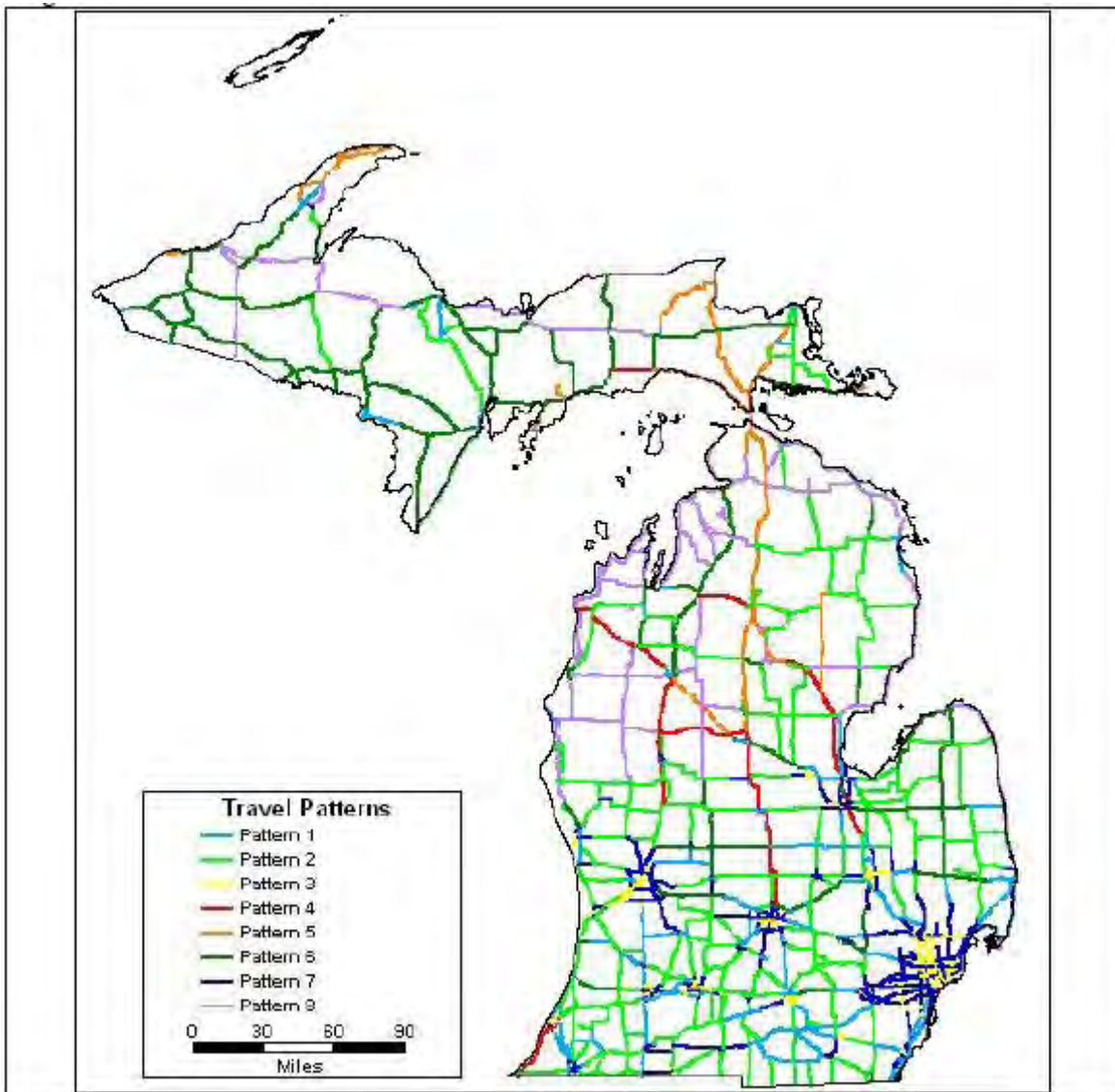
Pattern	Description	Location
1	Represents low seasonal variability typically found as routes between urban areas. This travel pattern has a low summer peak and a low winter dip.	Grand Rapids, Kalamazoo, and Flint
2	Represents high seasonal variability usually associated with rural areas throughout the state. This group shows a moderately low summer peak and moderate winter dip.	Southern half of Lower Peninsula.
3	Represents a low seasonal variability typically found in urban areas. This travel pattern has a flat summer with below average weekend traffic.	Lansing, Detroit, Flint
4	Represents very high seasonal variability usually associated with recreational travel patterns such as tourism-related travel and second homes. These patterns have high peaks on Friday and Sunday during the summer months.	Northern Lower Peninsula
5	Represents high seasonal variability with a high summer peak and sharp December decline.	Northern Lower Peninsula and the Upper Peninsula
6	Seasonal variability with a moderate summer peak.	Upper Peninsula
7	Represents a monthly variation that reflects the typical urban pattern, but drops very little on Saturday, as opposed to Pattern 3.	Fringes of urban areas
8	Represents very high seasonal variability usually associated with recreational patterns, with high summer peaks and low winter volumes.	Summer recreational areas

Source: MDOT State Long Range Transportation Plan, Travel Characteristics Report, prepared by MDOT with assistance from Wilbur Smith Associates, August, 2006, p. 47



Source: MDOT State Long Range Transportation Plan, Travel Characteristics Report, prepared by MDOT with assistance from Wilbur Smith Associates, August, 2006, p. 51

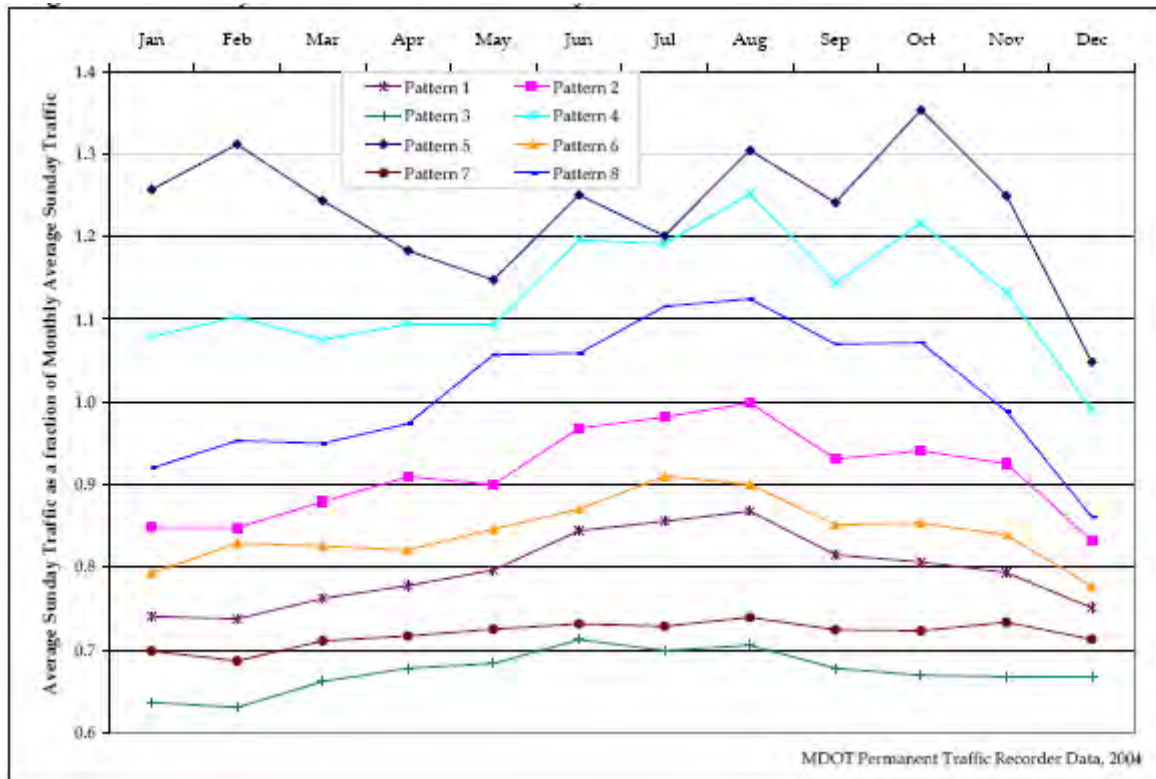
Figure 5. Monthly Traffic Pattern for Friday



Source: MDOT State Long Range Transportation Plan, Travel Characteristics Report, prepared by MDOT with assistance from Wilbur Smith Associates, August, 2006, p. 49

Figure 6. Patterns on State Trunklines

The process described in Steps 2 through 4 will be repeated in reverse for the Sunday evening peak. The percentage increase in trips applied to recreational destination zones for the Friday evening model will be applied to origin trips in the Sunday night model. Sunday factors are shown in **Figure 7**. Trips will be distributed to destinations based on the MSU Extension data described in Steps 2 and 3. Model volumes will be compared to traffic counts and adjusted as necessary. This process is described for the Sunday model in Steps 3 and 4.



Source: MDOT State Long Range Transportation Plan, Travel Characteristics Report, prepared by MDOT with assistance from Wilbur Smith Associates, August, 2006, p. 52

Figure 7. Monthly Traffic Pattern for Sunday

Specific adjustment factors from MDOT PTR in the Triangle Study Area are included in Appendix C. These adjustment factors were used to develop the traffic patterns shown in **Figure 4** through **Figure 7**. This information will be used as a check on the results, or where appropriate to readjust the factors.

Once the Friday and Sunday peak models are satisfactorily calibrated to adjusted traffic counts, model runs will be conducted for a base year (2010) and at least one future year to be determined. Areas of high congestion and anticipated growth areas will be identified and documented.

3.2 Alternative Development and Analysis

Model runs will be utilized to identify existing and future congestion “hot spots” on the main corridors in the Triangle Study Area. Crash and weather data, along with input from stakeholders, will be used to identify roadway segments with safety concerns. Depending on the outcome of the initial results of the analysis, additional runs may be made to simulate capacity restrictions resulting from incidents and/or construction projects. The number of viable alternate routes in the Triangle Study Area is limited, especially in the rural areas. The main corridors do provide some alternate routes, but they are primarily for long-distance trips. For example, if there is peak season

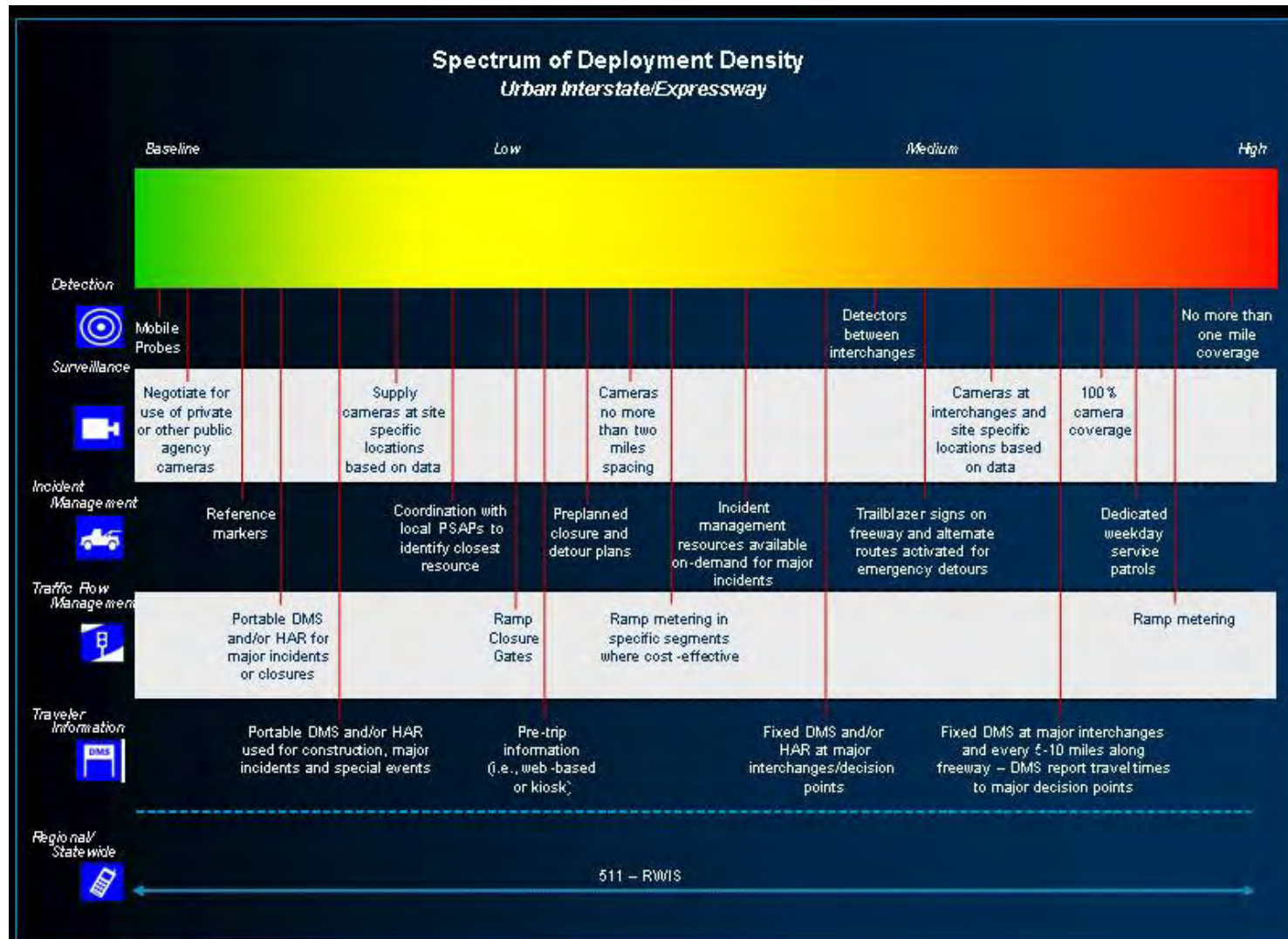
congestion on I-75 northbound north of M-10, a viable option for an alternate route for many motorists would include using M-10 westbound and US-127 northbound. Similar long distance “loops” exist further south with I-75/I-96/US-23 and I-75/I-96/US-127. The peak weekend models may be useful in identifying “tipping points” where alternate routes could be considered. There also are shorter “loop roads” in Flint (I-475) and Saginaw (I-675) that can be used to relieve traffic on I-75.

ITS projects were evaluated and documented in the North, Bay, Southwest, and SEMCOG Regional ITS Architecture and Strategic Deployment Plans. The areas that were impacted include MDOT North, Bay, Southwest, University, and Metro Regions. These deployment plan projects were based on ADT volumes derived from the statewide travel demand model and the SEMCOG regional travel demand model and will serve as the starting point for the development of project alternatives. The peak weekend models developed for this project may identify additional needs related to recreational traffic that did not surface in these earlier studies. If approved for further analysis by MDOT, benefit/cost analysis for these projects will be conducted. Because much of the Triangle Study Area is characterized by only periodic congestion, this project will focus more heavily on traveler information services and low-cost non-infrastructure solutions rather than more expensive denser infrastructure based deployments. The completed Regional Deployment Plans, however, did identify some areas where the latter are justified.

Many of the Triangle Study Area roadways in the Metro and University regions have had ITS deployed for over a decade, and this system is being expanded along several major freeways including I-96 and I-75. For these areas, the study will focus on ways that existing ITS can more effectively serve recreational traffic. There are wide ranges of needs in the Triangle Study Area and due to the large number of roadway miles included in the project; detailed analysis of all segments is not realistic. A methodology is proposed that will document needs and proposed solutions at a planning level for all roadway segments. This approach will use the concept of the “spectrum”, which has been applied in a statewide ITS plan for the Wisconsin DOT and is illustrated in **Figure 8**.

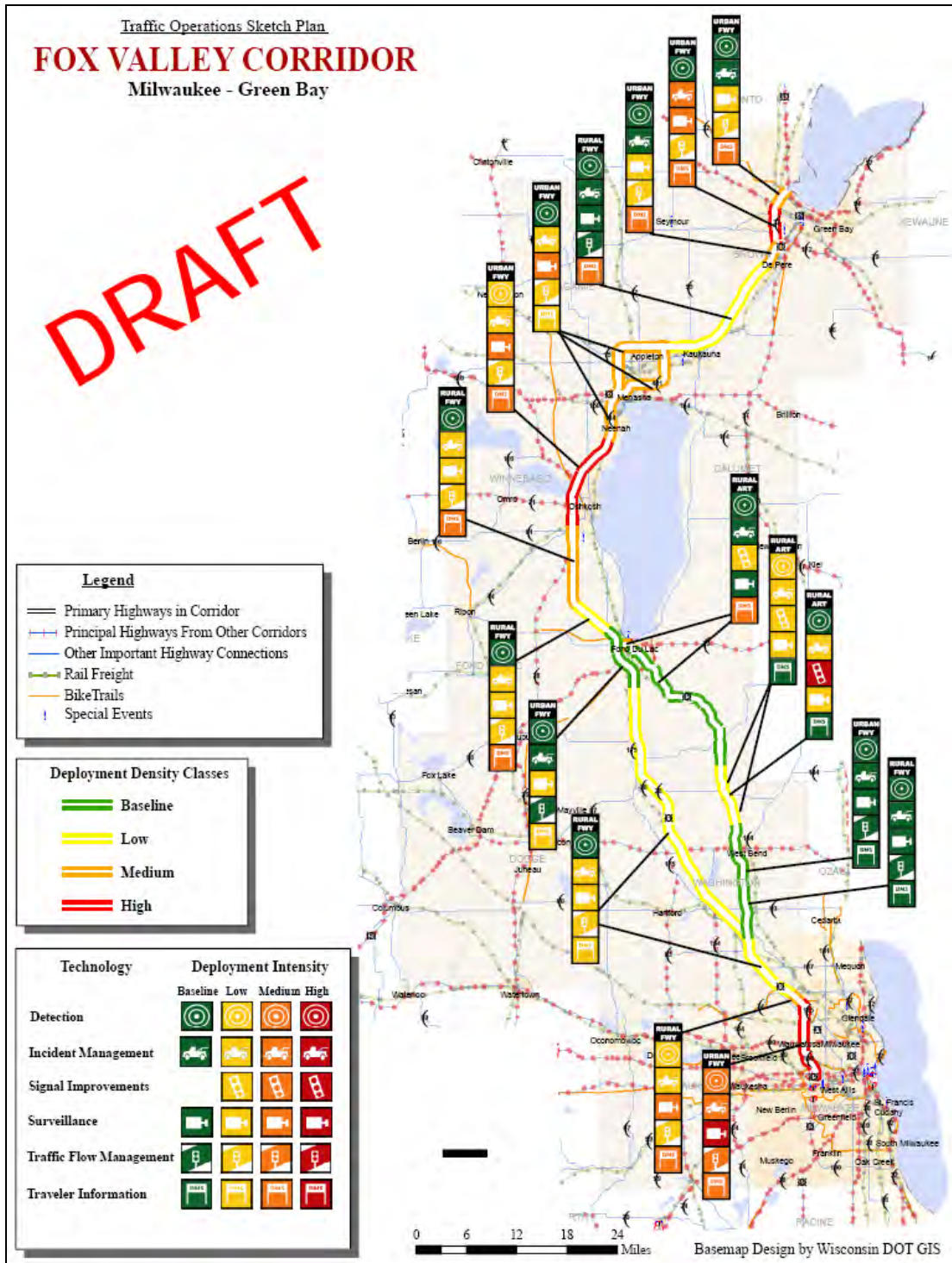
This methodology assigns varying deployment densities to roadway segments based on a variety of criteria including current and future traffic volumes, crash rates, weather severity, and special events. The Wisconsin methodology used a very specific scoring system, but for the Triangle ATIS project, a more qualitative approach to the spectrum will be adopted. Primary criteria will be existing volumes (from traffic counts and the statewide model), future volumes (from the statewide model), and crash rates (from MDOT crash database). Technology options along the spectrum will be specifically defined for this project and assigned to specific roadway segments using the signpost system shown in **Figure 9**.

Any modifications in the Southwest, Bay, North, or SEMCOG Regional ITS Architecture and Deployment Plans that result from these proposals will be identified. These projects will serve as the basis for cost estimates and evaluation of benefits and costs using IDAS.



Source: Cambridge Systematics and SRF

Figure 8. Spectrum of Deployment Density



Source: Cambridge Systematics and SRF

Figure 9. Example of Signpost System Application

4 Operational and Support Environment

In January 2009, MDOT released a Request for Proposals (RFP) for the explicit purpose of procuring a subscription for real-time traffic data for selected freeway routes in Michigan. NAVTEQ was awarded the contract to provide three years of traveler information with an option to extend the contract for a fourth and a fifth year. Initially, the RFP called for approximately 750 miles of coverage, but the final contract with NAVTEQ has offered to provide traveler information for selected routes covering the entire state.

Prior to the release of this RFP, MDOT identified a need to provide travelers with information on alternate routes as a result of extensive delays and queuing commonly experienced during summer weekends. A key component to an effective and reliable system is to collect real time traffic data over a wide area. NAVTEQ's contract provides the ability to meet these needs. Specifically, NAVTEQ will provide segmented speed data that will be updated at a minimum of once every five minutes. As of June 2009, MDOT and NAVTEQ have signed a formal contract agreement and NAVTEQ activated the data feed prior to the 2009 July 4th weekend.

4.1 Institutional Environment

Traffic management is a multi-agency effort within each region in Michigan and the ATIS project spans four of the MDOT regions. Within each region, there is collaboration between the MSP, MDOT, local agencies, and the CRC. Additionally some regions include collaboration with some municipalities.

Of these four regions, the Metro Region includes the largest number of agencies involved in traffic management. Some of the municipalities partner with MSP for the clearance of incidents along the trunk routes. The municipalities maintain constant communication with the MSP to confirm that information is reaching the correct destination. The Michigan Intelligent Transportation System Center (MITSC) in Detroit will rely on constant communications from the MSP and the other MDOT Transportation Management Centers (TMC) to verify information related to the conditions of the roadway so posted messages are as accurate as possible.

The Gaylord Regional Dispatch Center (Gaylord Regional) covers the MSP northern region, which coincides with the MDOT North Region and Bay Region, excluding Mason, Lake, Osceola and Gratiot Counties. Both the North and Bay Region TMC rely on integration and close communication with the Gaylord Regional to effectively detect and manage incidents.

In Michigan, the road surface maintenance and winter weather maintenance activities are conducted by MDOT for the "Direct Forces" counties and contracted to municipalities or county road commissions for "Contract" Counties. In the Triangle Study Area, all of the counties are Contract, except for Isabella, Saginaw, Eaton, Ingham, and Livingston Counties. The Metro Region also includes a small number of municipalities that are Contract counties. **Figure 10** displays the winter maintenance roles within the Triangle Study Area and surrounding area.

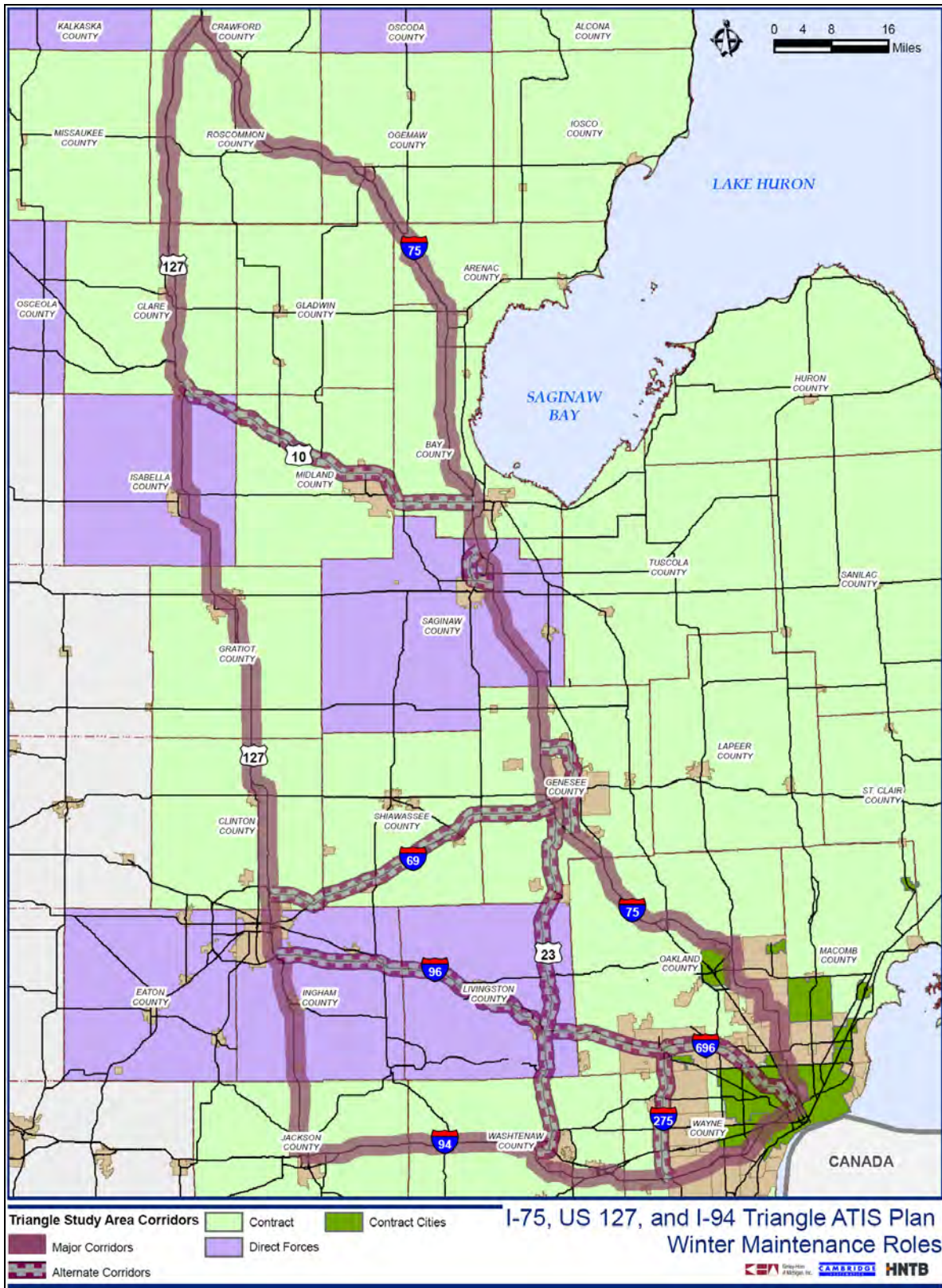


Figure 10. Winter Maintenance Roles

4.2 Operational Environment

The Triangle Study Area is comprised of four MDOT Regions: University, Metro, Bay, and North. Each of the regions operates slightly differently based on their population density and economy. Due to the economic and geographic landscape of each region, they experience varying levels of congestion. As a result, each region approaches ITS deployments and operations with an intensity level relative to the regional needs. Some of the more rural regions may not focus on recurring congestion as it relates to daily commuting, but rather recurring congestion based on fluctuations of recreational driving patterns. Since the geographic impacts also vary by region, the need for information dissemination and interagency coordination also are unique.

The Metro Region is the highest populated region in the Triangle Study Area and includes Detroit, the largest city in Michigan, with a population of 917,000 according to the 2007 Census estimation. The high population center focused in Detroit and the surrounding suburbs creates a large number of commuting travelers within, to, and from the Metro Region. The Metro Region also has a dense network of Interstate routes that make it a major hub for regional travelers and an important hub for goods movement across the international border with Canada.

The University Region is the second highest populated Region within the Triangle Study Area. The Region includes Ann Arbor, home to the University of Michigan, and Lansing, the state capital. Similar to the Metro Region, the University Region experiences higher levels of congestion due to local commuters in the Lansing and Ann Arbor metro areas. The University Region is the center of the Lower Peninsula and serves as a link between Detroit in the eastern part of the state and Grand Rapids and Kalamazoo in the west.

The Bay Region is not only the center of the Triangle Study Area, but also covers the largest portion as compared to the other regions. There are two main north-south corridors that run through the Bay Region, I-75 and US 127. The two largest cities in the Bay Region, Flint and Saginaw, both have loops that serve as local alternate routes, I-475 and I-675, respectively. I-69 is a major east-west connector for the Lower Peninsula and runs through Flint. US 10 also is an important east-west connector for the Triangle Study Area and intersects with I-75 just north of Saginaw in Bay City. Outside of these two cities, the Bay Region is mostly rural and does not experience higher volumes of daily traffic. The majority of the regional traffic consists of recreational travelers headed to destinations in the North and Superior Regions.

The North Region is comprised of 24 counties and is the largest region geographically, but only a small segment of the region is located within the Triangle Study Area. The size of the North Region introduces issues that are unique compared with the other three regions. In the area of traffic congestion, the region focuses mostly on tourism and weather. The economy for the North Region is largely based on tourism, second home ownership, and natural resources. The traffic peaks during certain times of the year and on certain days of the week. The amount of peak depends on the season and the available activities at the destinations. In particular, the volume peaks during the summer months are comprised of mostly vacationers and second homeowners, whereas the winter months are mostly vacationers traveling north for skiing. There is a concern that the increase in

congestion could result in reducing the number of visiting trips to the North Region; reduce revenue and jobs; and ultimately impact the regional economy.

4.3 Technical Environment

The current TMC environment in Michigan includes the MITSC in Detroit and the West Michigan TMC in Grand Rapids; however additional TMCs have been identified in the North, Superior, and Bay Regions as well as a statewide facility in Lansing. MDOT is in the process of procuring Advanced Traffic Management System (ATMS) software in preparation for the increased operations of ITS across the state. The new software will be the standard platform for controlling ITS field devices and sharing real-time incident, construction and special event information throughout Michigan. This software also will be available for use by some non-MDOT agencies, such as County Road Commissions, public safety agencies, and other local transportation agencies. The ATMS software will be the primary software tool used by all TMCs in the state and should improve the effectiveness and efficiency of transportation management throughout the state.

Not all of the local PSAPs are integrated with MSP computer-aided dispatch (CAD) systems, and not all calls are received by MSP. Since multiple CAD software platforms are being used across the Triangle Study Area, every incident is not recorded within the MSP CAD system and, therefore not automatically sent to MDOT via the ATMS. Some of the more heavily traveled trunk routes are covered by the local PSAPs and have considered integrating with the MSP CAD system. Incident information entered into the ATMS is distributed to stakeholders statewide, including other TMCs, local agencies, the public, and the media. **Figure 11** displays the wide range CAD software systems in place within the Triangle Study Area.

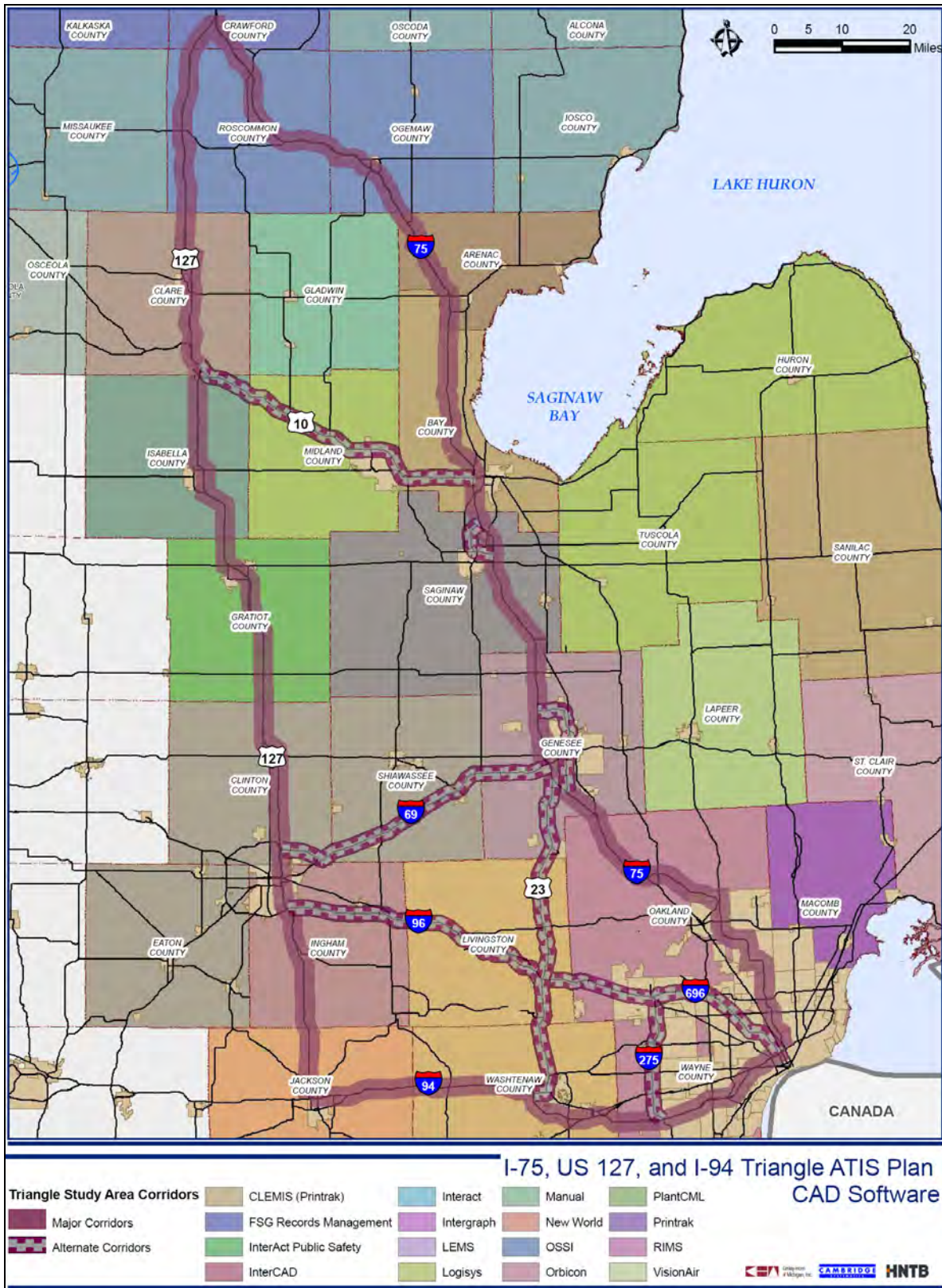


Figure 11. CAD Software Systems

Currently, the Bay Region is implementing a 2-phase deployment of devices focused on the heavily traveled corridors in the Region. The deployment includes vehicle detector stations, closed-circuit television (CCTV) cameras, and dynamic message signs (DMS). The system also will integrate data from the statewide probe data collection project. The first phase is along I-75/US 23, I-675, and M13 located within Saginaw and Bay Counties. The second phase will expand the deployment along US 127, US 10, and I-69. All of the devices in the Bay Region deployment will communicate back to the Bay Region TMC. **Figure 12** displays the location of the Bay Region deployment corridors as they relate to the Triangle Study Area.

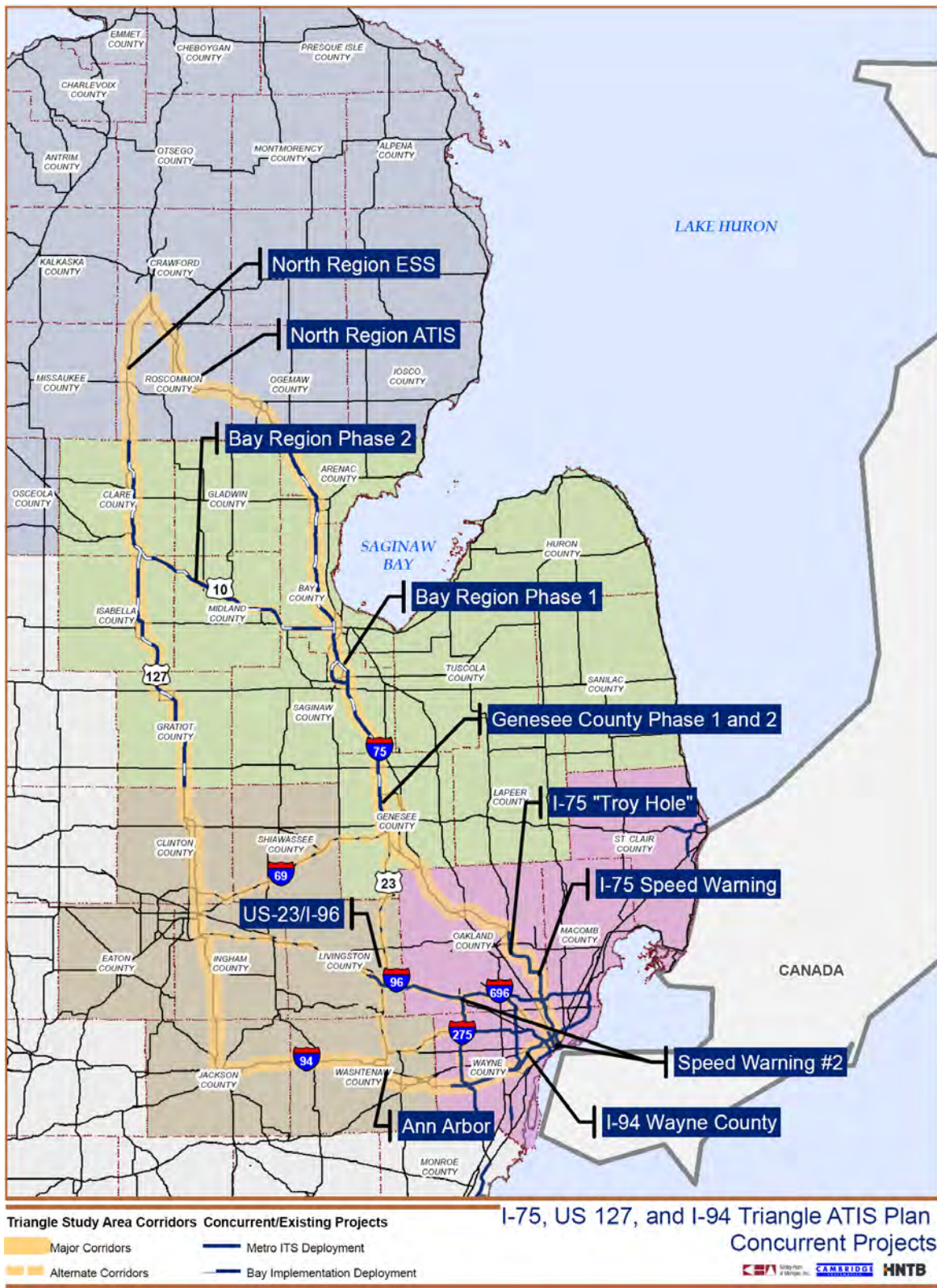


Figure 12. Concurrent Projects within the Triangle Study Area

Based out of the MITSC in Detroit, the Metro Region operates the largest ITS deployment in the State. The Region is equipped with CCTV cameras, DMS, a hybrid of agency owned and a public-private partnership supported detection sub-systems, and Freeway Courtesy Patrol (FCP). The current deployment does not cover all of the corridors in the Triangle Study Area, but future deployments along some of these corridors already are planned.

Michigan has a Road Weather Information System (RWIS) deployment that includes Environmental Sensor Stations (ESS) placed at key locations across the state. The system will be integrated with the new statewide ATMS software and data from the ESS will be available to all of the users across the state. The maintenance garages, local PSAPs, and National Weather Service (NWS) will have access to the data to improve on winter weather maintenance activities, incident response, and integration with other meteorological data sources for a more complete picture of weather conditions in the region.

4.4 Other Concurrent Projects

This project coincides with several current and recently completed studies within the Triangle Study Area. **Figure 12** in the preceding section displays the locations of each of these concurrent projects. The ConOps will align with the direction and goals of these documents as it also addresses the needs of the stakeholders and users from a more regional perspective. The concurrent studies include:

- US 23 Feasibility Study;
- I-96 Corridor Study;
- I-94 High Level Communications Study;
- I-94 ITS Design; and
- I-75 Integrated Corridor Management (ICM)

The US 23 Feasibility Study is an ongoing project with an anticipated completion date in late 2009. The project spans from the east junction of US 23/M-14 in Washtenaw County to I-96 in Livingston County. A 1999 Freeway Study revealed that several segments along US 23 were not operating efficiently. It also predicted that the level of service would deteriorate by 2020. Based on the findings, funding was provided to conduct preliminary engineering activities, but due to constraints, the activities were suspended in 2003. In 2006, MDOT initiated the feasibility study to investigate several alternates for the corridor. Several analyses were conducted, from multi-modal, tolling and managed lanes, to innovative funding opportunities. The findings were presented in September 2008, and the final findings will be available in the final report.

The I-96 Corridor Study has an anticipated completion date of late 2009. The study spans along the entire length of I-96 within Ingham and Livingston Counties. The study involves the development of a ConOps document. This document is the planning guide for an ITS deployment along the corridor.

The corridor has high traffic volumes, especially near US 23. The deployment would place technology along the corridor which currently has a limited amount in place. Operations would be handled by either by the MDOT MITSC in Detroit or the West Michigan TMC in Grand Rapids until the proposed Statewide TMC is operational in Lansing.

I-94 High Level Communications Study is near completion, with a ground breaking date of 2010. The project is planning to place several CCTV cameras along I-94 within Kalamazoo and Calhoun Counties. These cameras are scheduled to connect to the existing cell network within the MDOT Southwest Region. In addition to the CCTV cameras, four DMS signs are scheduled to be placed at the interchange of I-94 and I-69.

I-94 ITS Design project is designing ITS devices along I-94 from Moross west to the Washtenaw County line. The devices include fiber, DMS, CCTV cameras, detection, and other devices. The first part of the project includes the design from the Washtenaw County line east towards the I-96 freeway. This portion has a September 2009 letting date. The other portion of the project will be designed and shelved until further funding becomes available.

The MDOT ***I-75 Integrated Corridor Management (ICM)*** ConOps project was completed June 2009. It covered 25 miles along I-75 in Oakland County from Baldwin Blvd. to M-102 (8 Mile Rd). Along with the main Interstate segment, the analysis looked at the capacity and feasibility of arterial corridors as alternate routes during incidents such as crashes, special events, or construction. It also recommended effective device locations and communication links between stakeholders to facilitate operations during incident management scenarios.

5 Participating Agencies' Roles and Responsibilities

There are a number of participating agencies who, acting together will make the ATIS Plan for the Triangle Study Area a success. **Table 4** outlines how all of these stakeholders would operate in an operational/task level environment. These roles are detailed in the following section.

Table 4. Stakeholders and their Roles and Responsibilities

Stakeholder/Agency Name	Roles and Responsibilities
Statewide Lansing Transportation Management Center	The ConOps for this center is currently under development. It is anticipated that the Statewide TMC will monitor traffic conditions during interregional or statewide significant incidents using CCTV cameras, detection equipment, and data from the statewide probe data contract. The TMC will support incident management activities and provide traveler information services through DMS and media alerts. The TMC also will use the MIDrive website to share traffic information. In addition to the RWIS data, weather events will be coordinated with the National Weather Service (NWS).
MDOT University Region Office and Transportation Service Centers (TSCs)	The University Region Office and TSCs have the primary operations responsibility for all Interstates, US, and M routes in the University Region. Many of the routine maintenance functions are contracted to six of ten CRCs, but the Region Office and TSCs oversee the maintenance activities and are closely integrated with major incidents and planned events. They also are the primary offices involved with planning and operating work zones on routes within their jurisdiction.
Michigan Intelligent Transportation System Center (MITSC)	MITSC monitors traffic conditions in the Metro Region using CCTV cameras, detection equipment, and data from the statewide probe data contract. The TMC supports incident management activities and provides traveler information services through DMS and media alerts. The TMC also uses the MIDrive website to share traffic information. In addition to the RWIS data, weather events will be coordinated with the NWS.

Table 4. Stakeholders and their Roles and Responsibilities

Stakeholder/Agency Name	Roles and Responsibilities
<p>MDOT Metro Region Office and Transportation Service Centers (TSCs)</p>	<p>The Metro Region Office and TSCs have the primary operations responsibility for all Interstates, US, and M routes in the Metro Region. Many of the routine maintenance functions are contracted to all four CRCs and eleven local municipalities, but the Region Office and TSCs oversee the maintenance activities and are closely integrated with major incidents and planned events. They also are the primary offices involved with planning and operating work zones on routes within their jurisdiction.</p>
<p>Bay Region Transportation Management Center</p>	<p>The ConOps for the first Bay Region ITS Deployment is under development and will serve as the first phase TMC for the Region. It is anticipated that the Bay Region TMC will monitor traffic conditions for the Bay Region using CCTV cameras, detection equipment, and data from the statewide probe data contract. The TMC will support incident management activities as they coordinate with the MSP Gaylord Regional Dispatch Center and will provide traveler information services through DMS and media alerts. The TMC also will use the MIDrive website to share traffic information. It will temporarily be housed in the Bay City TSC until a more permanent location has been determined.</p>
<p>MDOT Bay Region Office and Transportation Service Centers (TSCs)</p>	<p>The Bay Region Office and TSCs have the primary operations responsibility for all Interstates, US, and M routes in the Bay Region. Many of the routine maintenance functions are contracted to eleven of the thirteen CRCs, but the Region Office and TSCs oversee the maintenance activities and are closely integrated with major incidents and planned events. They also are the primary offices involved with planning and operating work zones on routes within their jurisdiction.</p>

Table 4. Stakeholders and their Roles and Responsibilities

Stakeholder/Agency Name	Roles and Responsibilities
North Region Transportation Management Center	<p>The ConOps for this center is currently under development. It is anticipated that the North Region TMC will monitor traffic conditions throughout the North Region using CCTV cameras, detection equipment, and data from the statewide probe data contract. The TMC will support incident management activities and will provide traveler information services through DMS and media alerts. The TMC also will use the MIDrive website to share traffic information. In addition to the RWIS data, the North Region TMC will coordinate with the NWS. They will coordinate their efforts with the Grand Traverse TMC in order to help monitor weather and incident conditions in the northwestern portion of the region. The TMC will be housed temporarily at the Grayling TSC until a dedicated facility is created.</p>
MDOT North Region Office and Transportation Service Centers (TSCs)	<p>The North Region Office and TSCs have the primary operations responsibility for all Interstates, US, and M routes in the North Region. Many of the routine maintenance functions are contracted out to twenty of twenty-four CRCs, but the Region Office and TSCs oversee the maintenance activities and are closely integrated with all major incidents and planned events. They also are the primary offices involved with planning and operating work zones on routes within their jurisdiction.</p>
West Michigan Transportation Management Center	<p>The West Michigan TMC currently monitors traffic conditions in the Grand Valley Metropolitan area through CCTV cameras and detection equipment. The West Michigan TMC will coordinate with the TMCs in the Metro, Bay, University, and North Regions to disseminate traveler information to travelers approaching the Triangle Study Area.</p>

Table 4. Stakeholders and their Roles and Responsibilities

Stakeholder/Agency Name	Roles and Responsibilities
MDOT Grand and Superior Region Office and TSCs	The Grand and Superior Region Office and TSCs will coordinate with North, Bay, University, and Metro Regions for resource needs and incident information of regional or statewide significance.
County Road Commissions	CRCs are responsible for traffic management operations services including maintenance and winter road maintenance of all Interstate and M routes within MDOT Contract counties (excluding Isabella, Saginaw, Eaton, Ingham, and Livingston Counties). They also coordinate with municipal winter maintenance personnel. They are involved in work zone management, routine road maintenance and traffic control for incident management. CRCs are managed through the corresponding TSC.
Local Agencies	Local Agencies maintain local transportation systems, including signal timing and local road maintenance. Local Agencies operate local law enforcement resources for incident response and management.
MSP Gaylord Regional Dispatch Center	The MSP Gaylord Regional Dispatch Center serves as a central coordination point for a majority of the incident management activities in the North Region, excluding Mason, Lake, and Osceola Counties. Gaylord Regional also manages incident management activities in the Bay Region, excluding Gratiot County. The ATMS will provide Gaylord Regional with the ability to monitor the road network on behalf of MDOT during off peak hours.
MSP Headquarters – East Lansing	Michigan State Police headquarters that oversees statewide operations of MSP. MSP Headquarters oversee resources for large interregional and statewide incidents. It covers the portions of the University Region as well as Gratiot County in the Bay Region.

Table 4. Stakeholders and their Roles and Responsibilities

Stakeholder/Agency Name	Roles and Responsibilities
MSP Second District Regional Dispatch	The Second District Regional Dispatch serves as a central coordination point for the incident management activities for the MDOT Metro Region as well as Washtenaw and Monroe counties in the University Region. It receives 911 calls and forward calls to appropriate local or other MSP dispatcher centers.
Local PSAPs	Local PSAPs receive 911 calls within their jurisdiction (typically counties) and dispatch emergency response resources. They coordinate closely with the MSP vehicles responding to incidents.
MSP Office of Highway Safety Planning	The Office of Highway Safety Planning manages the statewide crash data for all crashes on MDOT routes.
County Emergency Operations Centers	County Emergency Operations Centers serve as coordinating agencies during incidents of a defined magnitude that warrant their activation. They are made up of various local, state, and federal agencies. They also include elements of the disaster relief agencies such as the Red Cross.
National Weather Service	The NWS oversees meteorological activities across the state of Michigan. The NWS works closely with MDOT and other winter maintenance agencies to improve response and winter maintenance activities. The NWS continually coordinates with MDOT personnel during major storms.

6 Benefits of Traveler Information Research

6.1 Traveler Willingness to Divert

Numerous studies have been conducted regarding the impact of traveler information on driver behavior. As researchers have sought to understand the travel decision making process they typically have employed one of two methodologies: revealed preference or stated preference studies. Stated preference studies typically present travelers with various travel situations and alternatives and solicit a choice. Revealed preference studies involve field observations and driver reports of actual behavior. A third evaluation style typically uses survey data for the calibration of mathematical formulas for use in theoretical modeling of expected traveler responses.

The research summarized in this section documents varied traveler responses to and benefits of ATIS, but share in common the fact that they each document some degree of benefit achieved. Some of the studies document only minimal benefits as far as actions taken by drivers, but do indicate a positive impact on driver stress levels which benefits the transportation system in more subtle ways. An effort was made to focus on recent research since significant advances in mobile technology sources, the widespread use of the internet, prevalence of DMS, and increased driver awareness of traveler information sources have changed the research environment and study results significantly.

It is important to remember when reviewing the results of the studies presented here that the number of travelers who utilize available traveler information sources represents a small portion of total travelers and that the survey and evaluation methods presented in the various studies in this section are targeting those groups. The percentage of those travelers that show a willingness to divert in the studies cannot be applied directly to the general population. As the statistics show, the users typically perceive a personal benefit, but as field observations frequently show, the impacts across the regional transportation network generally are quite modest.

6.1.1. Stated Preference Research

Driver surveys are the main source of stated preference research information. They typically present respondents with hypothetical travel situations and solicit a response as to what action they would take in that circumstance.

Driver Response to Variable Message Signs-Based Traffic Information, S. Peeta and J.L. Ramos, Jr., 2006 – Peeta and Ramos developed variable message signs (VMS) driver response models for the I-80/I-94 corridor in Indiana using data collected through a combination of an on-site survey, a mail-back survey and an internet-based survey. A variety of factors impacted the willingness of a traveler to divert. One of the primary factors was whether or not they were familiar with alternate routes. Secondary factors included weather conditions, time of day, and information provided about the location and severity of the delay. The data summarized in **Table 5** presents the results of each of the survey types.

Table 5. Willingness to Divert Survey Results

Responses	Survey Type		
	On-Site	Mail-back	Internet
Regular driver on the study route	50%	81%	97%
Drivers at least somewhat familiar with alternate routes	65%	90%	97%
Drivers willing to divert to an alternate route in adverse weather conditions	70%	90%	82%
Drivers willing to divert at night	65%	67%	68%

Questions related to the amount of delay that would be required for both personal and work trips to cause a driver to be willing to divert revealed a lower time threshold for work related trips than for personal trips. Approximately 71% of respondents would divert for a work trip if travel time savings was between 5 and 30 minutes, compared with 47% for personal trips. Another portion of the study evaluated willingness to divert based on different types of VMS messages. Overall, drivers were most willing to divert when they knew the location of the incident, expected delay and the best detour strategy. Expected delay and the best detour strategy was the second most preferred message type, showing a strong desire for as much information as possible to aid in decision making.

Traveler Response to New Dynamic Information Sources: Analyzing Corridor and Area-Wide Behavioral Surveys, Youngbin Yim, et al., 2004 – Researchers from the University of California, Berkley, performed a study as part of the California Partners for Advanced Transit and Highways (PATH) program to develop a conceptual model to assess the value and impact of new traveler information sources based on the results of several behavioral surveys conducted in the San Francisco Bay Area from 1995 to 1999 to evaluate the TravInfo® system. At the time of the surveys the system provided information via telephone and the internet (through third party traffic web sites). The TravInfo® surveys utilized focus groups, surveys, and system observations. The TravInfo® surveys revealed that 30% to 50% of users who acquired travel information changed their travel decisions. Among those that did alter their travel plans, changing the route taken was the most common change, followed by changing their departure time. Respondents also indicated that a lack of alternate routes was a significant consideration in their decision to change travel plans. Very few mode changes or trip cancellations were indicated.

Another interesting result of the TravInfo® study is that drivers reported that travel information reduced their levels of stress and anxiety, suggesting that congestion that has an explanation is less stressful than unexplained congestion. This supports the importance of in-trip travel information through the radio or DMS, for example. With the increased use of cellular telephones and other handheld devices, the study cautioned that the devices could be “more of a safety problem than a solution” and that care should be taken to minimize driver distractions when developing traveler information sources.

A common theme running through the various survey methods was a lack of awareness about travel information options available, indicating that there was a need for marketing efforts to increase awareness and use of the system. The researchers pointed out that due to the low market penetration, the TravInfo® system did not appear to be having a significant influence on travel behavior in the Bay Area at the time of the surveys.

Since the time of the surveys this report was based upon, the Bay Area has established a much more robust traffic website (www.511.org) with the capability to provide customized trip information for both transit and personal vehicle trips that include both route and travel time information. This was a service that the researchers saw a demand for from the survey respondents, so it would be reasonable to expect that a new study would indicate a much greater impact on travel decisions given the additional information available today.

Evaluation of Drivers' Responses to ATIS: A Practical VMS Based Analysis, Chanyoung Lee, et al., 2004 – Frequent users of the freeway system in Wisconsin (a random sampling of drivers in 22 counties) were mailed a survey in 2001 to gauge familiarity with VMS and perceptions of benefits and reliability of messages. Sixty-five percent of respondents were at least somewhat familiar with VMS and 70% had the signs present on the routes they travel most frequently. They reported benefits including reduced stress, a contribution to freeway safety, and availability of improved travel time information. More than 86% of respondents indicated positive expectations related to travel time savings through the use of VMS. On a four point scale, the average rating for reliability of travel time information was 2.77. The average rating for reliability of traffic information was 2.92. The majority of the survey respondents indicated that they had changed their routes at least once based on information presented on VMS. In general, it was interesting to note that drivers show more of a tendency to adhere to their original route during the winter months, likely due to concern about unknown roadway conditions on alternate routes during winter weather. The quantity of delay expected also impacts willingness to divert; 85% indicated they would consider an alternate route in response to a message indicating a crash ahead and 76% to avoid construction delays. Among reasons for not taking alternate routes were concerns about getting lost, safety in unfamiliar areas, inaccuracy of information presented, and uncertainty about whether an alternate route would be faster.

Regression analysis of the data showed a link between perceived reliability of information and the number of route adjustments. Feedback indicated that drivers desire more specific information regarding travel conditions. Important recommendations when trying to provide this additional information reminds transportation personnel to keep message content brief so that drivers can read the entire message easily and to place portable VMS where they are visible, taking into account site selection and roadway factors.

6.1.2. Revealed Preference Research

Revealed preference research primarily relies upon post-trip driver surveys, trip diaries, or field observations to evaluate driver behavior in real situations. A significant drawback to this approach

is that it only measures the response to conditions during the limited study period. If there are no significant travel challenges during the study period, the results will have limited value.

The Role of Information in Decision-Making with Regard to Travel, G. Lyons, 2006 – Lyons reviewed a British Highway Agency study that sought to determine how widely used traffic information was used by travelers in Britain. Their research involved interviewing travelers at the end of their trips to learn about their use of information before and during their trip. Conducted in November of 2003 and 2004 the interviews of 1300 travelers revealed the following:

- 81% did not consult any pre-trip information sources
- 91% of the non-users gave familiarity with the trip as the main reason for not seeking information
- Of those that did consult pre-trip information, 65% of them did so to select the best route and the most common sources of information were map (8%), radio (5%) and the internet (4%)
- 72% of those interviewed did not consult information during their trip

Among those that used the most common information sources, the sources included fixed road signs (12%), radio (10%) and Radio Data Service/Travel Program (5%). Radio Data Service Program is a radio feature that interrupts the station being listened to with traffic and travel news information.

A more targeted study interviewed travelers in a specific area prone to heavy summer travel demand and found that travel information usage increased to 46% for pre-trip information and 54% for in-trip information. These results indicate a greater demand for information on longer, less familiar journeys than on regular day-to-day travel. These results are echoed in another study that revealed that 72% of information sought was for leisure travel rather than commuting and business purposes.

The effectiveness of traveler information on changing the behavior of travelers was described by Lyons as a “war of attrition,” a slow process whereby people’s perceptions change about alternate routes or modes. The results of numerous studies have indicated that there is not a great change in behavior as a result of traveler information, although some do indicate that additional information has a psychological benefit to travelers. In the British Highway Study mentioned earlier, only 7% of those who consulted in-trip information changed their route or otherwise altered their journey. Ultimately, Lyons sees the main market for traveler information being pre-trip information for unfamiliar trips.

Route Preferences and the Value of Travel-Time Information for Motorists Driving Real World Routes, Kathleen A Harder, et al., 2005 – While the primary goal of this study was to quantify the willingness of travelers to pay for pre-trip travel time information for alternate routes, the data collection efforts that were part of the study provide valuable insight into traveler behavior. A

combination of in-vehicle Global Positioning System (GPS) units, surveys and travel diaries were used to collect the data from a group of University of Minnesota at Minneapolis faculty and staff who participated in the route choice study. Seventy-four percent of the study participants indicated that they would use travel-time information similar to what they were given as part of the study if it was available. Of those that would use it the majority, 41%, said they would use the information once per trip. However, when asked how much they would be willing to pay for the information, 80% of those that responded said zero. Sixty-nine percent of respondents felt that travel-time information should be provided free by the public sector.

Evaluation of Intelligent Transportation Infrastructure Program (ITIP) in Pittsburg and Philadelphia, Pennsylvania, Batelle for the US Department of Transportation Joint Programs Office, 2003 – The ITIP evaluation report includes evaluations of a variety of aspects of the deployment of ITS in Philadelphia and Pittsburg, Pennsylvania. A portion of the evaluation addressed customer satisfaction and solicited feedback through a series of telephone and internet surveys to quantify the awareness and use characteristics of traffic information available for the Pittsburg and Philadelphia areas on Traffic.com. In both Pittsburg and Philadelphia the telephone survey results for people that had used Traffic.com did not produce a large enough sample to generate meaningful results. The web survey results did provide useful usage information as summarized in **Table 6**.

Table 6. TravInfo Web Survey Results for Pennsylvania

		Percent of Users	
		Pittsburg Internet Survey Results	Philadelphia Internet Survey Results
Travel Information Uses	Checked Specific Traffic Routes	84%	84%
	Checked Current Travel Speeds	31%	31%
	Checked for Accidents	61%	77%
	Checked Current Travel Times	38%	52%
Changes in Travel Behavior	Changed Travel Route	67%	86%
	Changed Travel Time	47%	66%
	Changed Mode of Transportation	6%	8%

511 Virginia Evaluation, Virginia Tech Transportation Institute, 2004 – A combination of web and phone 511 usage surveys, 511 awareness surveys, focus groups, and analysis of historic usage statistics was used to develop the evaluation of 511 in the Commonwealth of Virginia. Of 400 people surveyed about whether or not they had ever heard anything on 511 Virginia that caused

them to change their travel plans, 49% of respondents indicated that they had. Of those that did alter their plans the majority, 78%, changed their route. Almost all of those surveyed (99%) indicated that they would call 511 Virginia again.

Variable Message Signs and Link Flow Evaluation: A Case Study of the Paris Region, Youngbin Yim and Jean-Luc Ygnace, 1993 – Though an older study, the Paris Region case study has been included in this research review because it offers a unique perspective on driver’s willingness to divert. The data for the study was passively revealed by drivers as data was collected using loop detectors rather than the survey methods used in most studies. Traffic volumes on an access ramp downstream of a VMS were monitored to evaluate the changes in those choosing to stay on an alternate facility rather than entering the freeway when congestion related messages were displayed. The research shows that VMS alone can influence vehicle diversions; revealed diversion behavior was more conservative than stated preference results from previous surveys; the response of drivers is more significant during the AM peak rather than the PM peak; and that there is a close relationship between queue length and diversions. A queue length of 3 km (1.86 miles) appeared to be the threshold where a significant number of drivers responded to the messages and diverted. The message had almost no effect when a 0.5 km (0.31 mile) queue was indicated.

6.1.3. Theoretical Modeling of Driver Response

Many researchers have sought to develop theoretical models to predict the response of travelers to additional travel information. Many of these studies are based on complex equations developed from and calibrated using data from stated and revealed preference research.

The Value of Advanced Traveler Information Systems for Route Choice, David Levinson, 2003 – Levinson developed a theoretical model to calculate the time saved and change in trip variance associated with recurring congestion as well as incidents of varying degrees of severity for drivers who receive real-time traveler information (his study focused on in-vehicle navigation systems) and those that do not. In this study a freeway segment and parallel arterial were analyzed. Overall, the simulations show travel time benefits to system users and society as a whole in all cases evaluated. Informed drivers consistently have lower travel times than uninformed drivers, though uninformed drivers do benefit from the diversion activities of informed drivers. The simulation results also indicate that an informed driver does not save any additional time when additional drivers become informed, because of the resulting reduction in diversion opportunities that can be utilized as more drivers seek to change routes and therefore increase congestion on the parallel routes. As more and more drivers become informed, travel time for the uninformed drivers becomes increasingly reliable and the standard deviation between the two travel times approaches zero as the percent informed approaches 100%.

The Value of Travel Information: Decision Strategy-Specific Conceptualizations and Numerical Examples, Casper G. Chorus et al., 2006 – This study based the evaluation of perceived information value on the concept that travelers are working to minimize their amount of expected regret over their travel decision. This method was chosen to represent both those who seek to choose a satisfactory alternative (satisfying behavior) and those who seek the best available

alternative (maximizing behavior). While previous studies of this type have focused on one behavior approach or the other, this study sought to combine the responses by looking at the common goal of travelers reducing regret over their decision. Through a series of complex mathematical equations, the researchers evaluated the impact of perceived quality of unknown alternatives on information value, the impact of perceived knowledge for known alternatives on information value, and the impact of perceived information unreliability for known alternatives on information value. The goal of the study was to develop the equations as “building blocks” that could be adapted in future evaluations to more specific travel information evaluation.

Detroit Freeway Corridor ITS Evaluation, Vaishali P.Shah and Dr. Karl Wunderlich, 2001 – The study team developed a mesoscopic model of a 2 mile segment of the John C. Lodge corridor in Detroit to evaluate the impacts of various ITS deployments. The scenarios evaluated were:

- Existing ITS (DMS, Highway Advisory Radio (HAR), real-time trip information, and active ramp meters)
- No ITS (retrospective alternative)
- Only Ramp Metering
- Only DMS
- No Ramp Metering (retrospective alternative removing only ramp metering from list of existing ITS devices)
- Existing ITS with Accident-Responsive Signal Coordination

Each scenario was evaluated under congestion, major incident and minor incident conditions. Key highlights from the scenario evaluations include:

- Commuters using pre-trip HAR information see the greatest delay reduction benefit, realizing a delay reduction of over 80% through freeway to freeway route diversions
- Impacts of DMS were not statistically significant, used alone they did not significantly change the average flow or speed
- Ramp metering proved beneficial during major incident events, but its value became questionable in the absence of incidents or during minor incidents
- Existing ITS contributed to as much as a 250 vehicle per hour and 5.4 mile per hour increase over the no-ITS scenario as well as a 610 stop per mile decrease and 4.6 minute trip delay reduction. This translated into as much as a 22% delay mitigation.
- Based on the conditions evaluated, accident-responsive signal coordination provided limited benefits with current traffic volume levels and the most effective recommendation

to improve arterial conditions would be to remove ramp metering in the absence of a major incident.

Findings from the research will be used in identifying the most effective deployments for ATIS components. The characteristics of the geographic area (mostly rural) combined with the high percentage of recreational drivers creates a unique environment for deploying certain ATIS solutions. Additionally, technology is rapidly adapting to a society that desires a broad range of information now. It is recommended that MDOT pursue solutions that expedite the identification and verification of incident location and severity. Secondly, this information should be easily accessible by media outlets and private sector information service providers. Lastly, MDOT should pursue targeted information dissemination deployments that address the needs of the driver profile and geographic conditions that occur in the Triangle Study Area.

7 Operational Concept for the Proposed System

The Triangle Study Area experience a unique level of congestion occurring on the weekend during peak tourist seasons, the summer and winter months. Typically, the summer months experience higher levels of congestion along the major corridors, I-75, US 127, and I-94. There are some alternate routes available, but often at the expense of extended travel time. The trade-off for using the available detour is to know when the congestion level (caused either by pure traffic volumes or incident) creates a delayed travel time that is longer than the alternate route. These peaks in volume normally occur on Fridays and Sundays with recreational weekend traffic. For those traveling through these areas, up-to-date traveler information can improve the experience as a whole regardless of the resulting travel time.

In the summer, large volumes of vacationers travel north via I-75 from Detroit to either second homes or vacation destinations in Traverse City or similar locations. Beginning on Friday morning and lasting into late afternoon, the vacationers set off north. The volume of traffic alone can cause traffic delays lasting for hours. When an incident occurs along any one of the major corridors within the Triangle Study Area, the traffic delays increase and propagate onto alternate routes and surface streets. These incidents can include crashes, construction events, or major planned events and cause significant delays to the traveler. Collecting and disseminating accurate travel conditions to these travelers has become a significant task for MDOT.

During the winter months, the weather can quickly worsen, requiring winter road maintenance agencies to more closely coordinate response to ensure that the roads are cleared and drivable. Winter weather can make driving north more dangerous since the Regions become more rural and maintenance crews are required to clear more miles per maintenance vehicle. The local law enforcement and MSP are on alert during these times of extreme weather and have the authority to close roads or detour travelers to safer routes.

7.1 Incident Management

Figure 13 shows the general flow of information for incidents. Incidents are reported in a number of ways, but primarily through 911 cell phone calls. There are some locations in the Triangle Study Area where cell phone service may be limited. In these areas, incidents may be identified through either land line calls or law enforcement. 911 calls go to either MSP, County Dispatch, or a local dispatch. For the Triangle Study Area there are three regional MSP regional dispatch: Gaylord, East Lansing, and Second District.

Dispatch centers currently send the “closest car” to an incident. The closest car can belong to either MSP, county or local law enforcement despite the responding dispatch center. Field reports are sent back to the dispatch center that originated the call and requirements for additional help, such as fire and ambulance, are addressed. Regional dispatch and local dispatch often communicate via phone or radio, but this communication does not happen for all incidents. Stakeholders will have access to CCTV cameras on major highways across the state and the STOC or the Regional Coordinator will be able to verify incidents and provide more detail to emergency responders. The

STOC will be notified of all incidents that are reported to Regional Dispatch. The STOC will communicate with the dispatch centers to determine whether the incident is likely to impact traffic. If not, the STOC will continue to monitor the incident. If there is a DMS in the area, the STOC can post a message warning approaching traffic of the incident and encourage drivers to increase awareness. If there is an immediate or anticipated impact on traffic, the STOC will provide information to the public through several channels, including DMS messages, alerts to media outlets, the Mi Drive website, and other traffic information providers. Entry of the incident into the ATMS software also will disseminate the information to numerous stakeholders. The STOC will contact County Road Commissions in the area of the incident and coordinate with the Regional Coordinator and other MDOT TMCs as appropriate. For example, incidents on major corridors in the southern portion of the Triangle Study Area would be reported to the MITSC or the Bay Region Regional Coordinator and incidents in the northern portion will be reported to the STOC or North Region Regional Coordinator or the Bay Region Regional Coordinator. During periods of peak recreational traffic, conditions also will be reported to the MITSC in Detroit, the STOC, and possibly the West Michigan TMC in Grand Rapids.

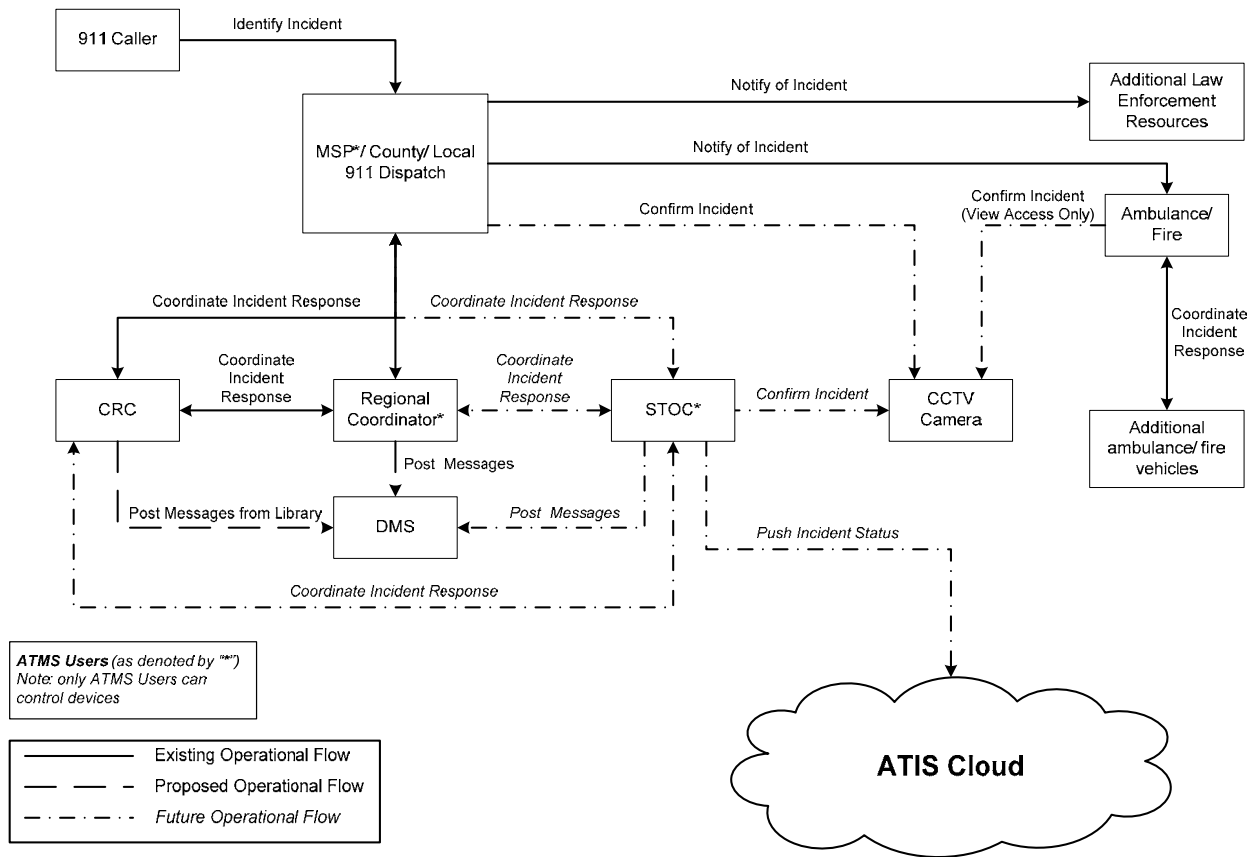


Figure 13. Incident Management

7.2 Road Closure

Figure 14 shows the general flow of information for road closures during incidents. Road closures generally will occur due to major incidents. The STOC role will be similar to that described in 7.1 under incident management. The Regional Coordinator and STOC will work closely with Regional and/or County Dispatch Centers to monitor conditions being reported from law enforcement personnel in the field. The STOC will provide traveler information through a variety of sources, including the media. The STOC also will coordinate with the Regional Coordinator to monitor the progress of MDOT and/or County maintenance personnel, who may be called in to support the road closure. The STOC and Regional Coordinator will provide information on detour routes and will provide updates until the incident is cleared and the road reopened.

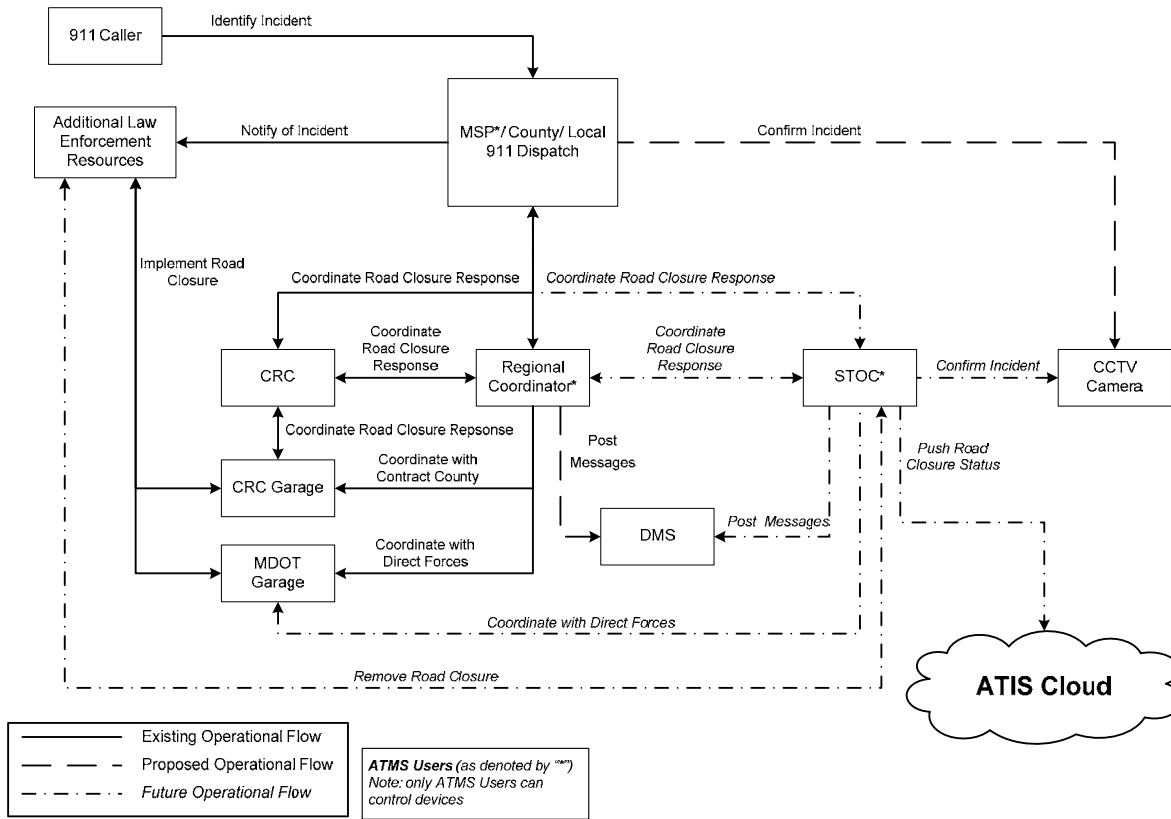


Figure 14. Incident Management – Road Closure

7.3 Construction

Figure 15 shows the general flow of information for construction activity. The Regional Coordinator will compile information on construction activity from the MDOT Lane Closure website database and the Delivery Engineers (DEs) who are responsible for the management of construction projects. DEs on major projects impacting roadway capacity will be contacted on a regular basis for updates. The Regional Coordinator will issue information on these projects through a variety of sources including DMS, media, MI Drive, and other Internet traveler information providers. Updates also will be provided to other Regional Coordinators and counties/local roadway agencies. For some major projects, Smart Work Zones may be implemented to monitor traffic conditions through temporary CCTV cameras and detection equipment. Portable DMS may be used as part of a Smart Work Zone, to slow traffic and advise motorists of conditions ahead. The Regional Coordinator will monitor conditions through the Smart Work Zone. They will provide input and recommendations on messages to be placed on the portable DMS. While the actual activation of messages on the portable DMS will be the responsibility of MDOT field personnel and/or the contractor, this function could be delegated to the Regional Coordinator or the STOC.

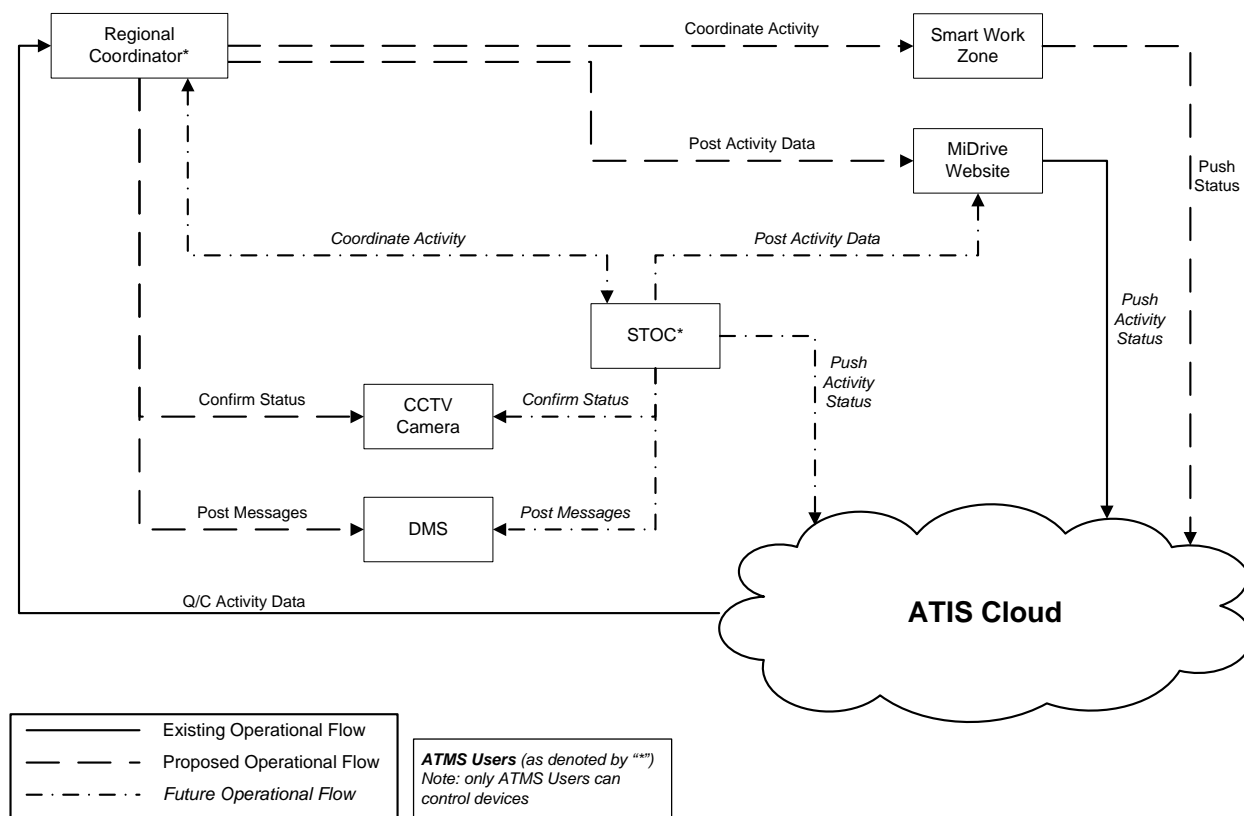


Figure 15. Construction Activity

7.4 Weather

Figure 16 shows the general flow of information for weather activity. The Regional Coordinator will play a key role in supporting field personnel during major weather events. Winter maintenance will be the primary focus of this activity, but other events such as heavy rain, flooding, and fog also can impact highway operations. Maintenance garages and dispatch centers currently receive information from sources such as the Weather Channel and National Weather Service. MDOT is currently developing a ConOps for an RWIS deployment in the North Region, Grand Region, and the Metro Region that will provide the Regional Coordinator and maintenance garages with both atmospheric and roadway surface conditions. An initial deployment of six RWIS in the Superior Region has been deployed; their experience with implementation, operation, and maintenance of the system will provide useful information to the three regions, as well as other regions. It is anticipated that Regional Dispatch and the Regional Coordinator will receive this information, and there is interest from County Dispatch Centers and maintenance garages as well. The Regional Coordinator will supplement this information with field reports from both MSP and County/MDOT maintenance personnel. Reports from snowplow operators will be sent through the maintenance garages back to the Regional Coordinator.

Some of the ESS in the RWIS regional deployment will likely include CCTV cameras, enabling the STOC to monitor conditions at key locations. CCTV camera installations along major highways also will be used to provide confirmation of weather conditions. Updated information will be provided to maintenance garages and to regional dispatch. In addition, the STOC will provide traveler information reports on road conditions. RWIS data will be available via web access. DMS messages will be used, along with media alerts, the Mi Drive website, and other internet traffic information services, to disseminate information to the public. Information also will be provided to other TMCs including the West Michigan, and MITSC and other Regional Coordinators in the North and Bay Regions. Notification also will be provided to other counties and local agencies.

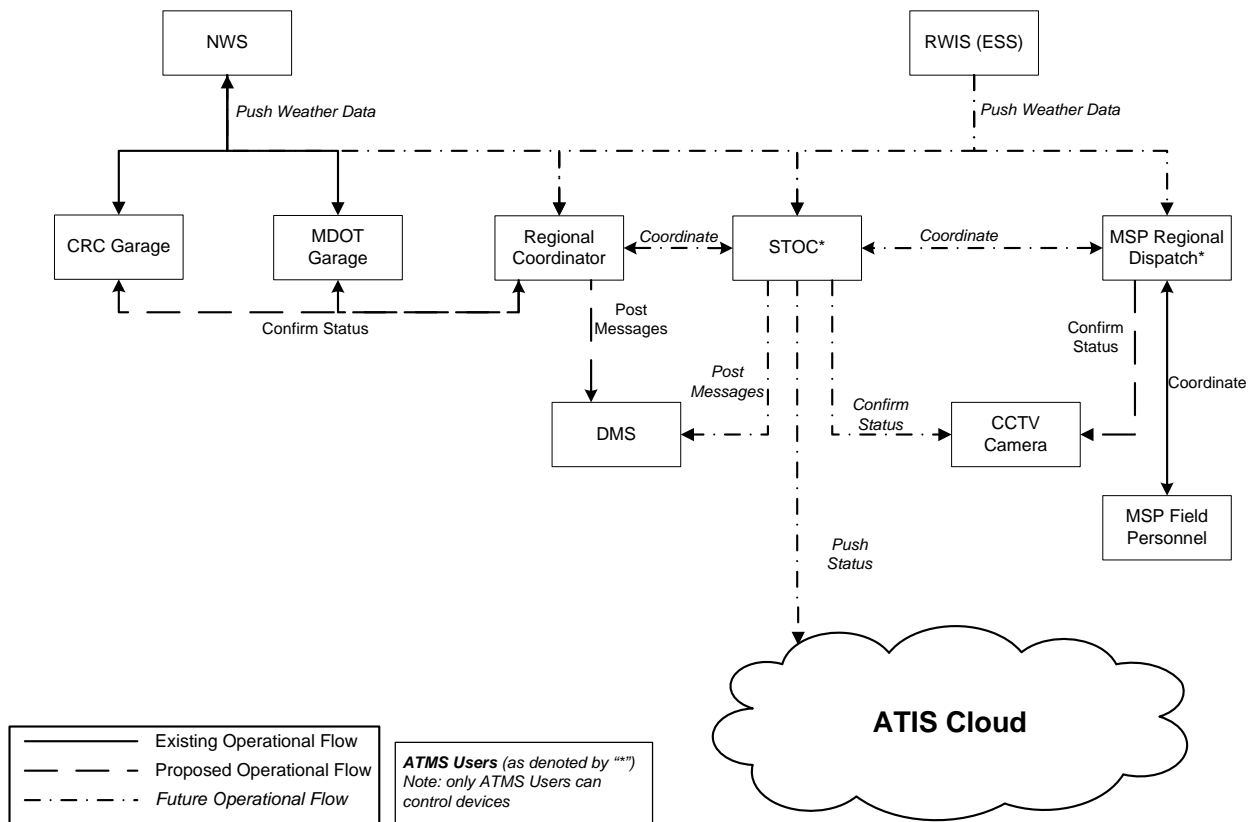


Figure 16. Weather Events

7.5 Advance Traveler Information System

Figure 17 shows the general flow of traveler information. Detection and probe data will be the primary method for collecting traffic information. Additional beneficial data includes images from CCTV cameras and RWIS data from ESS. The Regional Coordinator will coordinate activities with the STOC to monitor the information gathered. They also will work closely with MSP/County/ or

Local dispatch to obtain additional incident data. All of the data collected will be stored in the ATMS software. The STOC will coordinate the distribution of traveler information through a variety of sources, including the media and posting messages via DMS. Mi Drive also will serve as a source of traveler information.

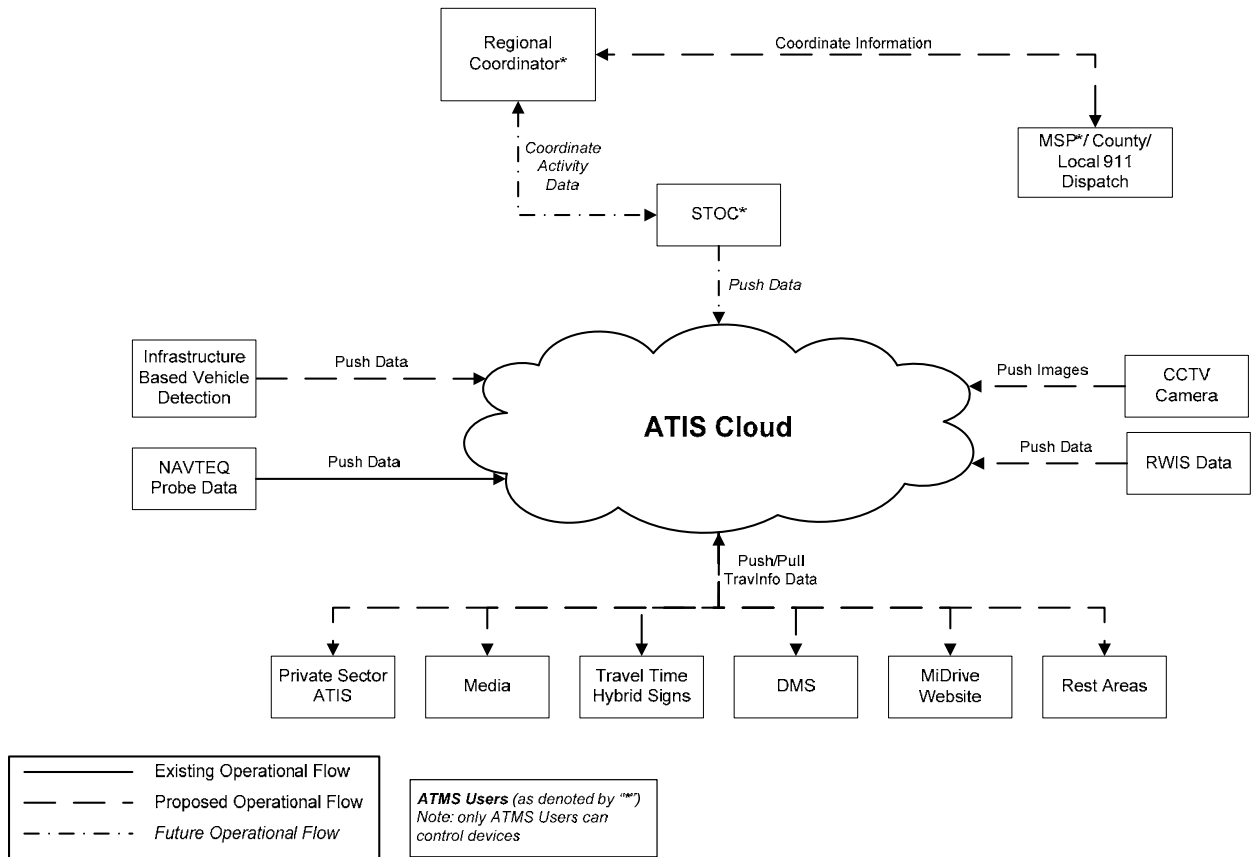


Figure 17. ATIS

8 Analysis of Road Closures

Incidents during peak recreational travel times are a major concern along the Triangle Study Area. Several factors increase both the likelihood and severity of incidents during peak recreational periods.

- Traffic traveling along the rural portions of these corridors, particularly along I-75, often reaches or exceeds capacity during peak recreational weekends. Stop-and-go traffic, which is unusual in many of these areas, can increase the likelihood of crashes particularly when there are unexpected slowdowns that significantly decrease the overall travel speed.
- In rural areas, alternate routes are limited and many motorists are not familiar with the options that do exist. Use of alternate routes also is limited due to the longer distances between interchanges.
- Currently, MDOT-owned surveillance and detection systems primarily exist in the southeast Michigan area, with systems under construction in the Bay region. Additional deployments of CCTV cameras and detection on some of the Triangle Study Area corridors are proposed in the regional ITS deployment plans; however, these deployments will be limited to key interchange locations and will provide limited coverage on the rural corridors.
- The previously mentioned factors combined with the geographic expanse covered by the Triangle Study Area corridors results in increased incident response times, which leads to greater congestion and longer delays.

To supplement the limited coverage, MDOT recently awarded a contract for the acquisition of average speed data from NAVTEQ. This contract will provide travel times along major routes and should help MDOT manage major incidents. This data feed will serve as the primary source of traffic information on the Triangle Study Area corridors for both agency operations personnel and the general public.

In order to assess the impact of major incidents, the MDOT statewide travel demand model was used to simulate two major incidents. One scenario involved a northbound closure on I-75 just south of Saginaw on a peak Friday night, while the other involved a southbound closure on US 127 in Clare just north of the US 10 cutoff to Midland. Both involve “worst-case” scenarios in that they occur in peak direction during busy periods and also occur upstream of a potential diversion point. It was assumed in both cases that the closure would be in place for at least several hours impacting most of the traffic for that day.

The model was used for two purposes; to assess the economic impacts of these incidents and to identify desired alternate routes around these closure points. The economic impacts of these closures in lost travel time and wasted fuel totaled roughly \$175,000 for the closure on I-75, consisting of \$115,000 in lost travel time and \$60,000 in wasted fuel. For the US 127 closure, the total economic cost was approximately \$240,000 including \$175,000 in lost travel time and \$65,000 in wasted fuel. Because most traffic is recreational, rather than work or business-related,

this analysis assumes a value of travel time that is half the amount generally used in IDAS analysis. While this scenario represents an extreme condition, it does indicate that both accumulation of smaller incidents and periodic major incidents are likely to have significant impact in terms of lost time and fuel. Additional costs resulting from secondary crashes and environmental degradation also may result but are not included in this analysis.

Figure 18 and **Figure 19** show possible diversion scenarios for the two incidents, and also indicate the value of a statewide traveler information system. In both scenarios the statewide model was utilized to estimate diversion. The model recalculates travel time based on the origin and destination of the vehicle and the viability of alternate routes, and re-routes traffic to optimize the travel times on the system. The model assumes that motorists have information on downstream incidents and congestion, and can make an informed decision on the most advantageous route. The figures show the estimated magnitude of traffic shifts on key corridors within the Triangle Study Area. Green numbers (which are positive values) show locations where traffic increases as a result of diversion caused by the road closure and red numbers (which are negative values) indicate locations where traffic is reduced. Since the closure in **Figure 18** was in the northbound direction, only northbound volumes are shown. Similarly in **Figure 19**, only southbound volumes are shown since the closure was in that direction. In **Figure 18**, for example, the numbers near the I-75/US 127 interchange show an increase of 10,000 vehicles northbound on US 127 and a reduction of 12,000 vehicles in the southbound direction. It is important to note that much of the traffic diversion occurs along local roads, which are not shown in these figures. It also should be noted that modeled volumes along the stretch of I-75 where the closure was placed tend to be higher than counted volumes. As a result, the estimated level of traffic diverted is slightly higher than what would be anticipated in actual traffic counts.

Figure 18 shows a diversion scenario for a northbound road closure just south of the I-675 loop in Saginaw. The model shows a desire for long-distance traffic to shift over to US 127. Motorists traveling from the Detroit area show a preference for using I-96 to reach US 127, although I-94 is used as well. There also is a large use of local roadways in the Saginaw area to get around the incident and continue along I-75. This is a clear demonstration of the potential benefits of MDOT's probe data system. In case of a major incident, the desired strategy would be to route long-distance traffic away from the vicinity of the incident to a different corridor. This helps to relieve some of the stress on local roadways and allow faster response.

Figure 19 shows the impact of a Sunday southbound closure along US 127 just north of the US 10 cutoff. This scenario shows a much lower rate of diversion than the I-75 northbound closure. This is likely due to a lack of alternate routes north of the incident and the fact that I-75 is experiencing volumes at or above capacity. As a result, the cost of delay in this scenario is slightly higher than that for the I-75 northbound closure scenario. Traveler information in this scenario may recommend that motorists delay departure rather than seek an alternate route.

It is important to note that while the statewide model has been adjusted to account for peak recreational traffic, conditions will vary from week to week during the peak season and this represents only one possible scenario of many. However, several conclusions can be drawn:

- The probe data collection service currently underway can provide critical information to help optimize network performance during peak periods.
- Northbound peak recreational traffic out of southern Michigan has several viable alternate routes if informed early enough about incidents and delays. It is desirable to route traffic away from these congested corridors. Information on the length and severity of delays is important to the decision-making process.
- Southbound peak recreational traffic has limited viable alternate routes. While detours may be necessary during major incidents, they will not have the same benefit as northbound detours. Encouraging travelers to change their departure times may have a more positive impact.
- Both regional and local detours are needed to help relieve incident-related congestion. Review of probe data over time can help to establish where, how, and under what conditions detours are implemented.

Additional deployment of incident management resources during peak travel periods can be helpful in providing more rapid incident response and limiting the costs of delay.

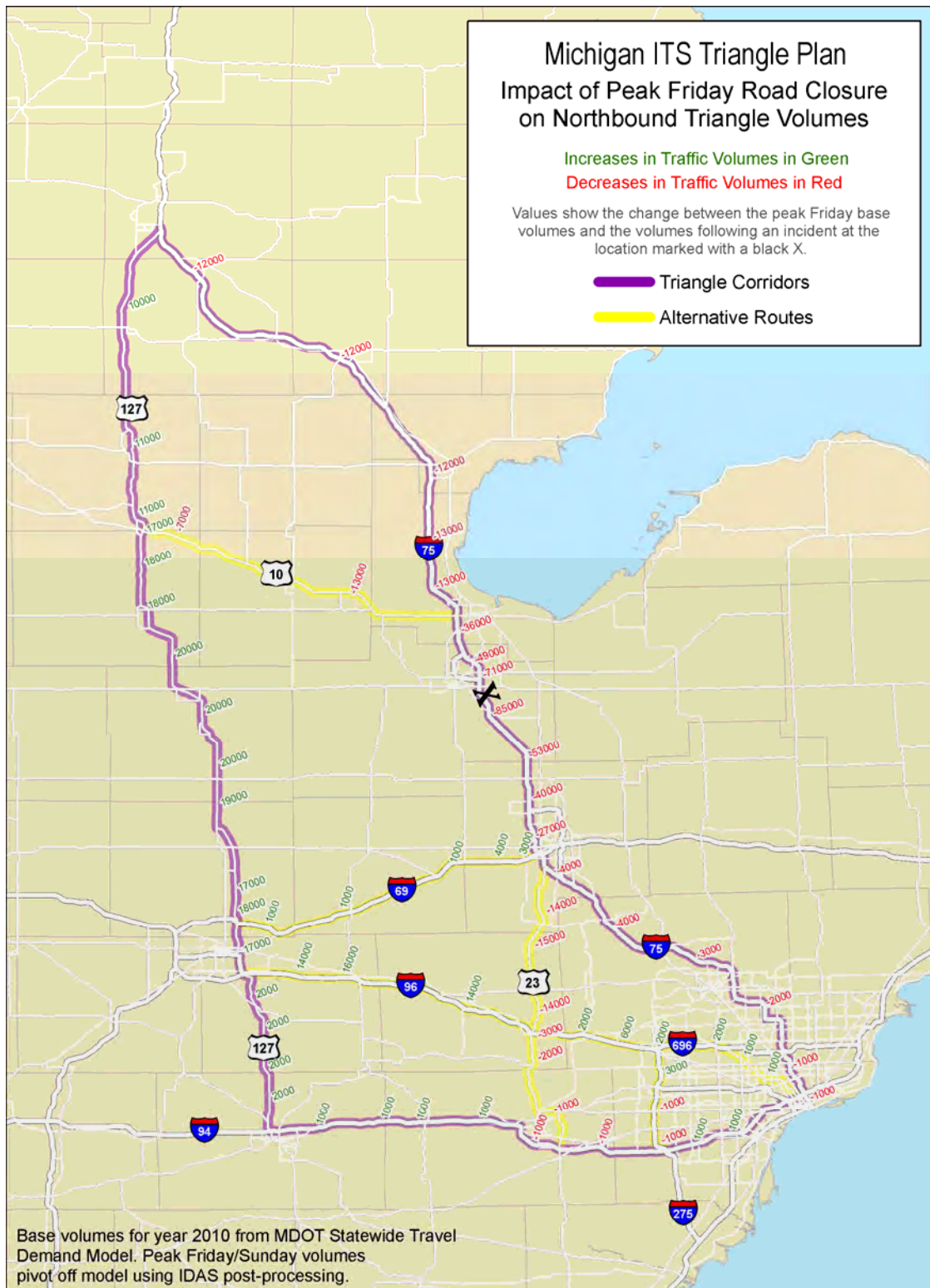


Figure 18. Traffic Impacts of Peak Friday I-75 Northbound Closure

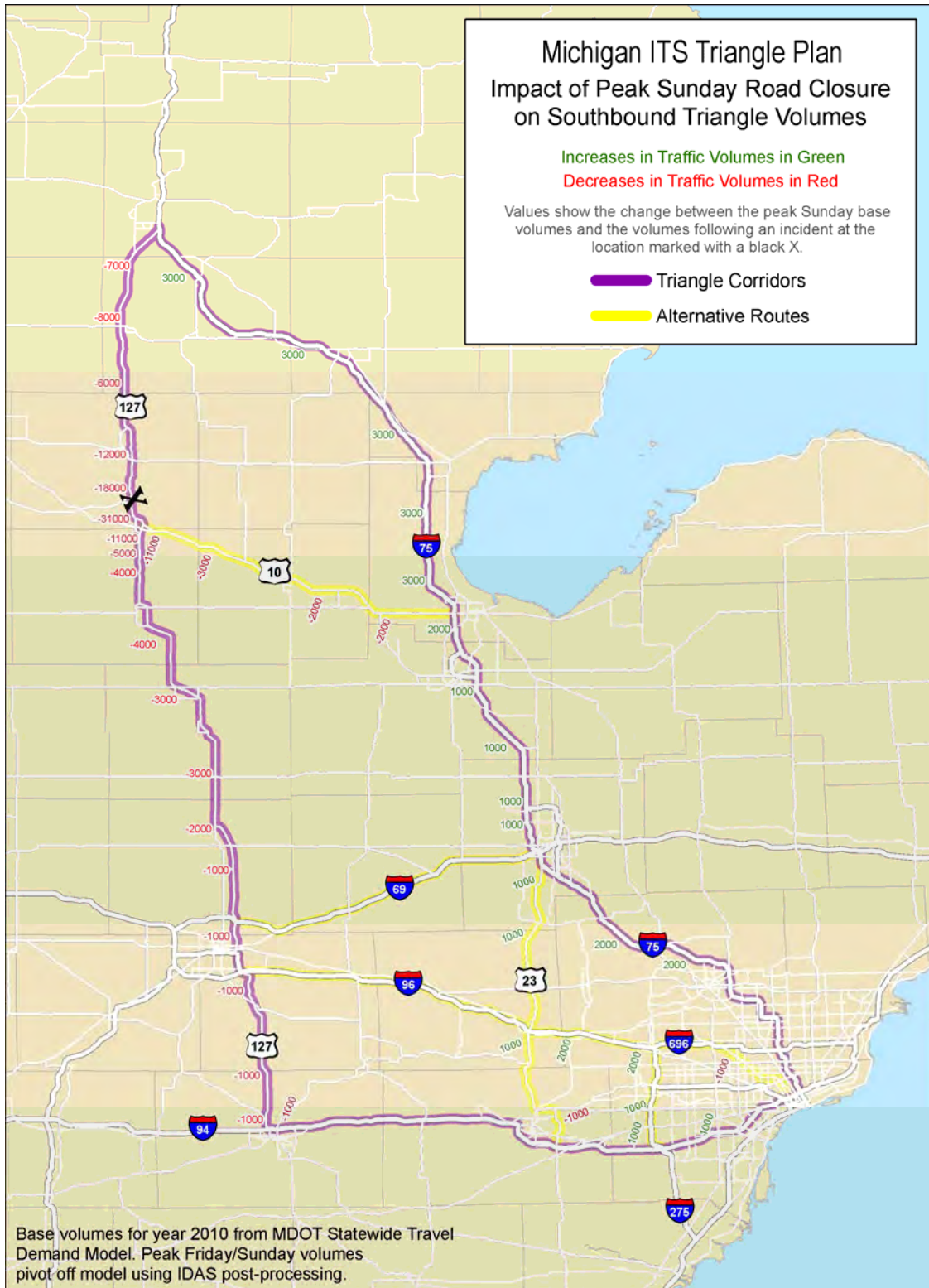


Figure 19. Traffic Impacts of Peak US 127 Southbound Closure

9 Operational Scenarios

This section outlines a series of five scenarios which illustrate how the concept of the proposed ATIS plan would function during common TMC operation situations. Please note this section is designed to give the reader a glimpse of what would occur on a given day given the concept for the Michigan Triangle ATIS plan; however, it is not an all inclusive narrative of all the actions that could take place.

9.1 Operational Tiers

A TMC should be considered an operational function and not necessarily a physical location. The operational need and level of traffic management needed depicts the physical characteristics associated with a TMC; there is no pre-set size, scope or “standard” that can be applied to every TMC. There are a variety of TMCs around the country that vary in size from an operator with a laptop who can access the ITS infrastructure from anywhere to a large multi-jurisdictional facility housing multi-modal functions with 24/7 operations. The TMC operations are segmented into three tiers of responsibilities. Each tier presents an example of the physical and operational environment of a TMC. A brief description of each tier is listed below.

- Tier 1: a traffic management facility operating 24/7 with multi-modal functions; monitors and controls devices; coordinates between various agencies; provides traveler information; and can dispatch transit, freeway courtesy patrol, and public safety personnel.
- Tier 2: a staffed traffic management center operating during predetermined hours; it may be co-located with other agencies; monitors and controls devices; coordinates between other TMC or TSC facilities; provides traveler information.
- Tier 3: “on-call” or “as needed” operations; special event operations, no set daily hours of operation; provides secondary monitoring and control of devices; coordinates between other agencies.

Figure 20 illustrates this “spectrum” of TMCs. On the left is a picture of the Texas DOT’s Houston TranStar TMC, which represents a Tier 1 TMC. The middle picture is The City of Chesapeake’s R. Wayne Harrell TMC as an example of a Tier 2. The Tier 3 example on the right depicts an MDOT ATMS user accessing devices on a laptop.



Figure 20. Spectrum of TMCs in Form and Function

9.2 Peak Hours

The Gaylord Regional Dispatch Center receives a call at 4 PM on a Friday afternoon from a bystander reporting a crash on I-75 in Ogemaw County. The operator obtains the precise location of the incident which is northbound just north of the M-30 interchange near West Branch. The operator puts out a call to identify the closest vehicle, which is an MSP vehicle on I-75 southbound in Roscommon County. There are no CCTV cameras available near the incident location, so the operator waits for the initial response vehicle to reach the scene and verify the incident location and severity. Based on the bystander description, fire and EMS also are dispatched. The operator receives verification from the MSP trooper arriving at the scene that this is a serious crash. Once the incident is input into the CAD system, the severity level selected warrants a statewide notification of the incident. This notification is broadcast to the Regional Coordinators in the North and Bay regions. The North Region operator takes primary notification responsibility and displays the event within the ATMS software. Emails are activated to additional MDOT offices including the nearby TSCs; all TMCs in the state; and key personnel in the MDOT Lansing offices, including the STOC. The Gaylord Regional notifies key local and county personnel.

The incident description received from the responding officer states that six vehicles are involved including one commercial vehicle. The incident scene appears to include two fatalities and several severe injuries. The MSP and MDOT personnel decide that it is likely going to take more than four hours to clear the incident scene due to the severity of the incident. They immediately decide to close the Interstate northbound. The North Region Regional Coordinator updates the information in the ATMS and additional fire and EMS are dispatched to the scene. Several tow trucks are called to the scene while several others are put on standby. Additional MSP personnel are called to close the

road and divert traffic. DMS signs are activated along I-75 south of the crash and advise that traffic traveling toward Grayling and points north should divert to US 10 and US 127. A detour is set up at the US 23/M-13 cutoff with motorists diverted to either US 23 or M-61. A local detour is set-up using MSP personnel to divert traffic off northbound I-75 at the M-30 interchange and traffic is detoured along M-30 to M-55.

First responders arrive and begin coordinating with ambulances to transport the injured to nearby hospitals. It takes five hours to remove the injured and clear the accident scene. During this period, all DMS signs south of the incident are used to notify the public. Recreational and long distance travelers are advised through the MIDrive website to delay northbound trips. Email notifications are distributed to media around the State. On-duty operations personnel at the STOC in Lansing monitor the situation using the statewide ATMS software. The MSP and MDOT monitor freeway detour routes using available probe data from the statewide system. During the incident, traffic backs up at the US 10 interchange with US 127 northbound, but no action is taken other than to continue informing motorists through DMS and media outlets. The local detour also becomes gridlocked so the MSP institute a secondary detour using M-33 northbound to M-76 northbound to M-55 westbound.

Five hours after the incident occurred, it has been cleared and the northbound lanes on I-75 are reopened. The North Region Regional Coordinator inputs the updated incident information into the ATMS software and notifies Gaylord Regional, who updates the CAD system. The updated information in the ATMS is pushed to MIDrive and media outlets. The STOC Operators update DMS messages to inform motorists that I-75 northbound is open to traffic. Over the next two hours, the probe data along the detour routes is closely monitored by MDOT and MSP to confirm traffic flow is regaining “typical” operations.

9.3 After Hours – Scenario 1

The Gaylord Regional Dispatch Center receives a 911 call at 1 PM on a Wednesday afternoon in September from a motorist reporting a crash that occurred on southbound I-75 in Saginaw County just north of the northern I-675 interchange. As additional calls come in, the operator obtains the precise location of the incident which is approximately three-eighths of a mile north of the I-675 off-ramp and enters it into the CAD system. Regional Coordinators in the Bay and North regions are automatically notified of the crash. The Bay Region Regional Coordinator takes on the primary responsibility and enters the incident into the ATMS. A passersby reports that there are two passenger cars involved with major damage to at least one vehicle but no apparent injuries in either vehicle. One of the vehicles is on the shoulder while the other is turned at a right angle and is blocking part of the right lane. The Bay Region Regional Coordinator coordinates with STOC. The STOC operator is able to turn a CCTV camera located north of the I-75/I-675 interchange to obtain a look at the scene. The operator is not able to get a close enough look to determine the extent of injuries or vehicle damage, but the operator can confirm that the right lane is blocked. Since it is mid-day, traffic is light and seems to be using the left lane to move around the crash. The operator reports these details to Gaylord Regional. Due to the uncertainty, the Gaylord Regional operator

alerts ambulance and fire who start toward the scene. The STOC operator activates DMSs on southbound I-75 near Grayling and north of Bay City, along with the DMS on eastbound US 10 at Midland to notify drivers that one southbound lane is closed due to a crash on I-75 at Saginaw. The Regional Coordinator sends emails to nearby TSCs and both the Saginaw Regional office and Bay City TSC are notified that MDOT personnel will be needed to clean up the site. MDOT does not recommend detours or alternate routes at this time since traffic is moving past the crash. The STOC operator brings up the probe data map for I-75 and connecting freeways to monitor traffic and take additional actions if major backups begin to occur behind the site of the crash.

The CAD operator puts out a call to identify the closest law enforcement vehicle, which is a county vehicle approaching downtown Saginaw from the west on M-58 (State Street). An MSP vehicle heading north on I-75 just south of Saginaw also is identified. The operator tells both vehicles that traffic is moving past the crash and that they can access the scene quickly from the north. Both vehicles head toward the scene via northbound I-75 and are able to use a turnaround about a ½ mile north of the accident scene. The law enforcement vehicles reach the scene and confirm that at least one vehicle will need be towed and possibly both. Each vehicle had a single occupant who is outside and appears not to be injured. One driver, however, appears a bit unsteady and law enforcement requests that ambulance and fire continue on their way to the scene. The CAD operator calls the local tow company to dispatch two tow trucks to remove the vehicles from the scene. Law enforcement begins to direct traffic around the scene and fire, ambulance and tow trucks arrive quickly. One vehicle is towed away and the driver is taken by ambulance to a nearby hospital for observation. The other vehicle is drivable and the driver is uninjured. Law enforcement personnel complete their reports and notify Gaylord Regional that the scene is clear. While the scene was being cleared traffic began to back up and the queue on I-75 southbound reached approximately two miles. As the STOC operator observed a decline in speeds upstream from the scene, additional notifications were sent to the media and other MDOT personnel that traffic was backed up from the crash. The length of the backup was added to DMS messages and modified as the queue increased. After approximately 30 minutes, traffic began to flow freely again; DMS messages were removed and notifications were sent that the incident was closed.

9.4 After Hours – Scenario 2

The MDOT Metro Region Office informs local television and radio stations of construction along I-75 where lanes will be closed during the event. The stations report that the two-lane closure along I-75 is between 12 Mile Road and M-59. It will begin April 1 and continue through September 25. The 15-mile stretch of road is under construction for bridge work and resurfacing. MDOT will maintain updates about the construction on their website.

MDOT has already coordinated with the Road Commission for Oakland County (RCOC) and MSP about the work zones. They have worked together to identify potential diversion or alternate routes. MDOT will provide a detour route at least one week prior. These routes will be posted on the MDOT MIDrive and RCOC websites, on the portable DMS located in the work zones, and communicated to the media.

The MITSC Operator will enter the construction event into ATMS as a scheduled event. The dates of the event are entered in addition to the type. The speed detectors that are deployed along the corridor in addition to the CCTV cameras will supplement the existing data collected to monitor the activity along the corridor.

MSP and the MITSC Operator continue to monitor the work zone and are prepared to detour traffic based on a significant traffic delay or a large incident. They will use the pre-defined routes and procedures already established.

9.5 After Hours – Scenario 3

The MDOT University Region Office informs the local television and radio stations of construction along US 127 where lanes will be closed during the event. The stations report that the one-lane closure along US 127 is between I-96 and the Ingham County line. It will begin June 1 and continue through August 17. The 15-mile stretch of road is under construction for resurfacing. MDOT will maintain updates about the construction on their website.

MDOT has already coordinated with the Ingham County Road Commission, MSP, and local law enforcements about the work zones. They have worked together to identify potential diversion or alternate routes. MDOT will provide a detour route at least one week prior. These routes will be posted on the MDOT MIDrive website, portable DMS which are located in the work zones, and communicated to the media. A flagger will be on-site to assist with the movement of traffic in certain areas along the corridor.

The STOC Operator will enter the construction event into the ATMS as a scheduled event. The dates of the event are entered in addition to the type. The speed detectors that are deployed along the corridor will supplement the existing data collected to monitor the activity along the corridor.

MSP and the STOC Operator will continue to monitor the work zone and are prepared to detour traffic in case of a significant traffic delay or a large incident. They will use the pre-defined routes and procedures already established.

9.6 After Hours – Scenario 4

At 8 PM on Monday, March 5, the NWS issues a warning for possible frozen precipitation in western and central Michigan, starting in the early morning hours of Tuesday and continuing until mid-morning. Temperatures are forecast to hover around freezing in the area from Lake Michigan east to the US 127 corridor. In the central portion of the State, snow is anticipated north of Clare with a high probability of ice/freezing rain between Clare and Jackson. As the storm moves east it is expected to warm up and turn to rain by the time it reaches the urban areas along the I-75 corridor. The major highways most likely to be impacted by icing include US 127, I-69, US 10, and I-96. Impacts also could occur along the northern portion of I-75 and I-94. A small shift in the storm track could dramatically change the situation.

MDOT TSCs in the impacted regions (Metro, University, Bay and North), as well as county garages have been tracking RWIS data and following the NWS forecasts. The North and Bay Regional Coordinators, as well as MITSC and the STOC in Lansing are put on alert and begin tracking the storm as well. As the storm approaches, they closely track pavement temperatures throughout the region with special focus on the US 127 corridor and the major east-west freeways between I-94 north and the I-75/US 127 junction. The STOC places a notice of potentially hazardous conditions on the MIDrive website. The boundaries of the impacted region are shown, but no specific routes are identified due to the rapidly changing forecast. Motorists are urged to continuously monitor weather conditions.

The NWS initiates webinars for MDOT personnel, county maintenance personnel, and emergency managers. Webinars are held prior to major winter storms, which are defined as storms with projected snowfall of 6" or more or an ice event. The webinars, previously available only from the Grand Rapids NWS office, were initiated throughout the state and are coordinated through the new statewide ATMS software installed statewide. During the webinar, NWS forecasters express greater confidence that the area of ice and freezing rain will occur between Lansing and Gaylord. Light snow is likely in the area west of US 127, but the NWS now believes that the I-75 corridor from Flint north could be impacted by ice and freezing rain. Rain is likely in the Detroit area as temperatures will stay in the high 30s.

County Road Commissions and MDOT forces in the area forecast to be impacted by the storm begin pre-treatment of roadways around midnight. CRC maintenance personnel begin pretreatment of local roads. Additional forces stand ready to be mobilized in case icing does occur further north and east than forecast. The North Region, Bay Region, and STOC call in staff overnight to monitor the situation, provide support to law enforcement and maintenance personnel, and update traveler advisories. They begin to monitor travel speeds using the probe data system, since slowing speeds at this time of light traffic will provide an early indication of snow or ice.

Around 3 AM an ESS station on US 127 at Mt. Pleasant shows air temperatures just above freezing and surface temperatures slightly below. Similar readings are found in the Lansing area with road temperatures just above freezing. Just before 4 AM ESS stations at Mt. Pleasant and Grayling both begin to report that frozen precipitation is falling. The ESS station in Lansing reports that rain is falling and road surface temperatures are still above freezing. The STOC confirms with the North Regional Coordinator and issues a media alert and places advisory messages on DMS along US 127, US 10, I-75 and I-96 that all roads north of Lansing could be impacted by ice and freezing rain. Reports from field personnel indicate that pretreatment has been effective and that most roads in the impacted area are free of ice. Around 5 AM ESS stations and field reports from the I-75 corridor indicate that rain is falling from Bay City south but that some freezing rain is being experienced north of Bay City*; however, road surfaces do not appear to be icing over in this area. The STOC expands its warning to note that ice and freezing rain are being experienced north of Bay City on I-75. TMC personnel tracking speeds notice a pronounced slowdown in speeds throughout the area where freezing rain is falling. Average speeds in the range of 20-30 MPH are reported on US 127 north of St. Johns, on US 10 between I-75 and US 127 and on I-75 north of Standish.

Around 6 AM, probe data indicate a traffic stoppage on US 127 just north of Harrison as speeds go to zero. A report comes in about 10 minutes later from Gaylord Regional that a multi-vehicle crash has occurred on US 127 southbound just north of Harrison. Law enforcement personnel are dispatched to the scene and report that injuries have been sustained in the crash, but appear to be minor. Law enforcement personnel decide to temporarily close the road on the southbound side. Due to the lack of a viable alternate route, and uncertainty about conditions on local roads, law enforcement decides not to implement a detour. DMS on southbound I-75 at Grayling and Gaylord are updated with information about the crash. A media alert is issued by the STOC and is updated regularly. Field observations and probe data are used to monitor the corridor and provide updates to the public regarding the length of the queue. The DMS north of the crash and the web alerts advise traffic traveling southbound on I-75 to avoid US 127 southbound if possible. Around 7:15 AM, the North and Bay Regional Coordinators, and STOC receive word from MSP that the incident has been cleared and US 127 southbound reopened. A media alert is issued that the road has reopened.

By 9 AM temperatures move above freezing throughout the region. Both field reports and ESS indicate that major roads are free of ice, although they are still wet and the possibility of isolated icy spots remains, especially in the northern portions of the region. Maintenance crews turn their attention to minor roads.

**Currently MDOT is deploying ESS in the Superior and North Regions, and is completing plans for the Metro and Grand Regions. No plans currently exist for the University and Bay Regions, but this case study assumes that at some point in the future all MDOT Regions will deploy ESS along major trunk routes.*

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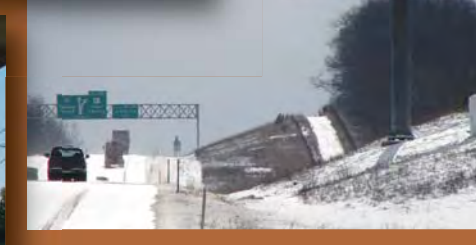


I-75, US 127, I-94 TRIANGLE ATIS PLAN

FINAL HIGH LEVEL
DESIGN DOCUMENT



WHEN SNOW FALLS
SO SHOULD
YOUR SPEED



Kimley-Horn
of Michigan, Inc.





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List of Acronyms

ATIS	Advance Traveler Information System
ATMS	Advance Transportation Management System
CAD	Computer-aided Dispatch
CCTV	Closed Circuit Television
CRC	County Road Commission
DMS	Dynamic Message Sign
ESS	Environmental Sensor Stations
FCP	Freeway Courtesy Patrol
HAR	Highway Advisory Radio
IDAS	ITS Deployment Analysis System
ITS	Intelligent Transportation System
MBA	Mackinac Bridge Authority
MDOT	Michigan Department of Transportation
MSP	Michigan State Police
RCTO	Regional Concept for Transportation Operations
RWIS	Road Weather Information System
SMS	Short Message Service
STOC	Statewide Transportation Operation Center
TMC	Transportation Management Center
TOC	Transportation Operation Center



Overview

The Triangle Advanced Traveler Information System (ATIS) Plan is intended to provide solutions that allow the stakeholders within the I-75, US 127, and I-94 Triangle Study Area corridors to collect and disseminate more accurate road condition data to the seasonal travelers visiting northern Michigan and to the commuters who live within the study area. The traffic environment within the study area includes unique high volumes of seasonal traffic traveling to and from key destinations such as recreational lakes, ski resorts, and casinos along the I-75 corridor during weekends. The I-75 and US 127 parallel routes can experience major breakdowns in services due to major incidents, construction activities, or adverse weather events that occur during the weekday or weekend. The challenge of monitoring road conditions also is increased by the large geographic coverage of the study area.

The study area includes portions of four Michigan Department of Transportation (MDOT) regions: Metro, University, North, and Bay. Within the study area, there are a limited number of north-south alternative route options. They were examined as well as east-west connectors and loops that include I-69, I-96, I-275, I-696, US 10, and US 23. Additional local loops that also were examined include I-475 in Flint and I-675 in Saginaw. **Figure 1** displays the study area and the possible connectors that are viable options. These all

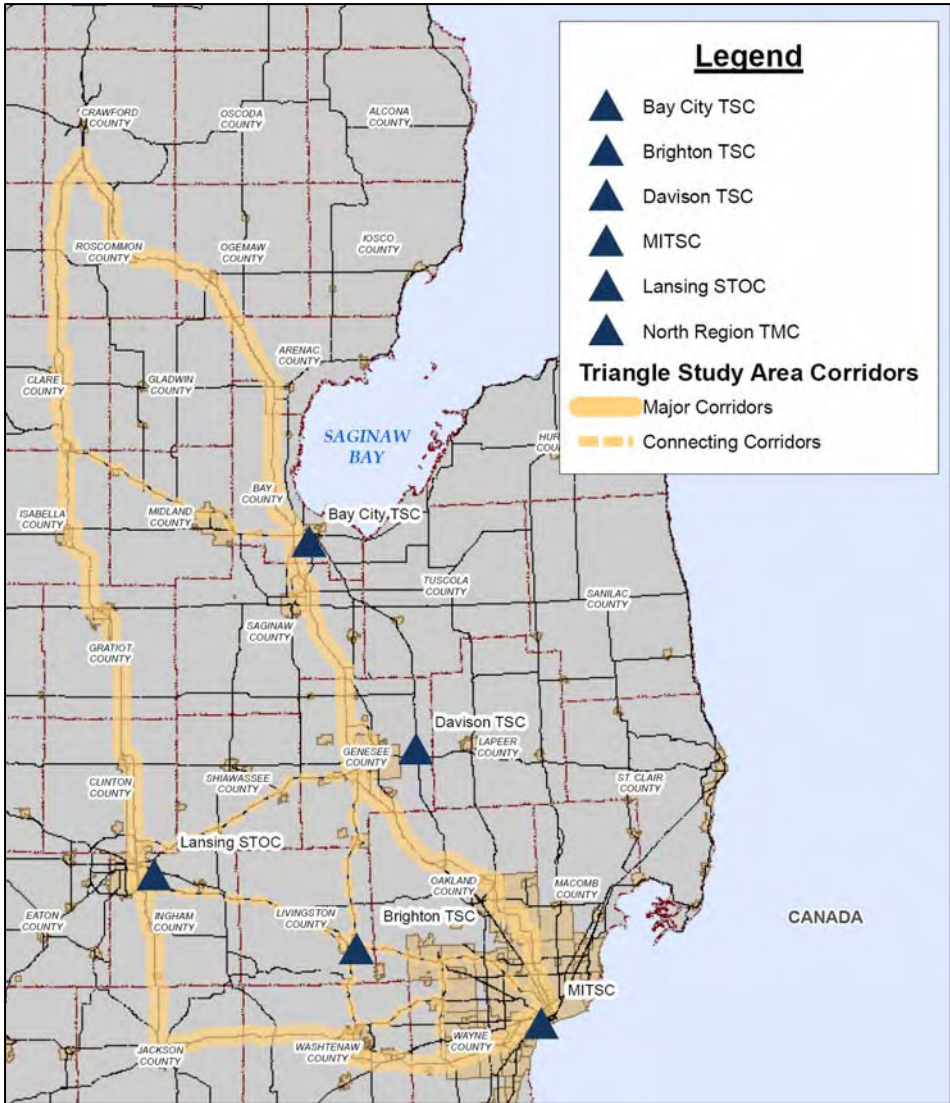


Figure 1. MDOT Triangle ATIS Study Area



are considered key corridors in this study.

The primary goal for the I-75, US 127, I-94 Triangle ATIS plan is to provide reliable traveler information by delivering a consistent message across the region. To attain this goal, the plan will provide MDOT with a comprehensive Concept of Operations and a High Level Design.

The Concept of Operations document identifies existing conditions, proposed deployments, and planned operations for the regional Intelligent Transportation System (ITS) deployment. It provides an analysis of the corridor; research and development of approaches and tactics; and institutional and operational environment.

The High Level Design Document presents the high level requirements developed from the user needs of the regional plan and aligns tactics that address those requirements. Individual tactics are identified to introduce general concepts for ATIS solutions. After stakeholder feedback, the tactics were refined into more specific projects with estimated costs and packaged into recommended phases for implementation.

Triangle Study Corridor

MDOT has recently initiated a contract to purchase third party data on all freeways in the state. This data will serve as a foundation for traveler information in the study area. Additional ITS solutions will enhance the opportunity to supplement the collection of real

time travel information and the ability to share it with a range of partners as well as the public.

ATIS connects a transportation user with the most up-to-date data specific to their current or planned trip. A comprehensive ATIS includes data about traffic conditions, incident details, transit arrival times, toll costs, and other data that assists the user in making the most informed decision. The data helps the user choose the most efficient route to their final destination.

The possible solutions should fit within MDOT's limited financial resources, but also allow management across multiple lines of responsibilities and agencies.

Stakeholders

The stakeholders establish the foundation and the needs of the project. They include the local agencies, emergency responders, County Road Commissions (CRC), and MDOT. The stakeholders identified for the Triangle ATIS Plan are listed in **Table 1**.

The users represent the agencies and categories of travelers that will access the data available through the ATIS. The users of the proposed plan are identified in **Table 1**.



Table 1. Corridor Stakeholders and Use

Stakeholders and Users	Stakeholder	User
MDOT	●	●
County Road Commission (CRC)	●	●
Local Agencies	●	●
Michigan State Police (MSP)	●	●
Local Public Safety Answering Points (PSAPs)	●	●
County Emergency Operations Center (EOC)	●	●
National Weather Service	●	●
Freight/ Trucking Industry		●
Local Users		●
Vacation Travelers		●
Commuters		●
Other States		●

Implementation

The implementation of ATIS within the Triangle Study Area needs to focus on pre-trip traveler information, en-route traveler information, and traveler information dissemination technologies. Traveler information may either be static or dynamic (real time). Both will assist the user in making trip preparations and en-route decisions. As mentioned in the US DOT *Developing Traveler Information Systems Using the National ITS Architecture*, characteristics of this information are described as:

- Timely, Accurate, and Available – travel information needs to be current and received in a timely fashion in order to respond to it. The

information needs to be correct regardless the type of information displayed. Also, the information needs to be available at any time.

- Cost Effective – Users are willing to pay for information as long as the cost is reasonable, the information will save time, and if it is relevant to the user.
- Provides Route and Decision Guidance – the information must be specific with certain details, such as location, times, and alternate routes.
- Easy to Access and Easy to Use – the user should be able to access the information in any form and from any location.
- Safety Implications – the information should help the user avoid dangerous situations such as a bad accident or similar incident.

Factors documented in the Statewide Long Range Transportation plan along with an evaluation of the travel demand model, traffic patterns, and safety issues were used in conjunction with the ITS Deployment Analysis System (IDAS) model, that was developed as part of this project, to evaluate ITS alternatives. General characteristics of the various patterns resulting from the analysis are located in **Table 2.**



Table 2. Description of Seasonal Patterns

Pattern	Description	Location
1	Represents low seasonal variability typically found in routes between urban areas. This travel pattern has a low summer peak and a low winter dip.	Grand Rapids, Kalamazoo, and Flint
2	Represents high seasonal variability usually associated with rural areas throughout the state. This group shows a moderately low summer peak and moderate winter dip.	Southern half of Lower Peninsula.
3	Represents a low seasonal variability typically found in urban areas. This travel pattern has a flat summer with below average weekend traffic.	Lansing, Detroit, Flint
4	Represents very high seasonal variability usually associated with recreational travel patterns such as tourism-related travel and second homes. These patterns have high peaks on Friday and Sunday during the summer months.	Northern Lower Peninsula
5	Represents high seasonal variability with a high summer peak and sharp December decline.	Northern Lower Peninsula and the Upper Peninsula
6	Seasonal variability with a moderate summer peak.	Upper Peninsula
7	Represents a monthly variation that reflects the typical urban pattern, but drops very little on Saturday, as opposed to Pattern 3.	Fringes of urban areas
8	Represents very high seasonal variability usually associated with recreational patterns, with high summer peaks and low winter volumes.	Summer recreational areas

Operational Support

A key component to an effective and reliable system is to collect real time traffic data over a wide area. In June 2009, MDOT and NAVTEQ signed a formal contract agreement. NAVTEQ will be providing segmented speed data that will be updated at a minimum of once every five minutes.

Within the four MDOT regions, there is collaboration amongst several agencies, including Michigan State Police (MSP), MDOT, local agencies, and CRC. There are already established partnerships that consistently communicate with each other to ensure the correct information is reaching the correct destination.

In Michigan, the road surface maintenance and winter weather maintenance activities are conducted by MDOT for the “Direct Forces” counties and contracted to municipalities or county road commissions for “Contract” Counties. In the Triangle Study Area, all of the counties are Contract, except for Isabella, Saginaw, Eaton, Ingham, and Livingston Counties.

Concurrent Efforts

Currently, there are a number of ongoing efforts within the area that this plan can build upon. MDOT is trying to focus on technology that would provide travelers along the Triangle Study Area with trip information they can use to make more informed decisions about their route choices.



MDOT is in the process of procuring Advanced Traffic Management System (ATMS) software in preparation for the increased operations of ITS across the state. The new software will be the standard platform for controlling ITS field devices and sharing real-time incident, construction and special event information throughout Michigan. This software also will be available for use by some non-MDOT agencies, such as County Road Commissions, public safety agencies, and other local transportation agencies. The ATMS software will be the primary software tool used by all Transportation Management Centers (TMCs) in the state and should improve the effectiveness and efficiency of transportation management throughout the state.

There are multiple computer-aided dispatch (CAD) software platforms being used across the Triangle Study Area. Because of this, not every incident is recorded within the MSP CAD system and, therefore not automatically sent to MDOT via the ATMS. Incident information entered into the ATMS is distributed to stakeholders statewide, including other TMCs, local agencies, the public, and the media.



Existing Deployment

MDOT has invested in establishing a substantial existing and planned ITS deployment within the study area. The majority of the deployments exist in the MDOT Metro region, but several projects are underway and planned to expand systems in the University, Bay, and North regions. This committed infrastructure serves as the foundation for the solutions proposed.

The projects include infrastructure deployments, systems integration, and operations projects to improve the management of ITS. The infrastructure projects include systems focused on collecting data such as road weather conditions with the North Region Environmental Sensor Stations (ESS); travel times through the Probe Data contract; and expanded closed-circuit television (CCTV) camera coverage on I-75 in Troy. Additionally, expansions of the existing freeway management systems are planned in all regions such as Genesee County, the Bay Region, and the US 23 / I-96 corridors. The main systems integration project is implementing a single user interface with the Statewide ATMS software procurement. Lastly, additional operational responsibilities are being planned within the study area including funded projects in Ann Arbor, Genesee County, and Bay City.

Along with the existing infrastructure that is mapped on the next page, additional projects are currently underway and funded. These projects are listed below as either under construction or in design. Additionally, some of the systems integration projects also are presented.

Projects under Construction (estimated completion date)

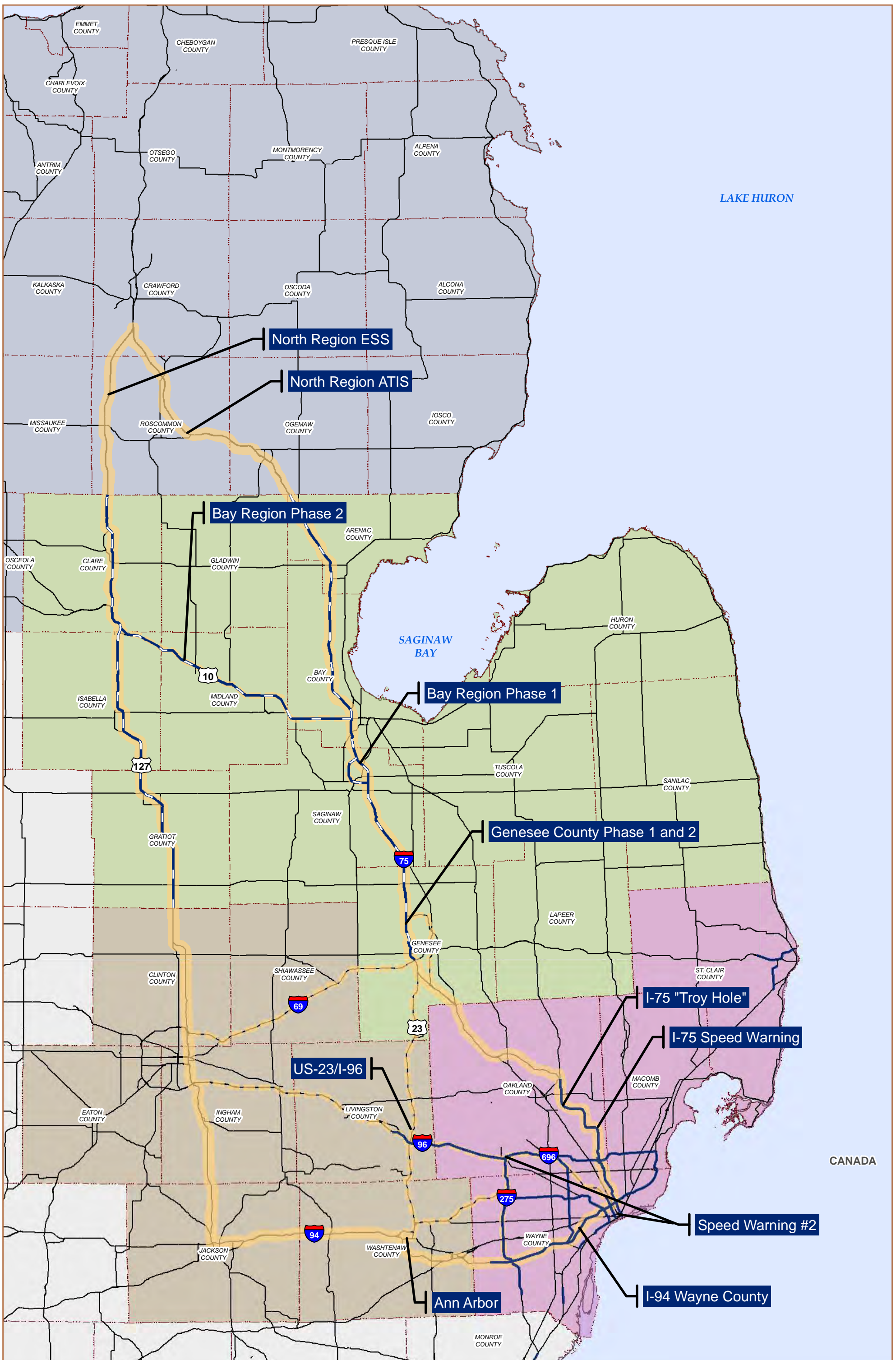
- Genesee County Phase 1 (June 2010)
- Bay Region Phase 1 (June 2011)
- US 23 / I-96 (October 2010)
- I-75 “Troy Hole” (June 2010)
- I-75 Speed Warning (June 2010)
- Speed Warning #2 (November 2011)

Projects in Design

- I-94 Wayne County
- North Region ATIS
- North Region ESS
- Ann Arbor
- Genesee County Phase 2
- Bay Region Phase 2

Systems-Related Projects for Integration

- Statewide ATMS Software (under procurement)
- NAVTEQ Probe Data
- Integration of Probe Data with Bay Region Phase 2
- Travel Times on Construction Zone Signs



Triangle Study Area Corridors **Concurrent/Existing Projects** **Proposed ITS Corridors**

— Major Corridors — Metro ITS Deployment — Bay Implementation Deployment
- - - Alternate Corridors

**I-75, US 127, and I-94 Triangle ATIS Plan
Concurrent Projects**



High Level Requirements

User needs were identified through the development of the Concept of Operations and the stakeholder workshop conducted. The revised Concept of Operations will capture the final user needs of the project. Leading into the development of tactics, the user needs were used to derive high level requirements. Those requirements are presented here in four specific categories.

1. Traveler Based Requirements

- 1.1. The traveler shall be able to determine current travel times.
- 1.2. The traveler shall be able to access information about all confirmed incidents, including crashes, construction events, and major planned events.
- 1.3. The traveler information shall be updated frequently to provide an accurate description of current conditions.
- 1.4. Collection and dissemination of traveler information shall be as automated as possible.
- 1.5. The traveler shall be able to access information about current driving conditions (e.g., road weather).
- 1.6. The traveler shall be able to access information about current road closures.
- 1.7. The traveler shall be able to determine current detour routes.
- 1.8. The traveler shall be able to report an incident via 911, where cellular service is available.

2. Public Safety Requirements

- 2.1. Law enforcement personnel shall always be able to contact their dispatch center through their radio link on even the most remote sections of roadway.
- 2.2. Either on-site law enforcement or the regional coordinator (RC) / statewide transportation operations center (STOC) operators shall be able to confirm reported incidents with a CCTV camera image of the scene.
- 2.3. Regional dispatch shall be able to notify the RC / STOC of all reported incidents (confirmed or unconfirmed).
- 2.4. Regional dispatch shall be able to advise the RC / STOC whether the incident is likely to impact traffic.

3. Regional Coordinator / STOC Requirements

- 3.1. The RC / STOC shall be able to post appropriate messages on nearby dynamic message signs (DMS).
- 3.2. The RC / STOC shall be able to alert media outlets of confirmed incidents and current road weather conditions.
- 3.3. The RC / STOC shall be able to post information on the MI Drive website about all confirmed incidents and current road weather conditions.
- 3.4. The RC / STOC shall be able to notify third-party traffic information providers of all known incidents and current road weather conditions.



- 3.5. The ATMS shall automatically notify the RC / STOC that are configured to be notified based on the incident's location and severity and the level of recreational traffic.
- 3.6. The RC / STOC shall monitor the progress of MDOT, County, or other responsible maintenance personnel during incidents.
- 3.7. The RC / STOC shall obtain information about construction activity from the MDOT Lane Closure website database.
- 3.8. The RC / STOC shall obtain information about construction activity from the Resident Engineers on a regular basis to obtain current status of the event.
- 3.9. The RC / STOC shall be able to notify county and local road agencies about relevant incidents.
- 3.10. The RC / STOC shall be able to monitor traffic conditions through temporary CCTV cameras and detection equipment used as a part of Smart Work Zones.
- 3.11. The RC / STOC shall be able to control portable DMS through direct communications with the sign, or when the sign is out of range, by notifying appropriate field personnel to post messages located within Smart Work Zones.
- 3.12. The RC / STOC shall be able to monitor CCTV cameras.

4. Maintenance Facility Requirements

- 4.1. Maintenance garage and dispatch center shall be able to access information from the Weather Channel and/or the National Weather Service.
- 4.2. The RC / STOC and maintenance garage shall be able to access atmospheric and road weather data from RWIS and NWS.
- 4.3. The Michigan State Police (MSP), maintenance garages, and County/MDOT maintenance personnel shall be able to notify the RC / STOC of current road weather conditions.
- 4.4. Snowplow operators shall notify the maintenance garages of current road weather conditions.
- 4.5. All available road weather information shall be provided to authorize external systems via a defined data interface.
- 4.6. Summarized road weather information shall be presented to users through a web interface.



Tactics

In response to the high level requirements defined for the Triangle Study Area, specific solutions or tactics were developed. Some of the requirements identified will be addressed through other projects, such as expansion of road weather information, but specific traveler information tactics are presented in this section and mapped back to the requirements.

A preliminary list of tactics was presented at the High Level Design Workshop and vetted through stakeholder discussions. Incorporating the feedback, the tactics were revised, and then were further scored by the stakeholders. The results of those stakeholder evaluations are presented in the next section along with more specific projects.

The tactics are presented in four categories, three that group similar solutions, and a fourth that contains miscellaneous tactics. The following sections present these categories and the corresponding tactics, but the following list and **Table 3** provide an overview.

- Traffic Monitoring – TM
- Traveler Information – IN
- Coordination – C
- Additional – A

Table 3. Tactic Categories

<i>Categories</i>	<i>Tactic</i>	<i>Requirements Addressed</i>
TM1	Expanded Detection Footprint	1.1, 1.4, 1.5
TM2	Predictive Travel Times	1.1
IN1	Primary Corridor DMS Deployments	3.1
IN2	Freeway DMS Deployments	3.1
IN3	Arterial DMS Deployments	3.1
IN4	Traveler Information at Rest Areas	1.5
C1	Event Coordination	1.2
C2	Coordination with other Agencies	1.2, 2.2, 2.3, 2.4, 3.2, 3.4, 3.5, 3.6, 3.9
C3	CAD Coordination with ATMS Software	2.3, 2.4
C4	Construction and Maintenance Activities	3.7, 3.8, 3.9, 3.10, 3.11
C5	RWIS Integration	1.5
C6	Public Outreach and Education	1.2
A2	Rest Area Capacity	1.3
A3	Freeway Courtesy Patrol	None
A4	SMS Text Messaging	1.2, 1.3



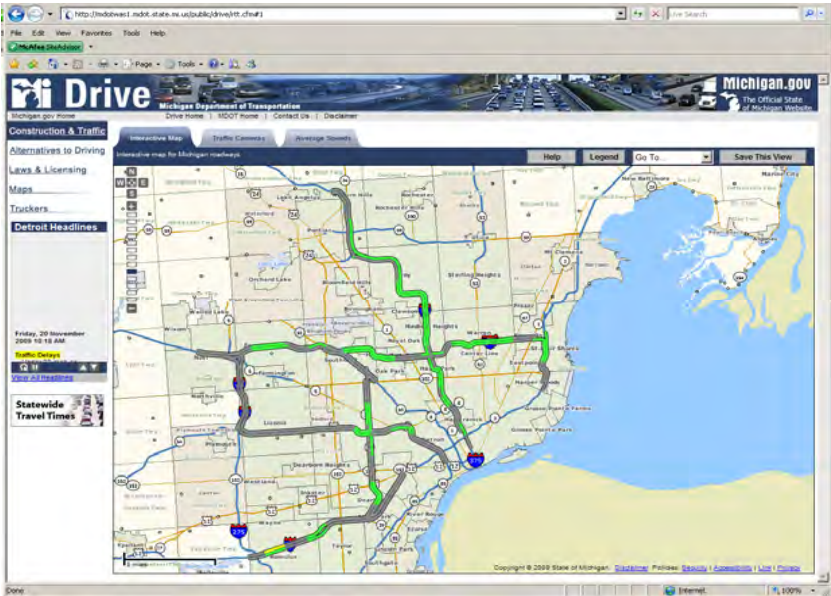
Traffic Monitoring Tactics

MDOT currently purchases third party probe data for travel speed data on all freeways statewide. Additionally, the Metro region has a substantial infrastructure based detection deployment including a mixture of MDOT owned devices and private sector maintained detectors. These tactics expand the travel time and volume related data that is being collected in the study area.

Expanded Detection Footprint.

This tactic includes more infrastructure based detection deployments on strategic routes to enhance the granularity of the available data. Probe data will provide travel speeds on the corridors, but the additional detection can provide volumes by lanes and vehicle types if needed. This additional level of detail then can be used to improve the information provided to the travelers. The data also can be used to supplement the data collected by detectors placed by the MDOT Planning Group, typically where the data is scarce.

It is expected that limited infrastructure based detection could be deployed on strategic routes, including alternate routes such M10, I-69, or I-96, which serve as the primary connectors between the study area major corridors. This additional data will provide more specific road condition data by collecting volumes and lane usage data. Notifications can be triggered more quickly through algorithms that analyze conditions on a per lane use.



MI Drive

Predictive Travel Times.

With the current probe data contract collecting information on all freeways, a substantial archive of historical data is being established. The predictive travel time tactic includes referencing this repository of data in future years to predict travel times based on specific days from previous years. This information is anticipated as a pre-trip information source instead of real-time, or en route. It would be integrated with large planned event press releases and specific holiday weekends to prepare motorists for anticipated road conditions.



Traveler Information Tactics

MDOT has successfully used dynamic message signs (DMS) for years to convey changing travel conditions, incident information, and even travel times. Current deployments are concentrated in the Metro and Grand regions with a few signs located near the Mackinac Bridge, I-75, and a few other specific points. These tactics expand the use of DMS as traveler information tools.

Primary Corridor DMS.

There are a select number of additional locations that along I-75 that can benefit from additional DMS. For the study area, two or three DMS at additional key decision points on I-75 are anticipated. The regional deployment plan looked at DMS needs across the region, but these locations will be refined to meet specific user needs related to recreational traffic demands. These signs also will provide information based on the expanded data collection tactics included with the ATIS plan.

Freeway DMS Expansion.

Additionally, the deployment of approximately three to five DMS on other major corridors is proposed to expand the availability of traveler information. It is expected that these DMS will supplement existing coverage and will be located

at key locations along the major routes such as I-75, I-94, and US 127. The DMS will supplement traveler information data so that travelers can make informed decisions about their routes based on real-time information.



MDOT North Region, I-75

Arterial DMS Deployments.

Lastly, this tactic proposes the installation of DMS on arterials routes. The locations will be determined based on key alternate routes and also coordinated with local signal operators. These signs can provide important information to travelers before they access major routes that may be impacted by incidents or large events.

Traveler Information at Rest Areas.

Information sources deployed at rest areas can reach a large number of travelers on the study area corridors.



I-75 4-Mile Road Rest Area

This information can be either static educational information regarding available data sources, flat screens displaying Mi Drive and camera images, or smaller DMS providing real time information about road conditions. Smaller DMS have been deployed at rest areas in the North region to relay information that currently is posted on highway DMS.



MDOT North Region



Coordination Tactics

There is a significant advantage in interagency coordination to pool resources to share information that can improve the services provided to the traveler. Initial phases of interagency coordination focus on resource sharing across jurisdictional boundaries. Often, the ability to employ these tactics relies more on institutional boundaries than actual technical limitations or funding. The Triangle Study Area is comprised of numerous agencies responsible for construction, maintenance, public safety, fleet operations and special event coordination. Integrating the data and operations of these players can improve the accuracy and timeliness of the information available to the traveler.

Event Coordination.

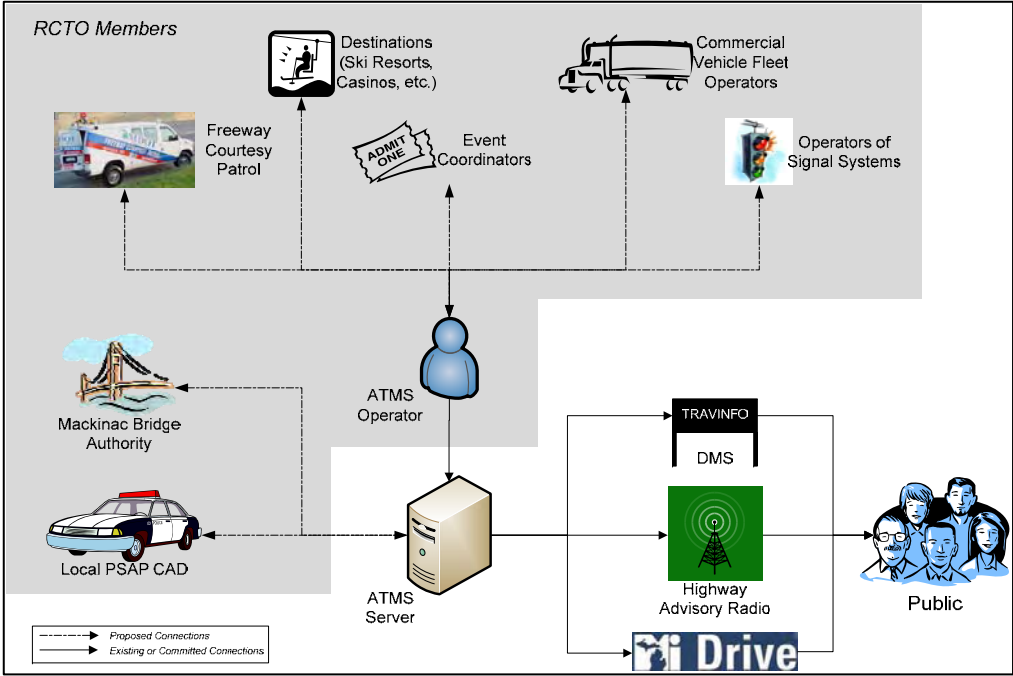
Several large planned events occur in Northern Michigan and attract a significant volume of traffic. This tactic provides an approach coordinating with the event sponsor in advance pre-event and sharing updates during the event. Improved coordination enhances the ability to disseminate information to the public. This data can be integrated with other impacts to the roadway to enhance the comprehensive data set available to the traveler.

Coordination with other Agencies

Initial agencies identified include the Mackinac Bridge Authority and larger commercial vehicle fleet operators. Coordination with the bridge will provide more timely information related to the travel conditions and allow travelers to make earlier decisions about detouring or delaying their trip. Coordination with the fleet operators is two directional in that fleet operators can modify routes based on existing



Mackinac Bridge





conditions and MDOT can access additional road condition information from the fleet vehicles that are on the roadway.

A Regional Concept for Transportation Operations (RCTO) document can be developed to address a consistent operations and management approach amongst the different agencies involved in the partnership. By forming a RCTO committee to focus on addressing multiple services over a designated period of time will be imperative to maintaining a RCTO document. The RCTO coordination efforts are long term and do not represent any one project, but rather continuous coordination between agencies.

Coordination efforts can be expanded to additional areas such as private sector destinations. The RCTO committee and document will help define and align services among its partners. Partnerships also should be established with large destinations such as casinos, ski resorts, and recreational lakes. This connection will enhance planned event information and provide additional information dissemination outlets for getting information to travelers before they depart for home.

Local signal operators are another potential partner for the stakeholders. As traffic volumes increase on major corridors or incidents occur, arterial routes also begin to experience a rise in volume. When incidents occur on the major and connecting corridors, timing plans should exist on the major arterials to absorb the potential increase in traffic volumes. With adequate timing plans in place and coordination with MDOT, these agencies can effectively operate and adjust to the variations in traffic volumes.

CAD Coordination with ATMS Software.

Coordination of the ATMS software with local computer-aided dispatch (CAD) systems is another valuable tactic that can improve the timeliness and accuracy of incident data. Even though local agency CAD systems in the study area vary greatly, considerations should be taken into

account as each system is upgraded or other opportunities arise to enhance existing systems. There is the potential for great benefit from the direct integration of this data, but the complex institutional challenges associated with this integration also are recognized.



ATMS Screen Capture

Construction and Maintenance Activities.

MDOT currently tracks construction activities and displays the information via the Mi Drive web site. The technology exists for the collection and dissemination of this data, but this tactic recommends expanding the functionality and availability of the data. This tactic expands the scope of the available information to include facilities maintained by county road commissions and municipalities that perform construction and maintenance activities. This data should be integrated into the data collection method to provide a comprehensive view of activities occurring throughout the

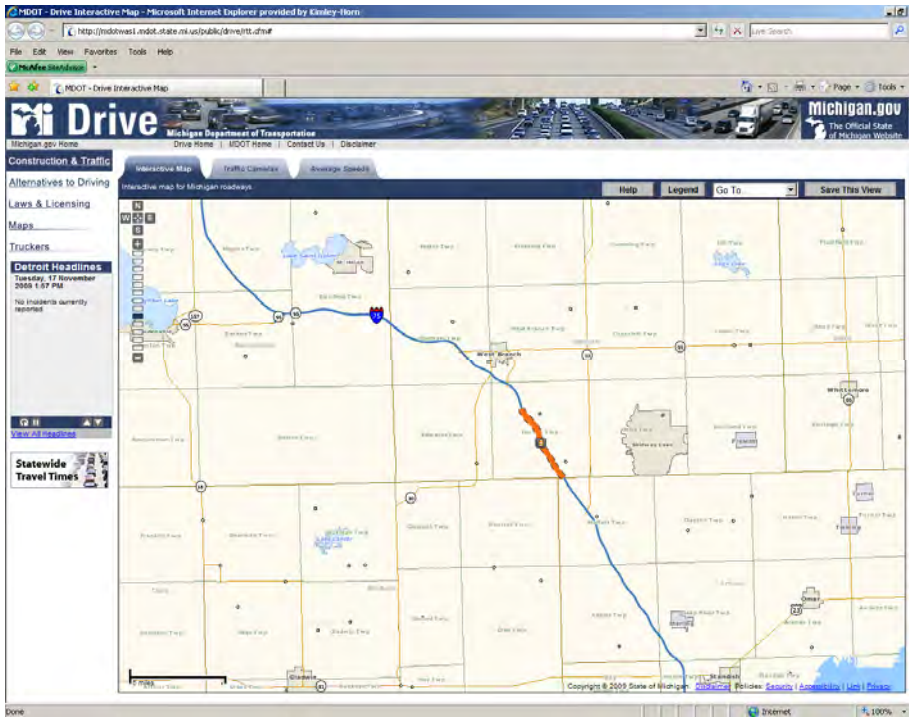


study area. Lastly, an outreach effort is needed to educate the stakeholders involved in the construction and maintenance activities to convey the importance of collecting timely and accurate information.

impacts to the road conditions related to deteriorating weather conditions. The ESS data will be monitored from a regional perspective, but integration of an ESS with a local DMS can provide more timely alerts to travelers as they approach unsafe conditions.



Livingston County Winter Maintenance Vehicle



Public Outreach and Education.

By providing travelers with education regarding the traveler information tools available, they can determine the most effective method for obtaining timely travel conditions. Additionally, they can integrate the existing traveler information resources into their route, whether it is a daily commute or a vacation trip. This tactic provides educational materials in rest areas and other large destinations.

RWIS Integration.

This tactic recommends the integration of environmental sensor station (ESS) data with DMS to inform travelers of road conditions as the potential for hazardous conditions are detected. Warning messages should alert the public of



Additional Tactics

Rest Area Capacity.

A recommendation is to instrument rest areas within the study area with technologies to track capacity. As rest areas lose capacity, this information can be disseminated to approaching travelers so they can make informed decisions regarding exits with amenities in advance of the rest areas. This information also can be integrated with road conditions at the Mackinac Bridge to alert commercial vehicle operators when they should use earlier truck stops or exits due to full rest areas.

Freeway Courtesy Patrol.

Freeway Courtesy Patrols (FCP) currently are operated in the MDOT Metro Region and lend to a viable solution within the study area. For the Triangle Study Area, the FCP is recommended to be accomplished through contract services operating on key weekends, including Fridays and Mondays. It would be operated along specific sections of I-75 based on historical crash and volume data. In addition

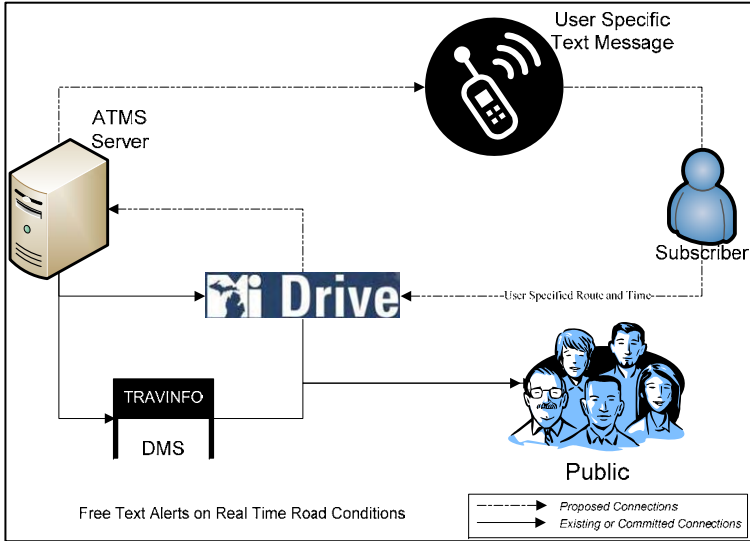


MDOT FCP Van

to improving incident management and response, the FCP will serve as additional incident verification along I-75 and improve the quality of the data being provided through the ATIS.

SMS Text Messaging.

Several ATIS solutions across the country are providing subscriber based notifications of changes in road conditions. These notifications can be provided through private sector companies, media outlets, or an expansion of the Mi Drive capabilities. It is anticipated that this would be a free service provided to travelers who subscribe to alerts on specific corridors. The traveler would be requested to provide their origin, destination and intended time of travel. As conditions change on the selected corridor, the system would generate text messages to the subscribed travelers. Currently, there are discussions pertaining to driver distraction laws within the State. These laws could impact the integration of this tactic.





Projects

The proposed collection of tactics for the MDOT Triangle ATIS Plan includes an integration of infrastructure and operation solutions. In the previous section, tactics were identified based on the outlined high level requirements. Based on the stakeholder input, the tactics were refined into projects and grouped into potential phases for implementation. The projects are ranked based on stakeholder ratings and cost estimates. The estimates include costs related to infrastructure implementation as well as personnel costs associated with institutional strategies, coordination efforts, and training. Ongoing operations and maintenance costs associated with staffing requirements are not identified within the estimate.

Stakeholder Ratings

In order to gauge the stakeholders' support of the tactics presented, a scoring mechanism was used to evaluate the perceived effectiveness and ease of implementation. Each stakeholder was asked to score the tactics on a scale from 0 to 5. For effectiveness, a score of "0" meant the tactic was believed to have no effectiveness at all and a "5" represented the most effective methods for conveying traveler information. For ease of implementation, a score of "0" identified tactics that were completely not implementable, whether it was due to institutional obstacles or technological limitations; a score of "5" represented technologies that were familiar to the stakeholders and created no concern for implementation.

Stakeholders from all of the regions within the study area were asked to provide ratings in these categories. The scores from the eleven responding stakeholders were averaged to arrive at the scores displayed in **Table 4**.

Unit Cost

Several of the projects represent deployments or tactics that can be applied in multiple locations. In order to establish a unit cost for each project, consideration was given to labor needs and infrastructure needs. For all labor needs identified, an assumed hourly rate of \$125 was applied. The unit cost for infrastructure based components was derived based on the 2009 MDOT average unit prices. Additionally, costs were used based on bid prices for like items over the last 2 years. These individual components were summed to arrive at a per location cost for each project.

This approach was used so the stakeholders could modify phases as needed to establish cost estimates in line with available funding. The "assumptions" column in **Table 4** presents the base data used to derive the estimate presented in the "unit cost" column.

Phases

Table 4 then was sorted based on three columns in the following order: effectiveness, ease of implementation, and unit cost. This project ranking was used to divide the projects into four phases, with Phase I including the highest ranking projects and Phase IV including the lowest



ranking projects or projects that were not well supported by the stakeholders. It also is important to note that specific quantities of projects can be implemented in each phase to distribute the cost over multiple phases.

Phase I includes some projects that are partially implemented over multiple phases, but also includes a few specific to Phase I. Projects specific to Phase I are expected to have a higher effectiveness in relaying traveler information and include strategic DMS, free text message alerts via Mi Drive, and expanded coordination with the Mackinac Bridge Authority. Several of the other projects are implemented in part during Phase I with expanded coverage occurring through the subsequent phases.

Phases II and III continue to expand on the foundation established in the first phase, but initiate a few additional projects that are not included within Phase I. These include coordination with fleet operators, public safety CAD systems, and the integration of individual ESS with local DMS. The integration of ESS with DMS has a higher score than strategic DMS installations; however it was included in Phase II due to the fewer number of existing ESS in the study area. Traveler information also is expanded to rest areas via smaller DMS that mirror messages displayed on the roadside DMS.

Phase IV further expands geographic coverage of projects in the study area. The travel time prediction tool scored well among stakeholders, but was included in Phase IV because of the extreme cost associated with the implementation. Phase IV also includes a project for implementing detectors that measure the capacity in rest

areas. This project is relatively low cost, but did not score well in effectiveness among the stakeholders.

Table 4 provides a summary of each project and the corresponding phase. Preliminary quantities are given for Phase I through IV with the understanding that as funds are available, the stakeholders can adjust priorities and quantities to spend those funds in the most effective way. Many of the projects involve expanded coordination with partnering agencies. It is important for the stakeholders to understand these should be ongoing relationships fostered through RCTO or similar involvement from the partners. As technologies change, staff turns over, and deployments expand, it is important for all participating agencies to maximize their resources through improved information sharing and coordination. From these partnerships, it is envisioned that additional deployments and technological solutions for improved traveler information will evolve.



Table 4. Summary of Projects by Phase

Project ID	Project	Effectiveness (5 to 0)	Ease to Implement (5 to 0)	Assumptions	Unit Cost	Phase I		Phase II		Phase III		Phase IV	
						Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
C1-001	Event coordination for planned special events with significant impacts	5	3	Cost is per event, assuming coordination with one TSC; 6 days of training for each TSC @ \$ 125 /hr; \$ 2,000 for the software for each TSC	\$8,000	2	\$16,000	2	\$16,000	2	\$16,000	2	\$16,000
C4-001	Coordination with construction and maintenance activities *	5	3	10 days for MOUs for each TSC (10); 2 days of training for each TSC (10); Labor (\$ 125 / hr); Software (\$ 2,000 / license)	\$14,000	2	\$28,000	2	\$28,000	2	\$28,000	4	\$56,000
C3-001	Coordination of ATMS software with Local Public Safety CAD Systems *	5	2	10 days for MOUs for each county (20); 2 days of training for each county (20); Labor (\$ 125 / hr); Software (\$ 2,000 / license)	\$62,000	0	\$0	5	\$310,000	5	\$310,000	10	\$620,000
C6-001	Public Information and Outreach on existing ATIS *	4	4	Unit cost is for a single advertisement; 2 days for development of materials (\$ 125 / hr); \$ 2,500 for printing (10,000 at \$0.25 each)	\$4,500	1	\$4,500	3	\$13,500	5	\$22,500	5	\$22,500
C2-001	Coordination with Mackinac Bridge Authority	4	4	10 days for MOUs for Mackinac Bridge (1); 2 days of training for Mackinac Bridge (1); Labor (\$ 125 / hr); Software (\$ 2,000 / license)	\$14,000	1	\$14,000	0	\$0	0	\$0	0	\$0
A3-001	Free text message alerts for travelers who subscribe for the alerts along their travel corridor	4	4	Server (\$10,000)Messaging subsystem within ATMS/MIDrive (\$50,000)	\$60,000	1	\$60,000	0	\$0	0	\$0	0	\$0
A2-001	Implementation of Freeway Courtesy Patrol (weekends only)	4	4	9 vehicles to fleet (\$35,000 per vehicle); Operating costs for 1 vehicle per year = \$234,000; Labor for 1 driver = \$3,328,000; Assume that dispatch is managed from STOC	\$360,520	0	\$0	0	\$0	3	\$1,081,560	6	\$2,163,120
TM2-001	Travel Time prediction tool based on historical data	4	4	Software development - \$ 700,000; Historical Data - \$ 250, 000; Testing - \$ 200,000	\$1,125,000	0	\$0	0	\$0	0	\$0	1	\$1,125,000
C2-002	Coordination with Casinos, Ski Resorts, Mackinaw Island to share road conditions with people preparing to leave or traveling to the destinations *	4	3	10 days for MOUs for each tourist site (25); 2 days of training for each tourist site (25); Labor (\$ 125 / hr); Software (\$ 2,000 / license)	\$14,000	5	\$70,000	5	\$70,000	5	\$70,000	10	\$140,000
A3-002	Alerting function of changing conditions based on location and destination	4	3	Server (\$10,000); Messaging subsystem within ATMS/MIDrive (\$50,000)	\$60,000	0	\$0	0	\$0	0	\$0	1	\$60,000
C5-001	Integrate RWIS with local DMS to provide warning messages *	4	3	Software component to integrate RWIS with DMS - \$ 60,000; Implementation and testing on each DMS - \$ 5000	\$65,000	0	\$0	1	\$65,000	1	\$65,000	1	\$65,000
IN1-001	Primary Corridor DMS Deployments	4	3	2 DMS locations @ \$ 180,000 each; 10 % of construction for Design; 10 % for CEI; 5 % for System Manager	\$225,000	2	\$450,000	0	\$0	0	\$0	0	\$0
IN2-001	Freeway DMS Deployments that supplement the primary locations	4	3	3 DMS locations @ \$ 180,000 each; 10 % of construction for Design; 10 % for CEI; 5 % for System Manager	\$225,000	0	\$0	3	\$675,000	0	\$0	0	\$0
C2-002	Coordination with major fleet operators	4	2	10 days for MOUs for each fleet operator (5); 2 days of training for each fleet operator (5); Labor (\$ 125 / hr); Software (\$ 2,000 / license)	\$14,000	0	\$0	1	\$14,000	2	\$28,000	2	\$28,000
IN4-001	DMS in rest areas (similar to North Region)	3	4	5 DMS locations @ \$ 30,000 each; 10 % of construction for Design; 10 % for CEI; 5 % for System Manager	\$37,500	0	\$0	2	\$75,000	3	\$112,500	0	\$0



Table 4. Summary of Projects by Phase

Project ID	Project	Effectiveness (5 to 0)	Ease to Implement (5 to 0)	Assumptions	Unit Cost	Phase I		Phase II		Phase III		Phase IV	
						Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
IN4-002	Flat screens in rest areas to show Mi Drive data and camera images (similar to Chelsea rest area) *	3	3	5 rest areas identified; Each flat screen will cost around - \$ 5,000; Installation, wires and conduit - \$ 2,500	\$7,500	1	\$7,500	1	\$7,500	1	\$7,500	2	\$15,000
C2-003	Coordination with operators of signal systems	3	3	10 days for MOUs for each county (20); 2 days of training for each county (20); Labor (\$ 125 / hr); Software (\$ 2,000 / license)	\$14,000	0	\$0	0	\$0	10	\$140,000	10	\$140,000
IN3-001	Arterial DMS Deployments	3	3	18 DMS locations @ \$ 180,000 each; 10 % of construction for Design; 10 % for CEI; 5 % for System Manager	\$225,000	0	\$0	0	\$0	6	\$1,350,000	12	\$2,700,000
TM1-001	Expansion of infrastructure based detection on all key corridors	0	0	<i>Will not be considered as probe data systems would provide all the required information along major corridors in the State of Michigan</i>		0	\$0	0	\$0	0	\$0	0	\$0
A1-001	Track capacity of rest areas based on ingress and egress	2	3	2 Detector locations @ \$ 8,000 each (\$ 15,000 central software); 10 % of construction for Design; 10 % for CEI; 5 % for System Manager	\$38,750	0	\$0	0	\$0	0	\$0	1	\$38,750
*Projects are implemented across multiple phases.						Phase 1		Phase 2		Phase 3		Phase 4	
						Total Cost		\$650,000		\$1,274,000		\$3,231,060	