Michigan Department of Transportation
Regional ITS Architectures and Deployment Plans

SEMCOG

MDOT Metro Region and Portions of University

Final
Regional ITS Deployment Plan

Prepared for:

SEMCOG
Southeast Michigan Council of Governments

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LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
AATA	Ann Arbor Transportation Authority
APC	Automatic Passenger Counters
APTS	Advance Public Transportation Systems
ATIS	Advance Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
BWATA	Blue Water Area Transportation Authority
BWB	Blue Water Bridge
CAD	Computer-Aided Design
CCTV	Closed Circuit Television
CLEMIS	Courts and Law Enforcement Management Information System
CMAQ	Congestion Mitigation and Air Quality
DDOT	Detroit Department of Transportation
DMB	Department of Management and Budget
DMS	Dynamic Message Sign
DTOGS	Detroit Transit Options for Growth Study
DTW	Detroit Metropolitan Wayne County Airport
EPE	Early Preliminary Engineering
ESS	Environmental Sensor Stations
FAST/NEXUS	Free and Secure Trade Program
FCP	Freeway Courtesy Patrol
FHWA	Federal Highway Administration
FMS	Freeway Management System
GPS	Global Positioning System
HAR	Highway Advisory Radio
IDAS	ITS Deployment Analysis System
ITS	Intelligent Transportation System
LETS	Livingston Essential Transportation Services
MDOT	Michigan Department of Transportation
MITS	Michigan Intelligent Transportation Systems
MITSC	Michigan Intelligent Transportation Systems Center

LIST OF ACRONYMS

MPO	Metropolitan Planning Organization
MRITS	Metro Region ITS
MSP	Michigan State Police
MVDS	Microwave Video Detection Systems
NTCIP	National Transportation Communications for ITS Protocol
O&M	Operating and Maintenance
PE	Preliminary Engineering
PITWS	Portable Intermittent Truck Weigh Station
PSAPs	Public Safety Access Point
PTR	Permanent Traffic Recorder
RCMC	Road Commission of Macomb County
RCOC	Road Commission for Oakland County
RE	Resident Engineer
RFP	Request For Proposals
RTCC	Regional Transit Coordinating Council
RWIS	Roadway Weather Information System
SCATS	Sydney Coordinated Adaptive Traffic System
SCOOT	Split Cycle Offset Optimization Technique
SEMCOG	Southeast Michigan Council of Governments
SEMSIM	Southeast Michigan Snow and Ice Management
SMART	Suburban Mobility Authority for Regional Transportation
TEA-21	Transportation Equity Act for the 21st Century
TMC	Transportation Management Center
TOC	Traffic Operations Center
TSC	Transportation Service Centers
TWA	Transportation Work Authorization
UMTRI	University of Michigan Transportation Research Institute
URITS	University Region ITS
VII	Vehicle Infrastructure Integration
WALLY	Washtenaw and Livingston Line
WIM	Weigh-In-Motion

1 Introduction

1.1 Project Overview

The Michigan Department of Transportation (MDOT) and Southeast Michigan Council of Governments (SEMCOG) Intelligent Transportation Systems (ITS) Deployment Plan is part of an overall effort to develop a statewide ITS architecture along with a deployment plan for each of MDOT's seven regions. These deployment plans will be referenced as the Department develops and maintains a statewide investment strategy for ITS. To date, ITS deployments have been concentrated almost exclusively in the two largest metropolitan areas, Detroit and Grand Rapids. Both systems include a Transportation Management Center (TMC) that utilizes closed circuit television (CCTV) cameras, detection equipment and dynamic message signs (DMS) to manage traffic on regional freeways. Freeway Courtesy Patrol (FCP) vehicles also are managed from the TMC in Detroit. Both systems focus on incident management activities and traveler information with the goal of improving the safety and mobility of the traveling public.

ITS in the Detroit area was one of the first installations in the U.S. Surveillance and monitoring equipment was first installed on downtown Detroit freeways in the late 1960's. In the early 1990's a major effort was initiated to implement ITS throughout the Detroit Metropolitan region. The current TMC was opened in downtown Detroit and staffed on a 24 hour/7 day per week basis. The Michigan State Police (MSP) Dispatch Center moved into the same facility, promoting coordination between the two agencies. By 2000, virtually all freeways within the I-696/I-275 "loop" had been equipped with CCTV, detection, and DMS. The Taylor Transportation Service Center (TSC) oversaw an ITS expansion to coincide with the opening of the McNamara Terminal in 2001-2002. It was expanded to the west and south. The system also was extended beyond the loop into Oakland County along I-75. A total of 180 miles of freeway were included in the system.

Between 2000 and 2002, two projects were conducted to address the expansion of the ITS system into outer portions of the region. The first was the development of a regional ITS architecture, by SEMCOG. The second was a Predeployment Plan for portions of the region, which was conducted by Cambridge Systematics, Inc. and Kimley-Horn and Associates, Inc. under contract to MDOT. The Predeployment Plan addressed the system expansion needs of Oakland, Livingston, Washtenaw and Monroe Counties, as well as a portion of Wayne County. Macomb and St. Clair Counties were not included in the study. The replacement and upgrade needs of the existing system also was not included in the study scope. A number of options for expanding the system were evaluated with a focus on freeway management, incident management and arterial improvements on State trunkline routes.

Since the study was completed, some of the recommended expansions have been completed or are underway. These include extensions of the ITS coverage westward along I-94 and I-96, and filling of a gap in the system along I-75 in Oakland County. In addition, major efforts are underway to upgrade the existing system, including the development of a statewide implementation of advanced traffic management system (ATMS) software and a new TMC.

While there is a priority on addressing the needs of the existing system, the previous study identified a need for targeted expansion of the system into fast-growing areas of the region. This deployment plan update will revisit the needs identified previously, and will include the areas of the region that were not addressed. Other recent deployment plans conducted for MDOT have been subdivided by MDOT Region. SEMCOG covers two MDOT regions, the Metro Region (Macomb, Oakland, St. Clair and Wayne Counties) in its entirety and a portion of the University

Region (Monroe, Washtenaw and Livingston Counties). Staff from both MDOT regions and SEMCOG played key roles in guiding the study.

A key element of this plan is to bring the SEMCOG Region into a comprehensive approach to assure compatibility of ITS deployment efforts throughout the State. MDOT recognizes that implementing ITS technologies in an ad-hoc manner across the State would not provide the system wide integration required, nor achieve statewide performance requirements, and would not be cost-effective. Coordination of services and communication between regions on program and project investments is a critical requirement for long-term success. Operations, maintenance, and ultimately replacement costs would be increased without this integrated approach. MDOT expects to identify ITS deployment projects in each region that address two major elements:

- **Development of an ITS architecture in regions where none existed and the updating of the architecture in areas where it existed but was out of date.** The program will establish regional architectures for the Superior, Bay, Grand, Southwest, and University Regions and update the existing architectures for the Detroit, Flint and Lansing metropolitan areas. The Federal Transportation Reauthorization bill of 1998 (TEA-21) greatly expanded the eligibility of ITS projects for Federal funding, but also included Section 940, which required that ITS projects eligible for Federal funding be compatible with the National ITS Architecture. The Federal Rule defines the national architecture as "a common framework for ITS interoperability. The National ITS Architecture comprises the logical architecture and physical architecture which satisfy a defined set of user services." The development of a consistent architecture across the State has several benefits. In addition to making ITS type investments eligible for Federal funding, it assures a consistent approach to technology applications across the State. The process also brings a variety of stakeholders together to open a dialogue that discusses issues of common concern and finds common ground on potential strategies to fund and implement the technologies.

- **Development of Regional Deployment Plans where they do not currently exist and update the plan for SEMCOG regional plan.** The architecture itself provides a structure that identifies packages of user services and also defines the connections between them. The Deployment Plan is needed to define the geographic location of the projects, the technologies that will be deployed, and the timing of the deployments. Projects are defined in a manner consistent with the planning, programming, design, and implementation processes of MDOT. The Deployment Plan accounts for financial constraints and provides benefit/cost analysis of various deployment combinations. Combining the architecture and Deployment Plans within the same project allows consistency between the two. Consistency in the process across regions facilitates the development of multi-regional projects where appropriate. The product of the Deployment Plan is a set of defined projects with estimated costs and benefits. These projects will then be considered for funding through MDOT's statewide planning process in rural regions or through the MPO process in the urbanized areas. These regional deployment plans will reflect an understanding of their impact in advancing statewide policies and objectives and agreed to integrated system performance measures and, as such, will support cross regional applications investment programs.

Both of these focused efforts are impacted by a separate project, the development of statewide software specifications for Advanced Traffic Management Systems (ATMS). The software utilized in the Michigan Intelligent Transportation System Center (MITSC) in Detroit dates back to the mid-1990's and has been in need of replacement for some time. MDOT is making temporary improvements while developing a specification for new software. The West Michigan TMC is currently operating in the Grand Region and additional future TMCs have been identified as part of the ATMS Specifications. These TMCs have been identified in the regional architectures and will also be a part of the statewide architecture and deployment plan. The ATMS project will provide a common platform for all ITS deployments across the state. This will enhance coordination between regions and enable centers to back each other up during off-hours or times of emergency. To this end, a series of stakeholder meetings were held across the state to identify user needs and obtain feedback on how the ATMS software can enhance operational and maintenance activities.

The SEMCOG region also includes county and municipal-based traffic operations centers (TOCs) that will play a key role in the regional ITS plan. Since the early 1990's the Road Commission for Oakland County (RCOC) has been deploying adaptive signal control systems along major arterial corridors. These systems are operated from a TOC located in the Oakland County Government Complex in Pontiac. RCOC works closely with the MDOT and the MITSC, including exchange of video images. The Road Commission of Macomb County (RCMC) also has a TOC that operates arterial systems within the County. RCMC is currently in the process of adding additional signal corridors and expanding their wireless communications system. The City of Detroit has been in the process of developing a TOC, which was scheduled for opening in September 2008. The TOC is primarily designed to operate City-owned signals but also will include detection, surveillance, and monitoring of emergency vehicles. There also is an active TMC at the Blue Water Bridge facility, which is operated by MDOT and monitors both traffic and security. TOCs for signal operation and traffic management have been proposed for the other Counties in the region as well as Metro Airport.

Deployment plans are based on stakeholder feedback, the recently completed MDOT state long range plan, regional long range plan, urban area long range plans, review of data on transportation needs and the technical feasibility of various technologies. The regional architectures and the ATMS software specification help to define the development and analysis of ITS investment alternatives.

1.2 SEMCOG Region Background

The SEMCOG regional boundary includes seven counties of Southeastern Michigan as shown in **Figure 1**. The three most populous Counties, Wayne, Oakland and Macomb form MDOT's Metro Region along with St. Clair County. The three outlying counties of Monroe, Washtenaw and Livingston are part of MDOT's University Region. As shown in **Table 1**, SEMCOG contains roughly half the State's population, with over 40% in the Metro region alone. The highest levels of growth however are found in the outlying counties of the University Region. The three University Region Counties have experienced a population increase of over 60,000 in the last seven years, while the Metro region counties have lost 16,000 residents. This loss is a result of a population decline of 75,000 in Wayne County. While this pattern may change due to rising energy prices and other economic factors, the dispersal of population and other economic activity to outlying areas has major implications for the region's transportation system.

Table 1 – Population of SEMCOG Counties

	2007 State Estimate	*2000 Census*	*Growth*
Metro			
Wayne	1,985,101	2,061,162	-3.7%
Oakland	1,206,089	1,194,156	1.0%
Macomb	831,077	788,149	5.4%
St. Clair	170,119	164,235	3.6%
University			
Monroe	153,608	145,945	5.3%
Washtenaw	350,003	322,895	8.4%
Livingston	183,194	156,951	16.7%
SEMCOG Region	**4,879,191**	**4,833,493**	**0.9%**
Michigan	**10,071,822**	**9,938,444**	**1.3%**
SEMCOG % of State	**48.4%**	**48.6%**	

Source: http://www.senate.michigan.gov/sfa/Economics/MichiganPopulationByCounty.PDF

Figure 2, from SEMCOG's annual population and household report, further illustrates the spread of population and households away from Detroit and its inner suburbs to the outlying areas of the region.

Figure 1 – SEMCOG Regional Boundaries

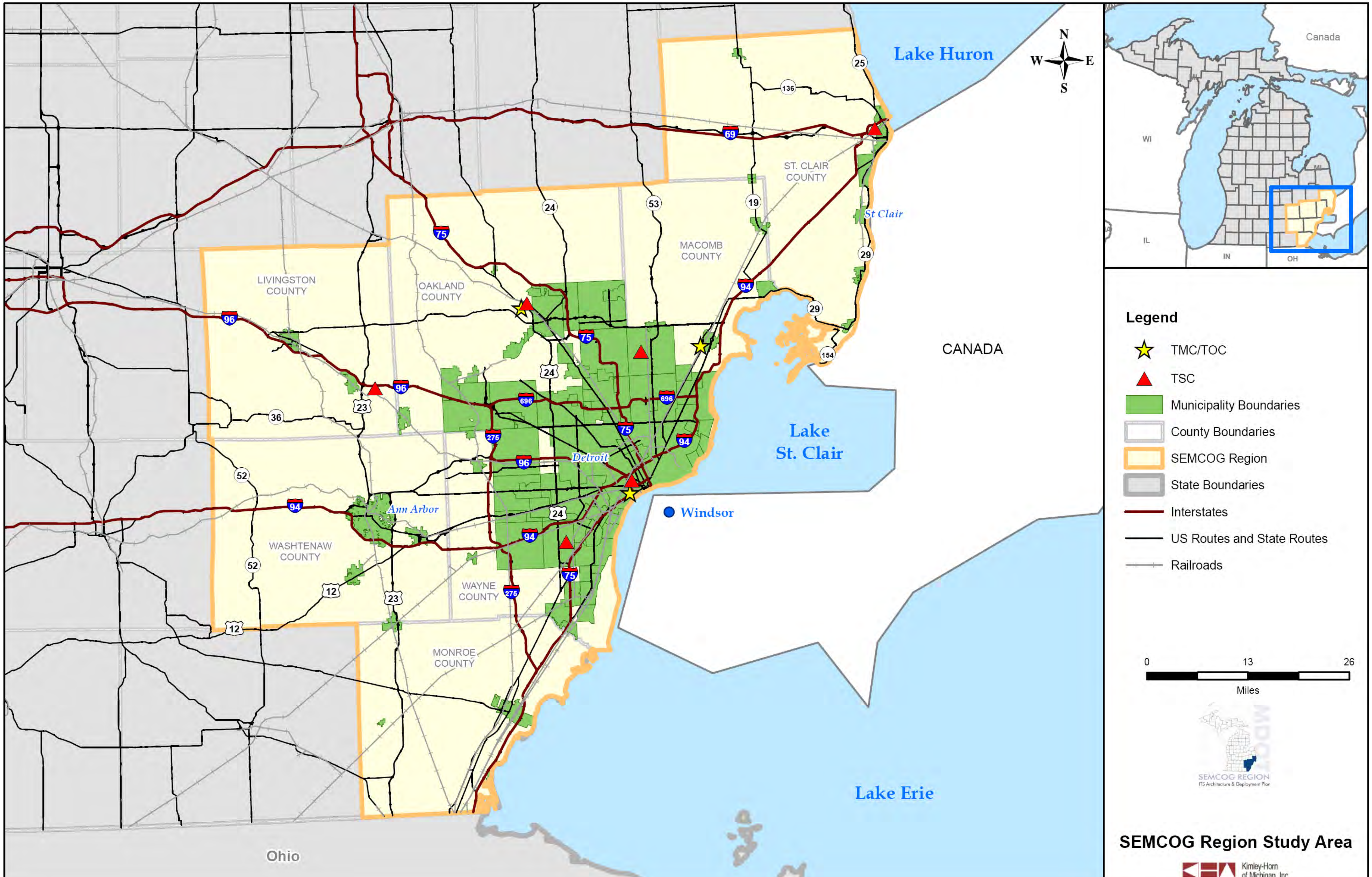


Figure 2 – Estimated Population Change, Southeast Michigan, 2000 - 2007

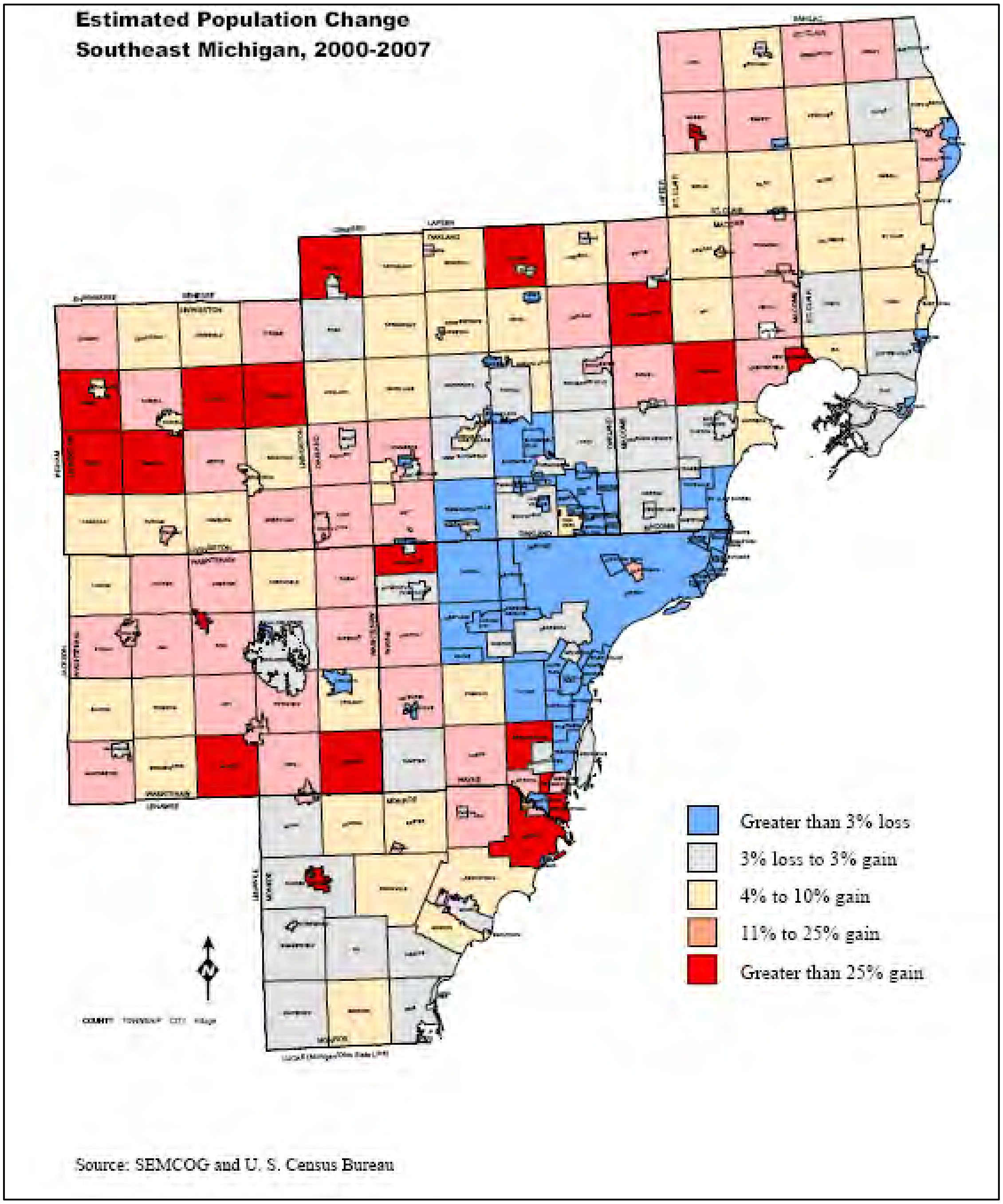


Table 2 shows employment data from the Michigan Economic Development Corporation for the period from 2002-2005. Overall employment in the region was 2.772 million in 2005, with 2.393 million or 86% in the Metro Region portion. While year-to-year employment data are impacted by general economic trends, this table further highlights the shift of economic activity from Detroit and some of the inner suburbs to outlying areas. Highest employment growth rates were found in Livingston, Macomb, and St. Clair Counties. Although it experienced a slight employment decline, the importance of Oakland County as an employment center for the region is also highlighted. While Wayne County exceeds Oakland in population by a total of nearly

800,000, the number of jobs is nearly equal between the two counties. Implications for the transportation system are a high level of reverse commuting as well as a significant level of commuting between suburban areas.

Table 2 – Employment for SEMCOG Region Counties 2002-2005

	2005	*2002*	*Growth*
Metro			
Wayne	976,937	1,000,586	-2.4%
Oakland	931,689	932,719	-0.1%
Macomb	416,584	402,539	3.5%
St. Clair	68,173	66,741	2.1%
University			
Monroe	59,474	59,481	0.0%
Washtenaw	244,320	242,755	0.6%
Livingston	75,165	70,018	7.4%
SEMCOG Region	**2,772,342**	**2,774,839**	**-0.1%**

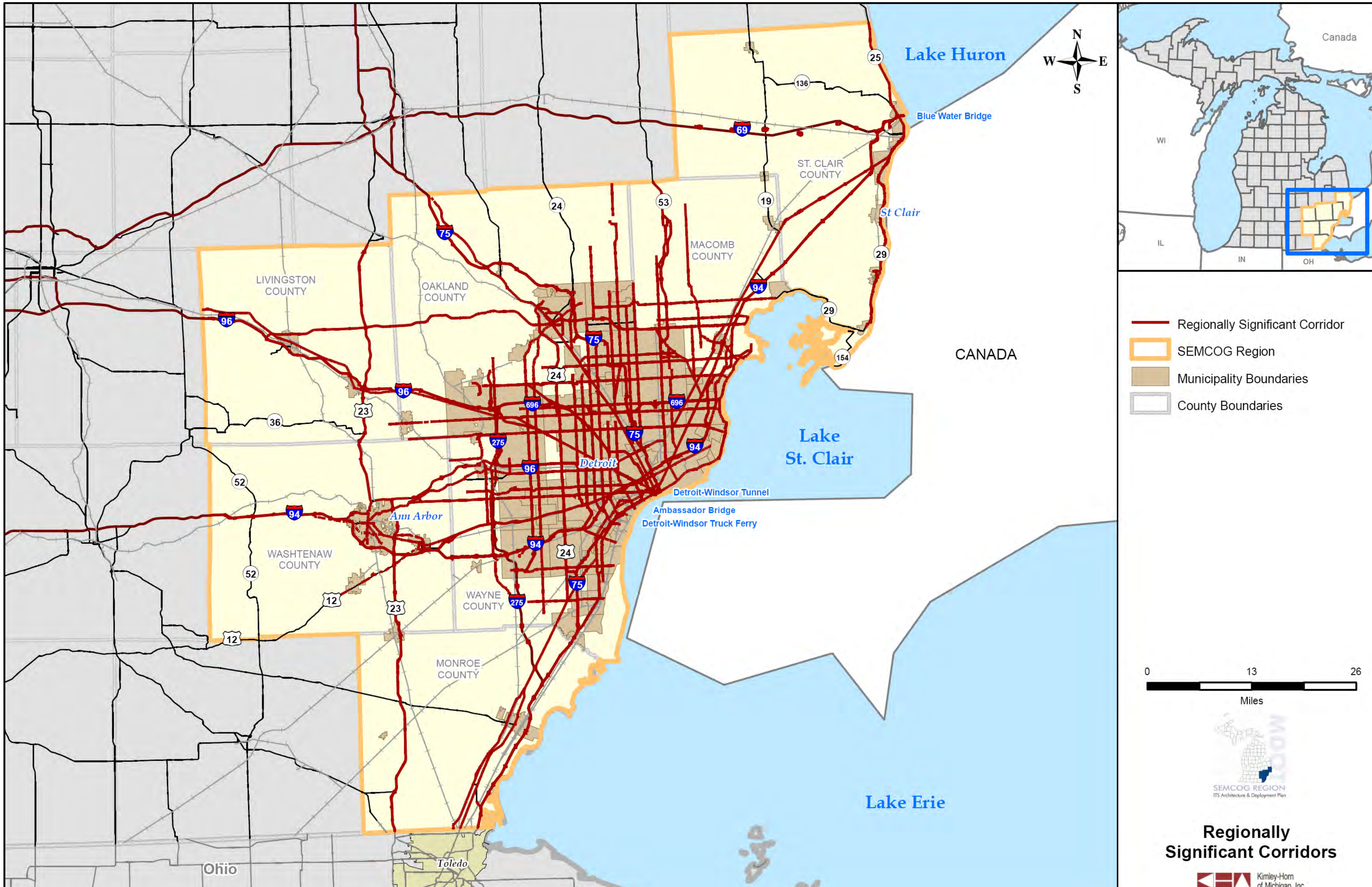
Source: http://ref.michigan.org/medc/miinfo/places/

Southeast Michigan has a large freeway system but a significant portion of the system converges on downtown Detroit, which has declined as an employment center. It should be noted however that of the three water crossings between Michigan and Ontario, two are located in downtown Detroit, the Ambassador Bridge and the Detroit-Windsor Tunnel. These facilities, along with Blue Water Bridge in Port Huron, have seen traffic increases largely associated with international trade. Major regional freeways include:

- I-94 connects Chicago and several cities in Southwest Michigan with Ann Arbor and Detroit. This is one of most significant industrial corridors in the U.S. and is characterized by heavy commercial vehicle volumes. I-94 continues through Detroit to the Blue Water Bridge in Port Huron.
- I-96 serves the rapidly growing northwest suburbs and connects Detroit with Lansing, Grand Rapids, and Muskegon.
- I-75 runs from the Ohio border through Detroit and continues up the Lower Peninsula of Michigan through the Upper Peninsula to the International Bridge at Sault Ste. Marie. I-75 is a major commercial vehicle route, a major commuter artery, and the largest recreational route in the State.
- I-275 and I-696 together form a perimeter freeway system to the west and north of Detroit. Both of these highways carry heavy volumes of commuter and general traffic.
- M-10, the Lodge Freeway connects major population and employment centers in the southern Oakland County suburbs with downtown Detroit.
- M-39, the Southfield Freeway, runs from Southern Oakland County through Detroit to southern Wayne County.
- US-23 runs from the Ohio Border northward through Ann Arbor and Livingston County to I-75 in Flint. This serves one of the region's fastest growing areas.
- In addition to these regional freeways, shorter freeway segments include M-59 between Pontiac and Macomb County, M-53 in Macomb County, and M-14, which provides a direct connection from I-275 to Ann Arbor.

The region also is served by a number of major trunkline roads. In some cases, such as M-59 between Pontiac and Livingston County, trunklines provide the only direct access. In other cases, such as US-12 in the western suburbs, the trunklines provide a parallel route to major freeways. **Figure 3** shows the Corridors of Significance in the region defined by SEMCOG as part of its Regional Planning Process. These corridors include both regional freeways and major arterials.

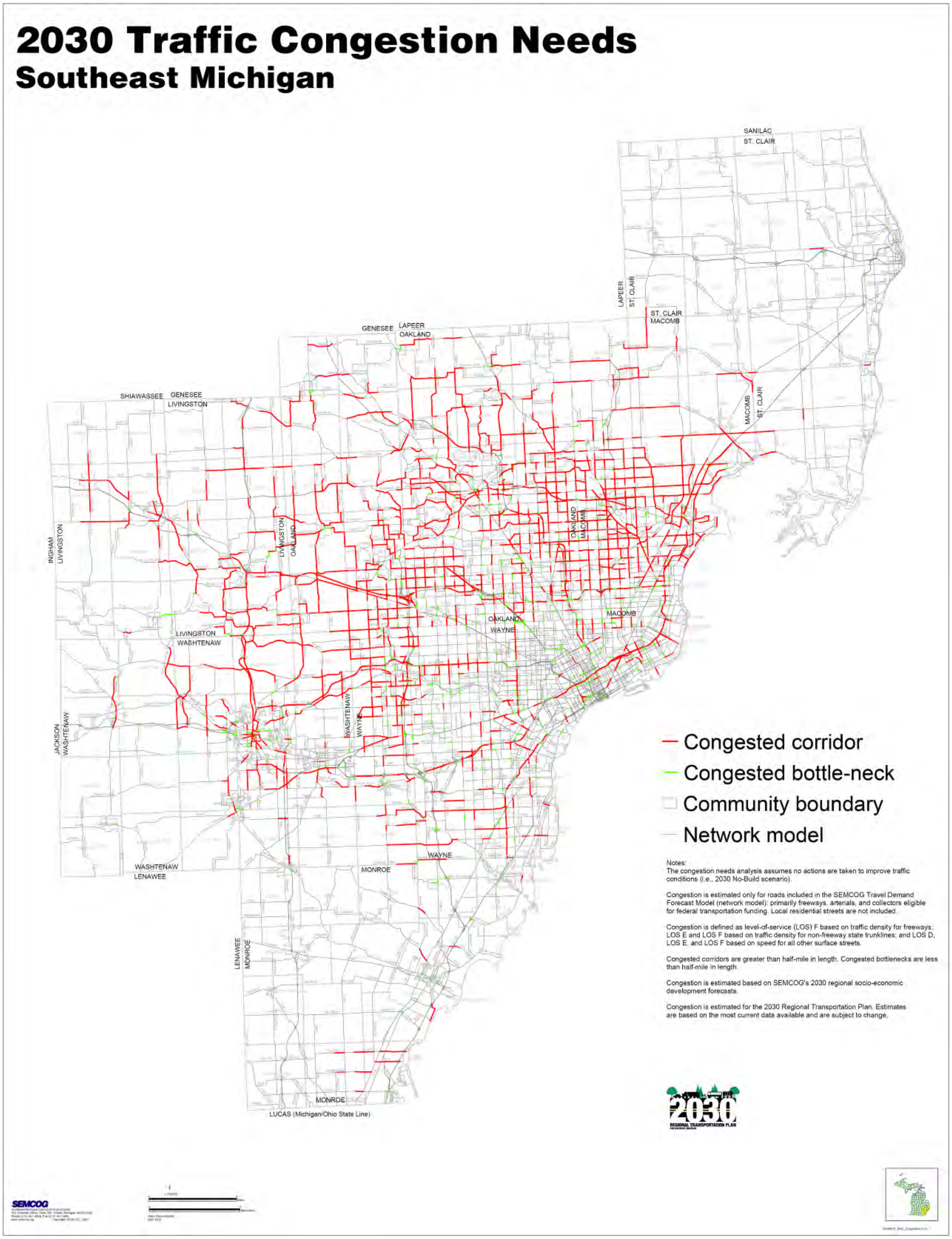
Figure 3 – Regional Corridors of Significance



The heaviest traffic volumes in the region are found on major freeways north and northwest of the City of Detroit. Volumes in the range of 150,000 to over 200,000 AADT are found along the length of I-696, the northern segment of I-275, and portions of I-75, I-96, and I-94 located between downtown Detroit and the I-696/I-275 loop. Volumes in the range of 150,000 AADT are found on I-75 in the area of Pontiac. Volumes in the 100,000 to 150,000 range are found on I-96 and I-94 approaching downtown Detroit, on I-94 west into Washtenaw County, on I-96 into eastern Livingston County, on I-94 through most of Macomb County, on I-75 south of Detroit, and on M-39. Major trunklines such as M-1 (Woodward), US-24 (Telegraph), M-3 (Gratiot), M-102 (8 Mile) and M-3 (Gratiot) carry between 50,000 and 100,000 AADT on their busiest stretches.

MDOT prepared a series of congestion maps for the recently released 2030 State Long Range Transportation Plan. Due to continuing changes in technology, ITS projects are generally planned over a short period. Even though an agency's operational approach may not change, the technology options and the communications approach can vary and thereby greatly affect the designs of an ITS deployment. **Figure 4** shows projections of congested locations and locations approaching congested conditions for 2030. Most of the major freeways in the SEMCOG region are projected to experience some level of congestion, with the most significant congestion along the I-696/I-275 "belt". The map shows increasing levels of congestion in outlying areas of the SEMCOG region along corridors such as US-23, I-75, I-94, I-75 and I-96.

Figure 4 – 2030 Michigan Congestion Levels



1.2.1 Safety

Safety is another key issue in considering ITS deployment alternatives for the SEMCOG region. **Table 3** shows key safety statistics, gathered from the 2007 Highway Safety Report, produced by the Michigan Office of Highway Safety Planning. SEMCOG has over 48% of the State's population but only has 43% of the State's crashes and 36% of the fatalities in 2007. Lower fatality rates are generally found in urban areas due to the lower speeds caused by congestion and the fact that more urban residents travel by public transportation and other alternate modes. The percent of injured persons in the SEMCOG region, however, is roughly 47%, which is close to the region's proportion of the State's population.

Overall, crashes have a major impact on the region. On an average day across the region, there is roughly one fatality, 100 injuries and nearly 400 crashes. These incidents have a major impact on regional mobility and elicit a tremendous cost, both to those directly involved and to society as a whole.

Causes are numerous and include winter weather, fog, lack of roadway lighting, animal hits, and increasing volumes at rural and suburban at-grade intersections in high growth areas. Heavy commercial vehicle volumes experienced on the region's major freeways have an impact as well. When commercial vehicle crashes do occur, they frequently result in lane or roadway closures, which in turn results in increased secondary crashes on both freeways and alternate routes.

ITS applications can help to reduce crash rates in a variety of ways. Detection, surveillance, and freeway service patrols all help to improve incident response time and reduce secondary crashes. Road Weather Information Systems (RWIS) proposed in the Metro Region and throughout the State will help to identify localized weather patterns more quickly, leading to faster clearance of roadways and more accurate, targeted traveler information on road conditions.

Table 3 - 2007 Safety Data for SEMCOG Region

	Total Crashes	***Fatal Crashes***	***Injury Crashes***	***PDO Only***	***Injured Persons***	***Persons Killed***
Livingston	5,401	19	984	4,398	1,296	21
Macomb	23,798	49	5,043	18,706	6,806	51
Monroe	4,050	23	870	3,157	1,218	26
Oakland	37,781	48	7,521	30,212	9,852	49
St. Clair	4,425	17	898	3,510	1.214	17
Washtenaw	10,787	29	2,214	8,544	2,947	29
Wayne	53,873	170	11,397	42,306	15,500	189
SEMCOG	**140,115**	**355**	**28,297**	**110,833**	**37,620**	**382**
Michigan	**324,174**	**987**	**59,550**	**263,637**	**80,576**	**1,084**
% of State	**43.2%**	**36.0%**	**48.6%**	**42.0%**	**46.7%**	**35.2%**

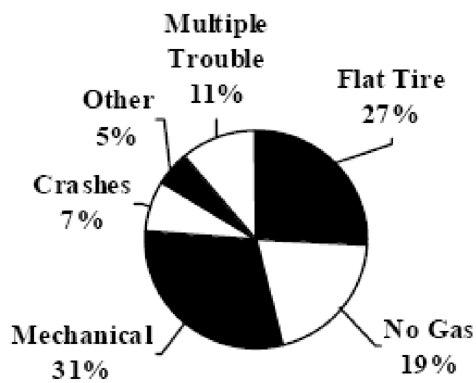
** Had been drinking*

Source: 2007 Michigan Traffic Crash Facts for County/Communities, Office of Highway Safety Planning

An important element of the transportation safety program in the SEMCOG region is the Freeway Courtesy Patrol (FCP) that is funded by MDOT. Since its inception in 1994, the FCP has grown from 2 vehicles to 24 and now covers most of the major freeways in

Oakland, Macomb, and Wayne Counties. In 2006 and 2007, FCP vehicles made over 50,000 stops that served a variety of needs. About 35,000 of these stops involved direct assistance to motorists, which are documented in **Figure 5**. Most of the other stops involved abandoned vehicles or road debris. As shown in **Figure 5**, crashes constitute only a small percentage of motorist assists. [1] Most stops involve vehicles that have been disabled by flat tires, mechanical trouble, or empty gas tanks. The rapid service provided to these disabled vehicles helps to advance safety and mobility in the region by reducing delays and crashes.

Figure 5 - Types of Assistance by FCP Drivers, 2007



Source: MDOT.

According to the 2007 FCP Evaluation Report, roughly half of all assists stops are made in the AM (6-9 AM) or PM (3-6 PM) peak periods, when traffic is highest. In 2007, over 3,200 assists were made in the highest hour; between 5 and 6 PM. Roads with the largest number of assists are I-75, I-94 and I-96. As part of the annual FCP evaluation conducted by SEMCOG, a benefit/cost ratio is calculated. Over the past several years this ratio has been in the range of 15-1. This ratio is very similar to that calculated through a different methodology in this report for proposed FCP expansions into Washtenaw and Livingston Counties.

1.2.2 Public Transportation

Public transportation is an important component of transportation service in the SEMCOG region. **Table 4** summarizes the operating characteristics of public transportation in the SEMCOG region. **Figure 6** shows the southeastern Michigan Transit Plan completed in 2004. This plan includes the existing bus routes for all of the transit providers, the current Amtrak route, park and ride lots, and proposed transit corridors for the region. Most of the service in the region is provided by two operators, the Detroit Department of Transportation (DDOT), which serves the City of Detroit, and SMART, which provides service in the suburban areas of Wayne County, as well as Oakland and Macomb Counties. SMART also runs the Lake Erie Transit system, which services the City of Monroe and the surrounding regions in Monroe County. The services of the two authorities are coordinated through a series of transfer centers, located primarily in southern Oakland and Macomb Counties. In

[1] MDOT Freeway Courtesy Patrol in Southeast Michigan: Evaluation Report, prepared by SEMCOG, May 2008

addition, SMART provides express service from the suburbs to downtown Detroit. There is an effort currently underway to establish a regional transit authority that would merge the services of DDOT and SMART.

A coalition of groups including local and state government leaders attempted to create a Detroit area regional transit authority to coordinate SMART and DDOT services. In November 2003, it was ruled that the group did not have the legal authority to enter into the agreement with SMART and the city of Detroit. Currently, there are efforts underway to establish a new agreement for a regional transit authority.

Outlying counties are served by other transit authorities, including the Ann Arbor Transportation Authority (AATA) in Washtenaw County, the University of Michigan Bus System, the Blue Water Area Transportation Authority (BWATA) in St. Clair County, and the Livingston Essential Transportation Services (LETS). There are a number of smaller providers in the region, located primarily in Detroit, that provide specialized service to specific clientele.

DDOT carries two-thirds of transit passengers in the region and their budget of over $162 million accounts for 57% of the total budget allocated to transit providers in the SEMCOG Region. DDOT's cost per passenger is lower than all other authorities in the region with the exception of Ann Arbor. There is substantial overlap between DDOT and SMART ridership. The dispersed pattern of employment and the heavy concentration of jobs in southern Oakland County attract a large number of Detroit residents who reverse commute. Many of these commuters transfer at one of the transfer points located across the region. Given the long distances traveled by many riders and the need for coordination between the two major regional systems, ITS provides potential opportunities to improve cost-effectiveness. AVL and traveler information systems can be particularly helpful in improving service quality and providing up-to-date information to passengers. The AATA has one of the more advanced ITS transit systems in the U.S. An AVL system has been in place for some time and the Authority is implementing more advanced technologies to address safety and efficiency.

There are three major transit infrastructure initiatives underway that would all be likely to involve the use of ITS technologies for operations and traveler information. These projects include:

- RTCC (Regional Transit Coordinating Council) – The RTCC is a group that includes both regional agencies and stakeholders dedicated to developing improved transit coordination in the short-term and a regional multi-modal system in the long-term. Their current initiative is a Comprehensive Regional Transportation Service Plan which will identify coordination activities designed to increase the efficiency and effectiveness of existing transit service.

- DTOGS (Detroit Transit Options for Growth Study) is evaluating the feasibility of a 9.3 mile Light Rail line along Woodward Avenue in the Cites of Detroit and Highland Park. This corridor was selected for preliminary engineering in the Spring of 2008 following a review of multiple corridors.

- Commuter Rail Service – Two commuter rail services are being planned for the region. A line is proposed between the Detroit and Ann Arbor AMTRAK stations with stops at Dearborn, Metro Airport and Ypsilanti. This line would serve major employment destinations and provide relief along the I-94 corridor. A Washtenaw-Livingston (WALLY) line is proposed between Ann Arbor and Howell in Livingston County. This

27-mile line would provide relief in the short term for planned construction along US-23 and in the long term could serve as an alternative to the widening of US-23.

Table 4 – Characteristics of SEMCOG Region Transit Authorities – 2005

Agencies	*Vehicles*	*Population*	*Veh Miles*	*Veh Hours*	*Passengers*	*Budget*	*Cost/Pass*
DDOT	611	1,769,000	18,452,000	1,488,000	34,724,000	$162,600,000	$4.68
SMART	395	1,591,000	18,001,000	985,400	10,191,300	$92,244,000	$9.05
SMART Lake Erie	21	135,000	805,000	55,200	365,000	$2,701,000	$7.40
Ann Arbor	75	234,000	3,868,700	294,600	4,887,000	$18,486,000	$3.78
Blue Water	40	54,000	1,921,000	128,600	867,100	$6,808,000	$7.85
Livingston	17	170,000	450,000	29,300	72,500	$1,437,000	$19.82
Total	**1,159**	**3,953,000**	**43,497,700**	**2,981,100**	**51,106,900**	**$284,276,000**	**$5.56**

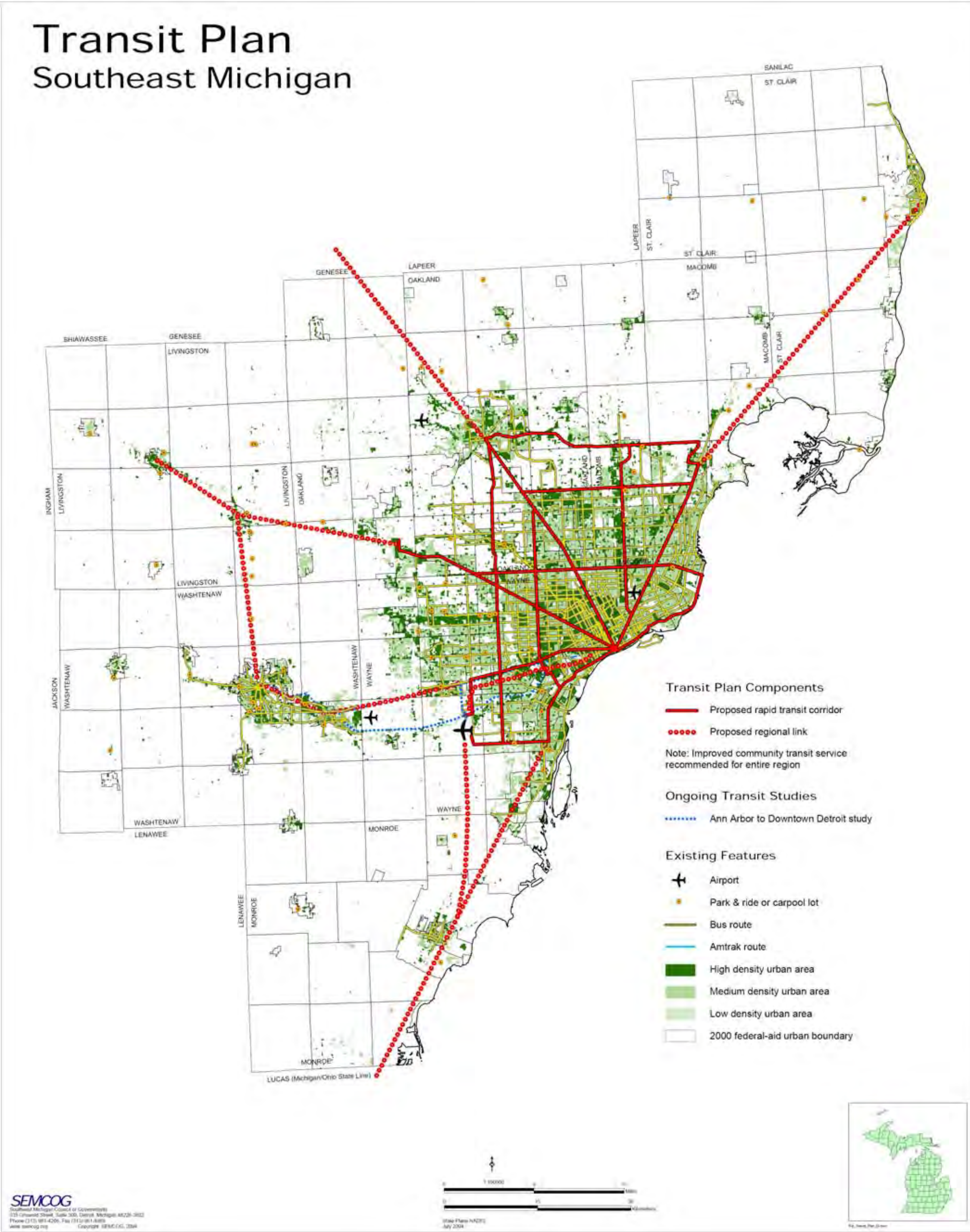
Source: MDOT Transit Management System, 2007

1.2.3 Existing ITS Infrastructure

The SEMCOG region has a long standing ITS infrastructure serving major freeways including and within the I-275/I-696 loop. The system extends beyond the loop along I-75 and is currently being extended along I-96 and I-94 to the northeast. The current MDOT system includes over 180 miles of freeway and consists primarily of DMS, CCTV cameras, detection equipment, and a freeway service patrol. A series of smaller DMS have been deployed over the past few years to provide real-time travel time information along the freeways. The system is operated from the MITSC in downtown Detroit, a facility that is shared with the MSP Dispatch Center and several private traffic data firms. Freeway Courtesy Patrols (FCP) also are managed from the MITSC, providing roadside assistance to motorists. The FCP has recently been expanded and covers close to 300 miles of regional freeway.

The other major component of ITS technology in the region is the SCATS adaptive signal control system, which is deployed in Oakland County. The system is deployed at over 600 intersections and has been successful in increasing the efficiency of the arterial system. Macomb County also has a TOC for signal control and the City of Detroit is nearing completion on its TOC. All three centers have plans to expand the number of coordinated signal corridors within their jurisdictions. A more detailed description of existing ITS systems is found in Section 2.0 of this document.

Figure 6 – Transit Plan: Southeast Michigan



Source: SEMCOG, 2004

1.3 Report Summary

Transportation agencies in the Southeast Michigan region are looking for ways to gain greater capacity from existing facilities and to better "manage and operate" the system. As more ITS systems are deployed, more information becomes available with respect to the costs, benefits, and performance characteristics of these systems. This document focuses on the benefits and costs of proposed SEMCOG regional ITS deployments as they relate to overall system performance. This enables transportation agencies to make the most cost-effective use of limited available funds, coordinate ITS investment with normal road and bridge project decisions, and to evaluate ITS on the same footing as other transportation improvements. Unlike the other regions of the State, most of the current system has been established for some time. As a result, difficult decisions must be made to balance replacement of existing equipment and service to growing areas. The tools being applied to this study will further enhance ongoing efforts to "mainstream" ITS into the day-to-day business of MDOT, SEMCOG, and other transportation agencies. Because MDOT is in the process of upgrading the current system, this report will focus on expanding deployments and additions to the existing system. This report presents the general process designed by MDOT and the Study Team to develop an ITS Deployment Plan Update for the SEMCOG Region.

The remainder of the report includes the following information:

- A description of the study process including:
  - Overview of Study Process
  - Needs assessment methodology
  - Inventory
  - Stakeholder feedback
  - Definition of alternatives
  - Evaluation of alternatives– criteria and process
  - SEMCOG Region projects for analysis
- Findings
  - Benefit/cost analysis methodology
  - IDAS model documentation
  - IDAS results
  - Description of benefit/cost analysis

2 Regional ITS Architecture Development Process

2.1 Overview of Study Process

Once the regional needs and user services, or market packages, have been identified, the next step in the regional architecture process involves the selection and prioritization of projects. This step can be accomplished at a preliminary level or involve an in depth analysis in order to generate a more detailed deployment plan for the region. The purpose of the SEMCOG Regional ITS Deployment Plan is to identify feasible ITS projects that can meet the needs of the region's stakeholders and develop a realistic plan to implement them. A key outcome of this process will allow the "mainstreaming" of ITS technologies, concepts, and projects into the planning process and the project development process of MDOT, SEMCOG, and other key planning and transportation agencies in the region. In order to accomplish this objective, the process used to evaluate ITS projects must be compatible with that used to evaluate more traditional transportation projects. For example, ITS projects have been considered as alternatives to major roadway capital investment, or at least as a way to provide temporary relief until major capital investments can go through what is often a lengthy funding and approval process. In order to help make investment decisions, planners and engineers must have the tools and procedures to compare the benefits and costs of ITS investments and their impact on meeting agreed-to system performance goals with those of other projects. This process facilitates activities that will allow transportation agencies to better manage and indeed operate its transportation system assets and get the most from its transportation investment decisions. The process developed for this project was designed to address this objective. **Figure 7** provides a high-level overview of the process used to accomplish the study objectives. The primary feature of this approach is that it follows the process used to plan other types of transportation improvements. Steps included:

- Review previous studies and documents including documentation of any existing ITS system and corridor studies which address ITS as a potential solution to transportation problems.
- Define the transportation facilities and services to be included in the study.
- Collect and review planning level data to identify specific system problems. Sources primarily included statewide and urban area transportation plans, traffic volumes, crash data and travel demand forecasts.
- Develop and implement a stakeholder process to help identify transportation system needs and problems, and potential ITS solutions. Extensive meetings were held with a wide range of regional stakeholders.
- Define and document transportation system problems and needs based on the information obtained from the above sources.
- Develop a process for defining ITS alternatives and a set of alternatives.
- Conduct a benefit/cost analysis of the proposed alternatives, using the SEMCOG regional travel demand model as a basis. The ITS Deployment Analysis System (IDAS), a sketch-planning tool used to estimate the impact of ITS deployments, was used for this purpose.
- Develop an implementation plan with funding options as a guide to help decision-makers prioritize ITS deployments.

Figure 7 – Deployment Study Process Chart

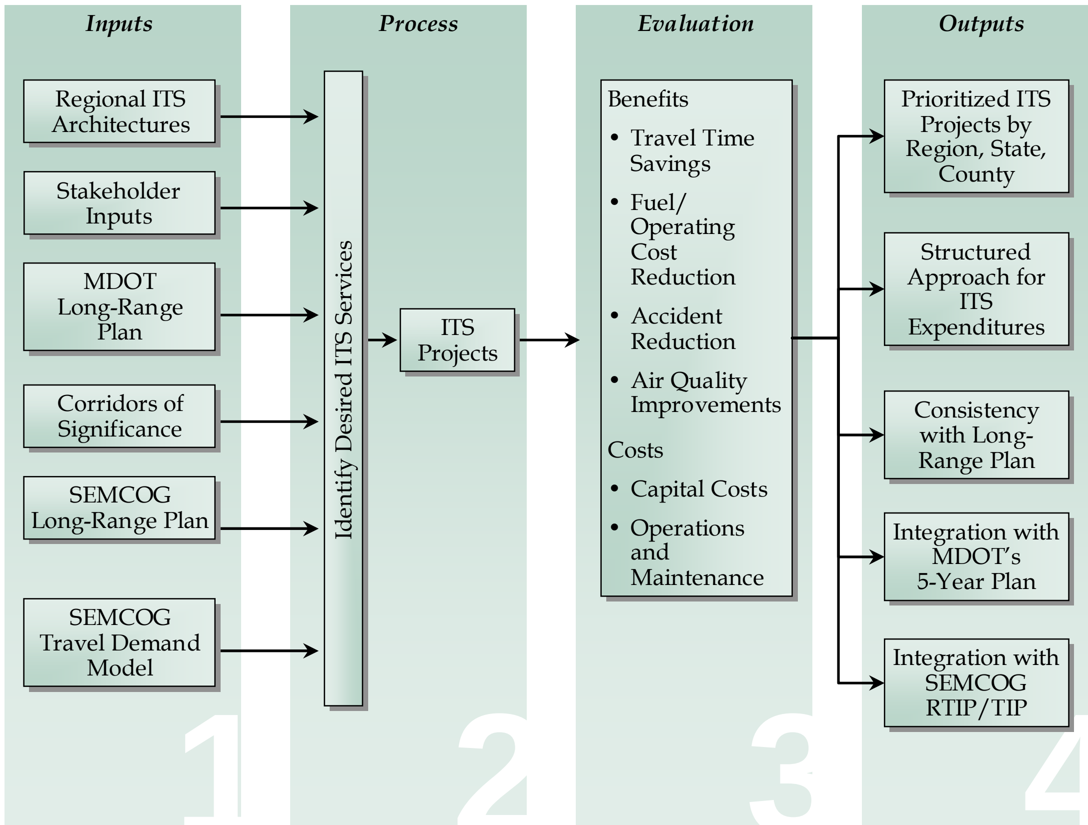
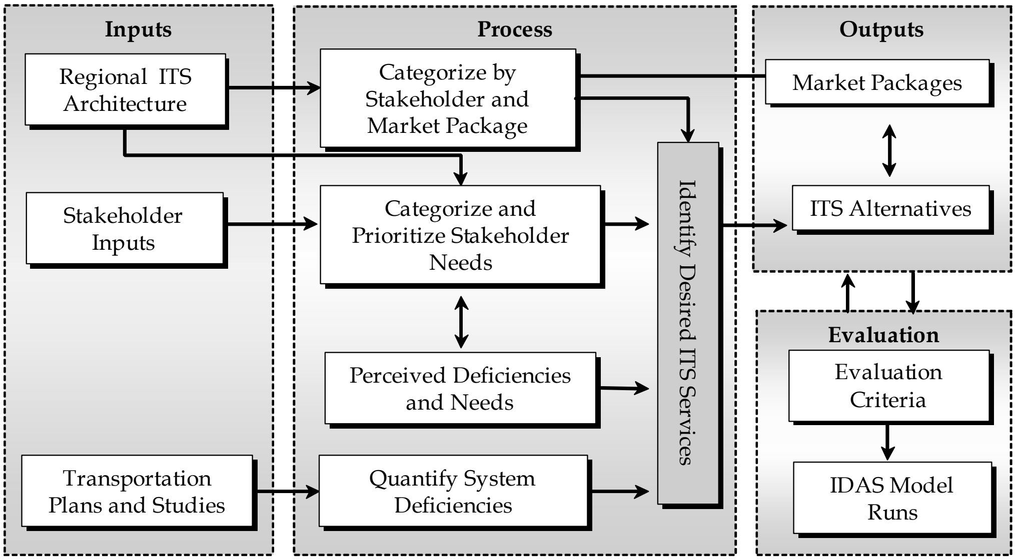


Figure 8 provides a more detailed view of the process used to develop and evaluate ITS alternatives. Inputs used to develop the alternatives are shown in more detail and include:

- Output of the regional ITS architecture process;
- Stakeholder input; and
- Review of transportation plans and studies for the study area.

Regional needs were identified using these inputs. Subsequently, the needs served as the base for the development of alternatives.

Figure 8 – Process to Develop and Evaluate ITS Alternatives



The process shown graphically in the middle box includes four steps.

1. Categorize the output of the SEMCOG Regional architecture projects by stakeholder and market package. This information is used to help identify ITS-related projects of interest to various stakeholders, and to assure that the ITS plan is compatible with the regional architecture.
2. Categorize and prioritize needs that were identified by stakeholders through meetings, reports and interviews. This information is used to help identify system problems and deficiencies, attitudes toward existing ITS services, and potential applications of ITS.
3. Identify perceived needs and deficiencies in terms of congestion, safety, and other criteria.
4. Quantify system deficiencies and problems to the extent possible using the data described above and other data such as traffic volumes, existing and projected volume/capacity ratios, and crash data.

The output of this process is used to identify ITS alternatives that address the needs identified. The process of defining and developing ITS alternatives is described in Sections 2.2 and 2.3. The ITS alternatives are then evaluated using the IDAS model. The model provides cost estimates in addition to benefit calculations related to travel time/mobility; crash reduction; fuel and operating cost savings; and air quality.

2.2 Needs Assessment

This section includes a summary of the needs assessment conducted for the SEMCOG Regional ITS Deployment Plan. While the data presented in Section 1 provided a good foundation for analysis, the discussions at the stakeholder meetings provided the critical information focus required to develop alternatives for analysis. The Study Team worked with MDOT and SEMCOG to identify a list of key stakeholders, who would provide input to both the architecture and the deployment plan. During the meetings stakeholders were asked to focus on:

- Identification and assessment of existing ITS systems;
- Perceptions of current transportation system, including system performance and effectiveness;
- Existing transportation needs that could be addressed by ITS;
- Future needs that could be addressed by ITS;
- Problems and opportunities in ITS deployments;
- Impact of technology on future ITS deployments; and
- Priorities for future ITS deployments.

2.2.1 Inventory

The first step in the needs assessment process was to develop an inventory of existing ITS and ITS-related services in the SEMCOG region. The needs assessment process, conducted primarily through a stakeholder process, also was used to identify agencies that may benefit from ITS solutions. The major ITS deployments in the region are MDOT's freeway management system and adaptive signal systems operated by local agencies.

The Southeast Michigan ITS system is the country's oldest, with the first installation of CCTV cameras along the Lodge Freeway (M-10) in the 1960's. During the 1970's and 1980's a system of CCTV cameras, detectors, and DMS was installed along 32 miles of freeway in downtown Detroit. A series of ramp meters were installed in the same area in the 1980's. In 1991, a new TMC was opened on the second floor of the Greyhound Bus Terminal in downtown Detroit. A major expansion of the system took place in the 1990's to cover most of the freeway network inside the I-275/I-696 "belt" along with an extension north along I-75 to Pontiac. In 2003, the system was expanded beyond Metro Airport along I-94, as well as along I-275 and I-75 in Wayne and Monroe Counties. As of 2007, the system had expanded to 63 DMS, 163 CCTV cameras, and 2250 detectors covering over 180 miles of freeway. In addition, a FCP program implemented in 1994 has expanded to cover 300 miles of freeway with 22 drivers and 24 vans. Graphic depictions of the existing Southeast Michigan ITS system are shown in **Figure 10** through **Figure 12.**

The MITSC is staffed 24 hours/7 days per week and is shared with the Regional Dispatch Center of the MSP. This close relationship has helped greatly to improve incident response times and assure that information provided to both field personnel and the traveling public is accurate. The Control Center room has a video wall with 36 monitors and one large screen. Operators have desk monitors, multiple computers, phones, and a camera control unit. In 2007, an 800 MHz radio system was installed to enhance communications with FCP field personnel. The Advanced Traffic Management System (ATMS) software, which controls field devices, is currently in the process of being replaced with an up-to-date, more robust system that will eventually be deployed at all MDOT TMCs throughout the State. Other key ITS deployments in the region include:

- SCATS System –Since the early 1990's the Road Commission for Oakland County (RCOC) has been deploying adaptive signal control systems along major arterial corridors. The system uses Autoscope technology and the Sydney Coordinated Adaptive Traffic System (SCATS) to monitor traffic volumes and automatically adjust signal timing to optimize flow along the corridor. Over 600 intersections in Oakland County are now on the system. Both RCOC and RCMC have TOCs that are being used to monitor arterial corridors. RCMC, the City of Detroit, and the City of Ann Arbor are not using SCATS, but they do have the ability to access and adjust timing for their signals from a TOC. Plans are underway to link both the RCOC and RCMC TOCs more closely with the MITSC.
- Southeast Michigan Snow and Ice Management (SEMSIM) Program – This program has been expanded since the late 1990's to coordinate winter maintenance activity in Oakland, Wayne, and Macomb Counties. Partner agencies include the RCOC, RCMC, Wayne County Department of Public Services, the City of Detroit, and the Suburban Mobility Authority for Regional Transportation (SMART). SEMSIM combines several technologies to improve the efficiency and effectiveness of winter maintenance. Infrared sensors on plow trucks are used to read pavement and ambient temperatures so that operators know when to apply materials to the roadway. Global Positioning System (GPS) technology and SMART's 900 MHz radio system are used to link the vehicle to the fleet management center in order to track vehicle location, speed, and materials usage. SMART utilizes the information to make more informed routing and scheduling decisions during adverse weather. Discussions are continuing regarding expansion of the system to outlying Counties.
- Vehicle Infrastructure Integration (VII) – Michigan is a national leader in VII and currently has three active test bed projects in the SEMCOG region; one in Dearborn focused on the Ford Headquarters, one in the Pontiac/Auburn Hills areas focused on the Chrysler headquarters and one in the Novi area. MDOT plans to expand these demonstration projects from these initial test beds into a wider portion of the region. **Figure 9** shows the geographic location for the current test bed projects in southeastern Michigan.
- SMART uses an AVL system which supports both the SEMSIM operation and provides real-time information on bus locations. The Ann Arbor Transportation Authority (AATA) and the University of Michigan Bus System both have location technology as well, and provide real-time bus locations and estimated arrival times on a website. The AATA also has deployed advanced technologies for safety and security including on-board computers/communication for reporting maintenance problems and on-board security cameras.

Existing deployments, along with proposed expansions, are shown in **Figure 10**, **Figure 11**, and **Figure 12**. Detailed ITS inventory sheets for each agency were collected during the stakeholder outreach process. A summary of this inventory is shown in **Table 5** and detailed inventory sheets by agency are included in **Appendix A**. More detailed descriptions of new projects are provided later in this report.

Figure 9 – VII Test Bed Projects

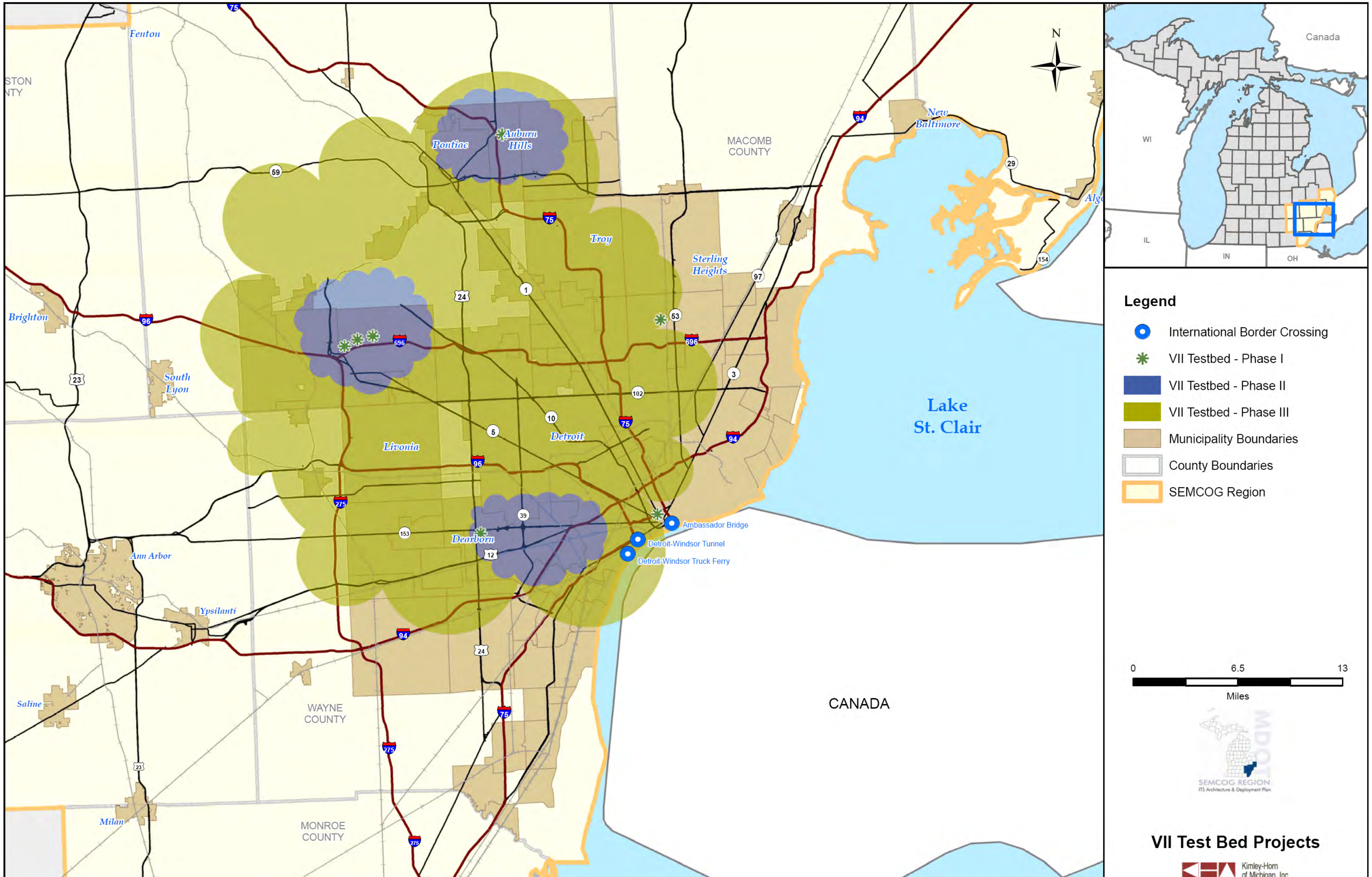


Figure 10 – MDOT Existing Network Surveillance & Signal Systems

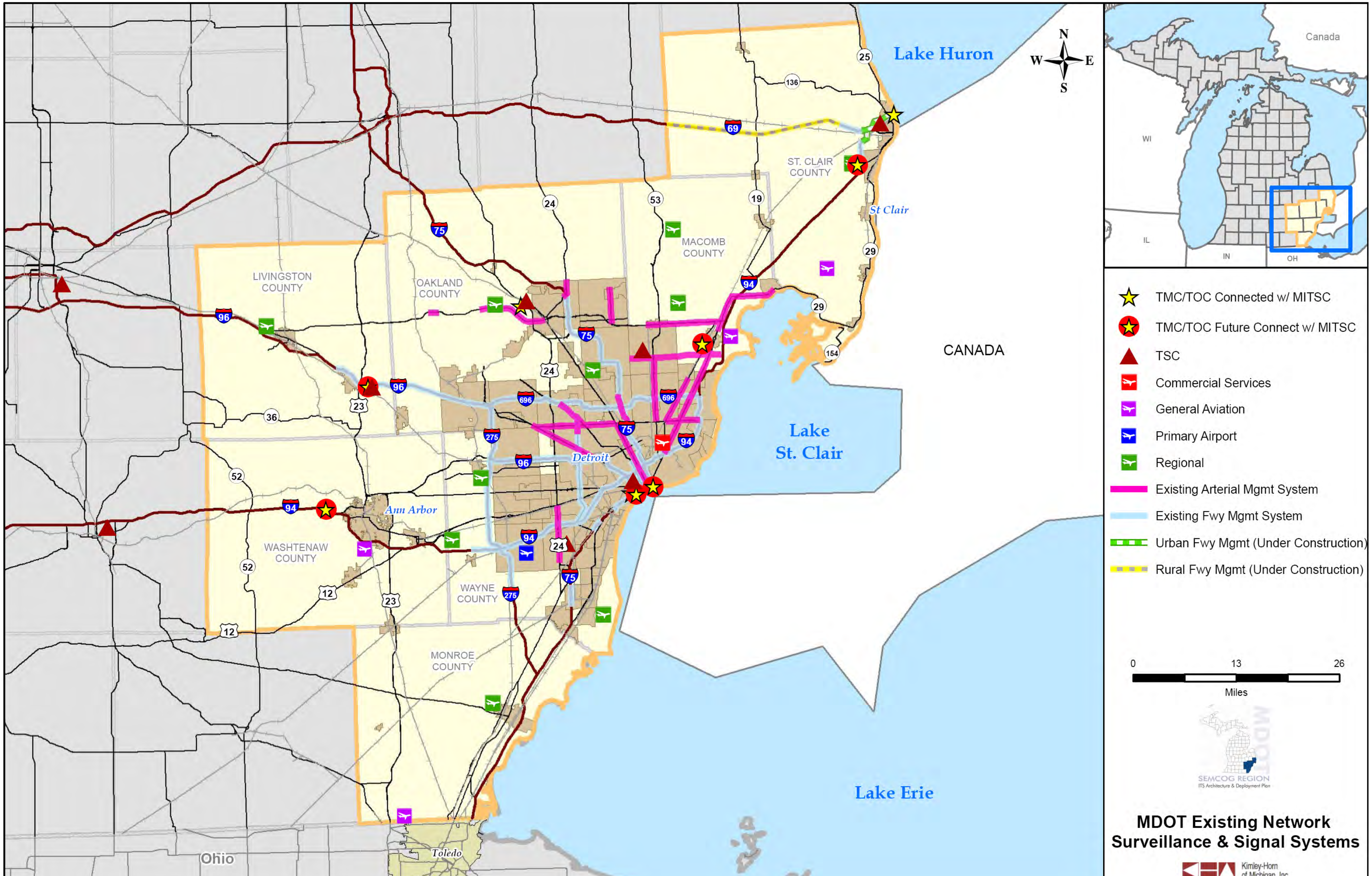
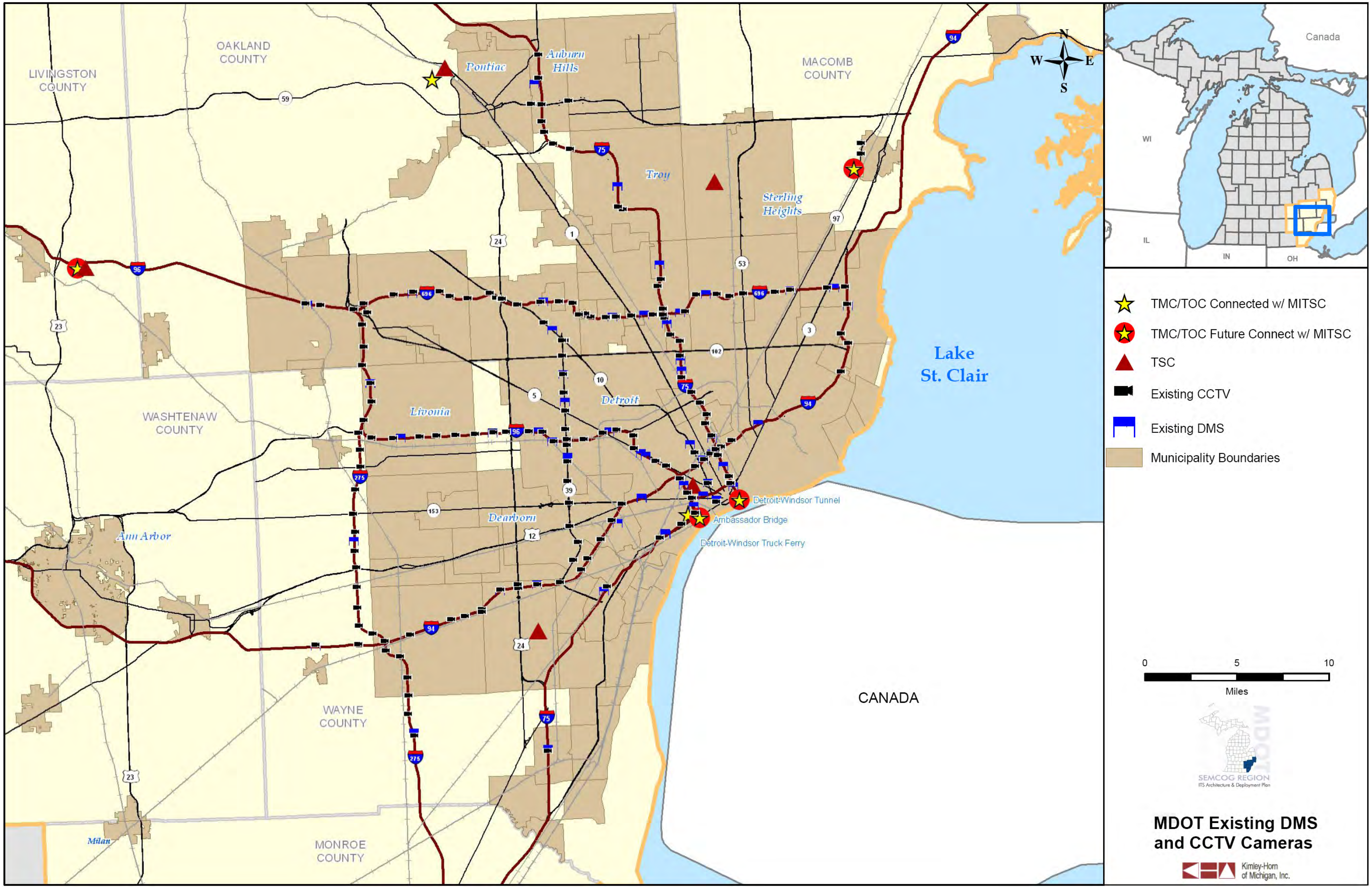


Figure 11 – Existing DMS and CCTV Cameras



Kimley-Horn of Michigan, Inc.

MDOT

Figure 12 – SEMCOG Freeway Courtesy Patrol & Winter Maintenance

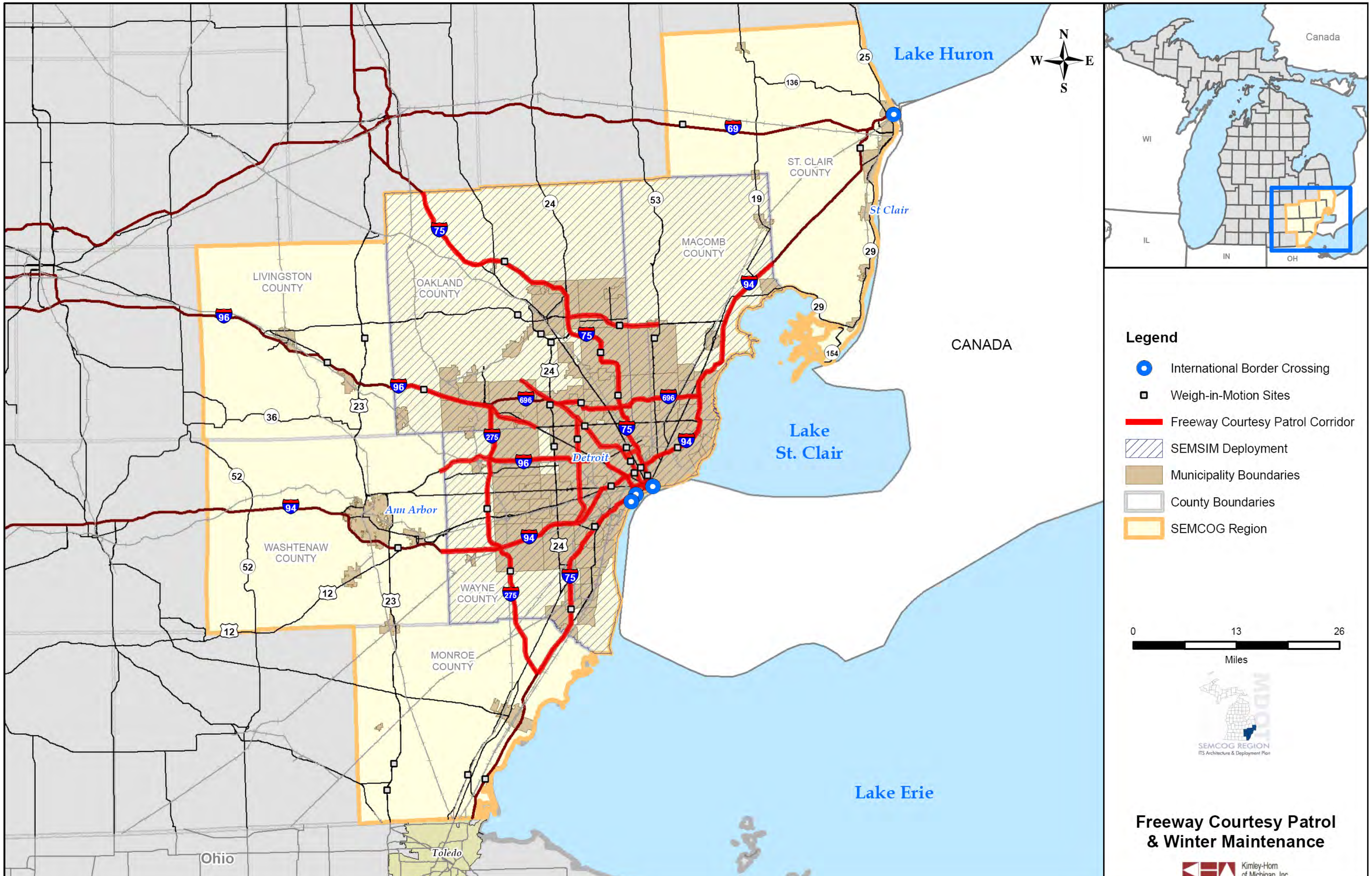


Table 5 – Summary of SEMCOG Region ITS Inventory

	System, Technology or Capability	Status	Primary Operating Agency
Travel and Traffic Management	Coordinated Signal System	Existing	City of Detroit, RCMC, RCOC, Ann Arbor, MDOT
Travel and Traffic Management	Video Detection Systems	Existing	City of Detroit, MDOT, RCMC, RCOC
Travel and Traffic Management	CCTV Surveillance	Existing	US Customs and Border Protection
Travel and Traffic Management	NEXUS and FAST Border Crossing Express Credentialing	Existing	US Customs and Border Protection
Travel and Traffic Management	Traffic Operation Center	Existing	RCMC, RCOC, MDOT, BWB
Travel and Traffic Management	Traffic Operation Center	Planned	City of Detroit
Travel and Traffic Management	Operations Center	Existing	Blue Water Bridge, Detroit/Windsor Tunnel
Travel and Traffic Management	AVL	Existing	RCOC
Travel and Traffic Management	Wireless Communication Architecture	Planned	RCOC
Travel and Traffic Management	Master Communications Plan	Existing	RCMC
Traveler Information	MIDrive Program	Existing	MDOT
Traveler Information	Video Detection Systems	Existing	City of Detroit, RCOC, RCMC
Traveler Information	CCTV Surveillance	Existing	US Customs and Border Protection
Traveler Information	CCTV Surveillance	Planning	RCMC
Traveler Information	Web Site used to disseminate Traffic Information	Existing	RCOC, DTW Airport, Blue Water Bridge, Detroit/Windsor Tunnel, Private Sector Web Sites
Traveler Information	Web Site updated daily during bad weather	Existing	MSP
Traveler Information	HAR	Existing	DTW Airport, Blue Water Bridge
Traveler Information	ESS installations for RWIS (see **Appendix A**)	Existing	RCOC
Public Transportation Management	Public Transportation Networks	Existing	SMART, DDOT, BWB Transit, Transit Windsor, St. Clair and Wayne Counties
Public Transportation Management	AVL for Transit Vehicles	Existing	SMART, DDOT

Table 5 – Summary of SEMCOG Region ITS Inventory

System, Technology or Capability		Status	Primary Operating Agency
Emergency Management	911 Dispatch	Existing	Homeland Security, MSP, Police & Fire Chief Association, County Sheriff
	Incident Management Groups	Existing	ITS Michigan, Urban Area Security Initiative, (PSAPs) St. Clair, RCOC, RCMC, Livingston, Washtenaw, Monroe and Wayne Counties
	Web Site updated daily during bad weather	Existing	MSP
	Shared Public Safety Information and Incident Management	Existing	DTW Airport Security Center
	Roadside Emergency Management System	Existing	Wayne County
	Video Surveillance Sharing	Existing	Approximately 50 Public Safety Agencies
	Emergency Vehicle Preemption	Existing	Troy, Novi
	AVL for FCP Vehicles	Existing	MDOT
Maintenance and Construction Operations	I-75 Corridor Phase I Construction	Existing	MDOT
	I-75 Corridor Phase II Construction	Planned	MDOT
	I-75 Corridor Phase III Construction	Planned	MDOT
	SMART Work Zones	Existing	MDOT
	Winter Weather Maintenance	Existing	(SEMSIM) RCOC, RCMC, Wayne County, and Detroit
Commercial Vehicle Operation	Weigh-in-Motion	Existing	MDOT
Archived Data Management	Data for Border Commuting	Existing	DTW, Windsor
	Traffic Count Data and Travel Time (MITSC, PTR, SCATS)	Existing	Midwestern Consulting
	Legacy System and Operations Information Shared	Existing	Metro, University, RCOC
	Public Information Disseminated	Existing	DTW Airport
	MITSC Information Archived for Freeways	Existing	MDOT
	Vehicle Infrastructure Integration Test Beds Archiving	Existing	UMTRI, MDOT
Advanced Vehicle Safety Systems	Vehicle Infrastructure Integration Test Beds	Existing	UMTRI, MDOT
	Vehicle Infrastructure Integration Phase 2 and Phase 3	Planned	UMTRI, MDOT

UMTRI – University of Michigan Transportation Research Institute

Most of the planned projects listed in **Table 6** have been funded and are in some phase of implementation. The Metro Region has developed a list of projects that are currently funded, with a number of them underway. These projects primarily address upgrade and replacement of the existing MITS system, including replacement of DMS, CCTV cameras, and field communications equipment. Filling of the MITS system gap along I-75 in Troy is a major priority for the Region. All of the current MITS deployments are contained within the Metro Region. Active Metro Region ITS projects are shown in **Table 6**.

Some of the arterial projects include CCTV camera installations. It is important to note that CCTV camera installations typically are designated for pan-tilt-zoom (PTZ) cameras that are intended for surveillance, but can CCTV cameras can sometimes provide a detection alternative through fixed CCTV cameras at signalized intersections. For the purposed of this table and the deployment plan, it is assumed that CCTV cameras are PTZ cameras and are intended to serve surveillance needs, while fixed cameras are captured under the umbrella of detection, unless otherwise specified.

Table 6 – Active ITS Projects in Metro Region

ROUTE	LOCATION	WORK TYPE	ITS TOTAL	REMARKS	STATUS	OPERATING AGENCY
I-96, I-69 and I-94	I-96; I-275 to Livingston County, I-94; Moross to 23 Mile, I-69; M-19 to BWB and I-94; 23 Mile to I-69 including BWB Operations Center	ITS Expansion Project (Cameras, Signs, Detectors, Canopy, Ethernet	$12,000,000.00	Project involves Designer (contract services quals), Brick and Mortar (MDOT letting), Integrator (Contract Services quals with low bid), and System Manager (contract services quals). CMAQ Project	Under construction	MDOT
Metropolitan Parkway	From Dequindre to Jefferson	Part of a three-corridor ATMS deployment project	$2,000,000	ATMS project includes a corridor wide, wireless, broadband communications network, CCTV cameras at every major intersection and an early deployment of traffic responsive components to be expanded with a future project.	Under construction	RCMC
MITS Network	Node 4 and Node 8	Microwave Communications (OC3 Backbone) Upgrade Project	Design $100000 Construction $1.2 million	Contract will be done with Node 4 as Node 8 will be redone with the I-94 project under a separate job number	In Design Phase currently	MDOT
I-696/M-5/12 Mile Road	Interchange Area	VII Test Bed		Equipment was bought off state contract with Motorola (Direct job)	In Construction phase	MDOT
I-96	Ambassador Bridge to I-696/I-96/M-5 Interchange	ITS Expansion Project (Cameras, Signs, Detectors, Ethernet) Design	Design: $1,010,000 Construction 10 million	Design completed. Project was let and construction is underway. Motor City is the Prime - Erben is the RE	Design Completed	MDOT
	See attached list for locations	DMS Replacement Project	$2,000,000.00	Money for DMS signs only. Project will be packaged with Device Integration project.	In Design Phase	MDOT
Jefferson	Jefferson	CCTV and Comm Installation	$459,000.00	Project design completed. Project has been let and is under construction. Rauthorn is the prime - Galindo is asst RE	Design Completed	MDOT
Various	Various	RCMC High Bandwidth Connection to MITSC	$100,000.00	TWA issued to RCMC for this connection	TWA sent to RCMC	RCMC

Table 6 – Active ITS Projects in Metro Region

ROUTE	LOCATION	WORK TYPE	ITS TOTAL	REMARKS	STATUS	OPERATING AGENCY
Various	Metro Region	Device Replacement and Integration	$2,000,000.00	This project is to upgrade existing CCTV, Conversion boxes, connections etc.	Submitting price proposal package to Lansing week of June 1, 2008	MDOT
	Metro Region	Communication Implementation Plan Strategy	$150,000.00		Project in progress	MDOT
I-94	US-24 to I-96	ITS Expansion Project (Cameras, signs, detectors etc) Construction	$3,101,000.00	Project designs completed and currently under construction. Motor City is the prime and Sharbenau is the RE	Design Completed	MDOT
I-75	MITS	Troy In Fill Project	Design $50,000 Construction $500,000	Camera installation to fill gaps in coverage	Design in Progress. Project scheduled for a Sept 2008 letting	MDOT
M-39		DMS Replacement		Combining the DMS replacement work with the M-39 Bridge project with Matt Chynoweth in 2010	We will need to supply information for the DMS work so it can be incorporated	MDOT
N/A	Metro Region Office	Installation of Monitors, Kiosk in lobby and work stations for temp ops center in conference room if needed		Plan complete for region office needs and locations. Just waiting funding to come available for work.	Waiting funding to come available	MDOT
MITSC	MITSC	Video Wall Replacement in operations center	$1,500,000.00	RFP is out and Consultant selected for project. Prime is Motor City.	Project is underway	MDOT
Various	Various	Cat Walk / Ladder Modifications		Working on solutions for existing DMS signs for access		MDOT
	MITSC	Emergency Response Vehicles	$300,000.00			MDOT
I-696	Drake to Woodward	Wireless Interconnect - Design	$50,000.00	Construction planned for CMAQ 2009 program ($400,000 budgeted)	CMAQ funded from 2007	MDOT

Table 6 – Active ITS Projects in Metro Region

ROUTE	LOCATION	WORK TYPE	ITS TOTAL	REMARKS	STATUS	OPERATING AGENCY
I-696	Beck to Orchard Lake	Wireless Interconnect - Design	$30,000.00	Construction planned for CMAQ 2009 program ($200,000 budgeted)	CMAQ funded from 2007	MDOT
I-94	Detroit to County Line	ITS Expansion Project (Cameras, Signs, Detectors, Ethernet) Design	$1,092,000.00	Partial construction planned for 2009 CMAQ program ($4,787,500 budgeted) Remainder of project to be const as funding permits	Design CMAQ funded from 2007 - Design in progress	MDOT
Northwestern	I-696 to 14 Mile Road	Wireless Interconnect - Design	$190,000.00	Construction planned for CMAQ 2009 program ($2,350,000 budgeted)	CMAQ funded from 2007 _ TWA written to RCOC for work	MDOT
M-10	@ Wyoming	CCTV Installation	$10,000 Design $50,000 Construction		CMAQ funded from 2007	MDOT
M-8	I-75 to M-10	ITS Expansion Project (Cameras, Signs, Detectors, Ethernet) Construction	$70,000.00	Project currently in design phase. Scheduled for 2009 letting	CMAQ funded from 2007	MDOT
M-10	@ Davison (M-8)	CCTV Installation	$10,000 Design $50,000 Construction	Project being done in conjunction with the Device Integration project	CMAQ funded from 2007	MDOT
M-14	@ Sheldon	CCTV & DMS Installation	$50,000 Design $390,000 Construction	Project being done in conjunction with the Device Integration project	CMAQ funded from 2007	MDOT
I-75	@ Woodward	CCTV Installation	$10,000 Design $90,000 Construction	Project being done in conjunction with the Device Integration project	CMAQ funded from 2007	MDOT
I-75 SB	North of Lapeer	DMS Installation	$30,000 Design $220,000 Construction	Project being done in conjunction with the Device Integration project	CMAQ funded from 2007	MDOT
I-275 NB	@ Ford Road	DMS Installation	$30,000 Design $220,000 Construction	Project being done in conjunction with the Device Integration project	CMAQ funded from 2007	MDOT

Table 6 – Active ITS Projects in Metro Region

ROUTE	LOCATION	WORK TYPE	ITS TOTAL	REMARKS	STATUS	OPERATING AGENCY
I-75	Auburn Hills North to Genesee County Line	ITS Expansion Project (Cameras, Signs, Detectors, Ethernet) Design	$1,080,000 Design		Requested CMAQ funding from 2009 design phase	MDOT
I-75	Ambassador Bridge to State Line	ITS Expansion Project (Cameras, Signs, Detectors, Ethernet) Design	$1,900,000 Design		Requested CMAQ funding from 2009 design phase	MDOT
M-10 NB	@ West Grand Blvd	DMS Installation	$40,000 Design $310,000 Construction	Project being done in conjunction with the Device Integration project	ITS Template Money 2008	MDOT
I-75	South of I-275	DMS Installation	$30,000 Design $220,000 Construction	Project being done in conjunction with the Device Integration project	ITS Template Money 2008	MDOT
Wayne County		Center to Center Communications	$2,800,000 construction		Requested CMAQ funding from 2009	MDOT
Metro Region	MITSC	DMS Replacement	$1,075,000.00	Costs are associated with replacement of the existing DMS signs and foundations, including communications infrastructure, computer systems and software, and user interfaces housed at the Michigan Intelligent Transportation System Center (MITSC) needed for	Proposed 2007 ITS Template Funded (Field Maintenance) Packaging project for Sept 2008 letting Money moved to 2008 template from 2007 template due to obligation issues	MDOT
Metro Region	MITSC	Incident Detection	$200,000.00	The cost includes implementing a pilot project to install CCTV cameras at high-crash locations on the freeway to assist in the detection of incidents at these locations.	Proposed 2008 ITS Template Funded (Ongoing Service Project)	MDOT

Table 6 – Active ITS Projects in Metro Region

ROUTE	LOCATION	WORK TYPE	ITS TOTAL	REMARKS	STATUS	OPERATING AGENCY
Metro Region	MITSC	RWIS Study	$100,000.00	This project includes developing a feasibility study and implementation plan for a region-wide Real-time Weather Information System in line with the statewide ITS Program Office goals	Proposed 2008 ITS Template Funded (EPE and PE) Cost proposal submitted awaiting approval. SRF is the consultant	MDOT
Metro Region	MITSC	ITS Infrastructure Replacement	$1,500,000.00	Costs are associated with replacement of the existing DMS signs and foundations, including communications infrastructure, computer systems and software, and user interfaces housed at the Michigan Intelligent Transportation System Center (MITSC) needed for	Proposed 2008 ITS Template Funded (Field Maintenance) Project in design currently	MDOT
Metro Region	I-75	Speed Advisory Project		I-75 @ 375 and I-75 @ 9 Mile Road	In design - Scheduled for Aug/Sept 2008 letting	MDOT
Metro Region	MITSC	MITS Operations Center Design		Coordinating design with DMB for inclusion with parts for building with Detroit TSC and other portion to be let separate for consoles etc	In design	MDOT
Metro Region	MITSC	Hub 2 and Node 5		Project in design phase currently		MDOT
	MITSC	Hub 6 and Node 7 Tower Reconstruction		Project design completed and project was let. Currently in construction with mid August completion. J. Ranck is the prime and Stuecher is the RE	Design Completed	MDOT
	MITSC	System Manager for M-8, M-10, I-96 and I-94			In progress	MDOT

Table 6 – Active ITS Projects in Metro Region

ROUTE	LOCATION	WORK TYPE	ITS TOTAL	REMARKS	STATUS	OPERATING AGENCY
Metro Region	MITSC	In - Vehicle Data Terminals	$200,000.00	Freeway Courtesy Patrol (FCP) vehicles would be equipped with in-vehicle data terminals and the associated communication equipment and software to facilitate incident response and dispatching.	Proposed 2009 ITS Template Funded (Ongoing Service Project)	MDOT
I-75	Wayne and Oakland County	I-75 Integrated Corridor Management Implementation	$500,000.00	The cost includes the cost of upgraded and new cameras, power feeds, and communications infrastructure to support the I-75 Incident Corridor Management program	Proposed 2009 ITS Template Funded (Improve and Expand)	MDOT

2.2.2 Stakeholder Feedback

Stakeholder feedback was the major input in identifying transportation needs of the SEMCOG Region. Three different workshops provided contributions to this process. While the first two were specifically geared toward architecture development, they provided an opportunity for stakeholders to identify specific ideas and projects. Stakeholders were asked to identify other interested parties and to respond to ideas developed by the consultant team. The three meetings included:

- October 22, 2007 – Architecture Kick-Off Meeting – Detroit, Michigan
- February 13, 2008– Architecture Development Workshop – Detroit, Michigan
- May 12, 2008– Deployment Plan Workshop – Novi, Michigan
- October 7, 2008 – Comment Resolution Workshop – Detroit, Michigan

Regional needs, planned improvements, and existing infrastructure were identified in the workshops and are summarized below:

Traffic/Incident Management – Region/Corridors

- A region wide deployment of emissions sensors is in place for collecting real-time emissions data.
- The M-59 Freeway section in Macomb and Oakland counties will be improved as part of a capital project and ITS elements will be incorporated.
- I-75 from downtown Detroit to the Ohio State line is scheduled for construction in 2012. This will provide an opportunity to expand ITS, possibly in association with the Ohio Department of Transportation (ODOT). This is a high priority corridor due to heavy freight traffic.
- I-75 from Pontiac to the Genesee County line is another area for system expansion.
- Several arterial signal improvement projects were discussed:
  - Woodward Transit Signal Priority out to 13 Mile Road, including signal retiming, communications and cameras
  - Michigan Avenue from Detroit out to Westland (I-275)
  - Gratiot to Mount Clemens (M-3)
  - Hall (M-59)
  - Groesbeck (M-97)
  - Cabinet, controller upgrades on Grand River, Telegraph (8 Mile to Pontiac Lake) and Woodward (8 Mile to Square Lake Road)
  - Mound Road
  - Metro Parkway
  - Mack, Warren and Jefferson in the City of Detroit (the City will supply additional recommendations)
- Expansion of the FCP on key routes outside of the Metro region was a key interest on several of the major routes. This would primarily be in the University region but also could extend north to the Bay region.
- Expansion of the freeway management system with the information connecting back to the MITSC is of interest to the counties surrounding the Metro Region.

Traffic/Incident Management – Spot Locations

- A drawbridge location was noted in downtown Detroit in the vicinity of 4th Street that may benefit from a coordinated system to manage traffic flow. The 4th Street location can impact traffic at the Ambassador Bridge.
- Drawbridge locations were noted in Port Huron that may benefit of a coordinated system to manage traffic flow (10th Street and Black River at Main Street)
- A specific location along I-96 near Bingham experiences recurring fog and may benefit from a RWIS deployment.

Maintenance Activities

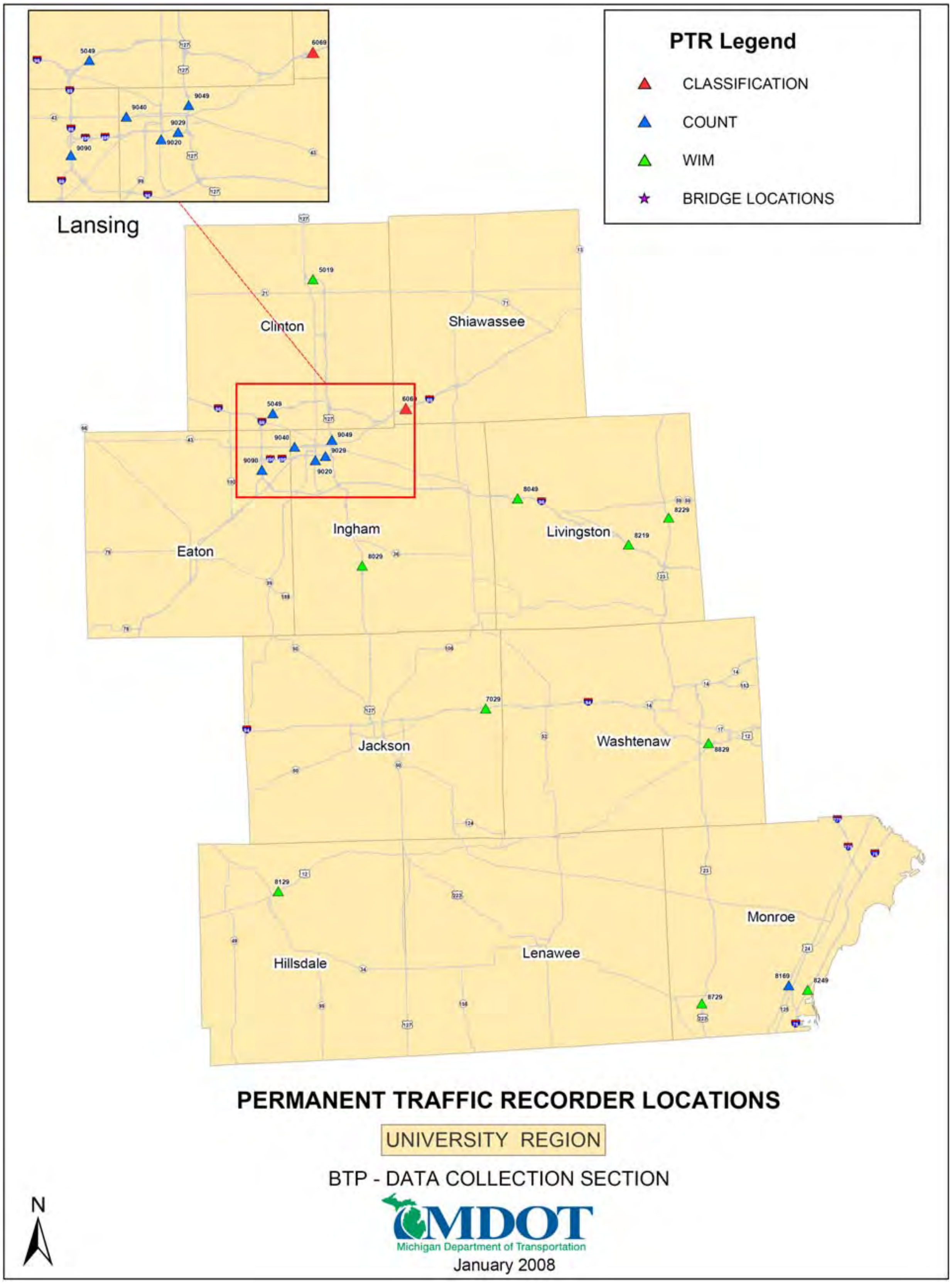
- Livingston, Monroe, Washtenaw, and St. Clair counties are interested in the deployment of AVL and other maintenance technologies similar to SEMSIM.
- It was noted that Weigh-in-Motion (WIM) locations have been prioritized in the University Region. The priorities for replacement and upgrade of existing installations are listed in **Table 7** and the locations are shown **Figure 13**.

Table 7 – Priorities for WIM Locations in University Region

Priority	*Location*	*Recommendation*	*Estimated Cost*
1	US-127 Holt Rest Area	Mill Existing PITWS; this job will be managed out of Lansing	$5,000
2	I-75 Northbound*	Replace Slow Speed WIM & Add Changeable Speed Signs	$283,500.53
3	US-23 Dundee Welcome Center*	Replace PITWS Virtual weigh station	$60,000
4	I-94 Eastbound	Replace Slow Speed WIM	$250,000
5	US-127 north to Barnes Road*	Upgrade WIM to wireless	$8,000
6	I-94 Westbound	Replace Slow Speed WIM	$250,000
7	M-50 Cambridge Scales*	Install PITWS	$131,248.95
8	I-69 Potterville Rest Area NB/SB	Replace PITWS	$60,000
9	US-23 SB Northfield Church Rest Area	Install PITWS	$60,000
10	US-23 SB North of Northfield Church Rest Area	Install wireless WIM	$60,000
11	I-69 Woodbury Rest Area	Install PITWS	$60,000
12	I-69 South of Potterville Rest Area	Install new wireless WIM	$60,000
13	US-12 East of Jonesville	Upgrade WIM to Wireless	$8,000
14	I-75 Southbound	Replace slow speed WIM, Static Deck, & add changeable speed signs	$320,000
15	I-96 Fowlerville Scale WB	Replace Slow Speed WIM	$250,000
16	I-96 Fowlerville Scale EB	Replace Slow Speed WIM	$250,000

*Approved Projects for 2009

Figure 13 – University Region WIM Locations

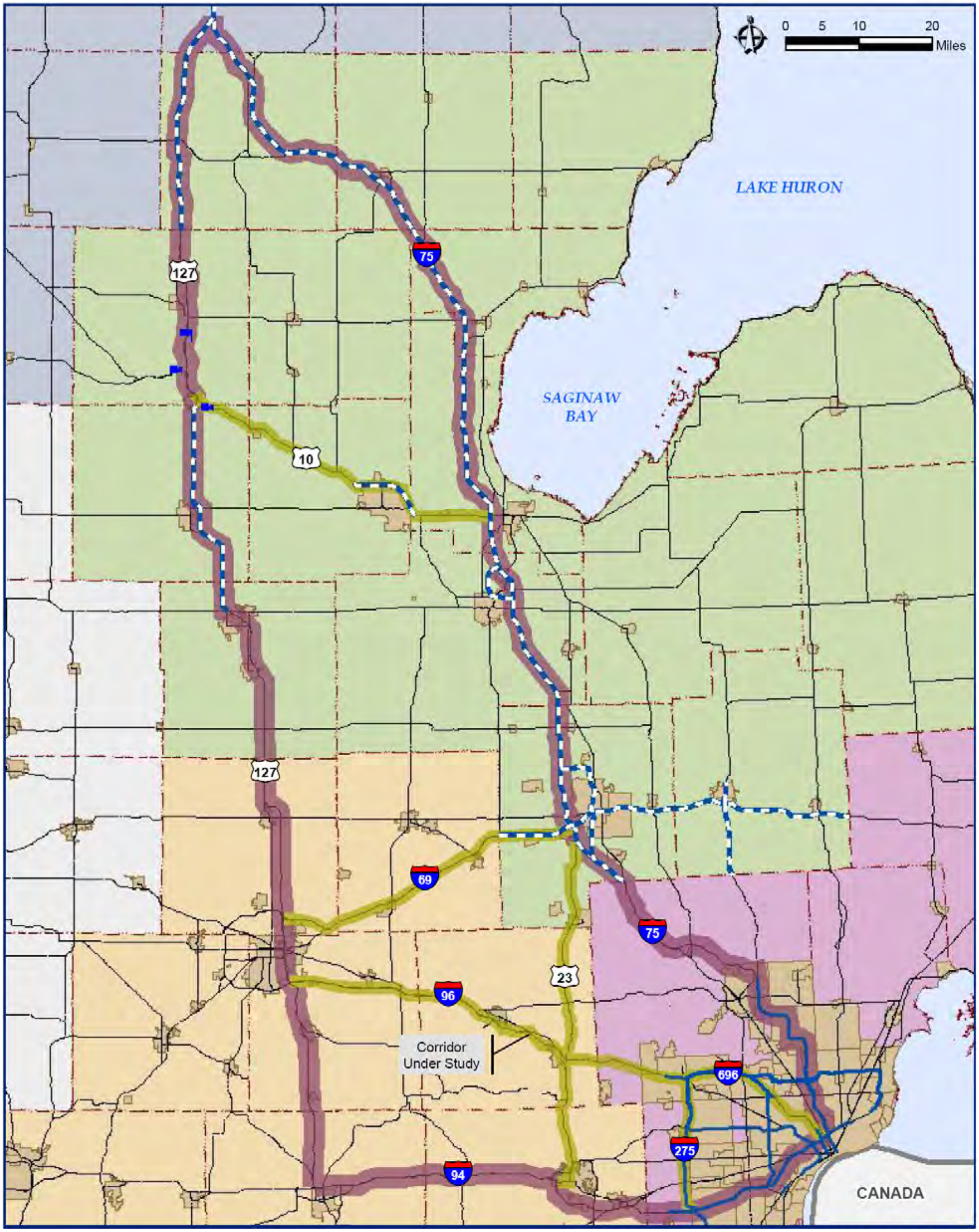


Source: MDOT University Region, January 2008

Traveler Information

- County TOCs should consider providing Advanced Traveler Information Systems (ATIS) services.
- The MDOT Triangle of corridors that are being evaluated for effective data collection and traveler information is shown in **Figure 14**. The outcome of that study will have an impact on projects in the SEMCOG Region on these corridors.
- Border crossing information is a priority, but the information itself is political when there are delays at one crossing and not another. In general, customs will not report wait times over 30 minutes. There is a system for posting of information in Ontario at the 401/402 split.

Figure 14 – Study Area for MDOT Triangle of Corridors



Public Transportation

- There is interest in installing an AVL system on DDOT buses, but there is no funding available.
- SMART would like to build upon their current AVL system with installation of security and safety-related CCTV cameras. Automatic Passenger Cards and fare cards are also priorities.
- SMART and Ann Arbor would like to build upon their current AVL system and also has an interest in Automatic Passenger Cards.

Funding/Institutional Issues

- Ongoing funding for operations is a major concern for all operations centers. The MITSC as well as the RCOC and RCMC TOCs currently use funds from the Congestion Mitigation and Air Quality (CMAQ) Improvement Program for most of their operational funds. The City of Detroit TOC is scheduled to come online in September and Wayne County is still considering a TOC or similar facility. The availability of CMAQ funding, which now provides most operating funds, is uncertain after 2009 and will be subject to Federal reauthorization. MITSC has identified State funds as a potential backup source, but the other centers may need to identify new sources. If other ITS funds have to be shifted to pay for operations, it will have a major impact on any capital expenditures.
- Stakeholders discussed whether freeways should always have priority over arterials for ITS deployment. It was noted that some arterials have higher volumes and greater congestion problems. Arterial sections of M-53 and M-59 along with US-24 were all mentioned as corridors that may justify consideration. M-102 and M-153 also were mentioned as heavily traveled corridors. The responsibility for monitoring CCTV cameras and operating DMS on arterials is an open question that needs to be resolved between the participating agencies.
- The Metro Region RWIS study that is being initiated will address the next level of detail for RWIS deployment in portions of SEMCOG, but will not address locations in the University Region. The study area will align with the MDOT Metro Region boundaries.
- Public Safety Access Point (PSAP) coordination was raised as an important issue for the region, particularly whether PSAP's should have transportation agency video and whether they should be given control during emergencies.

2.2.3 Demand Model Projections

SEMCOG's regional travel demand model was used as the basis for the analysis of benefits and costs for the different ITS alternatives. This model covers the entire region included in this deployment plan. ITS equipment has a relatively short life span compared to traditional highway projects such as bridges and pavement. In addition, technologies change much more quickly. For this reason, a relatively short time frame, 2015, was selected for the analysis. The regional model has four time periods, AM peak period, PM peak period, mid-day and off-peak. The benefits estimated for this project are based on combined runs for the AM and PM peak models, when most of the benefits of the ITS are likely to be realized. It is important to note that this approach does yield a conservative approach to the estimation of benefits.

2.3 Definition of Alternatives

2.3.1 Alternatives Definition Overview

One of the major challenges in the evaluation of ITS alternatives is the definition of those alternatives. Unlike roadway and public transportation improvements, ITS can include a wide range of technologies, packaged and implemented in different ways. The development of the most current MDOT Regional Deployment Plans has utilized a consistent framework for evaluation of ITS alternatives. Several characteristics of ITS alternatives were established early in the process, including:

- **Timing/Phasing** – Like other transportation improvements, ITS options need to be evaluated for a specific point in time, but the deployment can be phased in over a period of years with the most appropriate portion of the recommended solutions implemented to address the most pressing problems, and at the same time setting the technology framework for longer term investments. With limited funding available, projects need to be prioritized for implementation. (Over the past year, MDOT has developed and implemented a statewide process for allocation of ITS funding.) While 2015 is used for the analysis, the presentation of specific alternatives in this report does not tie them to a specific year. This approach provides flexibility to implement portions of these plans and assess their effectiveness.
- **Geographic Coverage** – Depending on the technology used, ITS alternatives can cover a specific facility, a corridor, or a region. Surveillance and management elements are tied to a specific corridor, while traveler information may be provided over a wide area. It is important that the geographic component of the ITS alternative be clearly defined. Some of the larger projects may be broken into segments and implemented in phases. Clear geographic limits also provide the opportunity to incorporate ITS projects into larger bridge or roadway reconstruction projects. It is also critical that statewide or inter-regional impacts or alternative deployments be considered. In this analysis, benefits and costs for future ITS alternatives are reported by County. Future projects are likely to be implemented on a corridor basis and may include both arterial and freeway management systems. These decisions, however, will be based on priorities and available budget. Because of the size of the region, however, reporting results only on a regional basis would not be meaningful. Counties are thus a reasonable unit for reporting of benefit/cost results.
- **Technology Component** – ITS consists of a series of technology deployments that work together to meet safety and congestion-related objectives. It is this component that makes ITS more complex and therefore more difficult to define than physical improvements or additions to roadways or public transportation systems. Also, the level of ITS deployment can vary in intensity. On heavily congested urban freeways, for example, full coverage with cameras and detectors may be desirable. In less congested areas, coverage may be needed only at major interchanges and/or high crash locations. The following section addresses the methodology used to develop conceptual alternatives, and specifically appropriate levels of deployment. This serves not only as documentation for the study, but also as a template for future use by transportation agencies.

2.3.2 Alternatives Technology Definition

Some of the key concepts in defining ITS alternatives are:

Coverage of ITS Deployment is a collective term that represents the extent of ITS deployment in a region. It accounts for:

- Number and length of routes covered;
- Number of infrastructure facilities covered (for example, number of traffic signals in an arterial traffic management system);
- The area covered, in the case of systems that have a network-wide impact (i.e. transit CAD and AVL);
- Equipment; and
- Overall geographical expanse of the ITS deployment including availability of traffic information.

ITS Deployment Intensity indicates the intensity of ITS deployment within the area of coverage which is a function of the quantity and quality of the ITS user services provided. There is no all-inclusive list of parameters that influence the deployment intensity, but typical examples of parameters that represent deployment intensity are:

- Spacing of ITS equipment such as CCTV cameras, detectors, DMS;
- Number of buses in an APTS that are equipped with CAD/AVL;
- The hours of operation of a TMC, TOC, or ATMS center; and
- The hours of operation of an FCP.

Deployment intensity is different from coverage of deployment as it represents the degree of the ITS functionality of a deployment within the coverage area. Therefore, two similar ITS deployments can have the same coverage but differ in their deployment intensities. A typical example would be the case where there are two FCPs that cover the same roadway mileage, but one of them operates only during the peak hours and the other operates from sunrise to sunset. In this case, the deployment intensity of the latter FCP is higher, thereby resulting in a higher functionality than the other FCP.

Different intensities for Freeway Management Systems have been proposed for this project, with a higher level of geographic coverage provided in urban areas of the region than in rural regions.

Conventional ITS Applications collectively include ITS applications and services that have been deployed extensively in different metropolitan and rural areas in the United States, and have been in operation for a significant period of time. ITS applications, technologies and services that are still under development or testing, or those that are yet to achieve widespread market penetration, do not fall under this category. A majority of conventional ITS applications and services are public infrastructure oriented rather than private infrastructure or vehicle oriented. Examples include electronic DMS and surveillance cameras. The capital, deployment, and operating costs of conventional ITS applications and services have mostly been paid for by public agencies, although there are exceptions.

Emerging ITS Applications collectively include ITS applications, technologies, and services that are either in the process of development or testing, and have not achieved significant market penetration or have not been widely deployed in the United States as of date. A majority of emerging ITS applications and services are private infrastructure and vehicle oriented rather than public infrastructure oriented, with the Vehicle Infrastructure Integration (VII) project as a primary example. Private companies are paying many of the capital, deployment and operating costs of emerging ITS applications and services. These technologies will not only result in a shift of some services to the private sector, but will change the way that the transportation and public safety agencies in the public sector do their work. Once an ITS application achieves widespread usage and market penetration, it may be considered as conventional at that point in time.

2.3.3 Deployment Philosophy

One of the major objectives of the project is identifying the optimal level of investment in ITS. The results of the needs analysis indicated that the level and nature of ITS investment in the study area should be varied based on several variables. These included traffic volumes, projected congestion, safety, and proximity to the existing ITS system.

The concept of *deployment intensity* is the method used to address these needs. Low-intensity deployments can be viewed as both a way to provide ITS coverage in areas of lesser need where only limited investment is justified, and as a first step toward higher intensity deployment. In this section, major ITS deployments are defined in terms of high and low density. These are flexible definitions and deployments are tailored to the specific system performance expectations of the region. For purposes of display, individual technologies are sorted into several categories. In the architecture section of the report, these broad categories are tied to specific architecture packages.

- Freeway Traffic Management;
- Arterial Traffic Management;
- Portable Traffic Management;
- Advanced Traveler Information Systems;
- Incident Management Systems;
- Advanced Infrastructure Based Warning Systems;
- Advanced Public Transportation Systems;
- Emergency Vehicle Dynamic Routing Systems;
- Parking Management Systems;
- Road Weather Information Systems; and
- Advanced Vehicle Technology.

2.3.4 Deployment Packages

Core deployments represent the basic ITS services that are currently in place in the region. These generally include proven technologies that have been in operation for some time. The amount of deployment, level of monitoring, and the specific services provided on a given portion of the transportation system, depend on whether it is slated for high-intensity or low-intensity deployment.

Freeway Traffic Management

The core grouping of freeway traffic management provides the basic monitoring, traveler assistance, and information feedback mechanisms for highway infrastructure. Together with arterial traffic management, freeway management functions provide the information skeleton on which additional services depend and build. As there is already an established ITS system in the region, upgrade and replacement of existing system is the highest priority. As systems are upgraded, changes in technology may change the definitions found below. Emerging use of probe vehicles to measure speed may reduce the required density of detection and increasing market penetration of in-vehicle navigation devices and other interactive technologies will reduce the need for major investments in DMS. For the purposes of this project, urban areas are proposed for high-intensity deployment and more rural areas for low-intensity deployment. MDOT has changed its philosophy regarding DMS. DMS require a large investment and new technologies are quickly emerging to provide motorists with in-vehicle, real-time information. Therefore, under both urban and rural scenarios, DMS are proposed only at freeway-to-freeway interchanges and at other problem locations. Lower-cost portable DMS may be used at other locations, particularly during construction.

Table 8 – Freeway Management Deployment Types

Function	*High-Intensity Deployment*	*Low-Intensity Deployment*
Detection	100% roadway coverage (Loop Detector, Microwave, Radar or Imaging technology) At least one detector on each segment and ramp, plus additional detectors for long segments	Majority coverage (Loop Detector, Microwave, Radar or Imaging Technology) Detector on each segment
Surveillance/ Verification	100% roadway coverage (Streaming CCTV camera images able to view entire mileage) Fixed cameras at priority locations; pan/tilt/zoom cameras at non-priority locations Pan/tilt/zoom camera coverage of all interchanges	Priority coverage Interchanges and other priority locations have pan/tilt/zoom camera coverage
Freeway Service Patrol	Dedicated service to specific routes during peak periods	Deployed only during busiest travel days; applies primarily to recreational routes.
Highway Advisory Radio (HAR)	100% reception coverage No need for HAR in high-intensity deployment, due to frequent DMS units	Announcement signs upon entering or leaving low-intensity coverage area Will include roadway weather information where available
Dynamic Message Signs (DMS)	At major regional decision points For specific safety warnings.	At major regional decision points For specific safety warnings.
Cell phone probes for reporting travel times	Reporting of travel times using cell phone probes on all roads where service is available and traffic volumes provide an adequate sample	Reporting of travel time using cell phone probes on major trunkline routes

Arterial Traffic Management

Arterial traffic management caters to the unique needs of high-volume surface streets. Deployments must address additional delay and safety concerns, resulting from the presence of signalized intersections and railroad grade crossings. Implementation of formalized incident management strategies require that excess traffic resulting from freeway incidents or construction information be accommodated. Information must be provided to both agency personnel and the public on arterial conditions, and where possible, signal timing be adaptable to major change in traffic flow. Both high and low-intensity deployments have been identified for the SEMCOG region. In areas served by adaptive traffic signal systems (i.e. SCATS), new signals will be added in response to both increasing traffic volumes and upcoming construction in the I-75 corridor. Corridor upgrades are also proposed in other portions of the region not covered by existing systems.

Table 9 – Arterial Management Deployment Types

Function	*High-Intensity Deployment*	*Low-Intensity Deployment*
Traffic Signal Coordination	Full signal coordination on all corridors identified as high-intensity, with "the bells and whistles" that go with it (actuation, coordination, control, traffic signal TOC, adaptation)	Traffic actuated signals isolated on an as needed basis; may be connected to TOC if needed for status determination purposes
Surveillance/ Verification	CCTV cameras deployed on an as needed basis at major locations, including: High crash, delay, or strategically important intersections, segments, or railroad grade crossings Key decision point for freeway/arterial incident management strategies Can be pan/tilt/zoom or slow-scan fixed cameras Can be combined with detection (in case of camera detection)	No CCTV cameras deployed except when needed to monitor isolated high crash/traffic locations. Tie existing detection data to TOC at specific locations
Signal Preemption for Emergency Vehicles	Deployed on an as needed basis, mainly in and around intersections/corridors such as: Intersections with high emergency vehicle traffic (around hospitals, fire and police stations) Densely developed areas (like central business districts) Low capacity/long signal phasing/high crash intersections (typically single-lane approaches)	Generally, no signal preemption. However, individual intersections or corridors may be equipped on an as needed basis, using the high-intensity criteria
Transit Signal Priority		
Rail Road Crossings	All railroad grade crossings on major arterials have advanced deployments, consisting of: Cross-bucks and flashing lights Quad-gates and incursion detection systems Railroad signal preemption At locations where major backups occur regularly and alternate routes are available: DMS, advanced warning/real-time rerouting, and at-location status updates Speed-based gate timing	All rail grade crossings have standard deployments consisting of: Cross-bucks and flashing lights Advanced deployments (listed under high-intensity) should be considered on an as needed basis for high rail traffic, crash, or delay locations.

Advanced Traveler Information Systems (ATIS)

ATIS can be accomplished through public/private partnerships. Many agencies contract their ATIS function to a private contractor. MDOT, through the MITSC, has participated in private partnerships. Decisions regarding high- and low-intensity deployment require assumptions about what services a private provider would be willing to offer, policies that a public agency could use to encourage particular service, and actions that a public agency should take to support full information provision. Some of the in-vehicle technologies being explored may enable traffic information to be obtained and disseminated to a larger number of rural roads. This is one of the fastest changing areas of ITS, making it important that investments be carefully considered to avoid locking in expensive technology that may quickly become obsolete.

Table 10 – ATIS Deployment Types

Function	*High-Intensity Deployment*	*Low-Intensity Deployment*
Cellular phones, Pagers, Handheld devices	Complete broadcast coverage Complete interactive, route-planning capabilities	Partial broadcast coverage Complete interactive, route-planning capabilities, within coverage Emphasis on real-time regional route choice information (for long-distance/intercity travelers)
Internet	Network Coverage for all portions of system where information is available Route-planning services for metropolitan areas focused more on disaggregated/ localized information Availability of real-time TMC CCTV camera feeds and speed data	Network Coverage concentrated on major routes Route-planning services for outlying areas focused on regional information
Kiosks Multimodal and public transportation only Broadcast (static TV screens and terminals) and interactive	Linked to TMC or other sources of transportation information Deployed at high pedestrian traffic facilities, on an as needed basis including major multi/modal terminals (airports, park-and-ride lots, rail stations, transit transfer points) and major commercial centers (office complexes, shopping centers, universities, public parking garages)	Displays static information on construction activity and/or transit routes. Deployed at similar locations to high intensity, but at fewer locations.
511 travel information service	Complete Coverage	Coverage confined to major, high-intensity routes

Incident Management – Freeway/Arterial Integration

Functions in this grouping are used to implement a defined incident management plan, to respond to major crashes or natural disasters. The functions help the designated relief arterials to accommodate increased traffic that has been rerouted off of impacted freeway segments. In high-intensity applications, active management of both freeway and arterial corridors is provided. In low-intensity applications, information is provided but proactive management of the arterial system is not. This is an important need identified for the SEMCOG region, particularly with major construction ongoing in downtown Detroit and major construction projects underway or planned for major corridors such as US-23 or I-75. It should be noted that the permanent ITS deployments proposed for the SEMCOG region are generally adequate to meet these needs.

Table 11 – Incident Management Deployment Types

Function	*High-Intensity Deployment*	*Low-Intensity Deployment*
Incident freeway-arterial signal coordination	For freeway-alternate arterial pairs identified in a regional incident management plan. Arterial signals along alternate corridor able to adjust for shifting traffic pattern Can be either manual control between freeway TMC and signal coordination center, or seamless sensor-automated control	For freeway-alternate arterial pairs identified in a regional incident management plan. Information provided on freeway through DMS Traffic monitored on parallel arterials but no proactive management
Alternate route guidance (Trailblazer)	"Trailblazer" or similar dynamic route guidance signs deployed at all potential decision points along alternate arterial corridor	"Trailblazer" signs not deployed but portable DMS may be used in certain situations

Advanced Warning and Safety Deployment

These include additional deployments that are generally deployed on an as needed basis at or in advance of roadway locations where potential safety hazards exist. They consist of detection, surveillance and/or information display systems that are deployed on the roadway or roadside. Based upon the characteristics of individual vehicles detected (for example, vehicles classification, and vehicle speed), these systems can trigger warning messages about potential safety hazards. These are different from advanced in-vehicle systems, in that, they are deployed on the roadway or roadside, and they are monitored and controlled by public agencies. These systems may be deployed in isolated areas where the core ITS infrastructure deployment is not very intensive, or may be deployed to supplement the core deployments. Since these are limited deployments tied to a single location, there is no explicit difference identified between high-intensity and low-intensity deployments. These deployments are not proposed as part of the SEMCOG region deployment plan update, but should be considered in the future when problem areas are identified.

Table 12 – Advanced Warning and Safety Deployment Types

Function	*Deployment Criteria and Assumptions*
Ramp rollover detection and warning systems. These are used to detect the speeds of exiting vehicles on a ramp and, based on the vehicle speed in relation to the geometry of the ramp, display advance warnings to prevent potential rollover. These apply generally to large trucks and trailers.	Deployed at specific ramps which meet the following criteria: Ramps that have a high rollover crash history. Ramps with tight geometrics and low exit speeds. Stakeholder identified safety hazard at that ramp location. Deployed at all ramp locations that are identified as "safety hotspots."
Downhill speed detection and warning systems are similar to ramp rollover systems, but they apply to roadway sections where the vertical gradient can prove to be potentially hazardous.	Deployed at specific locations where there is a downhill gradient, and where there are documented or observed safety hazards.
Advanced curve warning systems are again similar to ramp rollover systems, but they are used to warn motorists in advanced of hazardous curves based on real-time detection.	Deployed at specific locations where there is a hazardous curve, and where there are documented or observed safety hazards. Deployed at all roadway locations that are identified as "safety hotspots."

Advanced Public Transportation Systems (APTS)

APTS functions take advantage of electronic systems deployed on transit vehicles, at transit stops, or along transit routes. These deployments serve a variety of functions, including enhancing passenger safety; improving information and convenience to transit riders; improving speed and reliability; and reducing cost to the transit operator. AVL systems have already been installed in the SMART and DDOT systems and on both the AATA and University of Michigan bus systems in Ann Arbor. There is interest in a regional transit information system for the Detroit area which would require cooperation between SMART and DDOT. There also is interest in utilizing Transit Signal Priority to improve the efficiency and reliability of transit vehicles on key corridors.

Table 13 – APTS Deployment Types

Function	*High-Intensity Deployment*	*Low-Intensity Deployment*
Electronic fare payment	Fare card and readers deployed throughout system, can be connected to park-and-ride payment system or used to pay for other goods and services (Smart card)	Fare card and readers deployed throughout system
Automatic Vehicle Location (AVL)	All transit vehicles equipped with AVL. Vehicle locations monitored by central transit monitoring center. Communication links provided so that data can be used for traffic management system.	AVL used only on most heavily traveled routes or in largest divisions. Vehicle locations monitored by central transit monitoring center.
Transit safety systems	All transit vehicles equipped with incident monitors. Incidents detected by central transit monitoring center.	Incident monitors provided on new transit vehicles, or vehicles serving specific routes. Incidents detected by central transit monitoring center.
Advanced routing for demand responsive transit	Para-transit routing controlled in real-time by central AVL enhanced dispatching. Communication links provided so that data can be used for traffic management system	Para-transit routing controlled in real-time by central AVL enhanced dispatching. May be limited to certain routes and services.
Advanced transit vehicle monitoring/ maintenance	All transit vehicles equipped with vehicle status/driver condition monitors. Vehicle status monitored by central transit monitoring center.	Vehicle status/driver condition monitors limited to certain routes and services. Vehicle status monitored by central transit monitoring center.
Transit Signal Priority (TSP)	All transit vehicles equipped with AVL. Integration with central system to monitor schedule status and coordinate with signal system to elongate green time with schedule adherence is not achieved. Equipment installation at individual intersections.	Some transit vehicles equipped with AVL for travel on specific corridors. Schedule adherence integrated with closed loop or signal system. Corridor priority to service large portion of transit route, or entire route.
Enhanced transit information	Real-time vehicle location and time to arrival provided both at stops and in-vehicle	Real-time vehicle location and time to arrival provided at a limited number of high-volume stops

Emergency/Service Vehicle Dynamic Routing

Functions in this grouping take advantage of AVL equipment and the availability of real-time traffic information to improve the dispatching – and hence arrival time, utilization, and level of service – of service and emergency vehicles. Since this technology would be applied to all vehicles in a fleet, or division, there is no distinction made between high-intensity and low-intensity deployments.

Table 14 – Emergency Vehicle Deployment Types

Function	Deployment
Emergency and service vehicle AVL	All emergency and service vehicles equipped with AVL devices.
Computer aided real-time dispatch	Vehicle location and status monitored to provide optimum real-time dispatching

Parking Management Systems

In areas with pronounced peaks in demand for parking such as central business districts, park and ride facilities, universities, major medical centers, and sporting and entertainment venues, ITS technologies can provide information on parking cost and availability. Functions in this group help reduce congestion and delay associated with finding or paying for a parking space. It is anticipated that these systems will be implemented primarily through local authorities, financial institutions, and the private sector. No parking management systems are proposed as part of the SEMCOG Regional ITS Deployment Plan. It was noted during the stakeholder process that information on Park-and-Ride space availability would be helpful to SMART. Since SMART leases, rather than owns, most of its Park-and-Ride lots, however, an investment in real-time information systems would not be justified at this point.

Table 15 – Advanced Parking Management Deployment Types

Function	High-Intensity Deployment	Low-Intensity Deployment
Parking garage status monitoring	All participating garages equipped with occupancy sensors/vehicle counters to determine number and location of available spaces	Participating garages keep track of parking occupancy through sensors or other means and report to local control center
Regional parking availability information	Real-time information on parking status provided through varying channels: To dedicated parking management DMS at major local decision points Over Internet for pre-trip planning purposes To in-vehicle information systems (if available)	Information provided regarding parking availability is static or based on historic data through means similar to those in high-intensity deployment Information delivery mechanisms similar to those used in high-intensity deployment
Automated payment	All participating garages equipped with electronic payment tag readers. Optional service for equipped vehicles	Same as high-intensity deployment

Weather and Road Condition Monitoring/Management

Road condition monitoring and management functions help traffic managers detect potential weather-related problems and take appropriate measures to minimize the risks to travelers. One of the major benefits is improved efficiency in winter maintenance. This includes both more efficient deployment of resources based on localized weather condition information and tracking and subsequent analysis of materials usage. The SEMSIM project has outfitted winter maintenance vehicles in Oakland, Macomb, and Wayne Counties with AVL technology. Communication is through a radio system owned by SMART, which also has equipped its vehicles with AVL. Winter maintenance personnel use the data to more efficiently allocate resources during winter storms, while SMART is able to use the same information to track its vehicles and re-route them around problem areas when necessary.

The MDOT Metro Region recently initiated a project to develop a Concept of Operations for a Road Weather Information System (RWIS). Similar efforts are underway in the North and Grand regions, and an initial set of Environmental Sensor Stations (ESS) are being deployed in the Superior Region. The Metro Region study will produce recommendations for the number and location of ESS in the Metro Region. A similar RWIS study for the University Region has not been scheduled at this time.

Table 16 – Roadway Weather Information Deployment Types

Function	***High-Intensity Deployment***	***Low-Intensity Deployment***
Road Weather Information Systems (RWIS)	Selected segments to be equipped with weather monitoring/forecasting deployments Regular spacing in isolated areas Targeted monitors for segments with a history of weather-related crashes	Selected segments to be equipped with weather monitoring/forecasting deployments Targeted monitors only for locations with a history of weather-related crashes
Motorist warning systems	Selected facilities/segments equipped with DMS and/or Variable Speed Limit Signs to warn motorists of dangerous pavement conditions	Static warning signs or portable DMS used to warn motorists
Centrally controlled road closure gates and alternate route guidance	Remotely controlled barriers can close major ramps on selected isolated roadway segments. Accompanying DMS provide alternate route instructions.	Public safety officials notified through TMC when closure is warranted

Advanced Technologies

The VII program is the centerpiece of MDOT's efforts to implement advanced technologies in cooperation with the private sector. The VII Michigan Test Bed Program will provide opportunities for MDOT, industry, and academia to test a range of products and technologies related to:

- Intelligent vehicles collecting data;
- Intelligent vehicles communicating the collected data to infrastructure; and
- Intelligent vehicles receiving data

In addition, archived data are being saved to support a variety of agency activities. There are currently three Test Beds in the SEMCOG region focused on the Ford facilities in Dearborn, Chrysler facilities in Auburn Hills/Pontiac, and GM facilities in the Milford area. Plans are in place to expand these test beds. The longer-term vision of the test bed is to evaluate full use cases for VII that require either advanced technologies or a higher level of saturation of VII-enabled vehicles in the vehicle fleet.

VII technology utilizes On-Board Equipment that permits communications with other vehicles and with road side equipment. This system is supported by a network subsystem that connects road side devices to each other and to central processing systems. **Table 17** summarizes some of the applications that may be possible once VII technology reaches a higher level of market penetration. Some of these deployments will require participation from the public sector while others will be implemented solely within the private market.

Table 17 – Advanced In-vehicle Deployment Types

Function	***Deployment***
In-vehicle traveler information devices. (In the long term in-vehicles information may begin to phase-out traditional roadside information systems such as DMS or road signs.)	Information collected by the public sector for traffic management can help support in-vehicle travel information services provided by private firms Mayday system connected to public safety and transportation agencies can help to expedite response
In-vehicle safety warnings to detect hazardous roadway/pavement conditions	
Enhanced driver vision to enhance the driver's view of the roadway, or potential obstacles	
Driver condition monitoring to detect the driver's ability to operate the vehicle safely	
Collision avoidance systems to prevent longitudinal, lateral, and roadway departure collisions	
In-vehicle mayday systems that either deploy automatically in case of a crash, or can be used to automatically notify public safety or emergency response agencies at the push of a button	

2.4 Evaluation of Alternatives

2.4.1 Evaluation Criteria

Evaluation of the alternatives is based on several criteria, including:

Local Stakeholder Input

An understanding of local requirements and performance expectations is critical to the evaluation of alternatives. As documented earlier in this section, an extensive stakeholder process was used to help identify needs, define projects, and determine priorities. The process in the SEMCOG region was effective in bringing in a wide range of stakeholders. Specific projects are documented elsewhere in this report, but priorities were identified as follows:

- Assure adequate funding for ongoing operation and maintenance of the MITSC and County-level TOCs. Funding priority should be for maintenance, and where necessary replacement, of the existing system. Expansion of the current system beyond its boundaries along the major radial corridors is desirable, but should not be done at the expense of current operations. If the CMAQ funds currently used for operations can no longer be used, this will be a major problem.
- To the extent funds are available for MITS expansion, radial freeway extensions along I-94, I-96, and I-75 were identified as priorities, along with US-23 in Washtenaw and Livingston Counties. Stakeholders expressed an interest in expanding detection and surveillance on major parallel arterials so that traffic can be diverted in cases where there are major freeway incidents and excess capacity on the arterials. Expansion of the FCP along I-75, I-96, I-94, US-23, and M-14 also is proposed to support Freeway Management Systems.

- Expansion of arterial management systems also is a priority, particularly in areas with limited freeway options. Improved detection and surveillance on major trunklines should be considered as major freeway construction projects on I-75 and US-23 are planned. Expansion of the SCATS system in Oakland and Macomb Counties was identified as a priority. Expansion of the SCOOT (Split Cycle Offset Optimization Technique) adaptive system in Washtenaw County.
- A need for improved communication between County maintenance forces and MDOT TSC personnel who are managing maintenance contracts was identified. Interconnects between the MITSC and various County TOCs around the region also are proposed.
- Installation of AVL technology and expansion of SEMSIM into outlying Counties also was noted as a priority for stakeholders.
- Public transportation deployments were proposed for the SMART and Ann Arbor systems. Improvements include security surveillance, improved traveler information, automatic passenger counters and fare cards, and improved coordination between agencies.

Compatibility with MDOT Programs and Projects

One of MDOT's objectives in developing regional ITS architectures and deployment plans was to provide a common framework across the State. In addition, projects will need to be compatible with the statewide ATMS software that is being developed under a separate contract. MDOT wants to assure that systems developed at the regional level are compatible with statewide requirements. With a limited budget available, projects that can be implemented as part of the overall capital program may receive a higher priority for implementation. These projects can be implemented more cost-effectively and possibly take advantage of other funding sources. Several examples of this are already underway in the Metro Region and have been documented in this report. For example, a DMS Sign along M-39, the Southfield Freeway, is being replaced in conjunction with a Bridge Replacement project that also is underway.

ITS projects in the SEMCOG region have been able to take advantage of several funding sources, most significantly the CMAQ program. However, the limited budget of the ITS statewide program will have a major impact on project implementation. Funding may vary on an annual basis but is estimated to be in the range of $10-$12 million per year. Initial capital costs, as well as long term operation and maintenance requirements, will have a major impact on the feasibility of implementing specific projects. Larger projects will need to be phased in over a period of time, meaning that interim deployments should be able to show some benefit on their own.

Benefit/Cost Analysis

Using the IDAS model, benefits and costs for various ITS deployments, "packages" have been developed. Detailed evaluation criteria include:

- Benefits, including:
  - Impacts on recurring and non-recurring congestion (mobility savings and travel time reliability savings);
  - Safety (crash reduction);
  - Operating costs (fuel and operating savings); and
  - Emissions reductions.

- Life-cycle costs, including capital and operating and maintenance (O&M) costs for both public and private sectors.

2.4.2 Technical Evaluation Process

This section describes the methodology used to conduct this technical evaluation which included several objectives:

- To quantitatively assess the benefits and costs of each alternative;
- To refine alternatives based on benefit-cost analysis;
- To develop viable projects for implementation; and
- To provide guidance on deployment decisions.

The tools used also provide information that can be used to:

- Estimate implementation timeframe and resource requirements; and
- Documentation for transition into design and implementation.

2.4.2.1 IDAS Description

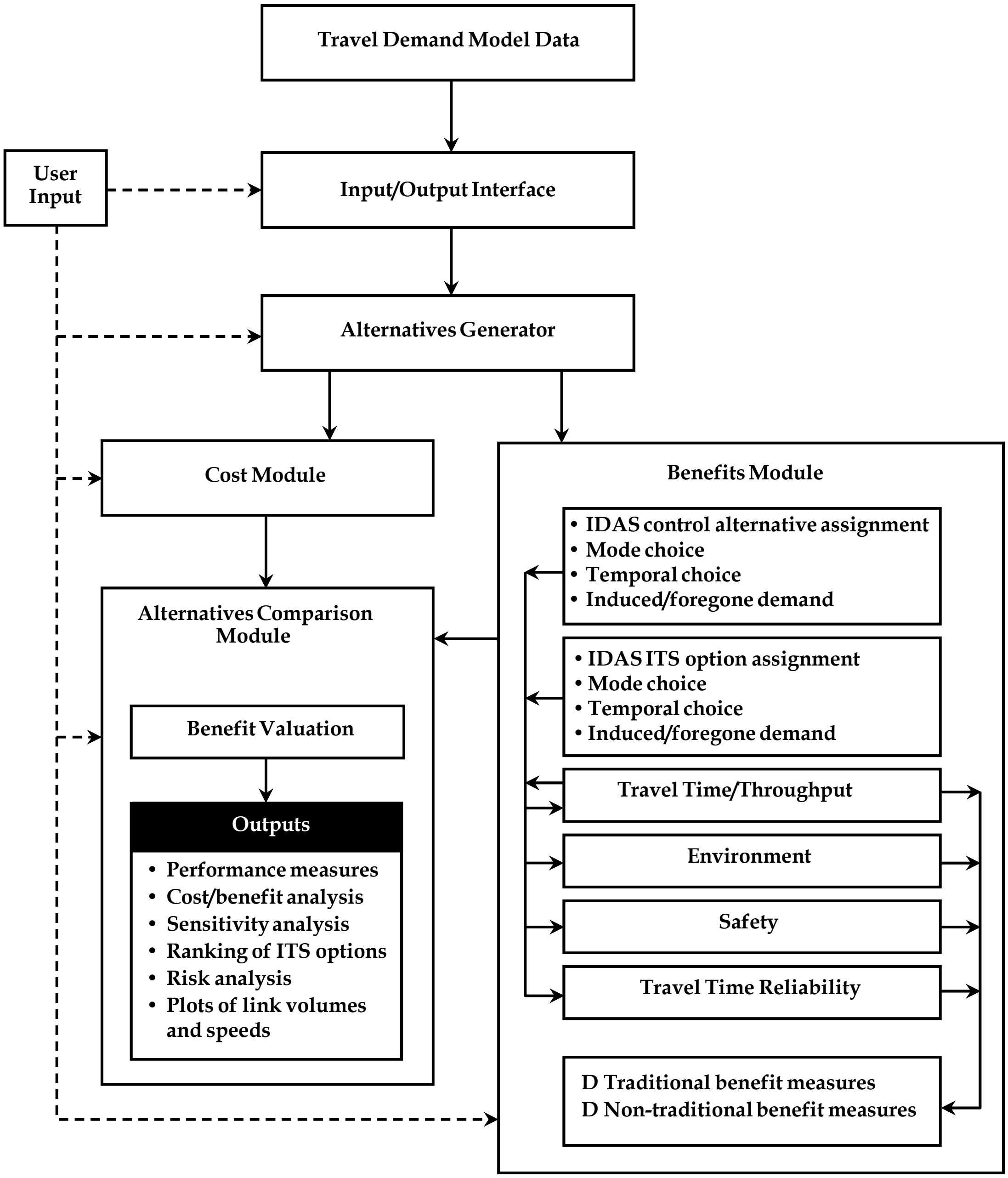
The most important quantitative tool used in the evaluation was the ITS Deployment Analysis System (IDAS). This software package was used to conduct the benefit-cost analysis of identified ITS improvements. IDAS is a sketch-planning software and analysis methodology developed by Cambridge Systematics for the Federal Highway Administration (FHWA).

IDAS was developed to assist state, regional, and local agencies in integrating ITS into the transportation planning process. Planners and others can use IDAS to calculate relative costs and benefits of ITS investments. IDAS currently predicts costs, benefits, and impacts for more than 60 types of ITS investments. These ITS components can be deployed in combination or isolation.

In order to be consistent with current transportation planning processes, IDAS operates as a post-processor to travel demand models used by Metropolitan Planning Organizations (MPO) and by state DOTs. IDAS, although a sketch-planning tool, can implement the modal split and/or traffic assignment steps associated with a traditional planning model. These are key steps in estimating the changes in modal, route, and temporal decisions of travelers resulting from ITS technologies.

The set of impacts evaluated by IDAS included changes in user mobility, travel time/speed, travel time reliability, fuel costs, operating costs, crash costs, emissions, and noise. The performance of selected ITS options can be viewed by market sector, facility type, and district. The district function was used in this project to produce data for the study area sectors. Given the diverse types of performance measures that may be impacted by ITS and the desirability of providing a comprehensive analysis tool, IDAS is comprised of five different analysis modules as shown in **Figure 15**.

Figure 15 – IDAS Model Structure



2.4.2.2 IDAS Inputs and Default Values

For this evaluation, data outputs were obtained from the regional travel demand model to use as inputs into the IDAS model. The model data included both network files and travel demand files (trip tables) representing daily volumes for 2010. Only highway facilities, including automobile and truck trips, were evaluated using the models. All analysis was conducted for the year 2010. Replacement and ongoing operations and maintenance costs were forecast for future years, but were then converted back to 2010 dollars.

Parameters, such as baseline travel time skims (zone to zone), turn prohibitors, volume-delay curves, in- and out-of-vehicle travel times, and vehicle occupancies from the model were incorporated into IDAS.

IDAS estimates the impacts of the various ITS deployments by drawing on a database of default impacts for each separate ITS component. These defaults were developed by assembling and analyzing observed impacts and evaluation results for similar deployments across the United States.

The default impacts form the basis for the estimation of impacts on traffic, such as travel time and speed, in the IDAS software. The project team used a combination of default values and values developed for the Southeast Michigan ITS Deployment Study conducted from 2000 to 2002. That study included a commuter survey of both the Detroit and Lansing regions that helped to refine the national parameters. In general, a conservative approach to estimation of benefits was taken. In some cases, the national default values were used for this analysis, while in others, default values produced very high impact estimates. Modifications were made based on Michigan specific data. **Table 18** presents the adjusted impact values used for the MDOT system benefits evaluation as compared to the IDAS national default values, while **Table 19** includes the monetary values used to convert benefits into a comparable values.

Table 18 – Comparison of Impact Values Used for IDAS Analysis (IDAS Model Default Parameter in Parentheses)

Deployment	***Benefit***	***Parameter***
Freeway Service Patrols	Reduction in incident duration	20% (55%)
	Reduction in fuel consumption	1% (42%)
	Reduction in fatality rate	1% (10%)
Traffic Signal Progression	Capacity improvement on impacted links	6% (8%)
DMS Signs	Percent of time significant events occur	10% (10%)
	Percent of drivers saving time	20% (20%)
	Time saved	5 minutes (3 min)
Freeway and Arterial Management Systems (CCTV and Detection) – Benefits from improved incident response	Reduction in incident duration	5% (ND)
	Reduction in crashes	1% (ND)
	Reduction in operating cost	1% (ND)
	Reduction in emissions	1% (ND)
Freeway and Arterial Management Systems (CCTV and Detection) – Benefits from Improved Traveler Information	Percent of time significant events occur	10% (10%)
	Percent of drivers saving time	10% (20%)
	Time saved per traveler	5 minutes (3 min)
APTS CAD and AVL	Operating Cost Savings	5% (5%)
Winter Maintenance AVL	Operating Cost Savings	5% (5%)

(ND) = No default value in IDAS.

Table 19 includes the monetized values of the benefit parameters used in this analysis. The parameters were developed by FHWA in 1995 and have been inflated to 2010 using a 3% annual inflation rate. The one exception was the price of fuel, which significantly exceeded the 3% inflation rate. This cost was raised to $3.80/gallon.

Table 19 – Monetary Values of IDAS Default Parameters

Benefit Parameters		***Parameter Values***
	Number of travel days in a year	247
	Year of $ values	2010
	Inflation Rate	3%
	Value of In-vehicle time	$15.00
	Value of In-vehicle time (commercial)	$26.42
	Value of Out-of-vehicle time (commercial)	$26.49
	Value of time multiplier for Emergency Vehicle	30.0
	Value of Out-of-vehicle time	$26.49
	Value of reduced delay time	$45.03
	Fuel Costs (gallon)	$3.80
Emissions Costs ($/ton)		
	HC/ROG	$2,763.83
	NOX	$5,812.78
	CO	$6,058.94
	PM10	$17,240.47
	CO2	$5.55
	SO2	$5.55
	GW	$0.00
Traffic Crash Costs	*Internal*	
	Fatality	$3,610,430.58
	Injury	$79,082.43
	Property damage	$4,399.70
	External	
	Fatality	$637,133.89
	Injury	$13,956.27
	Property damage	$775.87
	Non-Fuel operating costs ($/mile)	$0.10
	Noise Damage Costs ($/mile)	$0.0011
	Other mileage based ($/mile)	$0.00
	Other non-mileage based ($/mile)	$0.00
	Cost of winter Maintenance ($/mile)	$2,000.00

Figure 16 and **Figure 17** shows how individual elements of the ITS systems are deployed on links of the network in IDAS. **Figure 16** shows a section of the SEMCOG network in the western suburbs, primarily Washtenaw County. **Figure 17** shows how specific links can be coded with ITS alternatives, in this case CCTV is the technology deployed.

Figure 16 – IDAS Representation of SEMCOG Network in Western Suburbs

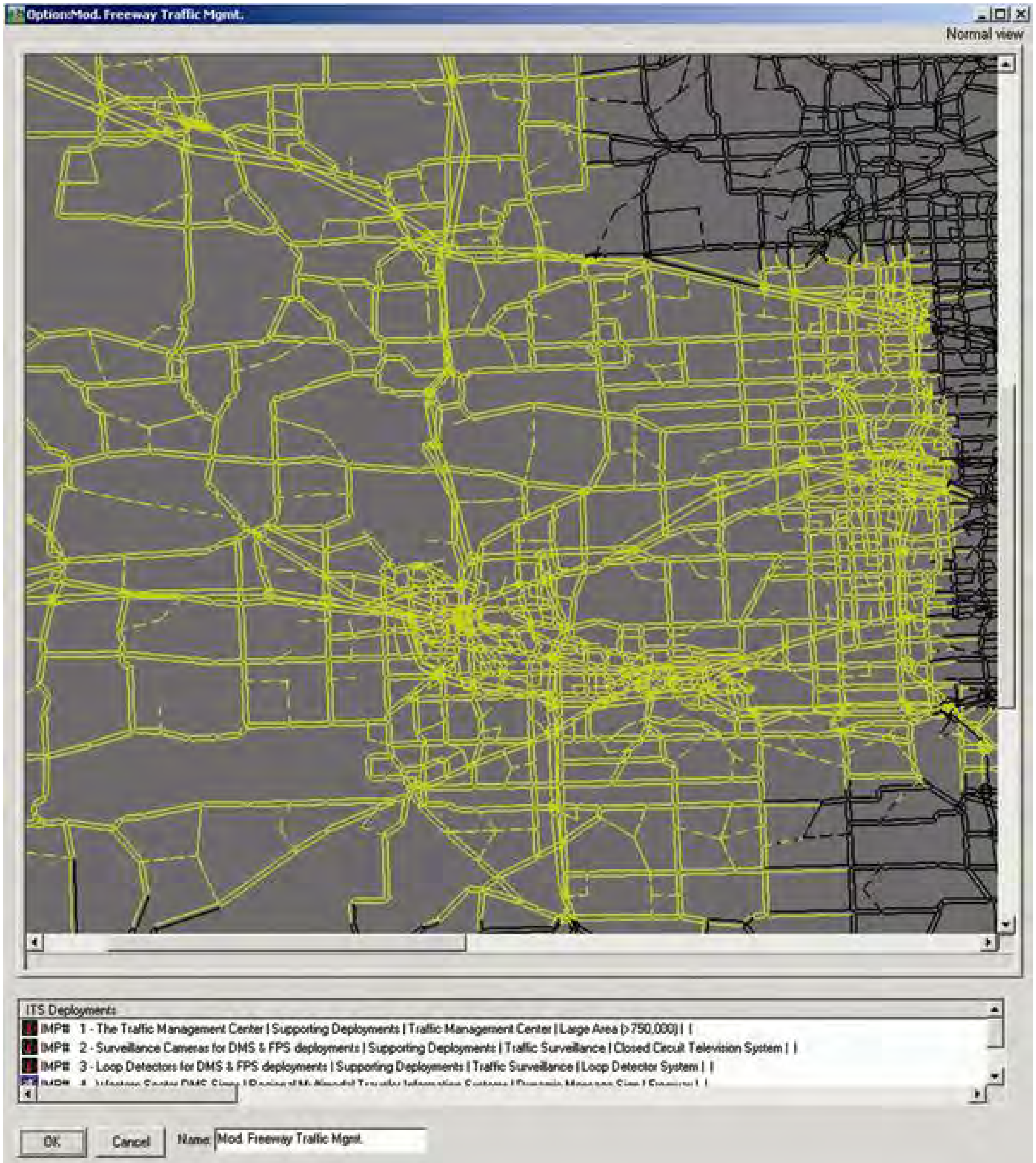
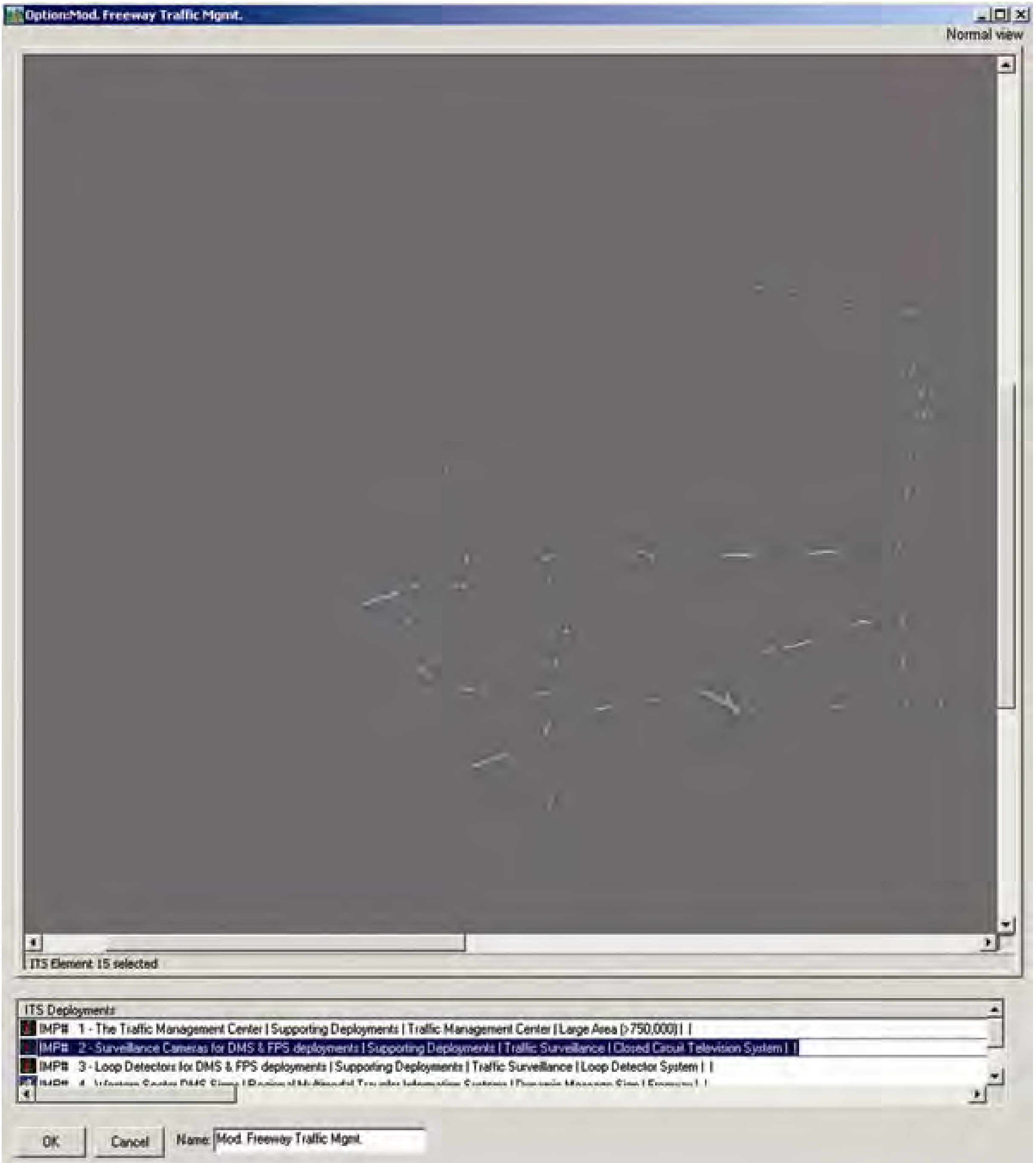


Figure 17 – Deployment of CCTV Cameras on the Network



Once an alternative is defined, the analysis procedures are initiated to estimate the incremental costs and benefits of ITS improvements. These benefit-cost results can then be compared with other alternatives defined and analyzed in the IDAS software. Summaries of project benefits and costs for each deployment package are shown in Section 4. In order to simplify the results, impacts were collapsed into four categories for purposes of presentation. These are shown below in **Table 20.**

Table 20 – Summary Categories for IDAS Benefits

Summary Category	*IDAS Subcategories Included*
Travel Time Savings	Change in User Mobility Change in User Travel Time In-vehicle travel time Out-of-vehicle travel time Travel time reliability
Fuel/Operating Cost Savings	Change in Costs Paid by Users Fuel Costs Non-fuel operating costs
Crash Reduction	Change in Costs Paid by Users Crash Costs (Internal Only) Change in External Costs Crash Costs (External Only)
Air Quality/Environmental	Change in External Costs Emissions HC/ROG NOx CO PM10 CO_2 Global Warming Noise Other Mileage-based External Costs Other Trip-Based External Costs

2.4.2.3 Estimation of ITS Alternative Costs

Development of cost estimates for the various ITS alternatives required full consideration of the unique characteristics and requirements of ITS strategies that impact the costs, funding, and implementation of improvements. Planning of ITS improvements requires an increased effort on operational planning that is not generally considered in planning for traditional transportation infrastructure projects. ITS strategies typically require that a greater proportion of resources be expended for ongoing O&M activities than do traditional improvements. A "rule of thumb" based on general experience is that annual operations and maintenance expenditures are about 15-20 percent of the original capital cost. However, this figure can vary depending on the size and complexity of the operation. A lower percentage may indicate that there is a lack of investment that will require premature replacement of equipment. The replacement cycles of equipment must be carefully considered as ITS equipment does not have as long a life cycle as traditional transportation agency assets. Failure to account for these continuing costs and funding responsibilities may result in future shortfalls in funding, personnel, or resources.

IDAS software can generate default values for a wide range of cost elements, in a manner similar to that used to calculate benefits. For this project, however, two separate efforts were undertaken in order to develop costs that better reflect the operating conditions in Michigan. Several sources were used to develop costs:

- The Michigan ITS Typical Deployment report and Systems Communications reports developed for the Southeast Michigan deployment Study were reviewed. It includes descriptions, conceptual drawings, and unit cost estimates for typical deployments of ITS components, including freeway management, arterial management, and some specialized applications such as railroad grade crossing applications and "smart" park-and-ride lots.
- MDOT cost data for operations and maintenance of the Detroit and Grand Rapids systems were obtained, as well as costs for recent ITS capital purchases.

These sources were used to develop data for input into the IDAS cost module. IDAS provides information, such as assumed equipment life, that is used to develop life-cycle costs for the identified projects. Life cycle costs are used in the analysis to calculate an annualized value for the equipment. This annualized capital component can be seen as either the cost of depreciation or the amount an agency would need to set aside to replace the equipment at the end of its life. Preliminary estimates of life-cycle costs and resource requirements were developed for the initial IDAS runs and then modified based on a review of the results. While preliminary design work is essential to refine cost estimates, the results of this study provide a reasonable initial estimate for up-front capital and ongoing O&M costs required for successful deployment of identified alternatives.

Table 21 shows the unit costs assumed for the deployments analyzed for the SEMCOG Region. These are based primarily on procurements in Michigan, but supplemented with information from the IDAS database. This includes both capital items, which were amortized based on the number of years and a 3% interest rate and operations and maintenance costs.

Table 21 – Unit Costs

Units	*Years (1)*	*Description*	*Unit Price*
Ea	10	ITS Cabinet (Ground Mounted)	$15,000.00
Ea	10	Microwave Vehicle Detection System (MVDS)	$25,000.00
Ea	5	Midblock Detector	$15,000.00
Ea	10	Freeway CCTV Camera	$45,000.00
Ea	10	Freeway CCTV Camera with MVDS	$55,000.00
Ea	10	Arterial CCTV Camera	$20,000.00
Ea	20	Dynamic Message Sign (DMS) Overhead	$180,000.00
Ea	20	Dynamic Message Sign (DMS) Roadside	$135,000.00
Ea	20	Dynamic Message Sign (DMS) Arterial	$50,000.00
Yr	Annual	Communications for DMS	$500.00
Mi	30	Fiber Optic Backbone	$175,000.00
Ea	30	Wireless Communications Link - Unlicensed (5 miles or less)	$12,000.00
Ea	30	Wireless Communications Link - Licensed Backhaul	$150,000.00
Ea	30	Wireless Communications Tower (200')	$250,000.00
Ea	30	Retrofitted 800MHz Radio Tower	$50,000.00
LS	10	ATMS Software Set-up	$25,000.00
Ea	10	Refurbish Existing Network Surveillance Systems	$150,000.00
LS	15	Intersection Signal Upgrade	$35,000.00
LS	15	Intersection Signal Upgrade (SCATS or SCOOT)	$100,000.00
Ea	15	Wireless Interconnect for Master Intersection	$11,000.00
Ea	15	Wireless Interconnect for Slave Intersection	$5,000.00
Ea	15	Replacement of Signal Controller	$5,000.00
Ea	Annual	Full Time Freeway Service Patrol Driver	$62,400.00
Ea	Annual	Full Time Freeway Service Patrol Supervisor	$83,200.00
Ea	5	Freeway Service Patrol Vehicle	$62,400.00
Ea	Annual	Weekend Only Freeway Service Patrol Driver	$18,000.00
Ea	Annual	Weekend Only Freeway Service Patrol Supervisor	$24,000.00
Ea	5	AVL System for regional transit vehicles	$500
Ea	5	AVL System Interface	$10,000
Ea	10	AVL Computer Hardware	$15,000
Ea	10	AVL System Software	$815,000
Ea	Annual	CCTV maintenance	$2,250
Ea	Annual	DMS maintenance	$4,500

(1) This column shows the assumed annual life of each component. Life cycles are based on IDAS default values, input from consultant engineering staff and input provided by MDOT staff during Regional ITS Architecture and Predeployment Studies..

These components were combined in order to form the deployment packages analyzed for the project. The deployment combinations are shown in **Table 22** with the different cost components. Detailed results of the benefit/cost evaluation are shown in Section 4.

Table 22 – Major Components of ITS Deployment Packages

DEPLOYMENT PACKAGES AND EQUIPMENT
Freeway Service Patrol Package
Freeway Service Patrol Vehicle
Freeway Service Patrol Driver
Freeway Service Patrol Supervisor (1 per 4 drivers)
Traffic Signal Improvement Package
CCTV Camera
Operation of Parking Management System
Maintenance of Traffic (less than 7 signals)
Maintenance of Traffic (7 or more signals)
Master Wireless Link
Slave Wireless Link
Towers
CCTV Camera
Licensed backhaul to TMC
Freeway Management System
Dynamic Message Sign (DMS)
Communications for DMS
Annual Training and Operational Costs for TMC
TMC: 1/2 of Level II New facility
Licensed backhaul to TMC
CCTV and detection
Towers
Road Weather Information System
RWIS Control System
Reduced Power RWIS ESS
Basic RWIS ESS
Enhanced RWIS ESS
Annual Maintenance and Replacement Costs per RWIS ESS
Annual Training and Operational Costs per RWIS ESS
Annual Cost of Telephone Connection
Wireless links
Winter Weather Road Maintenance
AVL Equipment for Vehicles
Radio Communication Equipment in Vehicles
Smart Work Zones
Smart Work Zone Mobilization
Monthly rental of equipment
Advanced Public Transportation Systems
AVL Vehicle Units
AVL Base Units (Hardware, System Interface, and Dispatch Station)

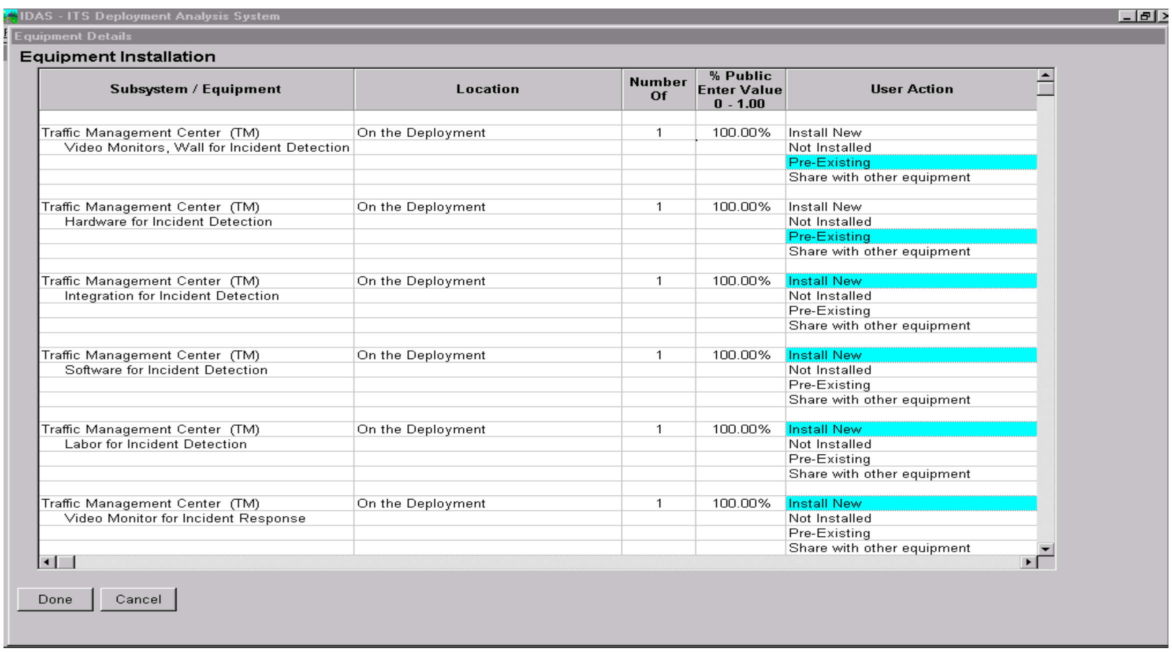
Once alternatives are evaluated in IDAS, the software produces several cost-related outputs that are valuable in refining the alternatives and developing an implementation plan:

- Inventory of ITS equipment needed to deploy the identified alternatives;
- Identification of potential cost-sharing opportunities where ITS equipment may be shared between two different deployments.

- Summary of the capital and ongoing O&M costs of the planned ITS improvements for the public and private sectors;
- Forecast of the life-cycle stream of costs for the improvement on a year-by-year basis; and
- Estimate of the average annual cost for each individual improvement and for all improvements.

The inventory of equipment needed will be produced by the IDAS software for each improvement specified by the model user. **Figure 18** shows a sample inventory of some of the equipment necessary to deploy an incident detection system. This inventory is based on ITS equipment packages required in the ITS National Architecture to deploy the various improvements; use of the same ITS equipment as in the National ITS Architecture guarantees compatibility of the plan with the Architecture. After initial review of the inventory developed by IDAS and the costs incurred in the development of the existing ITS system, packages and deployments were modified.

Figure 18 – IDAS – ITS Deployment Equipment Details



Subsystem / Equipment	Location	Number Of	% Public Enter Value 0 - 1.00	User Action
Traffic Management Center (TM)	On the Deployment	1	100.00%	Install New
Video Monitors, Wall for Incident Detection				Not Installed
				Pre-Existing
				Share with other equipment
Traffic Management Center (TM)	On the Deployment	1	100.00%	Install New
Hardware for Incident Detection				Not Installed
				Pre-Existing
				Share with other equipment
Traffic Management Center (TM)	On the Deployment	1	100.00%	Install New
Integration for Incident Detection				Not Installed
				Pre-Existing
				Share with other equipment
Traffic Management Center (TM)	On the Deployment	1	100.00%	Install New
Software for Incident Detection				Not Installed
				Pre-Existing
				Share with other equipment
Traffic Management Center (TM)	On the Deployment	1	100.00%	Install New
Labor for Incident Detection				Not Installed
				Pre-Existing
				Share with other equipment
Traffic Management Center (TM)	On the Deployment	1	100.00%	Install New
Video Monitor for Incident Response				Not Installed
				Pre-Existing
				Share with other equipment

Based on the agreed-upon list of ITS equipment for the preferred alternative(s), a detailed breakout of the life-cycle costs was estimated using IDAS and presented in the IDAS reports as year-by-year breakouts of anticipated costs. This stream of costs includes the up-front capital costs necessary for deployment, the equipment replacement costs necessary to replace obsolete equipment in later years, and the continuing O&M costs necessary to operate the improvements.

The stream of life-cycle costs for the various improvements is used as the basis of the average annual cost figure in IDAS. This average annual cost figure was used for comparison with the average annual benefits figure calculated by the model to provide a benefit-cost ratio for the alternative.

3 Deployment Plan

3.1 Deployment Plan Projects

Developing the initial list of projects to study within the Deployment Plan began, as noted earlier, with the update of the regional ITS Architecture. Based on the input from the SEMCOG Region and its stakeholders, a number of ITS services and associated Market Packages were identified. Translating those services and Market Packages into projects is the first step of the deployment plan. This translation was done initially at a functional level by the Study Team and produced an initial list of projects. The next step involved a screening process, which would eliminate projects that were not appropriate for the scope of the deployment plan. The screening process also would, through stakeholder input, develop detailed projects, which could then be analyzed and ranked against each other.

At a stakeholder meeting on May 12, 2008, maps were provided to attendees and breakout sessions were held; one for the Metro Region and one for the University Region. These efforts resulted in the final list of projects, which would be used in the deployment plan analysis outlined above. These projects are presented in **Section 3.3**.

3.2 Final List of Projects for Analysis

The final list of projects presented in **Table 23** through **Table 26** was developed by the stakeholders during the Deployment Plan Workshop. These are the projects that will be analyzed with the IDAS model for SEMCOG and ultimately combined into a statewide ITS Investment Plan for MDOT. Local agencies also can reference these projects as they are revising their input into regional plans and responding to annual calls for projects. Projects are sorted by architecture packet and provided a unique number with Metro Region projects starting with "MR" and University Region projects starting with "UR". **Table 23** through **Table 26** provide short descriptions of each project; denote each project with a unique project identifier so it can be easily referenced; and include the location and description of the project.

Table 23 – SEMCOG Region List of Projects: Traffic Management

Project	***Agency***	***Project Name***	***Project Description***
MRITS – 001	MDOT	I-75 – Oakland County from US 24 to County Line	Expansion of freeway management system
MRITS – 002	MDOT	I-75 – Wayne County downtown to Monroe County Line	Expansion of freeway management system
MRITS – 003	MDOT	I-75 – Monroe County from Wayne County Line to Ohio State Line	Rural deployment of freeway management system components
MRITS – 004	MDOT	I-275 – Wayne/Monroe County from existing deployment to I-75	Expansion of freeway management system
MRITS – 005	MDOT	I-94 – Wayne/Washtenaw County from I-275 to west of Ann Arbor	Expansion of freeway management system
MRITS – 006	MDOT	I-94 – Macomb County from Wayne County line to St. Clair County	Expansion of freeway management system
MRITS – 007	MDOT	I-94 – St. Clair County from Macomb County line to Port Huron	Rural deployment of freeway management system components

Table 23 – SEMCOG Region List of Projects: Traffic Management

Project	Agency	Project Name	Project Description
URITS – 001	MDOT	I-96 – Livingston County from west of US 23 to west of M59	Rural deployment of freeway management system
URITS – 002	MDOT	US-23 – Washtenaw County from I-94 to M14/US 23 split	Urban deployment of expansion of freeway management system
URITS – 003	MDOT	US-23 – Washtenaw/Livingston County from I-94 to I-96	Urban deployment of expansion of freeway management system
URITS – 004	MDOT	US-23 – Livingston County from I-96 to Shiawassee County Line	Rural deployment of freeway management system
URITS – 005	MDOT	US-12 – Wayne/Washtenaw County from US 24 to Ann Arbor	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 008	MDOT	US-24 – Wayne/Oakland County from 8 Mile Road to I-75	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 009	MDOT	US-24 – Wayne/Oakland County from US 12 to 8 Mile Road	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 010	MDOT	US-24 – Wayne/Monroe County from Taylor to I-275	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 011	MDOT	US-24 – Monroe County from I-275 to State Line	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 012	MDOT	M-59 – Oakland County from existing deployment to M 1	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 013	MDOT	M14 – Wayne/Washtenaw County from I-275 to US 23	Urban deployment of expansion of freeway management system
MRITS – 014	MDOT	M153 – Wayne/Washtenaw County from M 14 to M 39	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 015	MDOT	M102 – from M 1 to M 3	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 016	MDOT	M3 – Wayne County from I-94 to I-375	Signal System upgrade and interconnect. Expansion of arterial management system
^MRITS – 017	MDOT	Facility Integration Wayne County	Interconnect MITSC with Wayne County TOC
^MRITS – 018	MDOT	Facility Integration RCOC	Interconnect MITSC with RCOC TOC
MRITS – 019	MDOT	Facility Integration RCMC	Interconnect MITSC with RCMC TOC
URITS – 006	MDOT	Facility Integration Livingston County	Interconnect MITSC with Livingston County TOC
URITS – 007	MDOT	Facility Integration Washtenaw County	Interconnect MITSC with Washtenaw County TOC
MRITS – 020	MDOT	Facility Integration St. Clair County	Interconnect MITSC with St. Clair County TOC
^MRITS – 022	MDOT	Facility Integration Windsor	Interconnect MITSC with City of Windsor TOC
^MRITS – 023	MDOT	Facility Integration Toledo, Ohio	Interconnect MITSC with City of Toledo TOC
URITS – 008	MDOT	West Grand River Avenue, Livingston County from Lucy Road to Highlander Way	Signal System upgrade and interconnect. Expansion of arterial management system
URITS – 009	MDOT	West Grand River Avenue, Livingston County from US 23 to Dorr Road	Signal System upgrade and interconnect. Expansion of arterial management system
URITS – 010	MDOT	I-75 in Monroe County from I-275 to State Line	Expansion of Freeway Courtesy Patrol
URITS – 011	MDOT	I-96 in Livingston County from Oakland County Line to west of M59	Expansion of Freeway Courtesy Patrol

Table 23 – SEMCOG Region List of Projects: Traffic Management

Project	***Agency***	***Project Name***	***Project Description***
URITS – 012	MDOT	I-94 in Washtenaw County from Wayne County Line to west of M14	Expansion of Freeway Courtesy Patrol
URITS – 013	MDOT	US 23 in Washtenaw County from I-94 to I-96	Expansion of Freeway Courtesy Patrol
URITS – 014	MDOT	M14 in Washtenaw County from Wayne County Line to I-94	Expansion of Freeway Courtesy Patrol
URITS – 015	*Ann Arbor	SCOOT Expansion West Stadium Blvd.	
URITS – 016	*Ann Arbor	SCOOT Expansion Huron/Jackson corridor	
^MRITS – 024	RCMC	Countywide Surveillance System - (est. $6.5M)	Expansion of CCTV cameras and broadband radio communications along major arterials throughout the county
^MRITS – 025	RCMC	System Detection - (est. $19M)	Installation of arterial detection for traffic responsive systems and permanent count stations including radio communications
^MRITS – 026	RCMC	ITS Traffic Signal Hardware and Software - (est. $13.5M)	Upgrade traffic signals with ITS Cabinets and Advanced Transportation Controllers using NTCIP (or latest standards)
^MRITS – 027	RCMC	Wireless Access to Traffic Signal System Network - (est. $3.5M)	Installation of broadband radios at traffic signals for provide for wireless access to the traffic signal system network
^MRITS – 028	RCMC	Dynamic Message Signs - (est. $4.5M)	Installation of dynamic message signs, communications, and software procurement
^MRITS – 029	RCMC	Renovation and Expansion of Traffic Operations Center - (est. $2.5M)	Demolition, design, and construction to renovate and expand the Traffic Operations Center, including upgraded equipment and video wall
^MRITS – 030	RCOC	Future corridor	Upgrade signals along corridor to SCATS Not funded (est. $800K)
^MRITS – 031	RCOC	SCATS Communications	Upgrade SCATS communications to wireless technology (Estimated cost to be determined)
MRITS – 032	RCOC	RCOC – Expansion of SEMSIM	Integration of additional maintenance vehicles with AVL technologies

**Funded project*
^Provided on project input form

Table 24 – SEMCOG Region List of Projects: Advanced Public Transportation Systems

Project	Agency	Project Name	Project Description
^MRITS – 033	SMART	APC	Automatic Passenger Counters and fare cards
^MRITS – 034	SMART	Security Surveillance	CCTV Cameras of vehicles for security
^MRITS – 035	SMART	Traveler Information	Traveler information web site and kiosks
^MRITS – 036	SMART	Facility Integration	Interconnect with other transit dispatch facilities
^URITS – 017	AATA	AVL	AVL equipment for demand response vehicles
^URITS – 018	AATA	APC	Automatic Passenger Counters and fare cards
^URITS – 019	AATA	Facility Integration	Interconnect with Local Public Safety Dispatch
^URITS – 020	AATA	Facility Integration	Interconnect with University of Michigan Transportation Services
^URITS – 021	AATA	Bus Priority	Bus Priority – One of the elements of SCOOT is provision to provide bus priority
^URITS – 022	Livingston Essential Transp. Service	Local Vehicle Tracking System	Research and implement a vehicle locator system for transit vehicles which will be compatible with other AVL systems used by Livingston County Emergency Services after CLEMIS issues are resolved.

^Provided on project input form

Table 25 – SEMCOG Region List of Projects: Emergency Management

Project	Agency	Project Name	Project Description
^MRITS – 037	RCMC	Countywide Emergency Traffic Signal Pre-emption - (est. $8M)	Installation of emergency pre-emption equipment for traffic signals and emergency vehicles

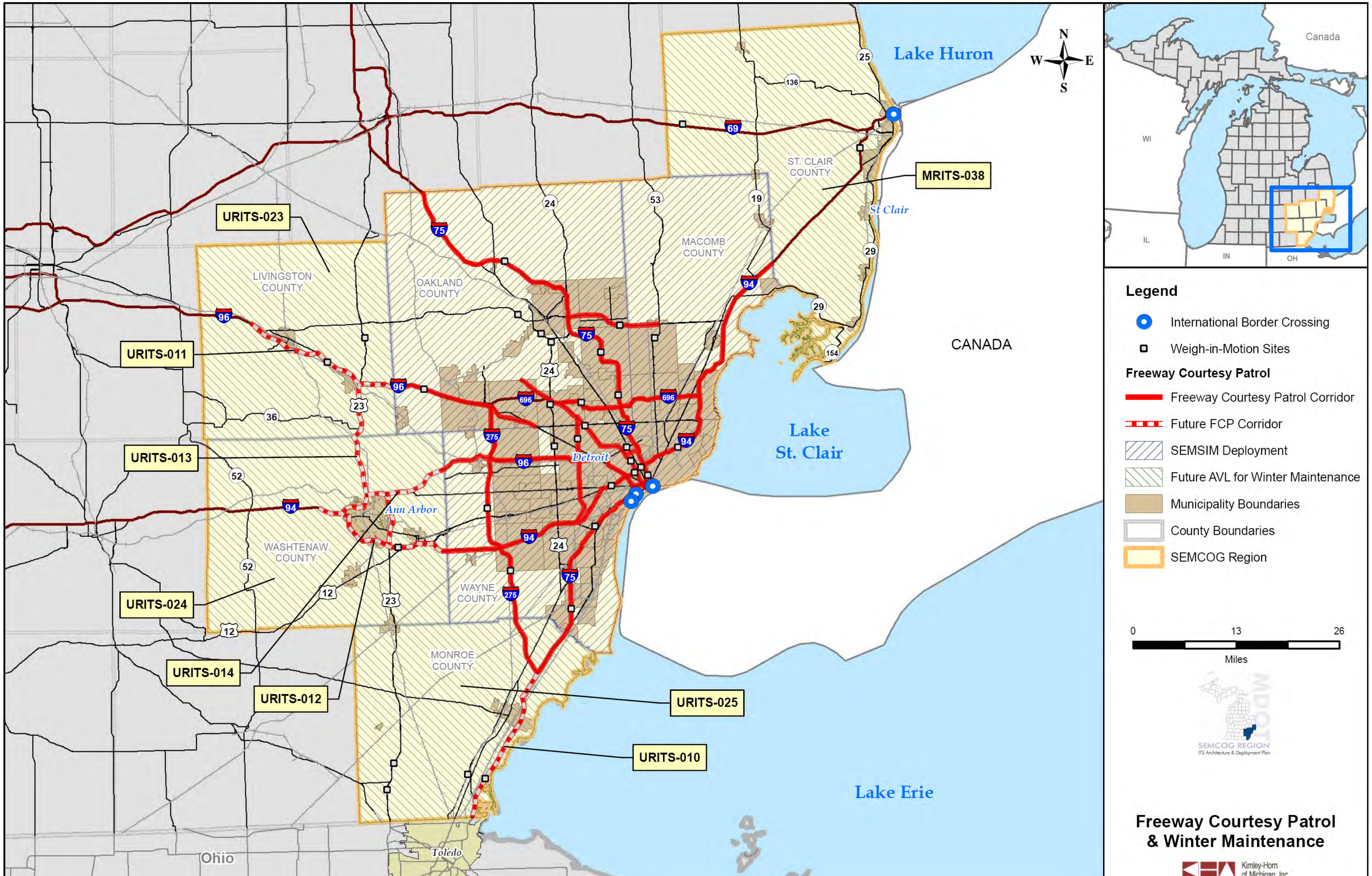
^Provided on project input form

Table 26 – SEMCOG Region List of Project: Maintenance and Construction

Project	Agency	Project Name	Project Description
^MRITS – 032	MDOT	Oakland County	Expansion of SEMSIM
MRITS – 038	MDOT	St. Clair County	AVL for winter maintenance operations
URITS – 023	MDOT	Livingston County	AVL for winter maintenance operations
URITS – 024	MDOT	Washtenaw County	AVL for winter maintenance operations
URITS – 025	MDOT	Monroe County	AVL for winter maintenance operations
MRITS – 039	MDOT	MDOT Routes	AVL for winter maintenance operations

^Provided on project input form

Figure 19 – Regional Proposed ITS Deployment Projects



4 Analysis of SEMCOG Region ITS Alternatives

4.1 Introduction and Background

ITS deployments in the SEMCOG region that were identified for further analysis are shown in **Table 23** through **Table 26**. For purposes of evaluating benefits and costs, these projects must be combined into implementation packages that form a logical system. CCTV cameras, for example, are considered part of a Traffic Management System, but do not inherently provide benefits. There must be staff in place to watch them, interpret what they see, and disseminate information to those who can make use of it. Users may include incident responders, transportation agency personnel, or the general public. Accurate representation of benefits and costs requires that various elements be modeled together as a system. The deletion of one key element may reduce or eliminate the benefits, but that element in and of itself, may not produce benefits. There also are a number of deployments that support multiple functions and projects, particularly the series of projects that integrate County and local TMCs with MITSC.

Because of the large size and population of the SEMCOG region, and the large number of proposed projects, a sub-regional approach was taken to the analysis of results. Combining the projects by County still enables local stakeholders to understand the impacts of ITS deployments in their area, without presenting results that are too long and detailed to digest.

There are numerous cases where projects overlap County boundaries. In the tables presented in this section, the project is listed under both Counties. It is very important to note that the benefits and costs, however, are divided based on the proportion of the project in each County. There are a number of projects, such as the facility integration projects, that do not directly generate benefits. These projects, however, underlie investments in projects such as Freeway Management and Arterial Management that do have direct benefits.

When comparing the results from freeway and arterial management system deployments, it is important to note the higher B/C ratio for the FMS is due to the higher VMT on these corridors. The arterial can yield greater benefits when efficiently operated and integrated with an existing FMS.

The benefits of improved winter maintenance activities can only be quantified from an operational viewpoint. Costs and savings were based purely on an estimated annual per-mile cost for winter maintenance, not on the number of vehicles outfitted. Since there are several assumptions used with the IDAS analysis, additional cost savings and benefits to the public may not be adequately captured.

Benefits for most of the proposed transit projects cannot easily be estimated either. Security improvements, for example, probably do have a positive impact on ridership in the long run, but no data exists to support an estimate. In these cases, qualitative factors must be considered by MDOT and local agencies in setting priorities.

The smart work zone deployment package is included in all of the other regional deployment plans, but did not receive much attention during the deployment plan workshop. This is due to the substantial technology infrastructure currently in place in the SEMCOG region. It is assumed that all of the projects in this region that would typically warrant a smart work zone deployment, will occur on corridors that are already covered through existing deployments or will include an ITS component during the construction.

It is assumed that the SEMCOG region would approach a smart work zone in one of three ways. For the first scenario, which includes a project location where ITS deployments are currently in place, the work zone would be managed with the existing technology, just as any other incident.

For projects that include deploying new ITS components, it is recommended that the technology be constructed during the earlier phases of the project, where feasible. This allows for the technology to be integrated and used to manage the work zone during heavier construction phases. Lastly, any project that occurs on a corridor that is not instrumented, and does not include an ITS deployment component, should be evaluated individually for the benefit of a smart work zone. Based on the region's approach to ITS, it is assumed that there will be minimal projects that occur in this category.

Each section below includes a table of projects by County, a map showing key deployments, and a table summarizing the initial benefit/cost analysis results. Several important caveats must be noted when reviewing the benefit/cost results:

- Results are based on the 2010 SEMCOG AM and PM peak period travel demand forecasting models. The AM model covers a two-hour period, while the PM peak model covers a 3-hour period. Overall about 38% of daily traffic in the region occurs during these five hours. While most congestion occurs during the five hour period covered by the SEMCOG models, there also are benefits that accrue during the off-peak period. As such, this represents a conservative estimate of the benefits obtained from these projects. The one exception made to this method of analysis was for arterial signal improvements. Signal coordination improvements may bring slightly greater benefits during peak periods, but do have clear benefits throughout the course of the day. As a result benefits for the arterial signal improvements were calculated for a 24-hour period, not only the peak periods.
- Because the calculation of benefits is highly dependent on volume, the IDAS model tends to forecast higher benefits for a Freeway Management System (FMS) than for Arterial Management. It also is difficult to compare a FMS, which are primarily oriented toward incident management activity, with Arterial Management Systems that are more focused on day-to-day traffic flow. Integrated Corridor Management strategies make use of both, in a synergistic manner, which make it difficult to separate the benefits.
- Because there is an extensive existing system, the costs shown here represent primarily incremental system costs. The current TMC and communications system is available to serve these additions, which reduces the capital cost. However, this core system requires regular replacement and also may require some expansion to serve additional facilities. Balancing the needs of outlying areas for expansion with the need to maintain and upgrade the existing system will be a major challenge for MDOT and SEMCOG.

4.1.1 Livingston County Projects

Livingston County is one of the fastest-growing counties in Michigan and has very limited ITS deployment. Growth in traffic along I-96 and US-23, the County's two major freeways, has been significant and major construction is planned on US-23. **Table 27** through **Table 29** shows the proposed ITS projects in the County while **Figure 20** shows a map of these deployments. FMS deployments are proposed on I-96 as far west as the M-59 interchange and for the full length of US-23 in the County. Urban deployment is proposed south and east of the US-23/I-96 interchange in Brighton. Rural deployment is proposed for segments north and west of this interchange. Extension of the FCP along I-96 also is proposed. Signal system upgrades are proposed along two stretches of West Grand River Avenue, a state trunkline located within the County. AVL systems are proposed for both the County's transit system (Livingston Essential Transportation Services) and for its winter maintenance fleet.

Table 27 – Livingston County Draft List of Projects: Traffic Management

Project	*Agency*	*Project Name*	*Project Description*
URITS – 001	MDOT	I-96 – Livingston County from west of US 23 to west of M59	Rural deployment of freeway management system
URITS – 003	MDOT	US-23 – Washtenaw/Livingston County from I-94 to I-96	Urban deployment of expansion of freeway management system
URITS – 004	MDOT	US-23 – Livingston County from I-96 to Shiawassee County Line	Rural deployment of freeway management system
URITS – 006	MDOT	Facility Integration Livingston County	Interconnect MITSC with Livingston County TOC
URITS – 008	MDOT	West Grand River Avenue, Livingston County from Lucy Road to Highlander Way	Signal System upgrade and interconnect. Expansion of arterial management system
URITS – 009	MDOT	West Grand River Avenue, Livingston County from US 23 to Dorr Road	Signal System upgrade and interconnect. Expansion of arterial management system
URITS – 011	MDOT	I-96 in Livingston County from Oakland County Line to west of M59	Expansion of Freeway Courtesy Patrol

Table 28 – Livingston County Draft List of Projects: Advanced Public Transportation Systems

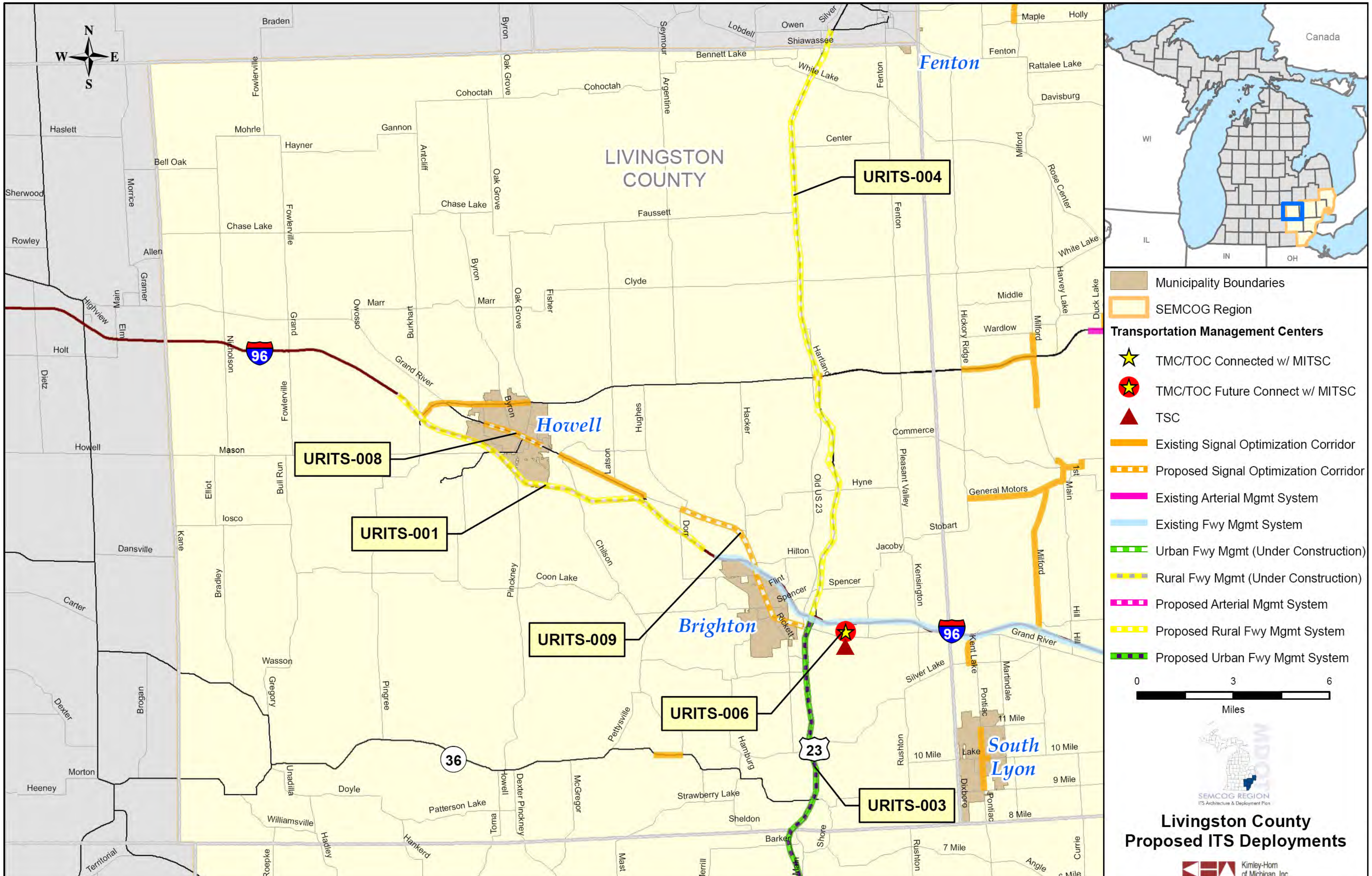
Project	*Agency*	*Project Name*	*Project Description*
^URITS – 022	Livingston Essential Transp. Service	Local Vehicle Tracking System	Research and implement a vehicle locator system for transit vehicles which will be compatible with other AVL systems used by Livingston County Emergency Services after CLEMIS issues are resolved.

^Provided on project input form

Table 29 – Livingston County Draft List of Projects: Maintenance and Construction

Project	*Agency*	*Project Name*	*Project Description*
URITS – 023	MDOT	Livingston County	AVL for winter maintenance operations

Figure 20 – Livingston County Proposed ITS Deployments



The benefit cost analysis for Livingston County shows significant benefits from expansion of the FMS and FCP into the County, with positive but somewhat lower benefits from arterial corridor improvements. The focus of this expansion is on I-96 and US-23. These freeways experience high volumes and are not served by the ITS today. Two relatively limited arterial management projects were proposed, but they did not yield positive benefits. There are lower volumes on these arterials relative to the freeways, and they are experiencing rapid growth. If an investment in ITS for these corridors is not made in the next few years, it should be revisited.

Table 30 – Livingston County Benefit/Cost Analysis

Benefits	*Freeway Mgmt*	*Arterial Mgmt*	*FCP*	*Total*
Travel Time	$2,259,000	$1,031,837	$1,540,000	$4,830,837
Operating Cost	$598,000	$68,790	$409,000	$1,075,790
Crash	$114,000	$32,495	$73,000	$219,495
Emissions	$298,000	$0	$172,000	$470,000
Total Benefits	$3,269,000	$1,133,122	$2,194,000	$6,596,122
Annualized Costs	$501,000	$459,071	$135,000	$1,095,071
Net Benefits	$2,753,000	$674,051	$2,059,000	$5,486,051
B/C Ratio	6.5	2.5	15.8	6.0
Initial Capital	$1,740,000	$1,570,132	$69,000	$3,379,132
Annual O&M	$261,000	$236,000	$150,000	$647,000

Other projects proposed include implementation of AVL systems on the LETS and maintenance vehicles for winter maintenance operations. The proposed AVL system for Livingston County is estimated to save roughly 5% of operating cost or about $80,000 per year. Costs for AVL systems can vary significantly based on software costs, but a planning level estimate for the system is approximately $300,000 to install with $50,000 of ongoing operating costs. Annualized costs are estimated at $80,000, or roughly equal to the benefits received.

Winter maintenance operations is more difficult to estimate since costs vary significantly from year to year and as in all SEMCOG region counties, the Road Commission is responsible for both trunkline and County roads. Using a rough estimate of $4,000/mile for annual trunkline snow removal costs would result in annual savings of roughly $25,000 on a $500,000 budget. If Livingston County were to expand this system to the entire County-maintained network, cost savings could be significantly greater.

4.1.2 Macomb County Projects

Macomb County is one of the three largest SEMCOG counties with nearly 900,000 residents. Nonetheless, there has been limited deployment of Freeway and Arterial Management Systems in the County. The full length of I-94 in Macomb County is proposed for deployment of a FMS. There currently are several projects programmed and funded and several others planned. The RCMC has a number of planned projects including a major upgrade of its TOC, a countywide surveillance system, and upgrading of signal systems along major corridors. CCTV cameras and DMS are proposed for deployment on some of the County's major arterials. Emergency preemption systems also are proposed for major arterial corridors. Finally, a series of operational and traveler information improvements to the SMART system are planned and will benefit transit riders in Macomb County. **Table 31** through **Table 33** lists the improvements proposed for Macomb County, while **Figure 21** shows proposed major trunkline improvements graphically. **Figure 22** shows the priorities established by the RCMC for arterial improvements. This map includes both State trunklines and County roads.

Table 31 – Macomb County Draft List of Projects: Traffic Management

Project	*Agency*	*Project Name*	*Project Description*
MRITS – 006	MDOT	I-94 – Macomb County from Wayne County line to St. Clair County	Expansion of freeway management system
MRITS – 019	MDOT	Facility Integration RCMC	Interconnect MITSC with RCMC TOC
^MRITS – 024	RCMC	Countywide Surveillance System - (est. $6.5M)	Expansion of CCTV cameras and broadband radio communications along major arterials throughout the county
^MRITS – 025	RCMC	System Detection - (est. $19M)	Installation of arterial detection for traffic responsive systems and permanent count stations including radio communications
^MRITS – 026	RCMC	ITS Traffic Signal Hardware and Software - (est. $13.5M)	Upgrade traffic signals with ITS Cabinets and Advanced Transportation Controllers using NTCIP (or latest standards)
^MRITS – 027	RCMC	Wireless Access to Traffic Signal System Network - (est. $3.5M)	Installation of broadband radios at traffic signals for provide for wireless access to the traffic signal system network
^MRITS – 028	RCMC	Dynamic Message Signs - (est. $4.5M)	Installation of dynamic message signs, communications, and software procurement
^MRITS – 029	RCMC	Renovation and Expansion of Traffic Operations Cente[1] - (est. $2.5M)	Demolition, design, and construction to renovate and expand the Traffic Operations Center, including upgraded equipment and video wall

^Provided on project input form

Table 32 – Macomb County Draft List of Projects: Advanced Public Transportation Systems

(Benefits assigned to both Macomb and Oakland County)

Project	*Agency*	*Project Name*	*Project Description*
^MRITS – 033	SMART	APC	Automatic Passenger Counters and fare cards
^MRITS – 034	SMART	Security Surveillance	CCTV Cameras of vehicles for security
^MRITS – 035	SMART	Traveler Information	Traveler information web site and kiosks
^MRITS – 036	SMART	Facility Integration	Interconnect with other transit dispatch facilities

^Provided on project input form

Table 33 – Macomb County Draft List of Projects: Emergency Management

Project	*Agency*	*Project Name*	*Project Description*
^MRITS – 037	RCMC	Countywide Emergency Traffic Signal Pre-emption - (est. $8M)	Installation of emergency pre-emption equipment for traffic signals and emergency vehicles

^Provided on project input form

Figure 21 – Macomb County Proposed ITS Deployments

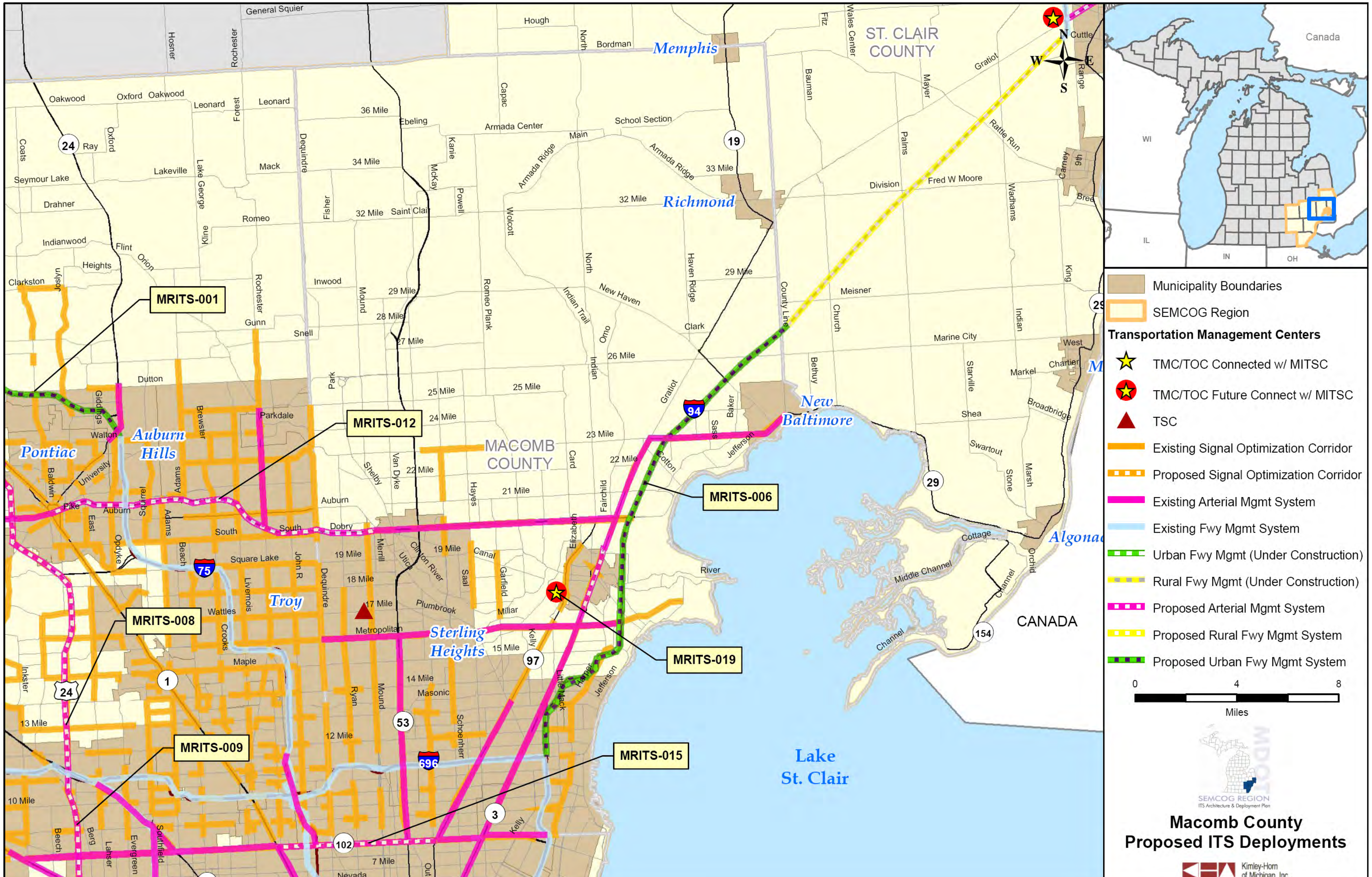
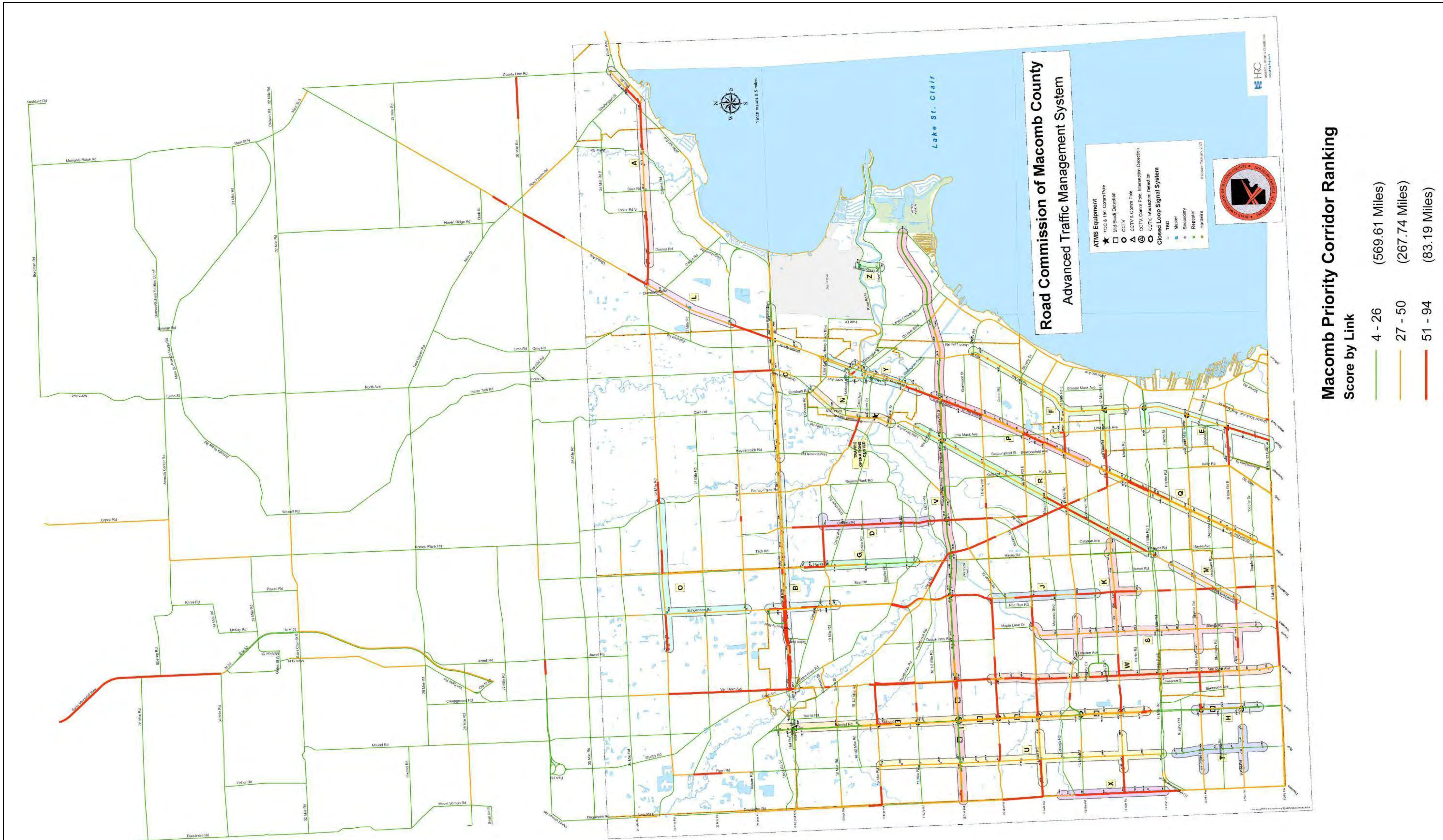


Figure 22 – RCMC Arterial Improvement Priorities



Source: RCMC, February 2008

The benefit cost analysis for Macomb County shows the greatest benefits accruing from the proposed FMS along I-94. Traffic on I-94 exceeds 100,000 AADT through most of Macomb County and approached 150,000 in the southern portion of the County. Proposed arterial management systems show a positive benefit based on a relatively large proposed investment in CCTV cameras and upgraded signalization.

It should be noted that some of the larger programs proposed for Macomb County were not included in the benefit/cost analysis below, but are seen as basic infrastructure investments to support the expansion of the arterial management system. These include investments such as wireless access, TOC improvements, and facility integration with the MITSC. Other investments such as countywide CCTV cameras and detection are major projects that will be implemented in stages. More specific locations will be identified in the future and benefit/cost analysis should be conducted on a project basis.

The transit alternatives proposed are supporting deployments, which may not have an immediate impact on ridership or operating cost savings. Deployments such as security cameras and automated fare cards are investments in technology that improve the quality of service for the customer. This investment will help to maintain current ridership and attract new riders. The proposed cost savings would be realized in the long run as older technologies are replaced with newer ones.

Emergency signal pre-emption is another technology that is important to the health and safety of the public, but is difficult to translate into a specific benefit/cost analysis. This was identified as a proposed technology for Macomb County, but no benefit/costs were captured as part of the analysis.

Table 34 – Macomb County ITS Benefit/Cost Summary

Benefits	***Freeway Mgmt***	***Arterial Mgmt***	***Total***
Travel Time	$4,992,000	$1,300,372	$6,292,372
Operating Cost	$205,000	$110,448	$315,448
Crash	$126,000	$52,742	$178,742
Emissions	$78,000	$0	$78,000
Total Benefits	$5,401,000	$1,463,563	$6,864,563
Annualized Costs	$280,000	$291,571	$581,000
Net Benefits	$5,130,000	$1,171,992	$6,292,992
B/C Ratio	19.3	5.0	12.0
Initial Capital	$965,000	$997,246	$1,962,246
Annual O&M	$144,000	$149,587	$292,000

4.1.3 Monroe County Projects

Proposed deployments in Monroe County are concentrated on I-75 and include a FMS on I-75 through the length of the County. Expansion of the FMS also would include an extension of the FCP. A signal system upgrade is proposed for US-24 from I-275 to the Ohio State line. **Table 35** and **Table 36** include the list of projects and **Figure 23** shows them graphically.

Table 35 – Monroe County Draft List of Projects: Traffic Management

Project	*Agency*	*Project Name*	*Project Description*
MRITS – 003	MDOT	I-75 – Monroe County from Wayne County Line to Ohio State Line	Rural deployment of freeway management system components
MRITS – 004	MDOT	I-275 – Wayne/Monroe County from existing deployment to I-75	Expansion of freeway management system
MRITS – 011	MDOT	US-24 – Monroe County from I-275 to State Line	Signal System upgrade and interconnect. Expansion of arterial management system
URITS – 010	MDOT	I-75 in Monroe County from I-275 to State Line	Expansion of Freeway Courtesy Patrol

Table 36 – Monroe County Draft List of Projects: Maintenance and Construction

Project	*Agency*	*Project Name*	*Project Description*
URITS – 025	MDOT	Monroe County	AVL for winter maintenance operations

Figure 23 – Monroe County Proposed ITS Deployments

The benefit cost analysis for Monroe County shows positive benefits and similar benefit/cost ratios for all three categories of improvements. Although benefit/cost ratios for the FMS are lower than those found in more heavily populated outlying counties such as Washtenaw and Livingston, they are still highly positive. These improvements are focused primarily on I-75, which experiences heavy volumes of commercial traffic and numerous major incidents. A series of arterial improvements focusing on US-24, a parallel route to I-75, also are proposed. While the benefit/cost ratio for this deployment is lower than that for FMS and FCP, it is an important supporting investment for the FMS, providing smoother flow when traffic must be diverted.

Winter maintenance operations is more difficult to estimate since costs vary significantly from year to year and as in all SEMCOG region counties, the Road Commission is responsible for both trunkline and County roads. Using a rough estimate of $4,000/mile for annual trunkline snow removal costs would result in annual savings of roughly $25,000 on a $500,000 budget. If Monroe County were to expand this system to the entire County-maintained network, cost savings could be significantly greater.

Table 37 – Monroe County ITS Benefit/Cost Summary

Benefits	***Freeway Mgmt***	***Arterial Mgmt***	***FCP***	***Total***
Travel Time	$746,000	$683,000	$59,000	$1,488,000
Operating Cost	$434,000	$67,000	$342,000	$843,000
Crash	$83,000	$33,000	$49,000	$165,000
Emissions	$218,000	$0	$124,000	$342,000
Total Benefits	$1,481,000	$783,000	$574,000	$2,838,000
Annualized Costs	$417,000	$478,000	$135,000	$1,030,000
Net Benefits	$1,064,000	$305,000	$439,000	$1,808,000
B/C Ratio	3.6	1.6	4.3	2.8
Initial Capital	$1,464,000	$1,634,000	$75,000	$3,173,000
Annual O&M	$220,000	$245,000	$121,457	$586,457

4.1.4 Oakland County Projects

Proposed project in Oakland County include expansion of the FMS along I-75 from Pontiac to the Genesee County line. The primary focus of the proposed program is on signal system upgrades to the major trunklines in the County, including US-24 and M-59. Other proposed improvements include improved communications for the SCATS system and expansion of the SEMSIM system. Finally, a series of operational and traveler information improvements to the SMART system will benefit transit riders in Oakland County. **Table 38** and **Table 39** list the improvements proposed for Oakland County, while **Figure 24** shows proposed improvements graphically.

Table 38 – Oakland Draft List of Projects: Traffic Management

Project	*Agency*	*Project Name*	*Project Description*
MRITS – 001	MDOT	I-75 – Oakland County from US 24 to County Line	Expansion of freeway management system
MRITS – 008	MDOT	US-24 – Wayne/Oakland County from 8 Mile Road to I-75	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 009	MDOT	US-24 – Wayne/Oakland County from US 12 to 8 Mile Road	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 012	MDOT	M-59 – Oakland County from existing deployment to M 1	Signal System upgrade and interconnect. Expansion of arterial management system
^MRITS – 018	MDOT	Facility Integration RCOC	Interconnect MITSC with RCOC TOC
^MRITS – 031	RCOC	SCATS Communications	Upgrade SCATS communications to wireless technology (Estimated cost to be determined)
^MRITS – 032	RCOC	RCOC - Expansion of SEMSIM	Integration of additional maintenance vehicles with AVL technologies

^Provided on project input form

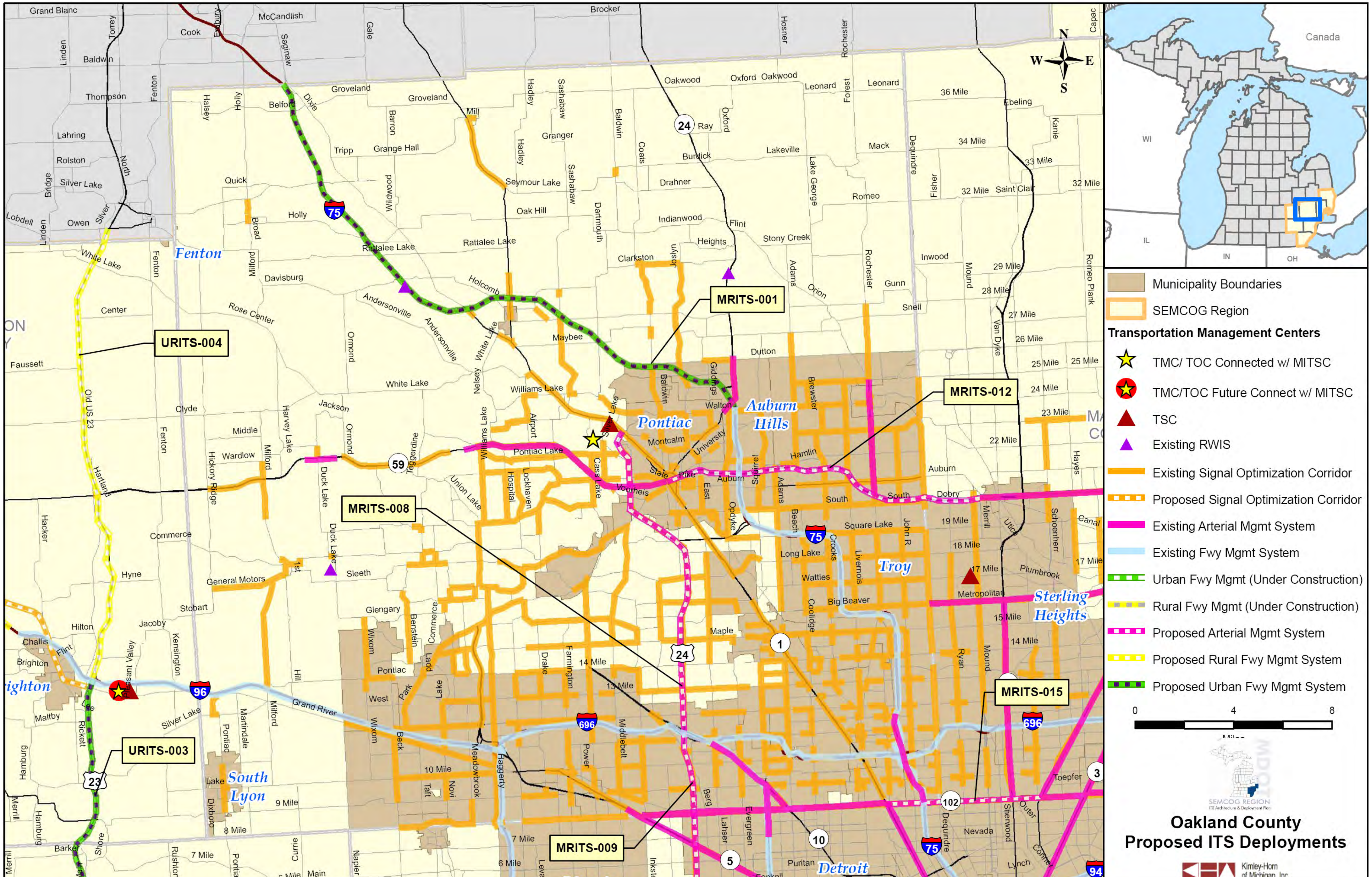
Table 39 – Oakland Draft List of Projects: Advanced Public Transportation Systems

(Benefits assigned to both Macomb and Oakland County)

Project	*Agency*	*Project Name*	*Project Description*
^MRITS – 033	SMART	APC	Automatic Passenger Counters and fare cards
^MRITS – 034	SMART	Security Surveillance	CCTV Cameras of vehicles for security
^MRITS – 035	SMART	Traveler Information	Traveler information web site and kiosks
^MRITS – 036	SMART	Facility Integration	Interconnect with other transit dispatch facilities

^Provided on project input form

Figure 24 – Oakland County Proposed ITS Deployments



The benefit cost analysis for Oakland County shows strong benefits for an investment in detection and surveillance along I-75 between the US-24 (Dixie Highway) interchange and the Genesee County line. This deployment shows a very high benefit/cost ratio. A relatively large investment is proposed in signal upgrades, primarily on trunkline arterials in the County. The benefit/cost ratio of 9.0 is among the higher benefit/cost ratios for proposed arterial investments around the region, reflecting high volumes and heavy reliance on the arterial system by Oakland County commuters. The net benefit of these investments is significant, but a major capital investment is required. With an estimated capital cost of nearly $6.7 million, this program will need to be spread over time.

It should be noted that some of the alternatives proposed for Oakland County were not included in the benefit/cost analysis below, but are seen as basic infrastructure investments to support the expansion of the arterial management system. These include improvements to the SCATS communications system and facility integration with MITSC.

The transit alternatives proposed also are supporting deployments that may not have an immediate impact on ridership or operating cost savings. Deployments such as security cameras and automated fare cards are investments in technology that improve the quality of service for the customer and, as a result, help maintain existing ridership and attract new riders. The proposed cost savings would be realized in the long run as older technologies are replaced with newer ones.

Table 40 – Oakland County ITS Benefit/Cost Summary

Benefits	***Freeway Mgmt***	***Arterial Mgmt***	***Total***
Travel Time	$5,056,000	$12,786,704	$17,842,704
Operating Cost	$307,000	$1,052,892	$1,359,892
Crash	$47,000	$506,172	$553,172
Emissions	$66,000	$0	$66,000
Total Benefits	$5,476,000	$14,345,769	$19,821,769
Annualized Costs	$355,000	$1,600,545	$1,955,545
Net Benefits	$5,121,000	$12,745,224	$17,866,224
B/C Ratio	15.4	9.0	10.1
Initial Capital	$1,262,000	$5,474,244	$6,736,244
Annual O&M	$190,000	$821,137	$1,011,137

4.1.5 St. Clair County Projects

A limited number of projects are proposed for St. Clair County including a FMS along I-94 and integration of MITSC with both the Blue Water Bridge and St. Clair County. As stated previously, any under construction or funded projects are counted as existing deployments for the analysis. Since the projects are planned for construction, analysis on the benefits of these deployments is not needed. For the Port Huron area, this includes deployments in the vicinity of the Blue Water Bridge and certain projects that resulted from the study completed in 2005. **Table 41** and **Table 42** show the list of proposed projects in St. Clair County while **Figure 25** shows this information graphically for the entire County and **Figure 26** shows a blow-up of the Port Huron area.

Table 41 – St. Clair County Draft List of Projects: Traffic Management

Project	*Agency*	*Project Name*	*Project Description*
MRITS – 007	MDOT	I-94 – St. Clair County from Macomb County line to Port Huron	Rural deployment of freeway management system components
MRITS – 020	MDOT	Facility Integration St. Clair County	Interconnect MITSC with St. Clair County TOC

Table 42 – St. Clair County Draft List of Projects: Maintenance and Construction

Project	*Agency*	*Project Name*	*Project Description*
MRITS – 038	MDOT	St. Clair County	AVL for winter maintenance operations

Figure 25 – St. Clair County Proposed ITS Deployments

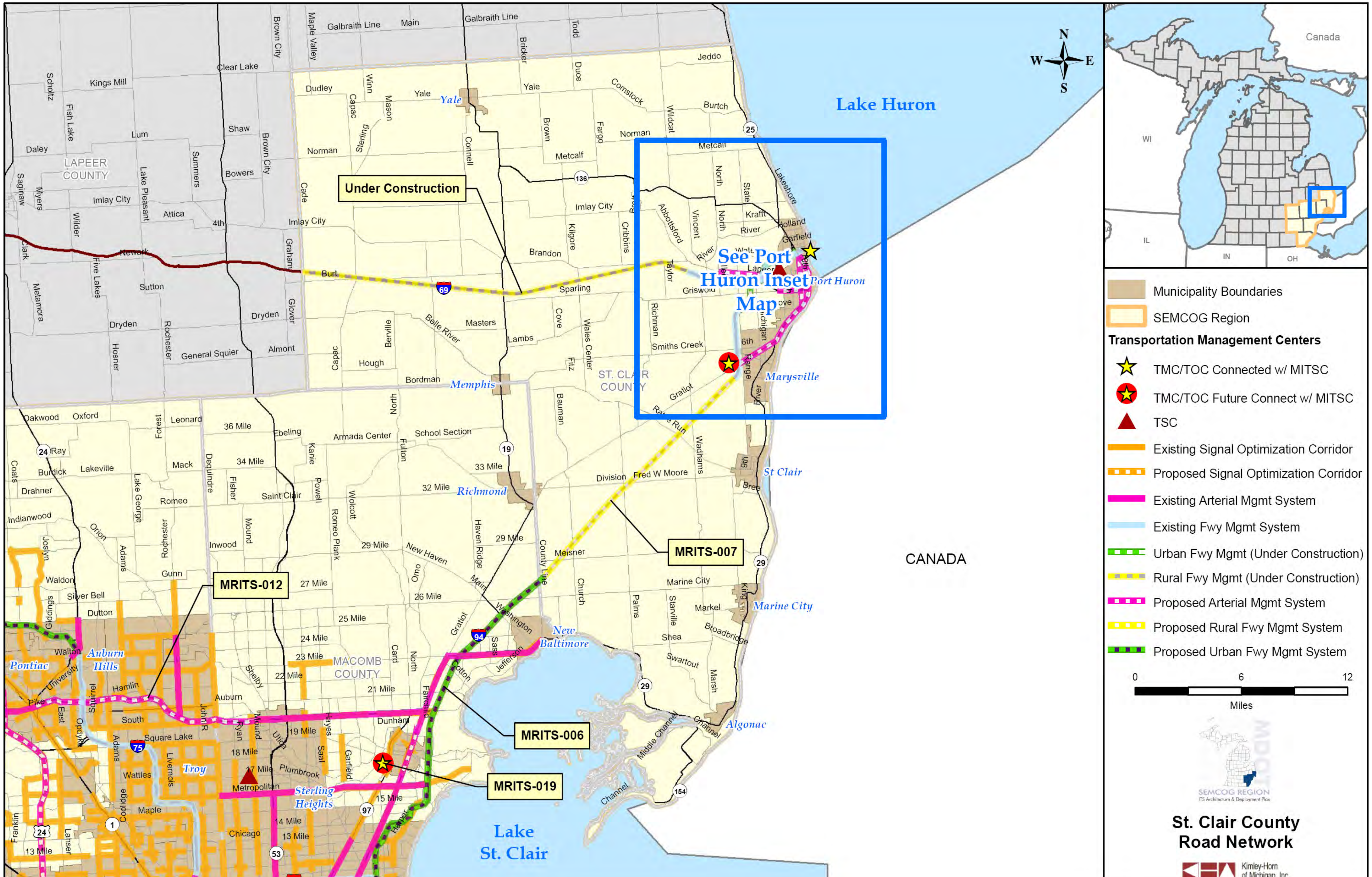
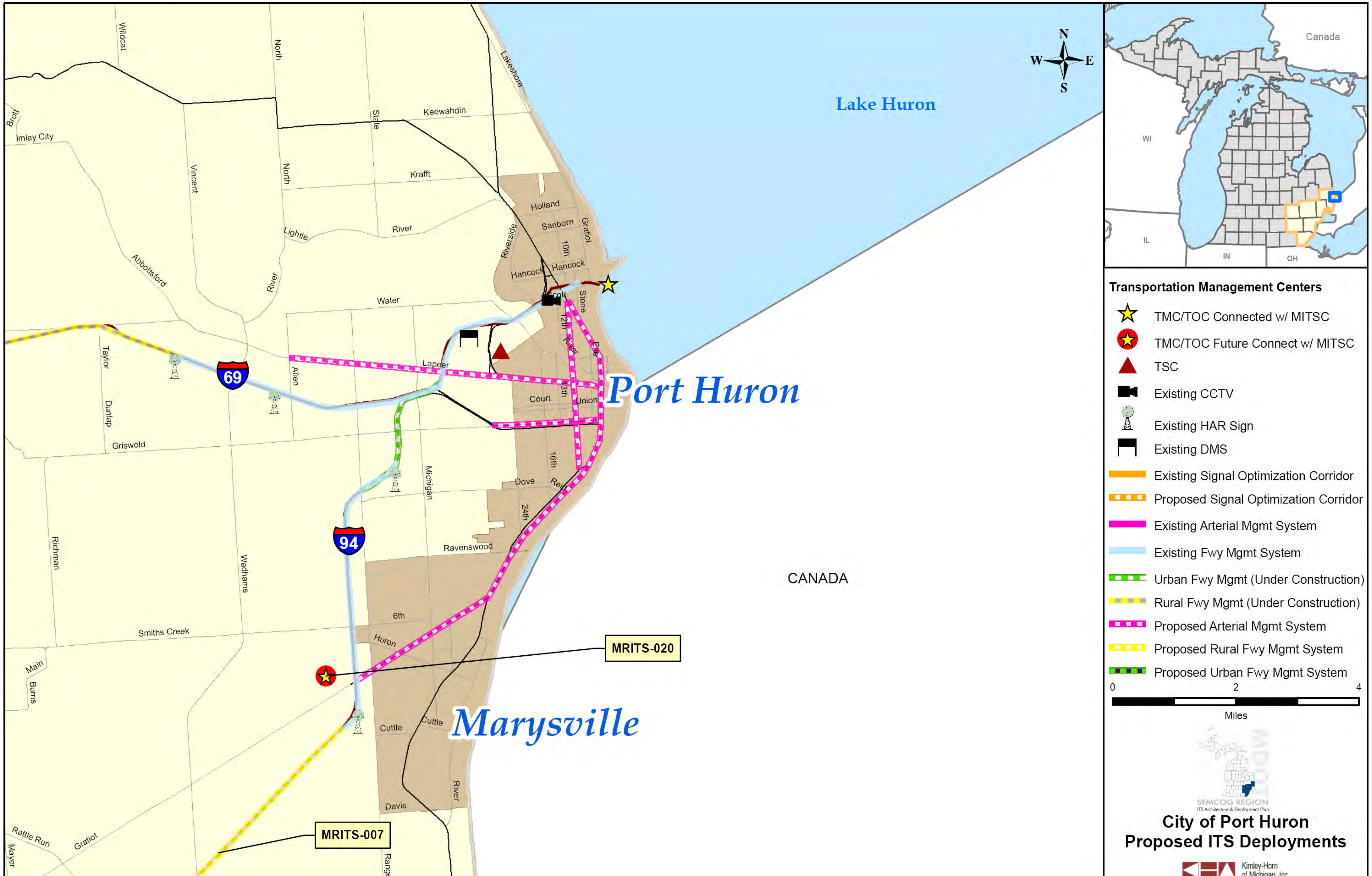


Figure 26 – Port Huron Proposed ITS Deployments



The benefit cost analysis for St. Clair County shows strong benefits for the extension of the FMS along I-94 from Macomb County to Port Huron. This is a rural deployment that includes CCTV cameras at interchanges and a more limited installation of detection. Three arterial corridors in and around Port Huron are proposed for signal corridor improvements. The benefit/cost ratio for these improvements is similar to that found for the FMS expansion and compares very.

The proposed facility integration with MITSC and the Blue Water Bridge TOC are seen as basic infrastructure investments to support the expansion of the FMS and to help manage international traffic using the Blue Water Bridge.

Winter maintenance operations is more difficult to estimate since costs vary significantly from year to year and as in all SEMCOG region counties, the Road Commission is responsible for both trunkline and County roads. Using a rough estimate of $4,000/mile for annual trunkline snow removal costs would result in annual savings of roughly $25,000 on a $500,000 budget. If St. Clair County were to expand this system to the entire County-maintained network, cost savings could be significantly greater.

Table 43 – St. Clair County ITS Benefit/Cost Summary

Benefits	***Freeway Mgmt***	***Arterial Mgmt***	***Total***
Travel Time	$63,000	$1,026,805	$1,089,805
Operating Cost	$158,000	$66,598	$224,598
Crash	$29,000	$31,487	$60,487
Emissions	$80,000	$0	$80,000
Total Benefits	$330,000	$1,124,889	$1,454,889
Annualized Costs	$65,000	$186,109	$251,109
Net Benefits	$265,000	$938,780	$1,203,780
B/C Ratio	5.1	6.0	5.8
Initial Capital	$223,000	$636,540	$859,540
Annual O&M	$33,000	$95,481	$128,481

4.1.6 Washtenaw County

Washtenaw County has a large proportion of the proposed new ITS projects in the region. Expansion of the regional FMS on I-94, US-23, and M-14 is proposed. Along with the FMS implementation, FCP would be expanded along these freeways as well. Arterial signal system upgrades are proposed for major trunklines that connect Washtenaw and Wayne Counties including US-12 and M-153. Expansion of the SCOOT adaptive control system is proposed in two corridors of Ann Arbor.

Several improvements are proposed for transit service in Ann Arbor, including expansion of AVL to demand responsive vehicles, implementation of automated passenger counters and fare cards, and improved coordination between the AATA and the University of Michigan bus system. **Table 44** through **Table 46** list the proposed projects for Washtenaw County, while **Figure 27** and **Figure 28** show improvements graphically for the entire County and Ann Arbor.

Table 44 – Washtenaw County Draft List of Projects: Traffic Management

Project	Agency	Project Name	Project Description
MRITS – 005	MDOT	I-94 – Wayne/Washtenaw County from I-275 to west of Ann Arbor	Expansion of Freeway Management system
URITS – 002	MDOT	US-23 – Washtenaw County from I-94 to M14/US 23 split	Urban deployment of expansion of freeway management system
URITS – 003	MDOT	US-23 – Washtenaw/Livingston County from I-94 to I-96	Urban deployment of expansion of freeway management system
URITS – 005	MDOT	US-12 – Wayne/Washtenaw County from US 24 to Ann Arbor	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 013	MDOT	M14 – Wayne/Washtenaw County from I-275 to US 23	Urban deployment of expansion of freeway management system
MRITS – 014	MDOT	M153 – Wayne/Washtenaw County from M 14 to M 39	Signal System upgrade and interconnect. Expansion of arterial management system
URITS – 007	MDOT	Facility Integration Washtenaw County	Interconnect MITSC with Washtenaw County TOC
URITS – 012	MDOT	I-94 in Washtenaw County from Wayne County Line to west of M14	Expansion of Freeway Courtesy Patrol
URITS – 013	MDOT	US 23 in Washtenaw County from I-94 to I-96	Expansion of Freeway Courtesy Patrol
URITS – 014	MDOT	M14 in Washtenaw County from Wayne County Line to I-94	Expansion of Freeway Courtesy Patrol
URITS – 015	*Ann Arbor	SCOOT Expansion West Stadium Blvd.	
URITS – 016	*Ann Arbor	SCOOT Expansion Huron/Jackson corridor	

Funded project

Table 45 – Washtenaw County Draft List of Projects: Advanced Public Transportation Systems

Project	Agency	Project Name	Project Description
^URITS – 017	AATA	AVL	AVL equipment for demand response vehicles
^URITS – 018	AATA	APC	Automatic Passenger Counters and fare cards
^URITS – 019	AATA	Facility Integration	Interconnect with Local Public Safety Dispatch
^URITS – 020	AATA	Facility Integration	Interconnect with University of Michigan Transportation Services
^URITS – 021	AATA1	Bus Priority	Bus Priority – One of the elements of SCOOT is provision to provide bus priority

^Provided on project input form

Table 46 – Washtenaw County Draft List of Projects: Maintenance and Construction

Project	Agency	Project Name	Project Description
URITS – 024	MDOT	Washtenaw County	AVL for winter maintenance operations

Figure 27 – Washtenaw County Proposed ITS Deployments

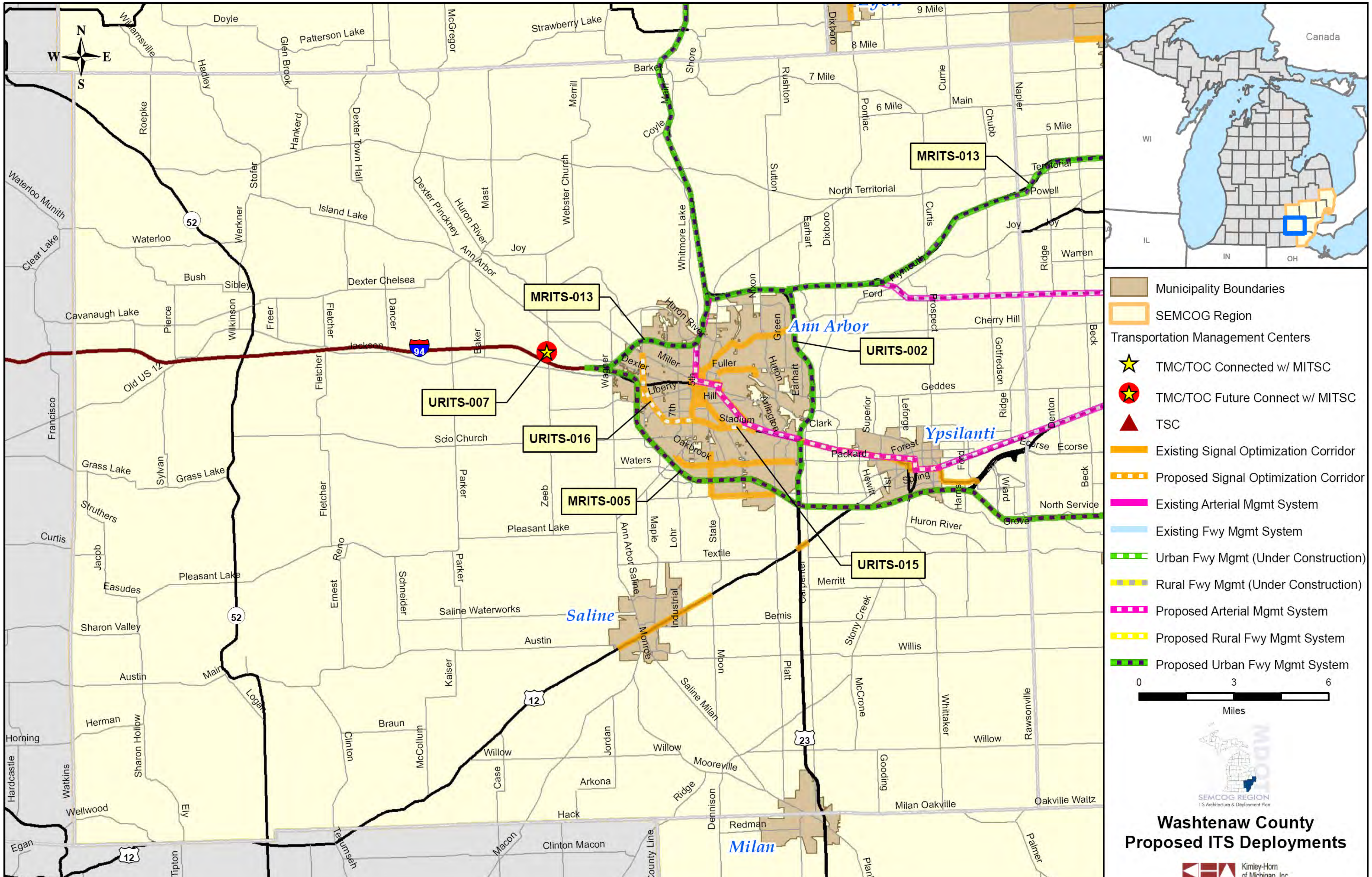
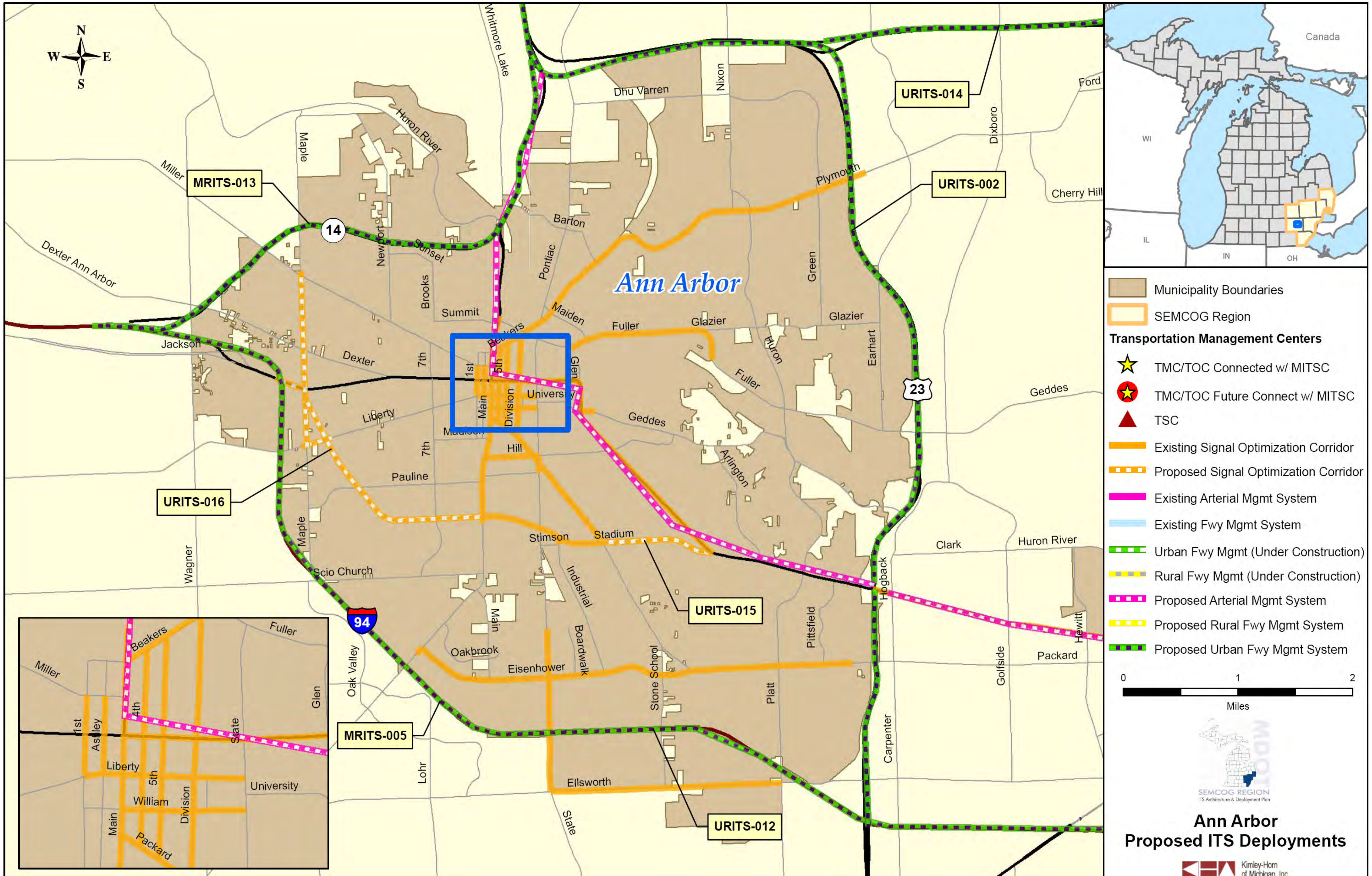


Figure 28 – Ann Arbor Proposed ITS Deployments



The benefit cost analysis for Washtenaw County shows a high benefit/cost ratio for extension of the regional FMS along I-94, US-23 and M-14. FCP would be extended along major freeways including I-94 through Ann Arbor and also has a very high benefit/cost ratio. Several major arterial trunklines are proposed for improvement as well. The arterial alternatives have a benefit/cost ratio of just under 3.0. It also should be noted that improvements along M-153 and US-12 will be helpful in relieving traffic when it must be diverted from M-14 and I-94, respectively. Facility integration between Washtenaw County and the MITSC also is proposed. This is a supporting deployment to improve coordination and overall performance of the FMS.

The transit alternatives proposed also are supporting deployments that may not have an immediate impact on ridership or operating cost savings. The main improvements proposed in this category are integration between the AATA and the University of Michigan bus system, as well as with public safety. Automatic Passenger Counters also are proposed. Cost savings may be realized in the long run as older technologies are replaced with newer ones.

Winter maintenance operations is more difficult to estimate since costs vary significantly from year to year and as in all SEMCOG region counties, the Road Commission is responsible for both trunkline and County roads. Using a rough estimate of $4,000/mile for annual trunkline snow removal costs would result in annual savings of roughly $25,000 on a $500,000 budget. If Washtenaw County were to expand this system to the entire County-maintained network, cost savings could be significantly greater.

Table 47 – Washtenaw County ITS Benefit/Cost Summary

Benefits	*Freeway Mgmt*	*Arterial Mgmt*	*FCP*	*Total*
Travel Time	$8,477,000	$8,477,000	$1,548,894	$7,365,000
Operating Cost	$224,000	$224,000	$110,841	$952,000
Crash	($2,000)	($2,000)	$52,911	$177,000
Emissions	($35,000)	($35,000)	$0	$348,000
Total Benefits	$8,664,000	$8,664,000	$1,712,646	$8,842,000
Annualized Costs	$803,000	$803,000	$620,367	$540,000
Net Benefits	$7,861,000	$7,861,000	$1,092,279	$8,302,000
B/C Ratio	10.8	10.8	2.8	16.4
Initial Capital	$2,806,000	$2,806,000	$2,121,800	$276,000
Annual O&M	$421,000	$421,000	$318,270	$374,000

4.1.7 *Wayne County*

Proposed improvements for Wayne County are focused on expansion of the FMS in outlying areas of Wayne County and surrounding Counties. Expansions are proposed on I-75 and I-275, as well as I-94. Signal system upgrades are proposed for major trunkline arterials including US-12, M-3, M-102, US-24, and M-153. **Table 48** summarizes the proposed projects and **Figure 29** and **Figure 30** show these improvements graphically for Wayne County and the City of Detroit.

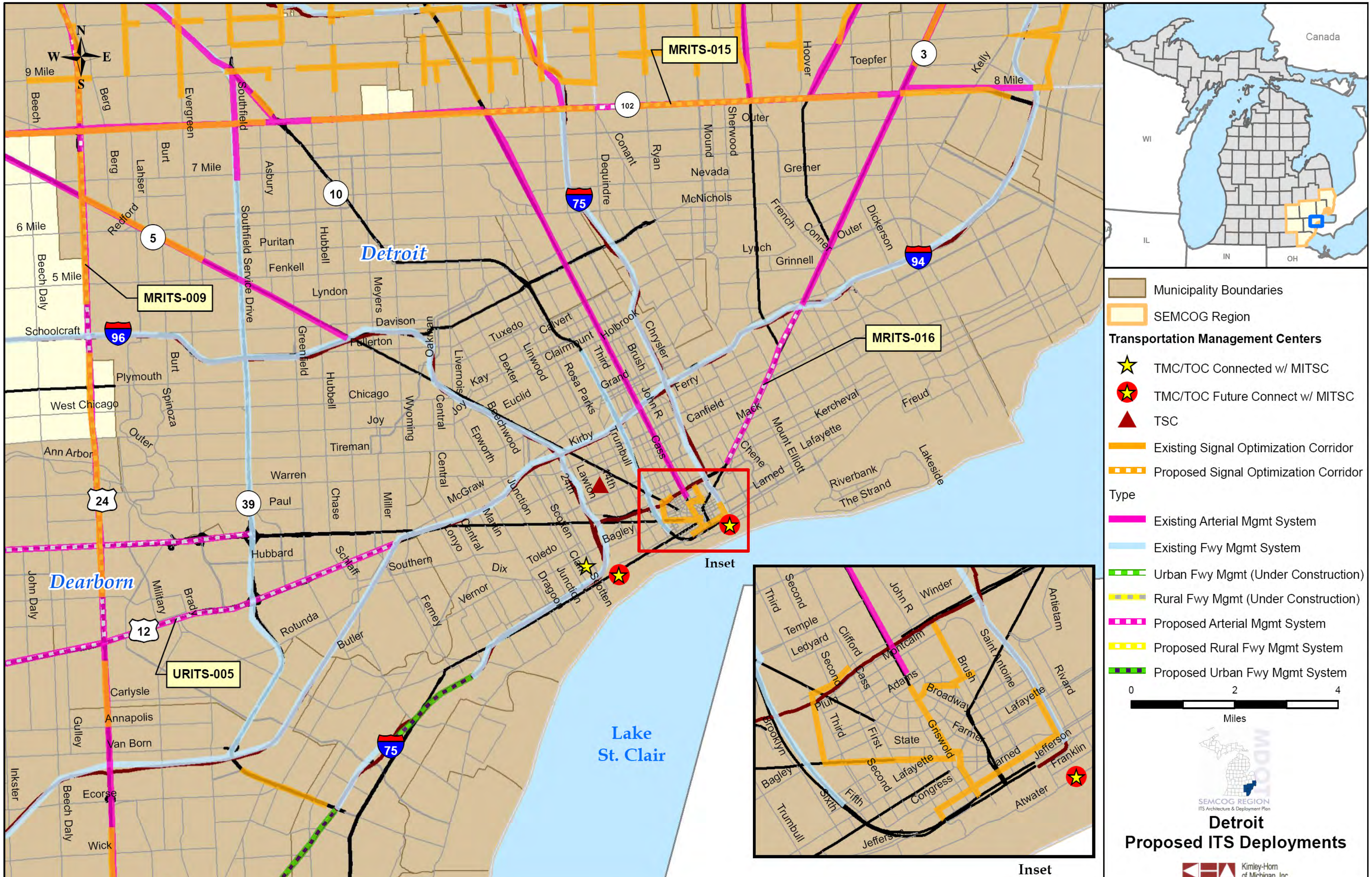
Table 48 – Wayne County Draft List of Projects: Traffic Management

Project	***Agency***	***Project Name***	***Project Description***
MRITS – 002	MDOT	I-75 – Wayne County downtown to Monroe County Line	Expansion of freeway management system
MRITS – 004	MDOT	I-275 – Wayne/Monroe County from existing deployment to I-75	Expansion of freeway management system
MRITS – 005	MDOT	I-94 – Wayne/Washtenaw County from I-275 to west of Ann Arbor	Expansion of freeway management system
URITS – 005	MDOT	US-12 – Wayne/Washtenaw County from US 24 to Ann Arbor	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 008	MDOT	US-24 – Wayne/Oakland County from 8 Mile Road to I-75	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 009	MDOT	US-24 – Wayne/Oakland County from US 12 to 8 Mile Road	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 010	MDOT	US-24 – Wayne/Monroe County from Taylor to I-275	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 013	MDOT	M14 – Wayne/Washtenaw County from I-275 to US 23	Urban deployment of expansion of freeway management system
MRITS – 014	MDOT	M153 – Wayne/Washtenaw County from M 14 to M 39	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 015	MDOT	M102 – from M 1 to M 3	Signal System upgrade and interconnect. Expansion of arterial management system
MRITS – 016	MDOT	M3 – Wayne County from I-94 to I-375	Signal System upgrade and interconnect. Expansion of arterial management system
^MRITS – 017	MDOT	Facility Integration Wayne County	Interconnect MITSC with Wayne County TOC

^Provided on project input form

Figure 29 – Wayne County Proposed ITS Deployments

Figure 30 – Detroit Proposed ITS Deployments



The benefit cost analysis for Wayne County shows significant benefits in the expansion of the FMS along I-94, I-275, and I-75 in the outer areas of the County. Significant investment in signal systems also is proposed for major arterial trunklines including US-24, US-12, M-102, and M-3, with a benefit/cost ratio of 5.4 similar to those found in other heavily-developed portions of the region. The benefit/cost ratio is relatively high for an arterial management system, but not as great as for the FMS. This is due to the high capital cost of the arterial system. A substantial investment of nearly $9.5 million is required for the proposed signal improvements so these will have to be phased in over time.

Table 49 – Wayne County ITS Benefit/Cost Summary

Benefits	***Freeway Mgmt***	***Arterial Mgmt***	***Total***
Travel Time	$5,056,000	$13,529,061	$18,585,061
Operating Cost	$307,000	$890,914	$1,197,914
Crash	$47,000	$422,967	$469,967
Emissions	$66,000	$0	$66,000
Total Benefits	$5,476,000	$14,842,943	$20,318,943
Annualized Costs	$355,000	$2,767,000	$3,122,000
Net Benefits	$5,121,000	$12,075,943	$17,196,943
B/C Ratio	15.4	5.4	6.5
Initial Capital	$1,262,000	$9,463,228	$10,725,228
Annual O&M	$189,000	$1,419,484	$1,608,484

4.2 Summary of Results

Table 50 through **Table 55** show the comparison of benefits and costs between different ITS packages. It is important to note that these results represent only one portion of the criteria that will be used by MDOT to select projects for implementation. Other considerations include eligibility of various funding sources; compatibility with the priorities of MDOT's ITS program as well the agency's overall program priorities; ability to incorporate in major construction projects; and compatibility with other regions' investment strategies. The benefit and cost data, however, provide useful guidance into which investments provide the best return.

Table 50 – Counties – Summary of B/C Ratio

County	*Freeway Mgmt*	*Arterial Mgmt*	*FCP*	*Total*
Livingston	6.5	6.5	2.5	15.8
Macomb	19.3	19.3	5.0	
Monroe	3.6	3.6	5.1	4.3
Oakland	15.4	15.4	9.0	-
St. Clair	5.1	5.1	6.0	-
Washtenaw	10.8	10.8	2.8	16.4
Wayne	15.4	15.4	5.4	-

Table 51 – Counties – Total Benefits

County	*Total Benefits*
Livingston	$6,596,000
Macomb	$6,865,000
Monroe	$4,487,000
Oakland	$19,822,000
St. Clair	$1,455,000
Washtenaw	$19,219,000
Wayne	$20,319,000
TOTAL	**$78,763,000**

Table 52 – Counties – Net Benefits

County	*Net Benefits*
Livingston	$5,486,000
Macomb	$6,293,000
Monroe	$3,458,000
Oakland	$17,866,000
St. Clair	$1,204,000
Washtenaw	$17,255,000
Wayne	$17,197,000
TOTAL	**$68,759,000**

Table 53 – Counties – Annualized Cost

County	*Annualized Cost*
Livingston	$1,095,000
Macomb	$572,000
Monroe	$1,030,000
Oakland	$1,956,000
St. Clair	$251,000
Washtenaw	$1,963,000
Wayne	$3,122,000
TOTAL	**$9,989,000**

Table 54 – Total Capital Costs

County	*Capital Costs*
Livingston	$3,379,000
Macomb	$1,962,000
Monroe	$3,173,000
Oakland	$6,736,000
St. Clair	$860,000
Washtenaw	$5,204,000
Wayne	$10,725,000
TOTAL	**$32,039,000**

** O&M incorporated into Traffic Management System*

Table 55 – Annual Operations and Maintenance Costs

County	*O&M Costs*
Livingston	$647,000
Macomb	$294,000
Monroe	$587,000
Oakland	$1,011,000
St. Clair	$128,000
Washtenaw	$1,113,000
Wayne	$1,608,000
TOTAL	$5,388,000

** O&M incorporated into Traffic Management System*

These summary tables are focused only on Freeway and Arterial management systems, which are the core of the region's ITS system. These alternatives alone have a capital cost of $32 million and would add $5.4 million to current system operations and maintenance costs. Additional investments in public transportation ITS, technologies to enhance winter maintenance, integration of facilities with the MITSC, and improved communications systems for arterial management will significantly increase the cost of the program.

The analysis indicates that expansion of the existing FMS along major freeways such as I-94, I-96, US-23, I-75, I-275 and M-14 would serve the largest number of customers and have the highest level of benefit. While arterial improvements show lower benefit/cost ratios, these are important to assure as MDOT and the Counties move toward an Integrated Corridor Management strategy. This strategy involves proactive management of trunkline arterials and freeways to optimize the system and provide commuters with viable options during major incidents and construction activity.

4.3 Project Timeframes

Project priorities will be set through input from the regional stakeholders based on a number of factors, of which benefit/cost analysis is only one. Other criteria include availability of funding, funding eligibility of proposed projects, geographic scope of project benefits and the feasibility of phasing projects into place over time. While benefits may be similar between different projects, some projects may offer more immediate relief to a problem. An assessment of emerging technologies is another key consideration. Certain deployments may show high benefits, but at a substantial capital cost. MDOT, through its work on the VII program and other technology initiatives, is a national leader in looking ahead to emerging technologies. If there is likelihood that a specific technology can be replaced by something more cost-effective during its life cycle, agencies may prefer to forego large investment and instead use a temporary solution that will not preclude the emerging technology.

Based on the analysis conducted for this report and the input from the stakeholders, the following project implementation plan is identified for near-term, medium term, and long term deployments. For the purposes of this assessment, short-term deployments are anticipated to be implemented within 0-3 years; medium term in 4 to 8 years; and long-term deployments are expected to occur in more than 8 years.

Table 56 – SEMCOG Short-Term (0 – 3 Years) ITS Deployment Plan Projects

Short-Term Deployments	Components	Comments
Freeway Management System	– MRITS-001 – I-75 FMS expansion in Oakland County – MRITS-002 - I-75 FMS expansion in Wayne County – MRITS-005 – I-94 FMS expansion in Wayne/Washtenaw County – MRITS-018 – MITSC facility integration with RCOC TOC – MRITS-019 – MITSC facility integration with RCMC TOC	– I-75 FMS expansion should be timed to support proposed construction. – These segments are listed as short term projects based on the higher benefit these corridors yield with the higher ADTs. – The integration of the facilities is key to the current I-75 ICM Concept of Operations that is under development.
Arterial Management System	– MRITS-008 – US24 Wayne/Oakland County-8 Mile to I-75 – MRITS-009 – US24 Wayne/Oakland County-US 12 to 8 Mile – MRITS-012 – M59 Oakland County-extending system to M 1 – MRITS-016 – M3 Wayne County-I-94 to I-375 – MRITS-025 – RCMC system wide detection for responsive system – URITS-005 – US12 Wayne/ Washtenaw County-US24 to Ann Arbor	– URITS-005 arterial project and MRITS-005 FMS expansion should be done together. – Similar to the FMS expansion, the arterials included here currently carry higher ADTs and therefore yield a greater benefit for the County and the region.
Advanced Public Transportation Systems	– MRITS-033 – SMART automatic passenger counters and fare cards – MRITS-034 – SMART CCTV cameras on vehicles for security – URITS-017 – AATA AVL equipment for demand responsive vehicles – URITS-018 – AATA automatic passenger counters and fare cards	– These projects were identified by the transit agencies as higher priority projects, but also yield greater benefits for the system and the region.
Freeway Service Patrols	– URITS-012 – I-94 in Washtenaw County from Wayne County Line to west of M14 – URITS-013 – US23 in Washtenaw County from I-94 to I-96	– Implementation of URITS-013 should be timed to support US-23 construction project

Table 57 – SEMCOG Medium-Term (4 – 8 Years) ITS Deployment Plan Projects

Medium Term Deployments	Components	Comments
Freeway Management System	– MRITS-003 – I-75 FMS expansion in Monroe County – MRITS-004 – I-275 FMS expansion in Wayne/Monroe County – MRITS-006 – I-94 FMS expansion in Macomb County – MRITS-013 – M14 FMS expansion in Wayne/Washtenaw County – MRITS-017 – MITSC facility integration with Wayne County TOC – URITS-001 – I-96 FMS expansion in Livingston County – URITS-002 – US23 FMS expansion in Washtenaw County – URITS-003 – US23 FMS expansion in Washtenaw/Livingston County	– MRITS-013 and arterial project MRITS-014 should be done together – URITS-002 and URITS-003 should be incorporated into US-23 capital improvements
Arterial Management System	– MRITS-010 – US24 Wayne/Monroe County from Taylor to I-275 – MRITS-014 – M153 Wayne/Washtenaw County from M14 to M39 – MRITS-015 – M102 from M1 to M3 – MRITS-024 – RCMC countywide surveillance – MRITS-026 – RCMC traffic signal software and hardware upgrade – MRITS-028 – RCMC arterial DMS installations – URITS-008 – Livingston County – West Grand River Ave from Lucy Road to Highlander Way – URITS-009 – Livingston County – West Grand River Ave from US23 to Dorr Road	– Additional study of priorities is needed for Macomb County projects MRITS-024, MRITS-026 and MRITS-028. A large capital investment is required to implement in the entire county so projects will need to be phased in over time. A priority for MRITS-028- arterial DMS – should be focused on arterials that parallel the freeways.
Advanced Public Transportation Systems	– URITS-019 – AATA facility integration with local public safety dispatch – URITS-020 – AATA facility integration with UofM – URITS-021 – AATA Bus Priority with traffic signals – MRITS-035 – SMART traveler information web site and kiosk	– MRITS-035 could be expanded to a regional transit traveler information system depending on the progress of coordination efforts between SMART and DDOT.
Maintenance and Construction Management System	– MRITS-032 – RCOC expansion of SEMSIM – MRITS-038 – St. Clair County AVL for winter maintenance – URITS-023 – Livingston County AVL for winter maintenance – URITS-024 – Washtenaw County AVL for winter maintenance – URITS-025 – Monroe County AVL for winter maintenance	– All of the counties within the region expressed an interest in utilizing AVL technology for winter maintenance. There was not a focus to join the SEMSIM program, but instead to implement similar technology within each county.
Freeway Service Patrols	– URITS-010 – I-75 in Monroe County from I-275 to State Line – URITS-011 - I-96 in Livingston County to west of M59	– The Livingston County expansion yields a much higher benefit/cost ratio than Monroe County, but each are expected to be implemented in the Medium term time frame.

Table 58 – SEMCOG Long-Term (Over 8 Years) ITS Deployment Plan Projects

Long- Term Deployments	Components	Comments
Freeway Management System	– MRITS-007 – I-94 FMS expansion in St. Clair County – MRITS-020 – MITSC facility integration with St. Clair County TOC – MRITS-022 – MITSC facility integration with Windsor TOC – MRITS-023 – MITSC facility integration with Toledo TOC – URITS-004 – US23 FMS expansion in Livingston County – URITS-007 – MITSC facility integration with Washtenaw TOC – URITS-006 – MITSC facility integration with Livingston TOC	– There is still a benefit recognized for continuing the FMS on these corridors. If other capital improvements are scheduled, these projects could be moved up to medium term. – Planning for facility integration projects needs to be coordinated with implementation of statewide ATMS software. Timing of projects will be dependent on development of county TOC's. Some projects may be able to move up to medium term.
Arterial Management System	– MRITS-011 - US24 Monroe County from I-275 to State Line – MRITS-027 – RCMC installation of broadband radios at signals for wireless access – MRITS-029 – RCMC renovation and expansion of TOC – MRITS-030 – RCOC expansion of system on future corridor – MRITS-031 – RCOC upgrade of SCATS communication to wireless technology	– Some of the Macomb County deployments could be moved to medium term if combined with other signal system upgrades.
Advanced Public Transportation Systems	– MRITS-036 – SMART facility integration with other transit dispatch facilities – URITS-022 – Livingston Essential Transportation Service local vehicle tracking system	– As regional integration of transit services expands, the SMART integration could be moved up to medium term.
Freeway Service Patrols	– URITS-014 – M14 in Washtenaw County from Wayne County Line to I-94	– A greater benefit is realized on the Interstates, but expanding FCP onto secondary freeways continues to yield a benefit to the County and Region.
Emergency Management	– MRITS-037 – RCMC countywide emergency traffic signal pre-emption	– This could be moved to medium term if combined with other signal system upgrades.