Genesee, Lapeer, and Shiawassee County Traffic Safety Plan

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Thank you to our many stakeholders who provided input to develop the Genesee-Lapeer-Shiawassee Region V Traffic Safety Plan, including the Traffic Safety Stakeholder Group.

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Executive Summary

Traffic crashes are the leading cause of death for Michiganders under the age of 45. Traffic crashes produce not only personal tragedy, but increased burdens on the region due to medical and insurance costs, lost production potential, and delay of passengers and freight.

A Regional Traffic Safety Plan (RTSP) is a ***locally coordinated*** effort that assists local agencies in taking a ***proactive stance*** in ***reducing*** and ***preventing*** local road fatalities and injuries. The plan provides an opportunity to improve relationships among stakeholders by working through a collaborative process, which results in improved road safety benefiting everyone. Developing an RTSP consists of a general six-step process as identified in Figure 1.

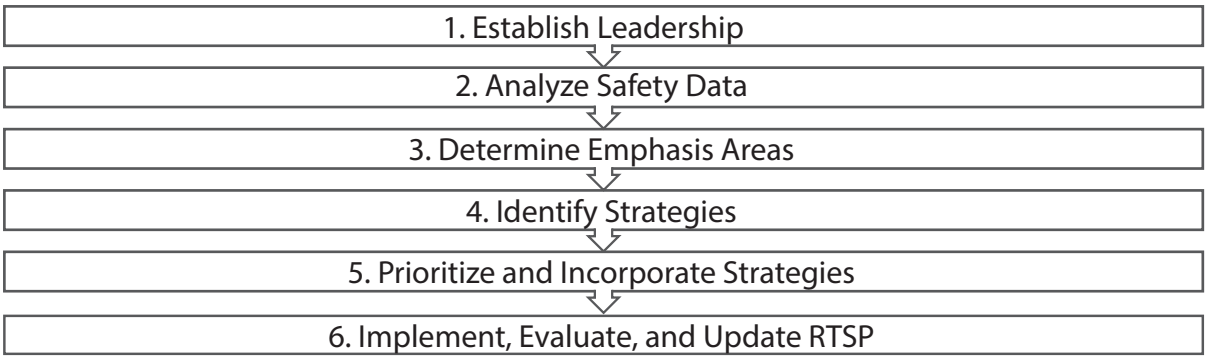


Figure 1: Steps for Traffic Safety Plan

The purpose of creating the *Genesee, Lapeer, and Shiawassee (GLS) Region V Traffic Safety Plan* is to identify the unique issues and assist with making informed safety investment decisions to reduce fatalities and serious injuries for all road users.

The GLS Region V and the Michigan Department of Transportation (MDOT) partnered, and Atkins was hired to develop this plan. The Traffic Safety Stakeholder Group was assembled to provide input on the key elements of the plan, identify region specific challenges, and help with the implementation of this plan. This RTSP is data-driven and establishes a vision, targets, emphasis areas, and strategies. This plan integrates strategies from the four E's of traffic safety:

- Engineering,
- Enforcement,
- Education, and
- Emergency Medical Services.

The emphasis areas were selected based on the crash data trends and stakeholder input. The Traffic Safety Stakeholder Group prioritized five traffic crash emphasis areas for GLS Region V, including:

- Intersection
- Lane departure
- Drivers age 24 and younger
- Impaired driving
- Pedestrian

This RTSP includes a list of strategies that are focused on addressing each of the emphasis areas. Strategy selection was also based on stakeholder input, with special consideration for their effective and validated practices. This plan includes lists of key locations (corridors and intersections) that will benefit from both systemic and spot safety improvements that help to achieve the RTSP goals mention under vision and targets section of this plan.

Regional Traffic Safety Policies

In addition to the specific four E's mitigating strategies included in this plan, several regional safety policies have been developed to guide plan implementation.

1. Apply a comprehensive, integrated approach when addressing highway safety problems that includes the vehicle, driver, other road users, and roadway elements through a combination of engineering, education, enforcement, and emergency services solutions.
2. Focus safety funding on high-priority road segments, intersections, and initiatives as identified in the *GLS Region V Traffic Safety Plan*.
3. Educate road users on their role and responsibilities in traffic safety, including distracted driving.
4. Promote and educate residents on safe walking and bicycling as a means to improve the health of residents, reduce traffic congestion, and provide viable alternatives to driving.
5. Incorporate elements of complete streets and green streets to holistically manage the transportation system for all users and reduce conflicts between vehicles, transit, rail, and non-motorized modes of travel.
6. Increase connectivity and accessibility for all modes of the transportation system to core services in Genesee, Lapeer and Shiawassee Counties, including hospitals, educational institutions, job centers, grocery stores, downtowns, and parks as a mechanism of improving safety
7. Coordinate with stakeholders, including the Governor's Traffic Safety Advisory Commission (GTSAC), local government, road agencies, advocacy groups, and other public and private entities, on safety implementation activities.
8. Support and promote the use of transportation-related technologies and travel demand management techniques that lead to safer, more efficient, and more economical highway systems in the region.
9. Support traffic incident management that is designed to facilitate the safety of motorists and first responders as well as the expeditious restoration of traffic flow stemming from both major and minor traffic incidents back to normal conditions.

Connections with Other Regional Plans

This plan will integrate with the safety issues exhibited in the following plans:

- 2040 Genesee County Long Range Transportation Plan (http://gcmpc.org/2040-long-range-transportation-plan/),
- Genesee County Transportation Improvement Program (http://gcmpc.org/transportation-improvement-program/),
- Genesee County Regional Trail Plan (http://gcmpc.org/wp-content/uploads/2015/01/2014-Genesee-County-Regional-Non-Motorized-Tech-Report_January20151.pdf), and
- Accelerate: Economic Development Strategy and Prosperity Plan for the I-69 Thumb Region (http://i-69thumbregion.org/the-plan/).

Chapter 1. Introduction

Local practitioners play a critical role in addressing crash risks at the local level. A RTSP provides the framework for local agency practitioners to take a proactive stance to identify the specific or unique conditions that contribute to crashes within their jurisdictions. This approach provides an opportunity for safety stakeholders and involved agencies at all levels of government to work together to align and leverage resources to address the safety challenges unique to their region.

Background

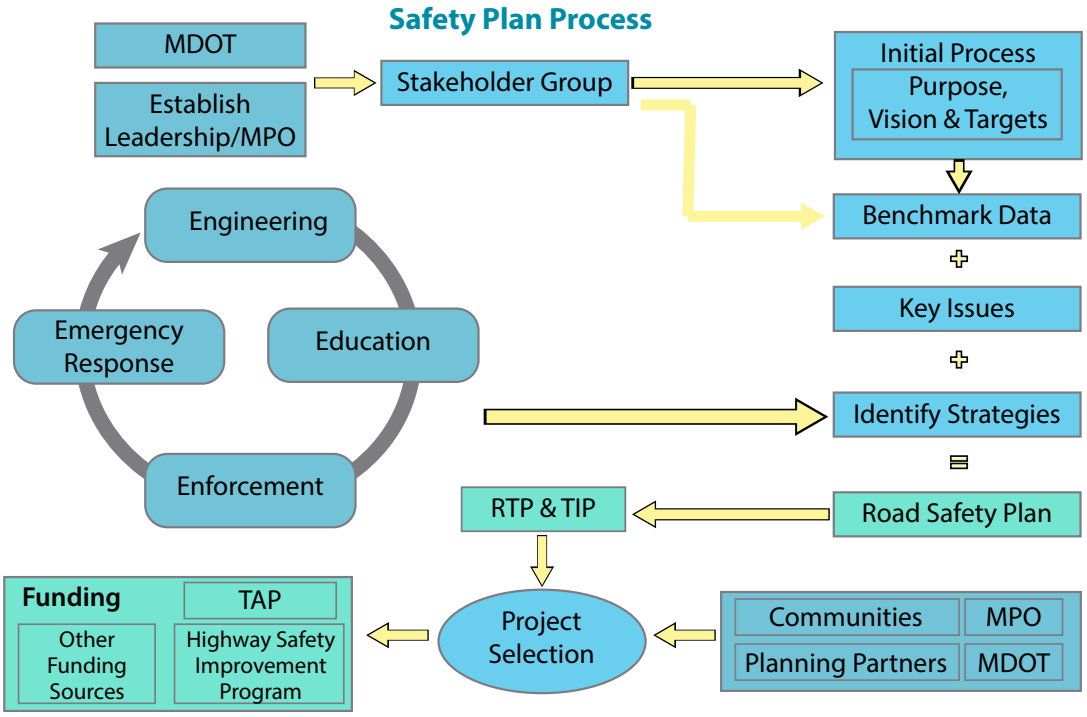
In 2015, 963 people were killed in traffic crashes in Michigan. More than five percent of these fatalities occurred in the three counties (Genesee, Lapeer, and Shiawassee) that constitute GLS Region V. GLS Region V has around six percent of the state's traffic volume and population. Traffic crashes are the leading cause of death for Michiganders under the age of 45. Traffic crashes produce not only personal tragedy, but increased burdens on the region due to medical and insurance costs, lost production potential, and delay of passengers and freight.

The Federal Highway Administration (FHWA) rolled out the Toward Zero Deaths (TZD): A National Strategy on Highway Safety in 2015 nationwide. The TZD initiative provides the national vision for driving the decline in fatal and serious injury crashes.

The GTSAC developed the Michigan Strategic Highway Safety Plan (SHSP) as a result of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users. The SHSP is a statewide, coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. The SHSP allows highway safety programs and partners in the state to work together in an effort to align goals, leverage resources, and collectively address the state's safety challenges. In Michigan, TZD is at the basis of the SHSP. MDOT, in coordination with the GTSAC, is leading the promotion of TZD in the state.

To address traffic safety issues at a regional level, MDOT is developing 14 RTSPs based on the State Planning and Development Regions for the entire state of Michigan. For this plan, GLS Region V and MDOT partnered to develop the GLS Region V Traffic Safety Plan to address this region's unique traffic safety issues and challenges.

Figure 2: Safety Plan Process



A diverse Traffic Safety Stakeholder group was formed to provide input to the plan, which consisted of safety stakeholders and partners from various local agencies including engineering, education, enforcement, EMS sectors as well as elected officials. Stakeholders provided input on traffic safety challenges, prioritized emphasis areas, and will also help with follow-up implementation.

Figure 3: Overview of GLS Region V Counties

As mentioned earlier, this safety plan identifies the region's key safety issues and guides investment decisions to reduce fatalities and serious injuries on all public roads. This safety plan is data-driven

and establishes a vision, targets, and key emphasis areas that integrate the four E's of safety – engineering, education, enforcement, and emergency medical services. This plan includes higher level regional crash data analysis, summaries of key safety issues, and a series of short-term and long-term strategies to improve safety within each emphasis area. Once the plan is complete, GLS Region V and its stakeholders are responsible for implementing, evaluating and updating the RTSP. An RTSP is a living document. The stakeholder group should review the RTSP, examine progress, and evaluate the effectiveness of the plan. The stakeholder group can also suggest changes or modifications to the plan if needed to address changing needs of the region and its priorities.

Vision and Targets

The plan's vision is outlined below. This vision is consistent with the statewide traffic safety vision outlined within the Michigan SHSP.

Toward Zero Deaths on Genesee, Lapeer and Shiawassee Roadways

The Toward Zero Deaths (TZD) National Strategy on Highway Safety (the National Strategy) provides a common vision that drives and focuses efforts to achieve the shared goal among various stakeholders to eliminate injuries and fatalities on all public roadways.

In order to achieve the TZD vision, local agencies and stakeholders must aggressively work toward intermediate targets specific to GLS Region V. The targets established are:

Reduce traffic fatalities by 5 percent by 2019

Reduce serious traffic injuries by 10 percent by 2019

The method used to set the targets is consistent with the proposed rules within Moving Ahead for Progress in the 21st Century Act (MAP-21). The rules require the use of a five-year rolling average of crashes to smooth out any anomalous jumps or drops in the data. The rules also specify that the above performance measure analysis is done using the prediction interval of the data, not just the linear regression. As mentioned earlier, GLS Region V has around six percent of the state's traffic volume. Appendix A has graphs that illustrates how above targets for fatalities and serious injuries were calculated. Five-year rolling average of crashes from 2004-2015 were used;, based on the observed trends logarithmic regression and prediction interval, more realistic targets were set for 2015-2019. This is because the number of crashes tends to rise and fall with the annual traffic volume, which is largely dependent on the economy.

Chapter 2. Analyze Traffic Safety Data

Safety data analysis will identify the safety issues and emphasis areas that the region should address. The analysis used in the development of this RTSP looked at the bigger picture and does not focus on analyzing crash data for a specific site. Crash data is the most useful to identify safety issues, select appropriate countermeasures, and evaluate performance. It also allows agencies to track progress in implementing safety measures. Five years of crash data were used to identify trends.

There are several methods used when measuring crash data. This chapter focuses on crash frequency and crash rate. Additional crash data analysis can be found in Appendix A.

Crash Frequency

Crash frequency is the sum of all traffic crashes in an area or at a specific location.

Figure 4 illustrates the severity of the region's traffic crashes. Between 2010 and 2014, over 14,000 traffic crashes occurred each year in GLS Region V. Of those crashes, 1.7 percent resulted in a fatality (K) or serious injury (A) each year. Figure 5 outlines the five-year moving average for the frequency of K/A crashes, where the trend is decreasing for serious injuries and remaining steady for fatalities.

GLS Region V accounts for five percent of the statewide severe crashes. Table 1 illustrates the percentage distribution of crashes by county for total crashes and K + A crashes in each county while Table 2 shows the frequency of K/A crashes in each county by year. Fatal and serious injury crashes decreased for GLS Region V in 2014.

Figure 4: Traffic Crash Severity in GLS Region V, 2010-2014

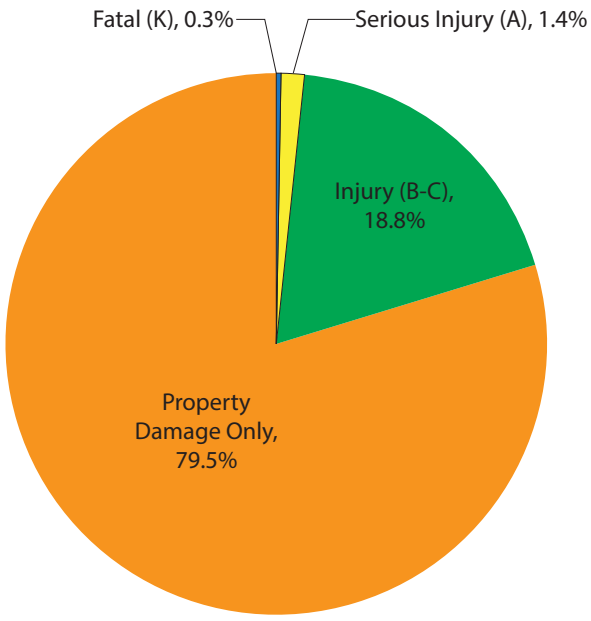


Figure 5: Fatal and Serious Injury Five Year Moving Average Crash Frequency in GLS Region V, 2010-2014

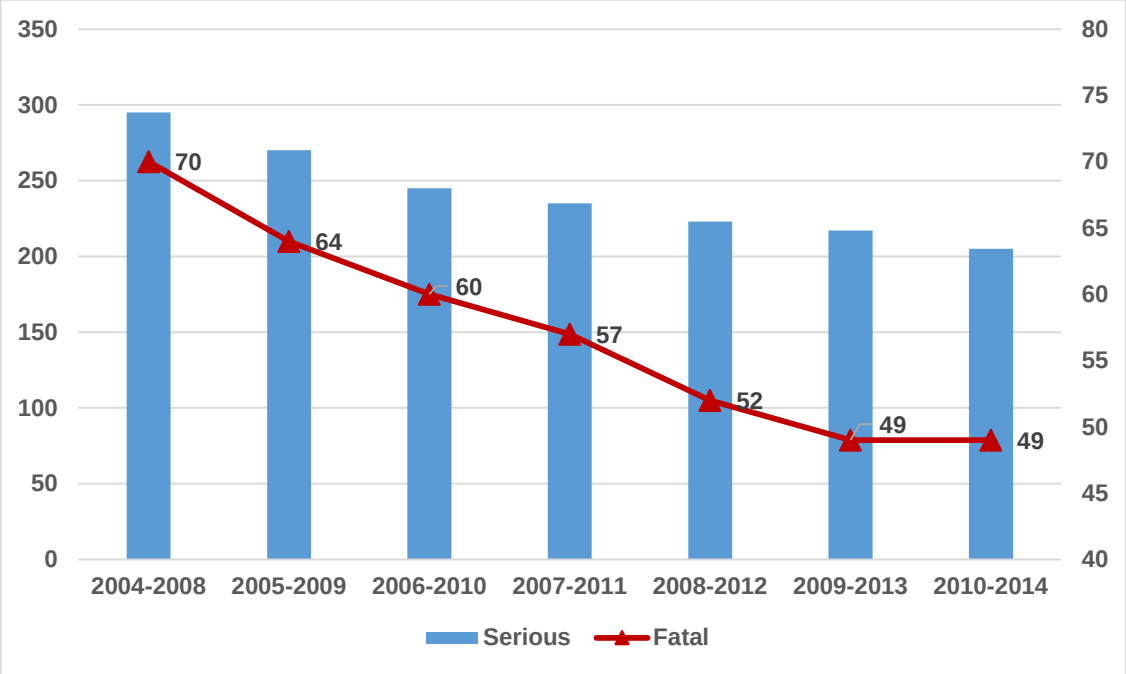


Table 1: Percentage Distribution of Crashes by County, 2010-2014

County	Total Crashes	Percent K + A
Shiawassee	13%	20%
Genesee	68%	59%
Lapeer	19%	21%
GLS Region V (Compare to Michigan)	5%	5%

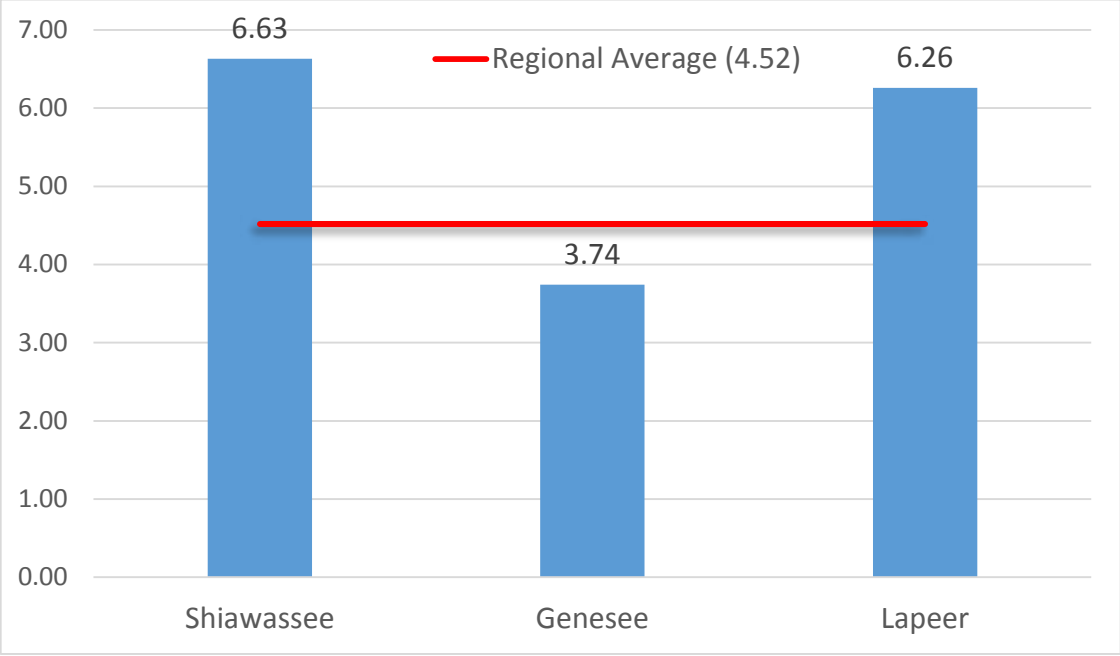
Table 2: Fatal and Serious Injury Crash Frequency by County, 2010-2014

County	2010	2011	2012	2013	2014
Shiawassee	49	58	49	56	40
Genesee	162	169	138	153	125
Lapeer	52	64	57	46	50
GLS Region V Total	263	291	244	255	215
Michigan Total	5665	5440	5410	5192	4851

Crash Rates

Crash rate is a measure of safety that takes into consideration crash frequency and traffic volume. Figure 6 illustrates the K and A combined rate by county per 100 million vehicle miles traveled. Crash rates are calculated based on Michigan's Highway Performance Management System (HPMS) traffic volume data. The red line indicates the GLS Region V average (4.52). The GLS Region V crash rate is lower than State of Michigan, which is 5.58.

Figure 6: Fatal and Serious Injury Crash Rate by County, 2010-2014



Chapter 3. Emphasis Areas

An emphasis area is an area of opportunity to improve safety through a comprehensive four E approach, where appropriate. The emphasis areas are consistent with trends identified by data analysis and the stakeholder working group.

Four E's of Safety:

1. **Education:**
   - Provide drivers with information about making good choices, such as not texting while driving, avoiding alcohol or medications affecting level of consciousness, wearing a seatbelt, or informing people about the rules of the road.
2. **Enforcement:**
   - Deter motorists from risky driving behavior with traffic laws and a visible police presence.
3. **Engineering:**
   - Address roadway infrastructure improvements to prevent crashes or reduce their severity when they occur.
4. **Emergency services:**
   - Provide rapid response and quality of care when responding to collisions causing injury by stabilizing victims and transporting them to other facilities.

Combining the efforts of multiple strategies, such as education and enforcement, can increase the likelihood of success when improving safety. Five high-priority emphasis areas were chosen for the plan, with each reflecting local issues identified by the stakeholder group and also to better utilize limited resources (financial, expertise, and time) available to put them into practice. Additional emphasis areas were also included in the plan to be consistent with the statewide funding structure.

Table 3: Emphasis Areas Crash Percent, 2010-2014*

Crashes by Involvement	Percent Crashes		Percent K+A	
	GLS Region V	Michigan	GLS Region V	Michigan
Intersection	30%	29%	30%	32%
Drivers age 24 and Younger	33%	33%	33%	34%
Lane Departure	22%	19%	42%	40%
Pedestrian	1%	1%	10%	10%
Alcohol	4%	3%	22%	19%
Senior Driver (65 and older)	15%	14%	16%	16%
Motorcycle	1%	1%	12%	12%
Drugs	1%	1%	8%	6%
Commercial Truck/ Bus	3%	4%	4%	6%
Bicycle	0%	1%	3%	3%

* Most crashes have multiple factors

High Priority Emphasis Areas

1) Intersection
2) Lane departure
3) Drivers age 24 and younger
4) Impaired driving
5) Pedestrian and bicycle safety

Additional Emphasis Areas

1) Commercial motor vehicle safety
2) Distracted driving
3) Motorcycle safety
4) Occupant protection
5) Senior mobility and safety (age 65 and older)
6) Speed management
7) Traffic incident management
8) Traffic records and information systems

Intersection

Intersections are planned points of conflict in any roadway system where people – whether in motor vehicles, commercial vehicles, walking, or biking – cross paths as they travel through or turn from one route to another. A major part of addressing road safety challenges involves intersections. Intersections make up an extremely small portion of the overall roadway network, yet over the past five years more than a quarter of traffic fatalities and serious injuries are attributed to these locations. Furthermore, congestion at intersections is an issue when traffic volumes are high, creating inefficiency that results in user delay and frustration. They are a focal point for both safety and operations.

Strategies to address intersection safety are diverse, with most using an engineering-based approach, including alternative geometric designs and the application of traffic control devices (such as signs, markings, and signals). Nationally, the FHWA states that, "one-quarter of traffic fatalities and roughly half of all traffic injuries are attributed to intersections." In Michigan, intersections are involved in nearly 29 percent of all traffic crashes, with 26 and 39 percent for fatal and injury crashes, respectively.

Key Findings

- More than a quarter of all fatalities in GLS Region V occur at an intersection
- Over 30 percent of all serious injury crashes in GLS Region V occur at intersections
- Genesee County has higher intersection-related crash numbers when compared to the region

Table 4: Percentage Distribution of Intersection Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-Injuries
Shiawassee	17%	24%	30%
Genesee	35%	27%	34%
Lapeer	18%	27%	25%
GLS Region V Average	30%	27%	31%
Michigan Average	29%	26%	33%

Table 5: Percentage Distribution of Intersection Crashes in the Region by Crash Type, 2010-2014

Crash Type	Crashes	Fatalities	A-Injuries
Single Vehicle	10%	22%	20%
Angle	37%	49%	48%
Rear-end	32%	8%	11%
Head-on Left Turn	8%	12%	12%
Head-on	1%	5%	4%
Sideswipe	9%	2%	2%
Other or Unknown	4%	3%	3%

Strategies

Develop a region-wide intersection inventory. Similar to roadway segments, limited roadway attribute data is available related to intersections. For the federal-aid system, data such as traffic volume, functional classification, and number of lanes is available within the FHWA HPMS. MDOT has some data related to the trunkline network. A regional intersection database should be developed to support more detailed analysis of intersection crashes utilizing MDOT's new statewide safety performance functions (SPF). Most of the data could be collected utilizing geographic information system mapping and online tools. The following is an initial list of data required for use in the new SPF, which should be considered for collection on a region-wide basis:

- Type of traffic control
- Presence of a median
- Presence and type of pedestrian signal
- Presence of lighting
- Posted speed limit
- Presence of no turn on red prohibitions
- Presence of a left-turn lane and presence of left-turn signal phase

Implement ranked and prioritized high-risk intersections. This plan, provides a ranking of signalized and unsignalized intersections with disproportionate numbers of crashes. These rankings are conducted utilizing the methods outlined in the American Association of State Highway Transportation Officials (AASHTO) Highway Safety Manual (HSM). These rankings also prioritize segments utilizing the excess expected crash performance measure. This performance measure identifies whether a site has a disproportionately high number of crashes. List of locations can be found in Appendix C. Agencies in GLS Region V should use those locations to make necessary safety improvements and this should be integrated into crash analysis and prioritization efforts.

Conduct road safety audits of high risk intersections. Segments demonstrating disproportionately high numbers of intersection crashes identified and prioritized in Appendix C are good potential candidates for road safety audits (RSA). A RSA is a formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team. MDOT currently conducts RSAs on trunklines as part of its Highway Safety Improvement Program (HSIP) project development efforts. Local agencies, county road commissions, and law enforcement across the GLS Region V should develop a process and funding strategy for conducting RSAs focused on intersections. This effort should be coordinated with similar strategies for lane departure and pedestrian/bicycle crashes.

Enhance the standard traffic signal layout. Several years ago, MDOT and local agencies worked together to apply the box configuration within its traffic signal designs through a systemic approach. The box configuration can be utilized either with span wire or mast arms. The box configuration replaced the use of diagonal configuration as a means to further enhance safety at signalized intersections across the state. It is suggested that the items listed below be considered for inclusion within the standard traffic signal layout utilized by MDOT and local agencies within GLS Region V.

- Add backplates with reflective yellow borders
- Provide an additional ground-mounted signal head in the far left corner of each approach for permissive turns
- Provide overhead street name signs
- Provide overhead street lighting
- Signal per lane for high speed (over 40 miles per hour [mph]) roads

Implement proactive signal optimization initiatives. The regular re-timing of traffic signals has been found to be an effective method to improve intersection safety and mobility. Agencies across GLS Region V should implement a variety of programs to regularly re-time and optimize their traffic signal networks. The Georgia Department of Transportation and local agencies have partnered to develop the Regional Traffic Operations Program (RTOP) and implemented an innovative signal optimization program that involves assigning dedicated corridor managers to actively manage signal timing. Agencies leverage their traffic operations center for this initiative. Another similar initiative is currently under way in Florida called active arterial management.

Implement intersection safety focused engineering countermeasures. Several engineering countermeasures examples to target intersection crashes that should be considered for initial or wider application across GLS Region V are listed below:

- Access management near intersections
- Enhanced traffic signal layout
- Far left-traffic signals
- Advance warning flashers
- Right-turn-on-red restrictions
- Advanced stop pavement marking lines
- Pedestrian countdown signals and signal timing for high pedestrians areas

Apply roundabouts at targeted locations. An MDOT research study indicated that single and dual lane roundabouts have reduced fatal and injury crashes by more than 60 percent when they replace a signal, and more than 75 percent when they replace a two-way stop controlled intersection. Since angle crashes are the most prevalent crash type in the region, road agencies should consider additional intersections for single and dual lane roundabouts. Roundabouts can provide lasting benefits and value in many ways. They are often safer, more efficient, less costly, and more aesthetically appealing than conventional intersection designs. Furthermore, roundabouts are an excellent choice to complement other transportation objectives – including Complete Streets, multimodal networks, and corridor access management – without compromising the ability to keep people and freight moving through our towns, cities, and regions, and across the nation. The FHWA Office of Safety identified roundabouts as a Proven Safety Countermeasure because of their ability to substantially reduce the types of crashes that result in injury or loss of life. Roundabouts are designed to improve safety for all users, including pedestrians and bicycles.

Conduct compact-roundabout pilots. A compact or mini-roundabout has many of the same benefits as a single lane roundabout including:

- Lowering speeds
- Reducing angle and left-turn head on crashes
- Ability to improve operations in many cases

Agencies in GLS Region V should consider piloting compact roundabouts at intersections involving collectors and minor arterials.

Implement innovative intersection designs. There are several alternative intersection designs that could help improve safety and congestion. Endorsed by the FHWA and largely implemented by MDOT, the following are examples for consideration:

- Displaced left-turn intersection
- Median U-turn intersection (highly utilized across Michigan)
- Restricted crossing U-turn intersection
- Quadrant roadway intersection

More information relating to these intersections is available in the *Alternative Intersections/ Interchanges: Information Report (AIIR)* by the FHWA.
http://www.fhwa.dot.gov/publications/research/safety/09060/

Evaluate the potential to utilize red light cameras. Red light cameras have been found to be an effective method of reducing angle crashes at signalized intersections. Research has shown that red light cameras can reduce fatal and injury crashes by 12 percent. In Michigan, photo enforcement is only authorized for use at highway rail grade crossings. A study should be conducted to determine the feasibility and identify potential impacts of authorizing the use of red light cameras in Michigan. While education and engineering solutions are important in preventing red light running, automated enforcement is another effective tool. The FHWA maintains a list of resources on red light cameras.

Develop intersection outreach materials for county and local officials. As many of the more effective intersection safety-focused countermeasures are not well-known by county and local officials, approvals for their implementation can face significant hurdles. An outreach program to highlight the issue of intersection safety on GLS Region V's roadways as well as effectiveness of proven countermeasures should be undertaken, including training programs for county and local agency officials. Because innovative intersections generally look or function differently from conventional designs, it is important for outreach and education to take place. These conversations begin by communicating the magnitude and importance of the intersection safety challenge. With roughly a quarter of all traffic fatalities in the United States associated with intersections, it is critical that safer designs are implemented as widely and routinely as possible. To help state and local road agencies advance innovative intersection designs, the FHWA produces materials intended to communicate their advantages and benefits to a variety of different audiences.

Lane Departure

Background

A lane departure or roadway departure crash is defined as a crash that occurs after a vehicle crosses an edge line, center line, or otherwise leaves the traveled way. While lane departure crashes represent a relatively modest proportion of all traffic crashes, they result in a greatly disproportionate percentage of fatal and serious injury crashes. Nationally, over 54 percent of all traffic fatalities are the result of lane departure crashes. Even though GLS Region V has a lower percent than nationally for lane departure fatalities at 42 percent, these crashes are frequently severe, and tend to be distributed across large areas of the network. As a result, the systemic approach to highway safety in many cases is an extremely effective approach to targeting lane departure.

Many factors contribute to lane departure crashes, including driver fatigue and drowsiness, distracted driving, poor traction between vehicles and road surfaces, and poor visibility in adverse weather conditions. These factors are sometimes compounded by excessive speeding. Alcohol and drug use can also contribute to both driver fatigue and speed.

Key Facts

- Over 42 percent of all fatalities in GLS Region V are the result of a lane departure crash
- More than 52 percent of all fatalities in Lapeer County involve a lane departure crash, which is a higher percentage than both the regional and statewide averages

Table 6: Percentage Distribution of Lane Departure Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	23%	48%	43%
Genesee	22%	38%	39%
Lapeer	22%	52%	51%
GLS Region V Average	22%	42%	42%
Michigan Average	19%	47%	38%

Strategies

Implement ranked and prioritized high-risk lane departure segments. This plan, provides a ranking of roadway segments with disproportionate numbers of lane departure crashes. These rankings are conducted utilizing the methods outlined in the American Association of State Highway Transportation Officials (AASHTO) *Highway Safety Manual* (HSM). These rankings also prioritize segments utilizing the excess expected crashes performance measure. This performance measure identifies whether a site has a disproportionately high number of crashes. List of locations can be found in Appendix C. Agencies in GLS Region V should use those locations to make necessary safety improvements and this should be integrated into crash analysis and prioritization efforts.

Conduct RSAs of high-risk segments. Segments with disproportionately high numbers of lane departure crashes identified in Appendix C are good potential candidates for RSAs. GCMPC

should work with local agencies across GLS Region V to develop a process and funding strategy for conducting RSAs on an annual basis focused on lane departure.

Promote and implement lane departure focused engineering countermeasures. Below are some examples of engineering countermeasures to target lane departure crashes, which should be considered for initial or wider application across GLS Region V. Promote and implement lane departure-focused engineering countermeasures, such as:

- **Shoulder and center line rumble strips** – MDOT advocates for the use of rumble strips on rural roads to improve safety. Recent research has shown that the use of rumble strips in Michigan is expected to "save 16 lives, and 62 serious injuries each year."
- **Provide adequate clear zone** – Providing adequate clear zone increases the chances of recover for vehicles that have departed from the pavement.
- **Safety edges on roadways** – Used to eliminate tire scrubbing, which causes vehicles to lose control when they contact the edge of a roadway. This is a low cost addition to pavement resurfacing projects with benefit-to-cost ratios on two lane roads ranging from 4 to 63.
- **High-friction surface treatments** – Most appropriate on high-speed horizontal curves.
- **Retroreflective pavement markings** – Helps to clearly define the roadway to prevent unforced roadway departures.
- **Fluorescent yellow sheeting on warning signs** – Under nighttime conditions, this improved sheeting will help the driver maintain visual acuity of roadway signs, especially when approaching roadway curves or other obstacles.
- **Curve delineation** – NHTSA estimates that 50 percent of single vehicle crashes on rural two-lane roads occur on curves. The use of post-mounted delineators and chevron signs on curves improves driver responsiveness and reduces the likelihood of lane departure incidents.
- **Partially paved shoulders** - Reduces crash severity if the driver leaves the roadway.

Develop and communicate lane departure outreach materials to county and local officials. An outreach program to highlight the issue of lane departure on GLS Region V's roadways as well as effectiveness of proven countermeasures for local and county officials.

Identify and resolve safety data issues. Work with the Michigan Crash Data Users Group in identifying and resolving any issues related to safety data.

Seek funding opportunities. Agencies are encouraged to collaborate with partners to identify and promote opportunities for funding to implement lane departure focused countermeasures. The Michigan Traffic Safety Engineering Action Team provides a strong partnership at the statewide level and could assist with identifying funding opportunities for identified projects. Other opportunities may exist between county and city partnerships to improve benefits to constituents.

Drivers Age 24 and Younger

Background

Traffic crashes are the number one cause of injury and death for teens, ages 15 to 20, accounting for more than one in three fatalities in this age group. While crash rates are highest for 16- year old drivers – the initial licensing (unsupervised driving) age in 34 states – drivers under the age of 20 have crash rates nearly four times higher than drivers age 65 and older. These statistics

are particularly troubling since teens represent approximately 15 percent of the United States population, but as drivers in crashes, they account for as much as 30 percent (approximately $26 billion) of the total cost of motor vehicle injuries nationwide. [1]

It is widely recognized that most novice drivers do not have sufficient experience to handle the complex task of driving when they are first licensed. Moreover, the late teen years involve continuing developmental changes that characterize the transition from childhood to adulthood. These changes result in a variety of behaviors that are risky when they occur in a motor vehicle. Young drivers are more likely than older adult drivers to engage in risky driving behaviors, such as speeding and allowing shorter headways. Although such behaviors are sometimes intentional, young driver crashes generally result from errors in attention, failing to recognize hazards, and driving too fast for conditions. Reducing young driver crashes will involve effectively addressing both the youthful propensity to engage in risky behaviors and lack of experience. The lack of seat belt use is another risky teen behavior contributing to the severity of crashes.

In 2014, drivers age 24 and younger constituted 14 percent of all licensed drivers in Michigan. However, over 35 percent of all incapacitating traffic injuries involved drivers age 24 and younger and over 30 percent of all traffic fatalities. On a statewide level, the GTSAC developed a statewide action plan to identify strategies to address this issue.

Key Facts

- Twenty-seven percent of GLS Region V fatalities are related to young drivers, which is slightly below the statewide average.
- Lapeer County has a slightly higher percentage of fatalities and serious injury crashes when compared to the region and state.

Table 7: Percentage Distribution of Young Drivers by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	29%	24%	37%
Genesee	34%	27%	31%
Lapeer	29%	30%	41%
GLS Region V Average	33%	27%	35%
Michigan Average	33%	30%	35%

Drivers Age 24 and Younger Countermeasures and Strategies

In 2011, MDOT commissioned the *Improving Driver Safety with Behavioral Countermeasures* study, where researchers examined five different emphasis areas, including younger drivers. Table 8 provides an overview of the countermeasures reviewed, along with grades for effectiveness, cost and implementation issues.

1 http://www.michigan.gov/documents/msp/DA24Y_Action_Plan_Update_May_2015_Final_526640_7.pdf

Table 8: Reviewed Countermeasures

Countermeasure	Effectiveness	Cost	Implementation Issues
Graduated Driver Licensing	High	Low	Low
Driver Education	Low	Medium	Medium
Parent Involvement	Medium	Low	Medium
Licensing Age	Medium	Low	Medium
Nighttime Driving Restrictions	High	Medium	Low
Passenger Driving Restrictions	High	Medium	Low
Seat Belt Laws and Youths	Medium	Low	Low
Cell Phone Use	Medium	Low	Low
Youth Programs	Medium	Medium	Low
School Education Programs	Low	Low	Medium

Implement or improve graduated driving licensing systems. The *Michigan SHSP - Drivers Age 24 and Younger Safety Action Plan* outlines a strategy for enhancing Michigan's graduated drivers licensing system. Strong graduated driver licensing (GDL) programs for new drivers are highly effective in reducing their crash risk. In Michigan, teen drivers under age 18 must complete two segments of driver education instruction and meet the requirements for three GDL levels:

- Level 1 restricts teens to only driving with a licensed parent/guardian or designated licensed adult age 21 or older
- Level 2 restricts the hours of operation between 10 p.m. and 5 a.m. and the number of passengers in the car to one, with some exceptions
- Level 3 is unrestricted

GDL requires young drivers to drive under supervision and also limits their exposure to hazardous situations until they gain necessary driving skills. Agencies in GLS Region V should support these statewide efforts.

Publicize, enforce, and adjudicate laws pertaining to young drivers. The Michigan Office of Highway Safety Planning (OHSP) and the Michigan Department of State (MDOS) are working on efforts to publicize, enforce, and adjudicate laws focused on young drivers. It is proposed that a working group be assembled that includes law enforcement, judicial, and other stakeholders to advance these efforts in GLS Region V. The focus of this group would be to publicize and promote laws pertaining to young drivers and encourage enforcement of laws pertaining to young drivers, including enforcement of GDL restrictions. It would coordinate these regional efforts with the GTSAC young driver safety action team.

Assist parents in managing teens driving. It is proposed that the working group suggested above champion statewide efforts in GLS Region V for assisting parents in managing teen driving. This would involve promoting the various publications and programs that have been developed by MDOS and OHSP as well as private sector groups such as AAA Michigan.

There is also an agreement available to parents for free through a grant to the University of Michigan Transportation Research Institute from the Centers for Disease Control and Prevention's National Injury Prevention and Control that is based on the latest teen driving safety research. This will help:

- Parents with facts about teen driving safety.
- Show parents what they can do to help their teens be safer drivers.
- Provide a free interactive Parent-Teen Driving Agreement that can be customized.

Improve young driver training. MDOS has taken the lead on efforts to improve driver training programs. The group should also promote the Michigan State Police (MSP) Teen Defensive Driving Training Course.

Employ school based strategies. The Michigan Department of Education has been working on efforts to promote a variety of school-based teen driving initiatives. This includes programs such as Strive for a Safer Drive (S4SD). The goal of S4SD is to put teens in the driver seat by providing applicants with grant money to create a traffic safety campaign. All schools participating in S4SD are eligible to attend a half-day, advanced driver training program focused on the following:

- Distracted and Impaired Driving
- Hazard Recognition
- Speed and Space Management
- Vehicle Handling

These efforts have been implemented in partnership with OHSP, student groups, such as the Michigan Association of Student Councils, and the private sector. The working group should champion these efforts in GLS Region V.

Conduct GLS Region V Social Media Campaigns. It is recommended that working groups suggested above work together to identify various partners, conduct social media campaigns to highlight the dangers of unsafe behavior, and spread awareness of available resources to parents and teen drivers.
http://www.prevent.org/data/files/transportation/pages%20from%20transportation%20and%20health_%20policy%20final%2007082011%20chapter%203.pdf

Impaired Driving

Impaired driving crashes are disproportionately more severe than other crashes, constituting 30 to 40 percent of all fatal crashes each year. Despite decades of efforts, impaired driving remains a devastating traffic safety and public health problem. Impaired driving is the greatest and most complex behavioral issue in Michigan traffic deaths.

Agencies in the GLS Region V are encouraged to implement a combination of prevention, enforcement, education, engineering, judicial, regulatory, and treatment countermeasures to combat impaired driving.[2]

Table 9: Percentage Distribution of Alcohol-Related Impaired Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	3%	16%	15%
Genesee	4%	29%	23%
Lapeer	4%	36%	18%
GLS Region V Average	4%	29%	20%
Michigan Average	3%	29%	17%

Table 10: Percentage Distribution of Drug-Related Impaired Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	0.6%	16%	1%
Genesee	0.9%	18%	7%
Lapeer	1.0%	30%	6%
GLS Region V Average	0.9%	20%	5%
Michigan Average	0.7%	15%	4%

The drop in the driving under the influence (DUI) fatality rate is a public health success story that can be built upon by extending the use of ignition interlocks, working to legalize sobriety checkpoints in Michigan, maintaining and increasing enforcement of the national minimum drinking age at 21, and strengthening zero-tolerance laws for young drivers. Checkpoints are not allowed in MI, but should be evaluated for their effectiveness and be considered.

In GLS Region V, impaired driving fatalities involving drugs exceed the statewide average in all counties. Impaired driving crashes involving alcohol exceeds the statewide average in Lapeer County. Lapeer County exhibits nearly twice the statewide average in fatalities involving impaired driving with drugs.

As part of the Michigan SHSP, the statewide Michigan Impaired Driving Action Plan was developed. Agencies should seek support of these statewide efforts.

Use of saturation patrols. Since sobriety checkpoints are not allowed, using saturation or roving patrols is recommended to help deter drunk driving. This style of patrolling consists of concentrating officers at known places for drunk driving during set times when the risks associated with impaired driving are the greatest. Publicity often accompanies these patrols and has been shown to reduce alcohol-related fatal crashes when combined with these patrolling efforts.

Promote officer training programs. Training officers to recognize impaired drivers, under the influence of either alcohol or drugs, is critical to reducing impaired driving. The MSP offer a multi-tiered impaired driver detection training course that includes: Drug Recognition Expert

2 http://www.michigan.gov/documents/msp/Impaired_Driving_Action_Plan_Reviewed_10-14-ksf_437300_7.pdf

(DRE), Advanced Roadside Impaired Driving Enforcement (ARIDE), and Standardized Field Sobriety Testing (SFST) programs. These courses include a mix of lecture, hands-on instruction, and field training. Local agencies in the GLS Region V should encourage their police departments to attend this training and increase the amount of DRE certified officers, and refresh their knowledge of the latest ARIDE and SFST techniques.

Public education and outreach. Due to the increased fatality rate among younger drivers, an effective education program through traditional outlets such as schools and news media provides a foundation for a paradigm shift among the youth. To that end, the use of social media to display public service announcements and advertisements can help target young drivers where they view content the most. Depending on the community, using billboards and posters may also help to supplement media campaigns and further reinforce the message. Communication and outreach is critical in helping prevent impaired driving before it begins.

Partner with national programs. There are several organizations promoting positive messages against drunk driving that should be partnered with on a local level across the GLS Region V:

- **Students Against Destructive Decisions (SADD)** – the goal of SADD is to educate students through, "scientific-based, peer-to-peer educational trainings, programs and events, awareness campaigns, and leadership development opportunities."[3]
- **Mothers Against Drunk Driving (MADD)** – the mission of MADD is, "to end drunk driving, help fight drugged driving, support the victims of these violent crimes, and prevent underage drinking."[4]
- **SafeRide America** – this organization has two goals to eliminate the two main excuses people use to drive impaired: not wanting to leave their car behind and not having money to pay to get their car home.

Agencies in the GLS Region V should contact these agencies to develop local programs furthering their messages and using their network for supporting educational programs and outreach.

Designated driver programs. Incentivizing the use of designated drivers by partnering with local drinking establishments to give groups designating a driver benefits, such as a free soft drinks or food for the designated driver. Partnering in this manner provides a more formal approach to a typically informal concept. Further reinforcing these programs with a local publicity campaign will help increase participation in the program and provide incentives for businesses to participate.

Support transit and ridesharing efforts. A new report completed by MADD and Uber indicated that, in California, a significant reduction in drunk driving crashes occurred following the introduction of ridesharing services. According to MADD a survey of attitudes about ridesharing services and their role in combating drunk driving, nearly 4 in 5 (78 percent) respondents said friends are less likely to drive home after drinking once ridesharing services like Uber and Lyft started operating in their city. In addition, 93 percent would recommend ridesharing as a safer

3 http://www.sadd.org/who-we-are/
http://www.madd.org/about-us/
http://saferideamerica.org/mission/

4 http://www.madd.org/media-center/press-releases/2015/new-report-from-madd-uber.html?referrer=https://www.google.com/

way home to a friend who had been drinking.[3] Agencies in GLS Region V should promote ridesharing, including use of carpooling and vanpooling, as a reliable alternative to impaired driving. Additionally, agencies should ensure their ridesharing ordinances take into consideration this benefit.

Identify and prioritize high-risk locations. Agencies in GLS Region V should identify high-risk impaired driving locations using safety data, and implement programs that use a multidisciplinary approach including education, enforcement, and engineering such as:

- Develop public information and education campaigns
- Explore innovative countermeasures for high-risk impaired driving locations
- Provide recommendations related to impaired driving legislation

Local agencies should work with law enforcement to conduct an enforcement and educational safety blitz at high-risk impaired driving locations.

Ignition interlocks program. Promote efforts to increase sobriety courts and the use of ignition interlocks.

Pedestrian and Bicycle Safety

Pedestrians—people who travel by foot, wheelchair, stroller, or similar means—are among the most vulnerable road users. As pedestrians, children are at even greater risk of injury or death from traffic crashes due to their small size, inability to judge distances and speeds, and lack of experience with traffic rules (http://www.cdc.gov/features/pedestriansafety/).

The issue of analyzing pedestrian and bicycle crashes is also more complicated as they tend to be more distributed across the transportation network. As a result, systemic and risk-based analysis methods are more effective in identifying where to specifically apply engineering focused pedestrian and bicycle safety improvements.

http://www.michigan.gov/documents/msp/Ped_Bike_Action_Plan_September_2013_Reviewed_09232013_CK_440777_7.pdf

Some of the key performance measures related to pedestrian and bicycle safety are listed below.

- For GLS Region V, the percentage of pedestrian fatalities exceeds the statewide average.
- Genesee County has the highest percentage of pedestrian fatal and serious injury crashes.
- Bicycle crashes in GLS Region V are lower than the statewide average.

Table 11: Percentage Distribution of Pedestrian Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	1%	0%	6%
Genesee	1%	26%	11%
Lapeer	0%	9%	4%
GLS Region V Average	1%	20%	8%
Michigan Average	1%	16%	8%

Table 12: Percentage Distribution of Bicycle by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	0.5%	12.0%	4.0%
Genesee	0.4%	1.7%	3.0%
Lapeer	0.2%	2.3%	0.9%
GLS Region V Average	0.4%	2.9%	2.7%
Michigan Average	0.7%	2.9%	3.5%

Following are several pedestrian and bicycle safety strategies suggested for implementation in GLS Region V.

The Michigan SHSP – Pedestrian/Bicycle Safety Action Team developed a statewide plan to target the engineering, enforcement, education, and emergency medical service (EMS) issues associated with pedestrian and bicycle safety. Agencies should seek support of these statewide efforts.

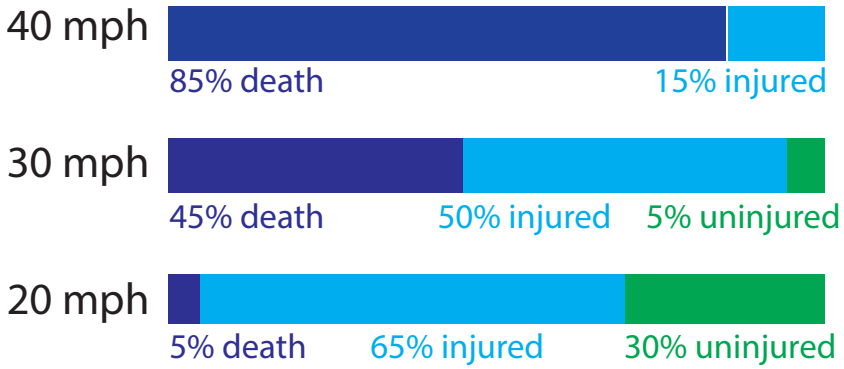
Implement pedestrian and bicycle focused countermeasures. Below are several examples for engineering countermeasures to target pedestrian and bicycle crashes that should be considered for initial or wider application across GLS Region V.

- Sidewalks or separated walkways and paths
- Landscaped buffers for high traffic volume and high-speed roads
- Pedestrian countdown signals
- Medians
- Rectangular rapid-flashing beacons accompanied by marked crosswalks
- Pedestrian crossing treatments at appropriate locations
- Road diet

Traffic calming. Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users. Traffic calming is typically implemented on low volume roads and is extremely effective in reducing frequency and severity of pedestrian and bicycle crashes due to its ability to reduce speeds. Examples of commonly used traffic calming treatments include single lane roundabouts, traffic circles, and getaway treatments near high-pedestrian and bicycle activity areas. Agencies on a county basis should work together to develop a region-wide process on where, when, why, and how to implement traffic calming.

The speed of a vehicle is a major determinant in the severity of a crash. Figure 6 shows that a pedestrian hit at 40 miles per hour has an 85 percent chance of fatality, while a pedestrian hit at 20 miles per hour has only a 5 percent chance of fatality (U.K.DOT, 1987). Injuries do still result from moderate and lower-speed crashes even though the proportion of fatalities resulting from crashes goes down as the vehicle speed decreases.

Figure 7: Pedestrian Injuries at Impact Speeds



Signs and pavement markings. Signs and pavement markings are used to educate drivers about their surroundings. Examples include the school advance warning sign, school speed zone and flashing speed zone signs, flashing yellow warning signals, in-street YIELD TO PEDS signs (placed mid-crosswalk), and driver speed feedback signs.

- Parking prohibitions near intersections and crosswalks: Parked cars decrease visibility for both pedestrians and motorists. Removing them from areas where there are high pedestrian activities that would likely cross or come into conflict with vehicles can improve safety for all users.
- High-visibility marked crosswalks: Marked crosswalks are used to indicate a preferred pedestrian crossing location and also to alert drivers to an often-used pedestrian crossing. However, marked pedestrian crosswalks, in and of themselves, do not slow traffic or reduce pedestrian crashes.

Targeted enforcement for all road users. Targeted enforcement near high pedestrian areas such as downtown, schools, universities, and community colleges may be helpful to improve driver behavior such as speeding and not yielding to pedestrian in crosswalks. Targeted enforcement may also help improve non-motorized behaviors, such as distracted, jay walking, and not following traffic laws.

Evaluate potential use of automated speed and red light cameras. Automated speed and red light cameras could be helpful near high pedestrian activity areas and school zones.

Public education campaigns. Along with pedestrian and bicycle safety infrastructure, public education is needed for safety improvements to be successful. Community members, citizens, parents, and drivers all need to be educated on the safety of all road users and rules of the road. It is proposed that this public education campaigns be conducted on high pedestrian and bicycle crash locations between local agencies, community leaders, enforcement, and MDOT.

Promote Safer Routes to School (SRTS) Programs. Many communities and schools in Michigan are using SRTS Programs to work toward making walking and bicycling a safe and appealing ways for children to get to school. Agencies and school districts should collaborate with Michigan Fitness Foundation (MFF) to promote and implement the SRTS program.

Promote other pedestrian and bicycle safety programs. Agencies should collaborate and work together to implement non-motorized safety focused initiatives such as:

- AAA School Safety Patrol
- Bicycle rodeo: a bike rodeo is usually a bicycle safety clinic featuring bike safety inspections and a safety lecture about the rules of the road, followed by a ride to show where and how to apply the rules.
- Walking school buses in partnership with MFF

Implement ranked and prioritized pedestrian and bicycle crash locations and conduct pedestrian and bicycle RSAs. Locations identified in this safety plan as exhibiting a high risk for pedestrian and bicycle crashes are good potential candidates for RSAs. Also, the GLS Region V should determine focus communities, cities, and agencies for priority assistance.

Information exchange. Agencies in the GLS Region V should work together to recognize successful pedestrian and bicycle safety initiatives and promote the use of those best practices when designing and operating pedestrian and bicycle facilities.

Chapter 4. Additional Emphasis Areas

In addition to the high priority emphasis areas, there are other emphasis areas including:

- Commercial vehicle safety
- Distracted driving
- Motorcycle safety
- Occupant protection
- Senior mobility and safety (age 65 and older)
- Speed management
- Traffic incident management
- Traffic records and information systems

Commercial Motor Vehicle Safety

In 1988, the Michigan Legislature enacted legislation creating the Michigan Truck Safety Commission (MTSC). The MTSC is responsible for oversight of truck safety funds to conduct truck driver safety education programs; encouraging, coordinating, and administering grants for research and demonstration projects in truck driver safety education; and conduct special enforcement programs within the MSP Commercial Vehicle Enforcement Division. The MTSC produces the Michigan Truck Strategic Plan, which was developed as part of the Michigan SHSP. The Michigan Truck Strategic Plan identifies common factors for the cause and severity of commercial vehicle crashes and outlines a variety of engineering, enforcement, and education strategies focused on improving truck safety. Agencies should seek support for these statewide efforts to generate funding within their jurisdiction. Local agencies should rely on the Michigan Truck Strategic Plan and other resources provided by the MTSC to utilize local crash analysis and provide effective strategy identification to address region specific commercial vehicle safety concerns.

https://www.michigan.gov/documents/msp/CMV_Strategies_Update_2013_Final_Report_441394_7.pdf

Key Facts

- Genesee County has the highest fatality percentage in the region.
- The region performs slightly better than statewide averages for all three categories reported.

Further study should be conducted to identify concentrations of crashes by time of day, number of vehicles involved, high incident locations, and other characteristics that can be used to target strategies.

Table 13: Percentage Distribution of Commercial Motor Vehicle Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	3.1%	8.0%	2.6%
Genesee	3.5%	9.7%	3.9%
Lapeer	2.8%	6.8%	3.1%
GLS Region V Average	3.3%	9.0%	3.4%
Michigan Average	3.8%	9.6%	4.9%

Strategies

Education and enforcement are the most commonly identified countermeasures suggested for commercial motor vehicles (CMV). Research has been conducted for many years in Michigan, where several strategies have been recently recommended in the *Strategies to Reduce CMV-Involved Crashes, Fatalities, and Injuries in Michigan* report as follows:

- Improve maintenance of CMVs
- Deployment of truck safety technologies
- Encourage the use of advanced safety technologies
- Increase knowledge on how CMVs and cars can share the road
- Strengthen commercial driver license program, education and outreach to truck drivers
- Improve crash data

Commissioned by the OHSP and conducted by the University of Michigan Transportation Research Institute, the report provides explanations and assessments associated with the implementation of these countermeasures, along with recommendations for areas requiring further investigation. Agencies in the GLS Region V are encouraged to review this report for any opportunities relating to their local communities.

Provide designated CMV parking areas. CMV drivers typically have difficulty finding adequate parking for rest periods required by law, and as a result are forced to park in unsafe areas or not rest at all. The federal government has recently increased funding for truck parking, with the recent passing of Jason's Law and other initiatives provided in the MAP-21 legislation. Agencies are encouraged to identify heavy CMV routes and seek funding from public and private sources to develop additional parking.

Additional strategies for considerations for CMVs:

- Improve CMV driver performance through education and enforcement
- Increase motorist awareness of safe driving near CMVs
- Educate and inform about the dangers of fatigue related and distracted driving crashes
- Address site-specific infrastructure and operations concerns
- Mandate maintenance programs and improve fleet safety management

Distracted Driving

The NHTSA reports that 10 percent of fatal crashes, 18 percent of injury crashes, and 16 percent of all police-reported traffic crashes in 2013 were distraction-affected crashes. The true influence of distraction in crashes is generally considered as underreported since pre-crash distractions often leave no evidence to observe. This is confounded by the fact that drivers are typically reluctant to admit distraction as the cause for a crash.

Distracted driving is any activity that diverts a person's attention away from the primary task of driving, thereby endangering driver, passenger, and bystander safety. Distractions typically include to the following actions while driving:

- Texting
- Cell phone or smartphone use
- Eating or drinking
- Talking to passengers
- Grooming
- Reading, including maps
- Using a navigation system
- Watching a video
- Adjusting a radio, CD player, or MP3 player

However, since text messaging requires visual, manual, and cognitive attention from the driver, it is by far the most alarming distraction. Five seconds is the average time eyes are taken off the road while texting. When traveling at 55 mph, that is enough time to cover the length of a football field blindfolded. http://www.distraction.gov/stats-research-laws/facts-and-statistics.html

http://www.distraction.gov/downloads/pdfs/812053-UnderstandingEffectsDistractedDrivingReportToCongress.pdf

Strategies

Law enforcement education and training. Training for police officers to identify distracted drivers is critical to the enforcement of laws. According to GTSAC's Distracted Driving Action Team, as of early 2013, Michigan was one of 39 states to ban text messaging for all drivers. Michigan also prohibits cell phone use for newly licensed drivers, which includes those with a Level 1 or Level 2 license.

Conduct effective communication and outreach activities. Michigan already has laws in place aimed at reducing distracted driving, namely Kelsey's Law, and a text messaging ban. Publicizing these laws, working with law enforcement agencies to enforce strong laws, and conducting high visibility text messaging enforcement campaigns across the GLS Region V on a local basis will remind drivers of the seriousness of the issue. To that end, a few activities were developed to reinforce the message to younger drivers:

- Inviting high school students to create billboard designs aimed at delivering the message to drivers (part of a statewide campaign). Agencies in the GLS Region V can apply this model by partnering with schools in their jurisdiction.

- The Kids Driving Responsibly Challenge is a campaign that "focuses on the youth in Michigan, educating them on the dangers of using a cell phone while driving."
- The Remembering Ally: Distracted Driving Awareness Campaign promotes safe, non-distracted driving through resources such as posters, public service announcements, and a simulated distracted driving crash video.

Implement low-cost engineering countermeasures. Currently, the Action Team recommends roadway alarm systems to alert distracted drivers (in the form of rumble strips) and removal of roadside obstacles (improved clear zone) to reduce the severity of accidents involving distracted drivers. MDOT is researching other countermeasures, including intersection warning systems and transversely mounted rumble strips in advance of stop signs at intersections. Many of the previously cited lane departure countermeasures are useful for distracted driving as well.

Motorcycle Safety

Per vehicle miles traveled, motorcyclists are more than 30 times more likely than passenger car occupants to die in a motor vehicle crash. This is because motorcyclists face risks not encountered when driving cars and trucks. When a crash occurs, motorcycle riders are much more vulnerable than passengers of other vehicles and lack the protection available in an automobile. Further, alcohol impairment and excessive speed are major contributing factors to the occurrence of motorcycle crashes and compound the serious nature of these crashes. Lack of proper licensing and training are often cited as areas of major concern with motorcyclists.

http://www.michigan.gov/documents/msp/MC_Safety_Action_Plan_12-01-2014_478724_7.pdf

Key Facts

- Lapeer County has a higher percentage of fatalities and serious injuries compared to the region and statewide averages.
- The number of fatalities and serious injuries is disproportionate to total crashes when compared to other emphasis areas.
- Over 48 percent of motorcycle fatalities in the region involved the use of drugs or alcohol.

Table 14: Percentage Distribution of Motorcycle Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	1.1%	12%	12%
Genesee	1.2%	11%	12%
Lapeer	1.2%	16%	15%
GLS Region V Average	1.2%	12%	13%
Michigan Average	1.1%	14%	12%

Strategies

Agencies should seek support of the efforts within the Michigan Motorcycle Safety Action Plan.

In addition, GLS Region V can use safety marketing campaigns to promote and encourage motorcyclist safety through training, wearing protective high-visibility gear, and proper helmet use.

Agencies should work with EMS in providing education that specifically addresses the trauma caused by motorcycle crashes to provide better on-scene care.

Also, agencies in GLS Region V should work together to:

- Support and create public information and education campaigns to raise awareness for motorcycle safety.
- Improve roadway design and maintenance of roadways to better accommodate motorcyclists.
- Provide recommendations related to motorcycle safety legislation.

http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/4640-report2.pdf

Occupant Protection

Car crashes are one of the leading causes of death for children ages 1 to 13 years old. Under many circumstances deaths and injuries can be prevented by proper use of car seats, boosters, and seat belts. Wearing a seat belt is the single best way any motorist or occupant can protect himself or herself in a crash; yet in 2013, 229 unrestrained occupants were killed or seriously injured in crashes in Michigan. If those occupants had chosen to wear a seat belt, they would have increased their chance of survival by 45 percent. Further, proper use of car seats reduced the risk of death by 71 percent for infants, and by 54 percent for children ages one to four.
http://www.trafficsafetymarketing.gov/cps

Michigan's primary seat belt law has led to a consistent seat belt use rate well over 90 percent for drivers and front seat passengers. This statistic is unknown for back seat passengers. In 2013, 25 unrestrained back seat passengers were killed, with 12 of those people being ejected from the vehicle.

Children in Michigan are required by law to be properly restrained in a car seat or booster seat until they are eight years old or 4'9". However, statistics show that less than 50 percent of children ages four to seven years old are riding in booster seats. The vast majority of children from birth to three years old are riding in car seats, yet the misuse of car seats due to improper installation occurs more than 70 percent of the time.

http://www.michigan.gov/documents/msp/Occupant_Protection_Action_Plan_Final_10-31_JH_439418_7.pdf

Strategies

To address this issue on a statewide basis, the Michigan Occupant Protection Action Plan was developed as part of the Michigan SHSP. This plan outlines engineering, education, enforcement, and EMS strategies to increase the education and use of restraints such as seat belts, car seats, or boosters, and installation of proper car seat. Agencies in GLS Region V should seek support and champion these statewide efforts in GLS Region V.

Senior Mobility and Safety (Ages 65 and Older)

Currently, every county in Michigan has some form of senior transportation service, which typically includes public transit providers, specialized service agencies, or volunteer driver services. The focus of these operations is keeping Michigan's aging population mobile and active in their respective communities. There also are a number of very innovative programs across the state demonstrating daily that senior transportation can be successfully delivered.

In 2014, there were 1.3 million older licensed drivers (age 65 and older) in Michigan, representing over 19 percent of all licensed Michigan drivers. The number of older licensed drivers in Michigan has increased by 29 percent over the past 10 years, while the total number of Michigan drivers has decreased by 1.2 percent. The number of licensed drivers over 65 is expected to continue this trend, with increases expected for the next two decades. This growth contributes to the high-priority classification of this emphasis area.

Key Facts

- Lapeer County has a slightly higher percentage of fatalities when compared to region and statewide averages.
- For the region, 20 percent of all fatal senior driver crashes involved the use of alcohol or drugs.

http://www.michigan.gov/documents/msp/Action_Plan-SMWG-7-15-15-final_495134_7.pdf

Table 15: Percentage Distribution of Senior Driver Crashes by County, 2010-2014

Location	Crashes	Fatalities	A-injuries
Shiawassee	13%	16%	16%
Genesee	16%	22%	15%
Lapeer	12%	23%	16%
GLS Region V Average	15%	21%	15%
Michigan Average	14%	22%	15%

Strategies

- Identify and encourage senior-friendly transportation options in GLS Region V and communicate or make aware of those options to a wider audience.
- Partner with local community leaders to plan for an aging population dependent on mobility and transportation.
- Enhance senior mobility by improving communication and coordination among partners at the state, regional, and local levels by using the following strategies:
  - Schedule regular meetings among transportation partners to share issues and successes with each program. These meetings will encourage conversation between stakeholders and improve the efficiency of their programs.
  - Designate a single agency, such as county, sheriff, or road commission, in charge of coordinating these meetings and championing senior driver mobility
  - Hold regular information sessions with senior drivers to explain what programs are available to them and gain feedback from the community
  - Survey the drivers and workers of these services to see if any opportunities for improvement exist within the existing funding and organizational structure
- Support and champion statewide efforts to promote strategies to reduce the rate and severity of senior driver crashes in GLS Region V.
- Support the Safe Drivers Smart Options Strategy at www.Michigan.gov/agingdriver
- Promote senior driver focused engineering countermeasures from MDOT's 2015 study.
- https://www.michigan.gov/documents/mdot/MDOT_Research_Report_RC1561_372531_7.pdf
- Promote the design and operation of Michigan roadways with features that better accommodate the special needs of older drivers and pedestrians.
- Promote engineering infrastructure strategies from the FHWA handbook for designing roadways for the aging population. http://safety.fhwa.dot.gov/older_users/handbook/
- Develop and/or enhance existing programs to identify older drivers at increased risk of crashing and take appropriate action.

Speed Management

Speeding is defined as traveling too fast for conditions or in excess of the posted speed limits, and is a factor in almost one-third of all fatal crashes. The determination of whether speeding was involved in a fatal crash is often based on the judgment of the investigating law enforcement officer. Speeding is a highly complex issue, involving public attitudes, road user behavior, vehicle performance, roadway design and characteristics, posted speed limits, and enforcement strategies. Speed management is a comprehensive approach using engineering, enforcement, and education to reduce speeding-related crashes, fatalities, and injuries.
http://www-nrd.nhtsa.dot.gov/Pubs/812162.pdf

Speed management involves a balanced effort:

- Defining the relationship between speed, speeding, and safety
- Applying road design and engineering measures to obtain appropriate speeds
- Setting speed limits that are safe and reasonable
- Applying enforcement efforts and appropriate technology that effectively targets crash producing speeders and deters speeding
- Effectively marketing communication and educational messages that focus on high-risk drivers
- Soliciting the cooperation, support, and leadership of traffic safety stakeholders

Effective solutions must be applied locally even though speeding can be considered a national problem. The speed-related fatality rate per vehicle mile traveled is highest on local and collector roads where the lowest speed limits are posted.

Figure 8: Vehicle Speed and Stopping Sight Distance

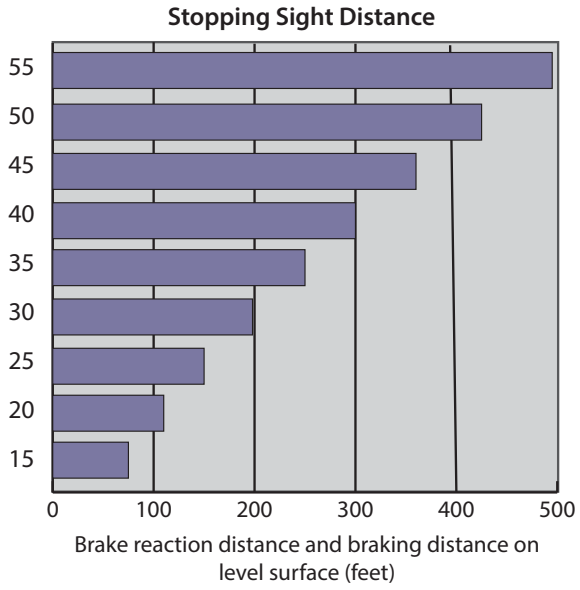


Figure 8 shows the relationship between motor vehicle speed and braking distance when traveling on a level surface [AASHTO, 2001]. Slower motor vehicle speeds allow drivers to stop in a shorter distance and reduce the chance of injuring other drivers, pedestrians, or bicyclists.

Strategies

Speed enforcement cameras. Evaluate the potential to use automated speed enforcement cameras where appropriate. It is an important strategy for reducing excess speed when used as an adjunct to traditional enforcement methods and engineering approaches. Automated enforcement is intended to augment – not replace – traditional traffic enforcement activities and addresses the public perception of the risk of "getting caught." Research has shown that automated speed enforcement can reduce fatal and injury crashes by 20 to 25 percent at conspicuous camera locations. Presently in Michigan, photo enforcement is only authorized for use at highway rail grade crossings. As a result, a change to the Michigan Vehicle Code would be required to utilize this approach. A study should be conducted to determine the feasibility and identify potential impacts of authorizing the use of automated speed enforcement in Michigan.

Traffic calming. Use of traffic calming methods can also reduce speed, increase safety and is particularly effective in reducing risk for vulnerable road users.

Traffic Incident Management

Traffic incident management (TIM) is the planned and coordinated multi-disciplinary process used to detect, respond, and clear traffic incidents as quickly as possible while protecting the safety of on-scene responders and the traveling public. The three shared objectives for TIM according to the National Unified Goal (NUG) are:

- Responder Safety
- Safe, Quick Clearance
- Prompt, Reliable, Interoperable Communication

An incident is defined as any non-recurring event that causes a reduction in roadway capacity. Such events include, but are not limited to, traffic crashes, disabled vehicles, spilled cargo, floods, and other unplanned natural or man-made events. The most common problem associated with highway incidents is traveler delay, but the most serious problem is the risk of secondary crashes. Many times a secondary crash is more severe than the primary crash. A side effect of all incidents is the danger posed to responding personnel at the scene.

http://www.michigan.gov/documents/msp/Traffic_Incident_Management_Action_Plan_Final_Reviewed_09272013_CK_476986_7.pdf

Strategies

Agencies in GLS Region V should work together on

- Promoting Michigan Traffic Incident Management Effort (Mi-TIME) training - Mi-TIME is a partnership between agencies, including the MDOT, state and local law enforcement, fire, EMS, and towing services, to work together to safely and efficiently clear traffic incidents from Michigan's highways. Mi-TIME responder training provides the responder community with TIM standards and good practices with the overall purpose of enhancing quick clearance efforts and improving responder and motorist safety.
- Promoting and educating the use of high-visibility apparel for first responders (including law enforcement, fire, EMS, towing, transportation and media personnel). The *Michigan Manual of Uniform Traffic Control Devices* Section 6D.03 Standard states all workers, including emergency responders, within the right-of-way who are exposed to traffic SHALL wear high-visibility safety apparel that meets ANSI performance class 2 or 3.
- Coordinating traffic incident response among all responders.
- Promoting public education of safe, quick clearance and Steer It Clear It & Move Over laws - quick clearance of incidents is an effective strategy to reduce the risk of secondary crashes.

Traffic Records and Information Systems

Good traffic records, which include databases on crashes, traffic volume, and roadway attributes, are the foundation to implement most of the previously listed strategies. Over the past decade, Michigan's traffic crash database has been significantly enhanced and has become one of the most

accessible and reliable systems in the country. With the Internet access to data from the HPMS, agencies have easy access to traffic volume and roadway attribute data for the federal aid road network. As a result, agencies have a much easier time accessing crash data than their peers in many other states.

Strategies

Following is a list of data enhancements as well as innovative data analytics solutions that will enhance the ability to effectively identify and address safety issues. To cost-effectively implement many of these solutions will involve collaboration between multiple agencies.

Maintenance of the traffic volume database for non-federal aid roads. Agencies in GLS Region V should collaborate on an effort to collect and maintain a non-federal aid traffic count database.

Speed data. Vehicle probe data now has the ability to calculate 85th percentile and mean speeds on roadway segments. As a result, it is now possible to access current and historical speed profiles of large portions of the roadway network. As speed is a primary indicator of the severity of traffic crashes, agencies in GLS Region V should collaborate on an effort to purchase access to this speed data. It will allow agencies to make more informed traffic safety decisions.

Pedestrian and bicycle data. Pedestrian and bicycle volume data will help agencies to more effectively identify improvements targeted at vulnerable road users. Local agencies in GLS Region V should collaborate to develop a strategy for collecting and analyzing this type of data.

Roadway attributes. Applying data analytic tools, such as the AASHTO HSM, requires significant amounts of roadway attribute data to accurately predict the number of crashes at intersections and along segments. To advance efforts to deploy and utilize the HSM for the GLS Region V, it is proposed that a task force or working stakeholder group be initiated to identify the data needs to effectively apply the HSM as well as strategies to efficiently and cost-effectively collect and maintain the database.

Chapter 5. Systemic and Spot Location Crash Analysis

GLS Region V adopted a TZD vision and, while all locations of a roadway network are important, there is a need to prioritize locations. In order to reduce fatalities and serious injuries, using advanced tools helps to assist local agencies in using quantitative measurements of safety during their planning and project development decision-making processes.

The HSM provides fact-based information and is used to facilitate roadway planning, design, operations, and maintenance decisions based on precise consideration of their safety consequences. The analysis conducted for this safety plan considers fatal and injury crashes. The following maps show the locations in GLS Region V where the implementation of engineering-focused countermeasures will result in great reductions in crashes.

Deficiency Ranking

Deficiency ranking is derived from excess expected crash frequency, and shows locations that would benefit from spot treatments. Only fatal and serious injury crashes were considered for this analysis. The excess crash threshold for each ranking is as follows:

- Low: 1 to 3 crashes per year
- Medium: 3 to 5 crashes per year
- High: 5 crashes per year

Definition from HSM (4-12)

Excess Expected Average Crash Frequency Using Safety Performance Functions (SPF)

A safety performance function (SPF) is an equation used to predict the average number of crashes per year at a location as a function of exposure and, in some cases, roadway or intersection characteristics. SPFs are used to predict crash frequency for a given set of site conditions. The site's observed average crash frequency is compared to a predicted average crash frequency from an SPF. The difference between the observed and predicted crash frequencies is the excess predicted crash frequency using SPFs. When the excess predicted average crash frequency is greater than zero, a site experiences more crashes than predicted. When the excess expected average crash frequency value is less than zero, a site experiences fewer crashes than predicted.

Level of Service Safety

Level of service safety (LOSS) provides a data driven approach to evaluating segments that would benefit from systemic safety improvements. LOSS is a statistical method where categories are developed based on their deviation away from 'normal.' Four categories are used for assessment. The average yearly crash number for each segment is compared to these deviations to assign a LOSS rating (I to IV). Segments with a high rating (III or IV) are performing poorly compared to similar segment types. These locations may not necessarily have a high deficiency ranking; however, they would benefit from systemic treatments to improve their relative performance.

LOSS Ranking

Sites are ranked according to a qualitative assessment in which the observed crash count is compared to a predicted average crash frequency for the reference population under consideration (1,4,5). Each site is placed into one of four LOSS classifications depending on the degree to which the observed average crash frequency is different than predicted average crash frequency. The predicted average crash frequency of sites with similar characteristics is predicted from an SPF calibrated to local conditions.

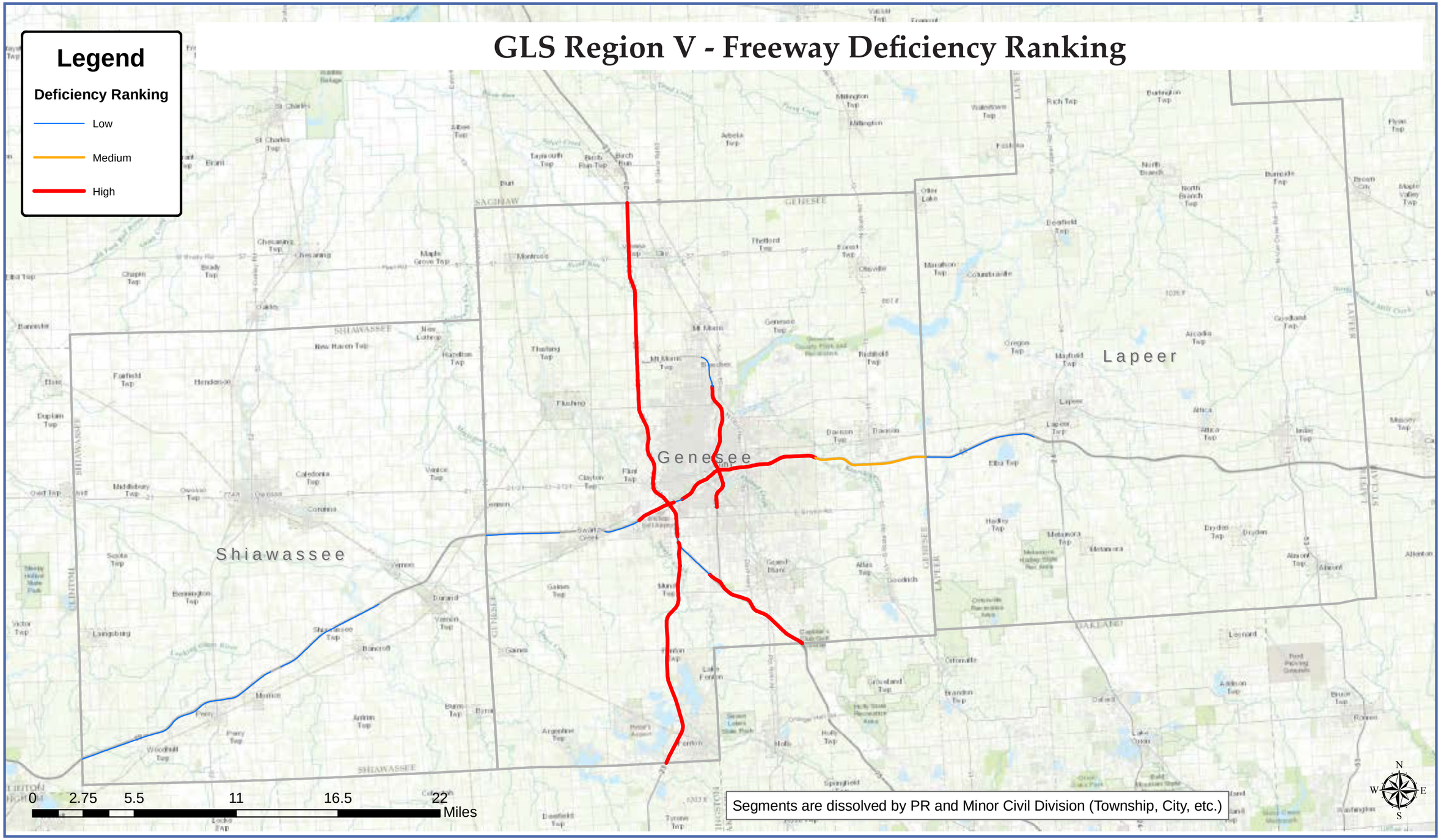
Analysis Process

The HSM procedures for calculating SPFs, expected predicted average crash frequency, and LOSS were utilized for analysis. Calibration factors were obtained from MDOT's "Michigan Calibration Values for the Highway Safety Manual" document, dated Spring 2012. Crash information was obtained from Michigan Traffic Crash Facts for years 2010 to 2014, which contained coordinates for spatial location. Only fatal and serious injury crashes were considered for this analysis; however, property damage only (PDO) crashes were also obtained for future use. SPFs from the report, "Michigan Urban Trunkline Intersections Safety Performance Functions (SPFs) Development and Support" were used for intersection analysis where applicable.

ArcGIS 10.3 was used to spatially join crash and segment information for modeling purposes. Roadway centerline and political boundary shapefiles were obtained from the Michigan Geographic Data Library. Volume and lane information was obtained for 2013 from the Federal Office of Highway Policy Information's HPMS data. Finally, census urbanized areas data was obtained from the United States Census Bureau.

Roadway segments were dissolved by physical reference (PR) number and minor civil division to obtain appropriate segment sizes for analysis. Only segments and intersections with complete volume data were used for analysis.

GLS Region V - Freeway Deficiency Ranking



Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

GLS Region V - Freeway Level of Service Safety

Legend

Level of Service Safety

- I
- II
- III
- IV

Lapeer

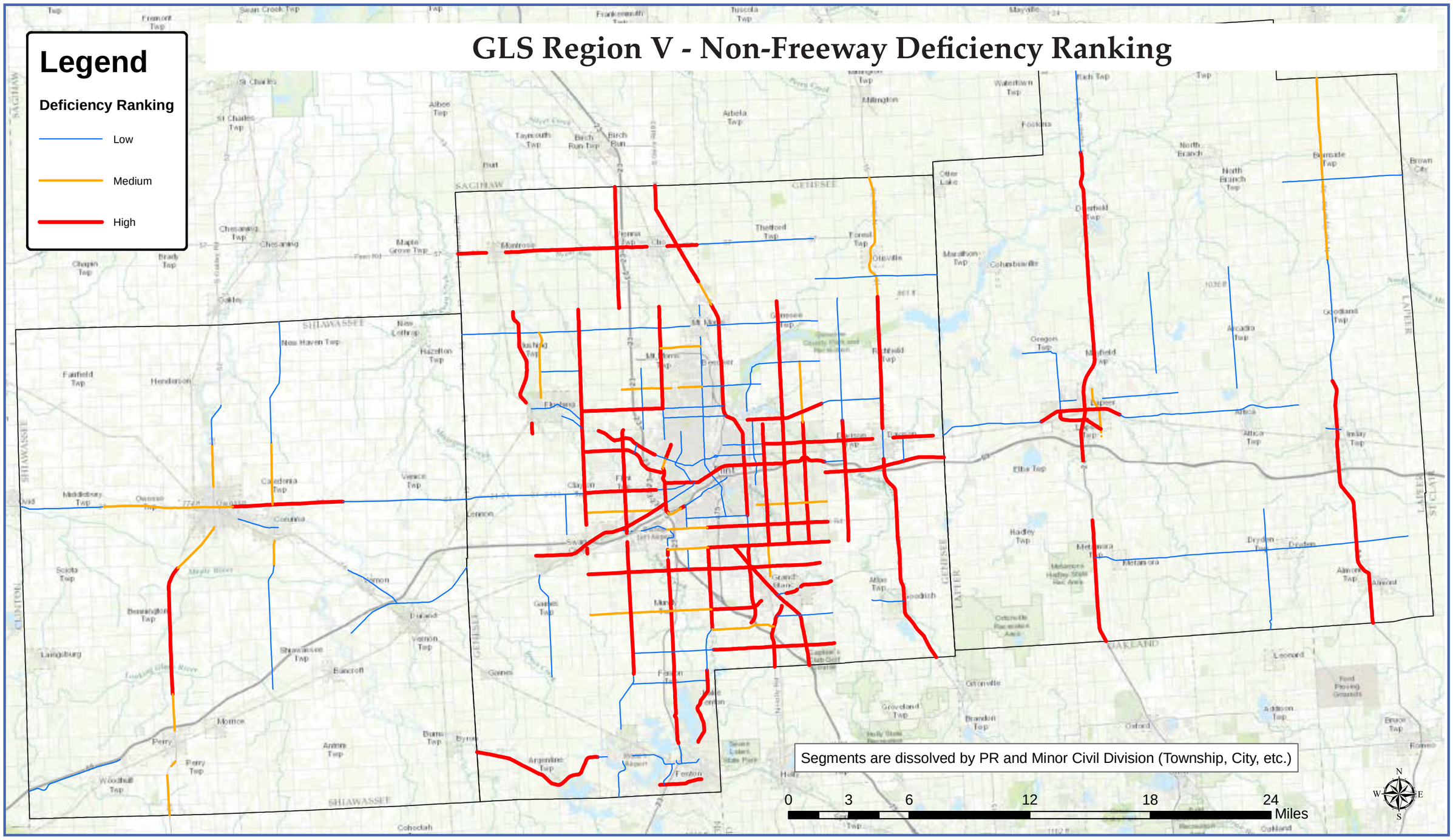
Genesee

Shiawassee

0 2.75 5.5 11 16.5 22 Miles

Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

GLS Region V - Non-Freeway Deficiency Ranking



GLS Region V - Non-Freeway Level of Service Safety

Legend

Level of Service Safety

- I
- II
- III
- IV

Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

0 3 6 12 18 24 Miles

GLS Region V - Intersection Deficiency Ranking

Legend

Deficiency Ranking

- Low
- Medium
- High

Genesee

Lapeer

Shiawassee

0 2.75 5.5 11 16.5 22 Miles

Chapter 6. Implementation and Evaluation of the Plan

The next steps for GLS Region V are to implement the strategies provided in the safety plan and use the analysis to identify locations for funding. Implementation, evaluation, and updating the safety plan is important for accountability.

It is recommended that a single lead agency be identified and a *GLS Region V Traffic Safety Working Group* encompassing the four E's be created to implement the strategies of this safety plan and evaluate various ongoing transportation activities and programs in the region. This group will meet on a regular basis to exchange information, monitor the progress of implementation, and also determine if the strategies used for each emphasis areas are working appropriately. This helps provide accountability and can be used to keep stakeholders informed and engaged. Short-term targets and milestones should be set to measure progress.

This safety plan identifies both systemic and spot locations, priority emphasis areas and countermeasures so that road agencies can seek opportunities to implement them. It is also recommended that agencies work together with other agencies and MDOT to provide assistance to communities in identifying low cost fixes to improve the safety by conducting:

- Road Safety Audits
- Safe Routes to School
- Local Safety Initiative

To ensure the effectiveness of the projects and the overall plan, evaluation of the strategies should be ongoing. After strategies have been in place for at least one year or several years, that may be necessary for sufficient data, an agency should evaluate their effectiveness for larger-scale implementations.

Finally, this safety plan is a living document. The working group should review the safety plan, examine progress, evaluate effectiveness, and, if needed, suggest changes or modifications to the plan. This ongoing evaluation of the safety plan may present opportunities for improvement of the plan.

Appendices

A. Crash Data for the Region

B. County Maps

C. Prioritized List of Locations for Implementation

D. GLS Region V Countermeasures Benefits

E. Potential Funding Sources

F. Summary of Stakeholder Meetings

Appendix A: Crash Data for the Region

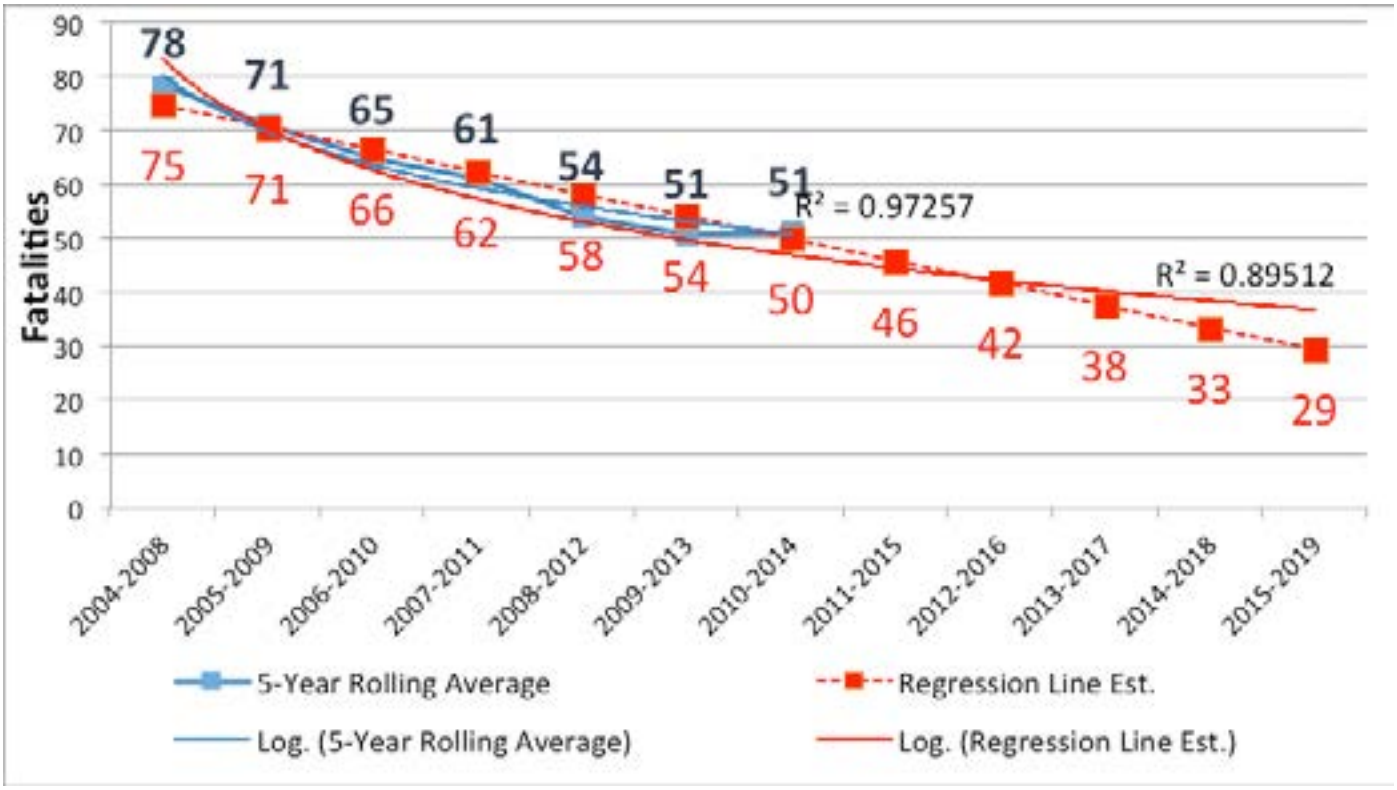
Table A-1: GLS Region V Characteristics

Region Wide Statistics	Miles of Road	Total Population (Census 2010)	Vehicle Miles Travelled (HPMS 2013 Data - Thousands)	Registered Vehicles
Shiawassee	1,370	70,648	760,009	64,196
Genesee	2,652	425,790	3,993,165	327,849
Lapeer	1,502	88,319	859,687	83,428
GLS Region V	5,524	584,757	5,612,861	475,473
Michigan	122,172	9,883,640	95,136,461	8,314,376

Table A-2: GLS Region V Characteristics Percentage Compare to Michigan

Region Wide Statistics	Miles of Road	Total Population (Census 2010)	Vehicle Miles Travelled (HPMS 2013 Data - Thousands)	Registered Vehicles
Shiawassee	1%	1%	1%	1%
Genesee	2%	4%	4%	4%
Lapeer	1%	1%	1%	1%
GLS Region V	5%	6%	6%	6%
Michigan	100%	100%	100%	100%

Target Setting Using Prediction Interval for Fatalities



Target Setting Using Prediction Interval for A-Injuries

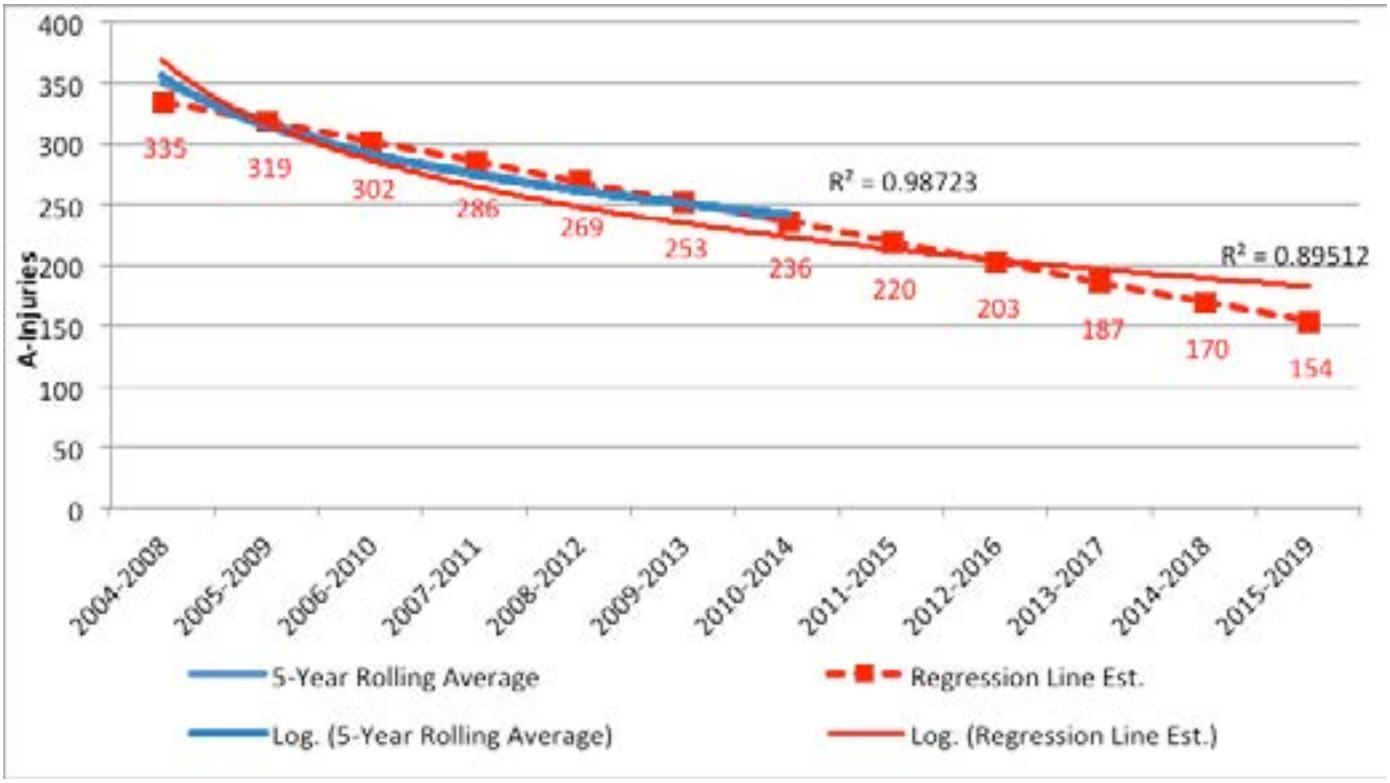


Figure A-1: Fatal and Serious Injury Crash Frequency, 2004-2014

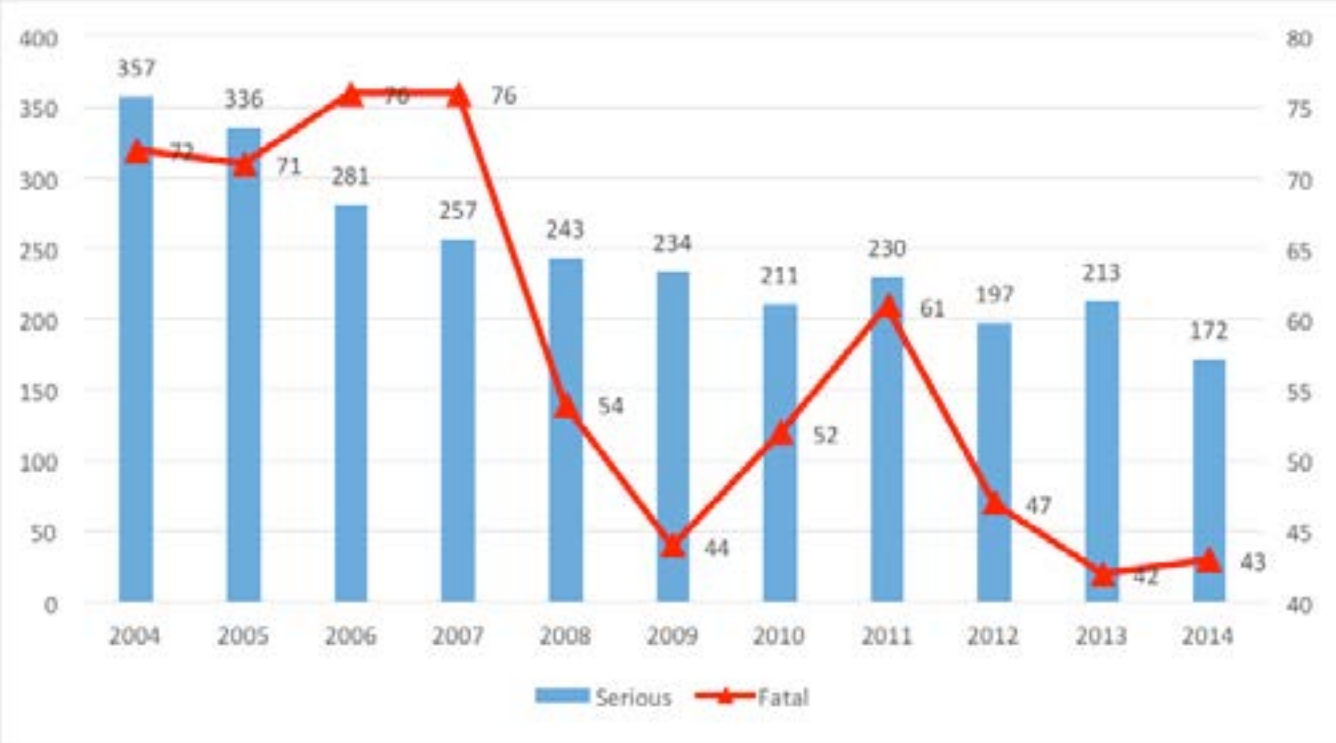


Figure A-2: Total Crash Rate by County, 2010-2014

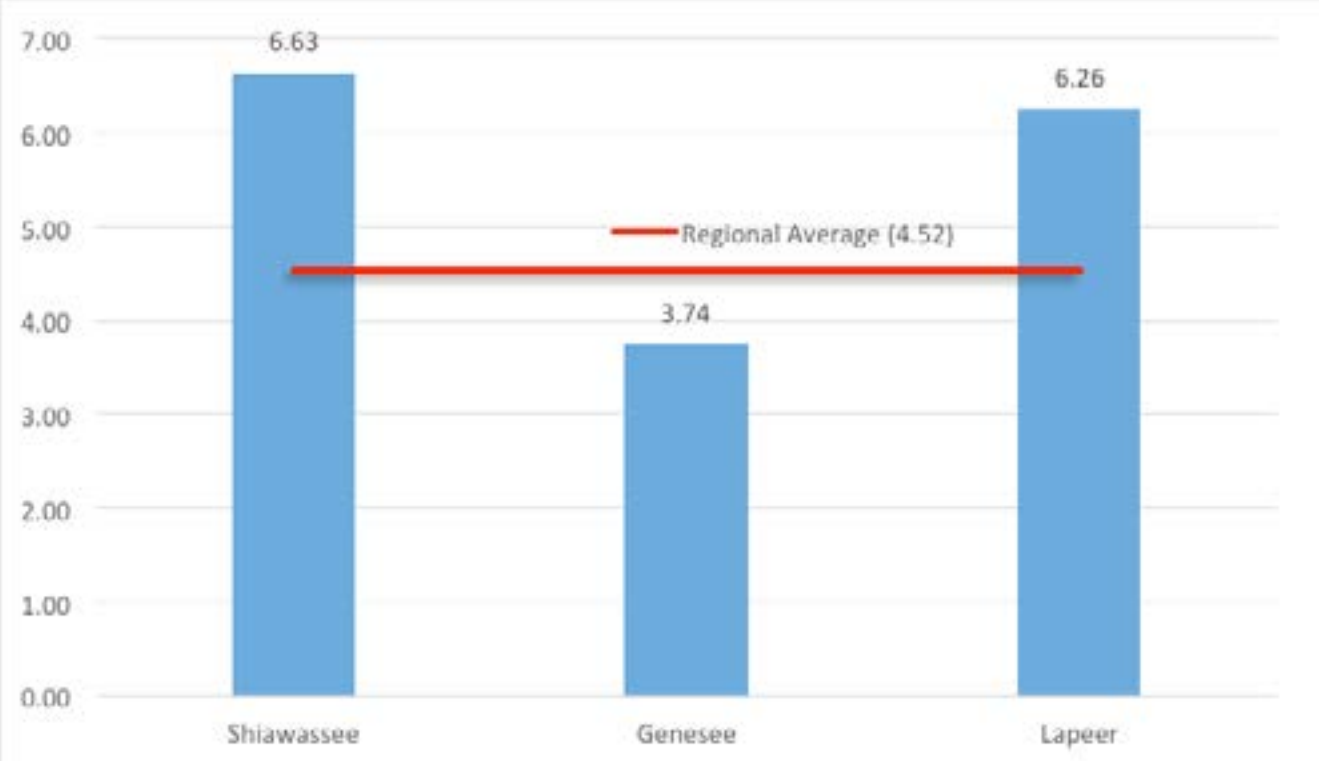


Figure A-3: Fatalities and Serious Injuries Percent Crash Type, 2010-2014

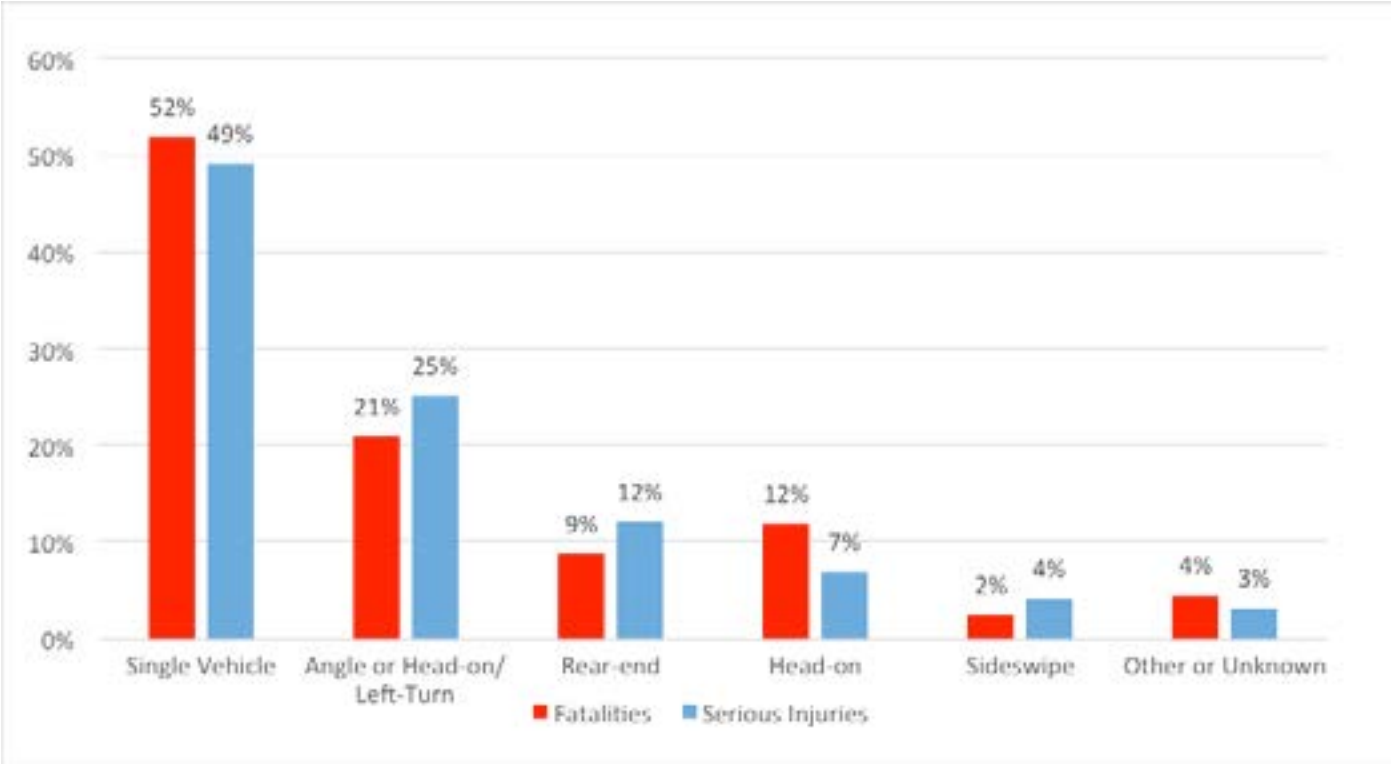


Figure A-4: Fatalities and Serious Injuries Crash Type by Month, 2010-2014

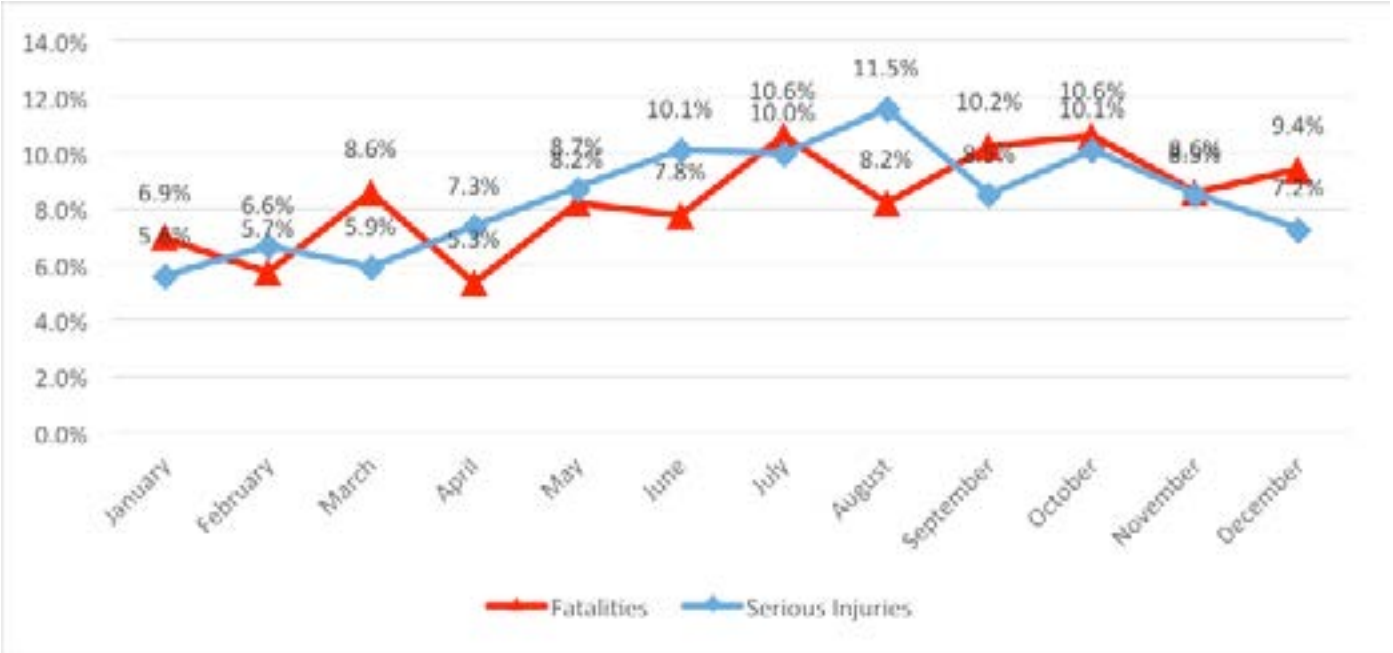


Figure A-5: Fatalities and Serious Injuries Crash Type by Week, 2010-2014

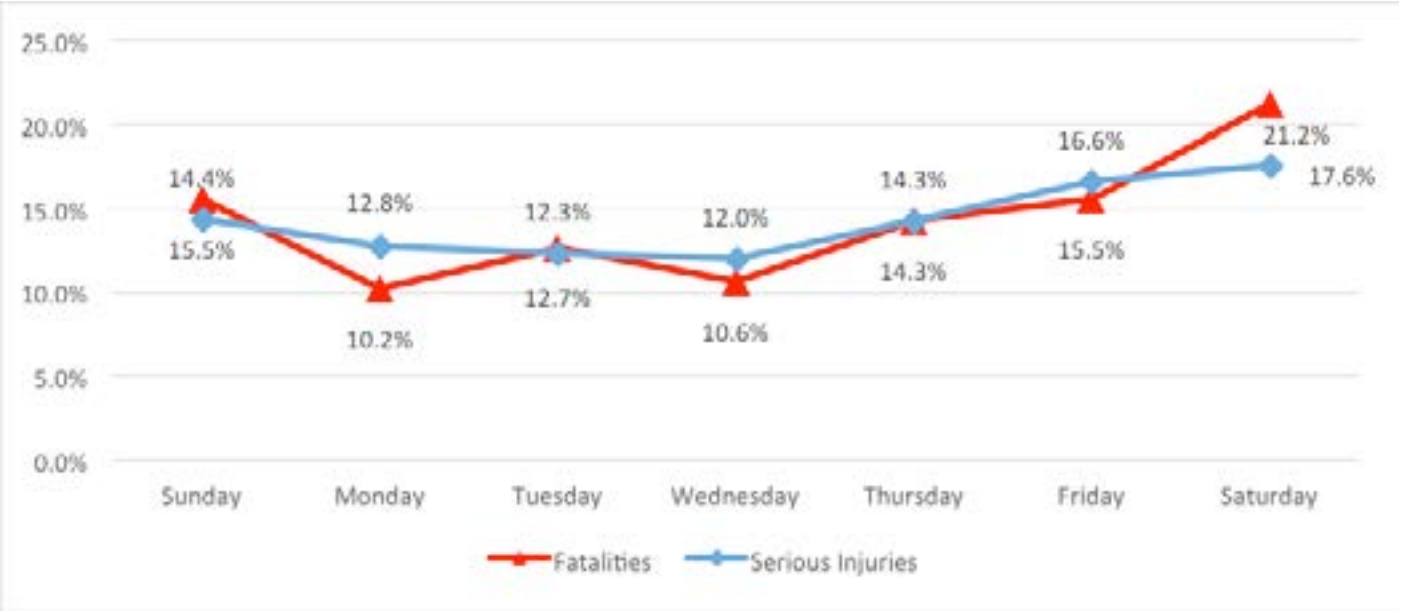


Figure A-6: Fatalities and Serious Injuries Percent Crash by Time of Day, 2010-2014

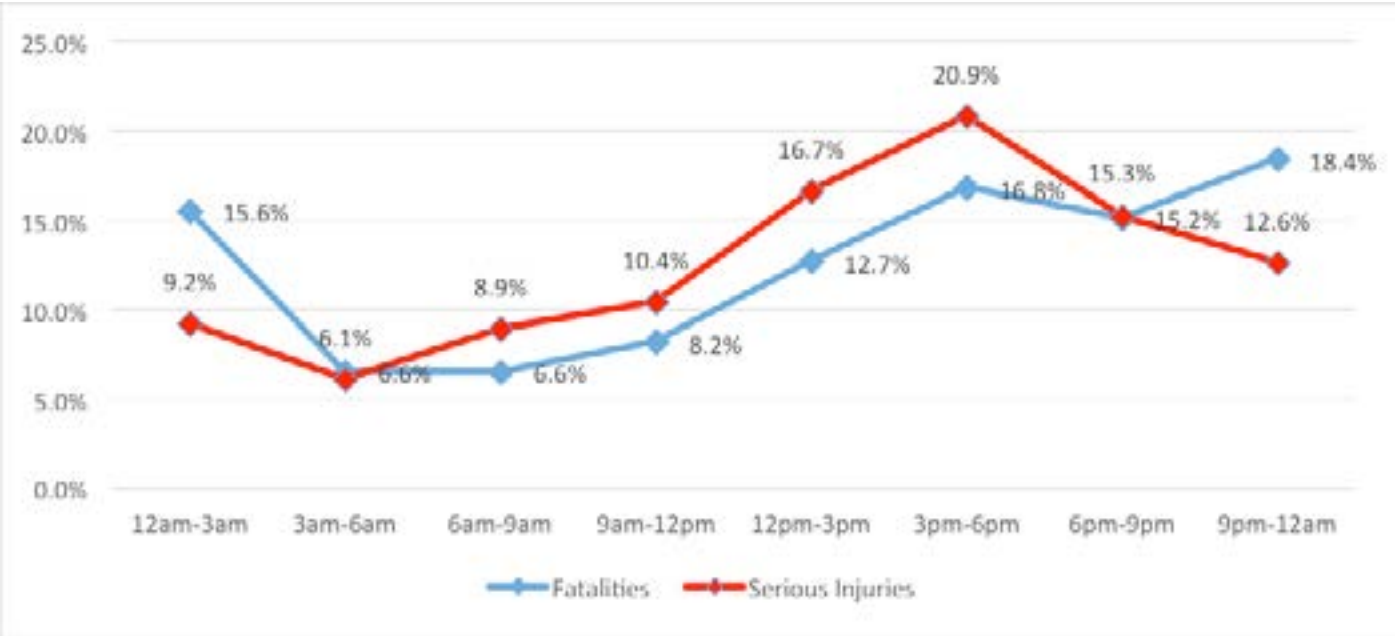
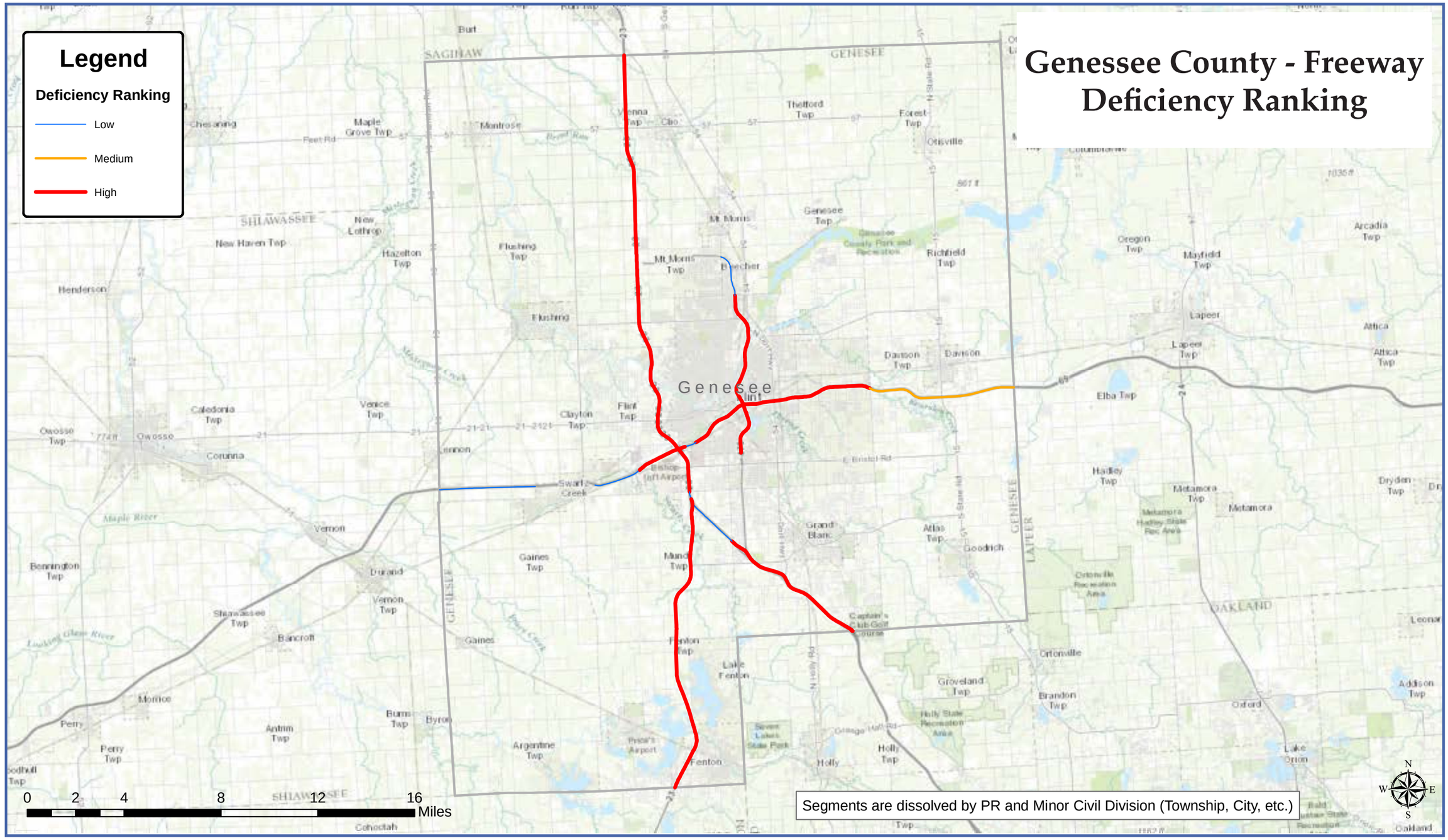


Figure A-7: Fatalities and Serious Injuries Percent Crash by Age Group, 2010-2014

Appendix B: County Maps



Genessee County - Freeway Level of Service Safety

Legend

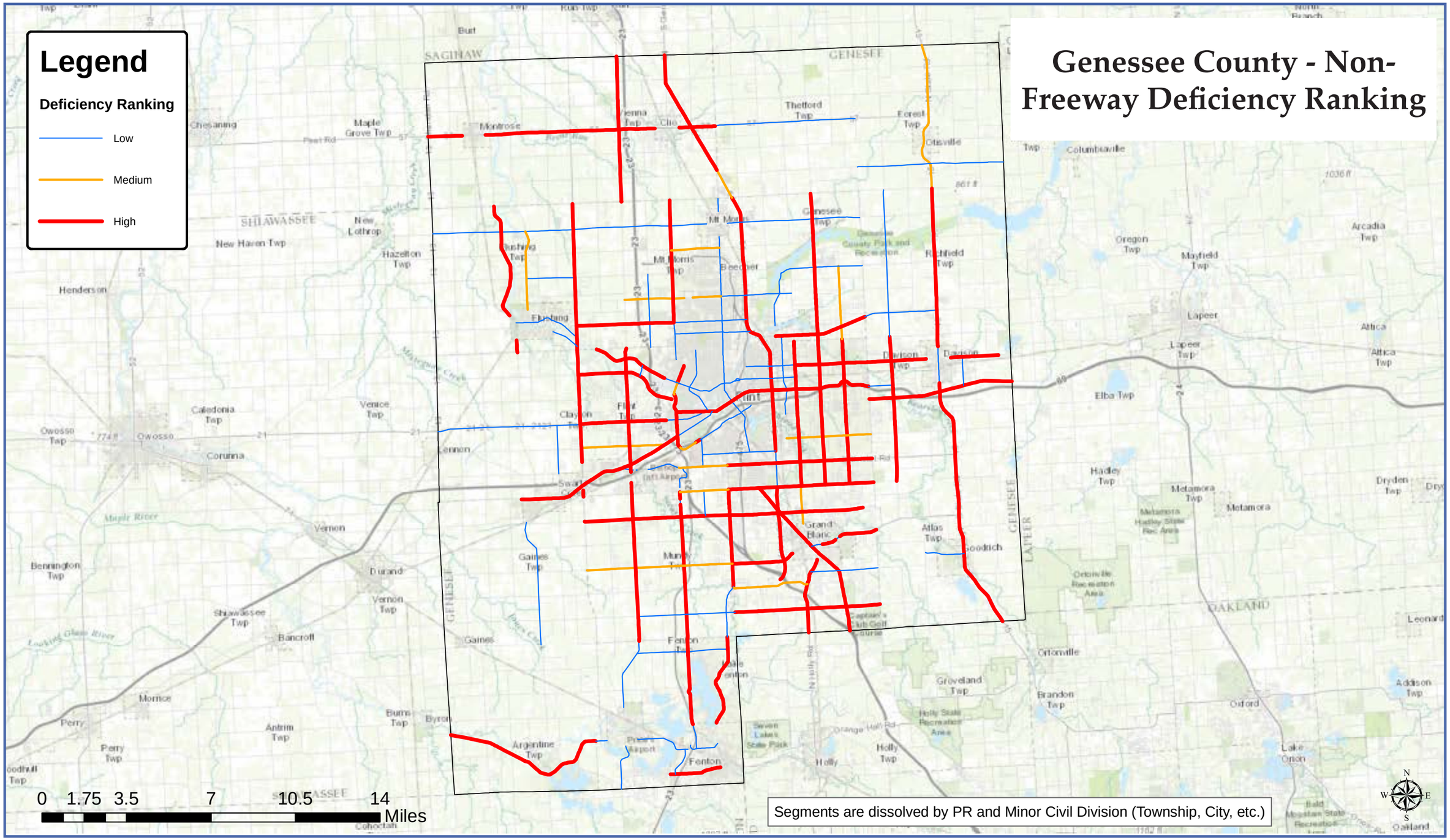
Level of Service Safety

- I
- II
- III
- IV

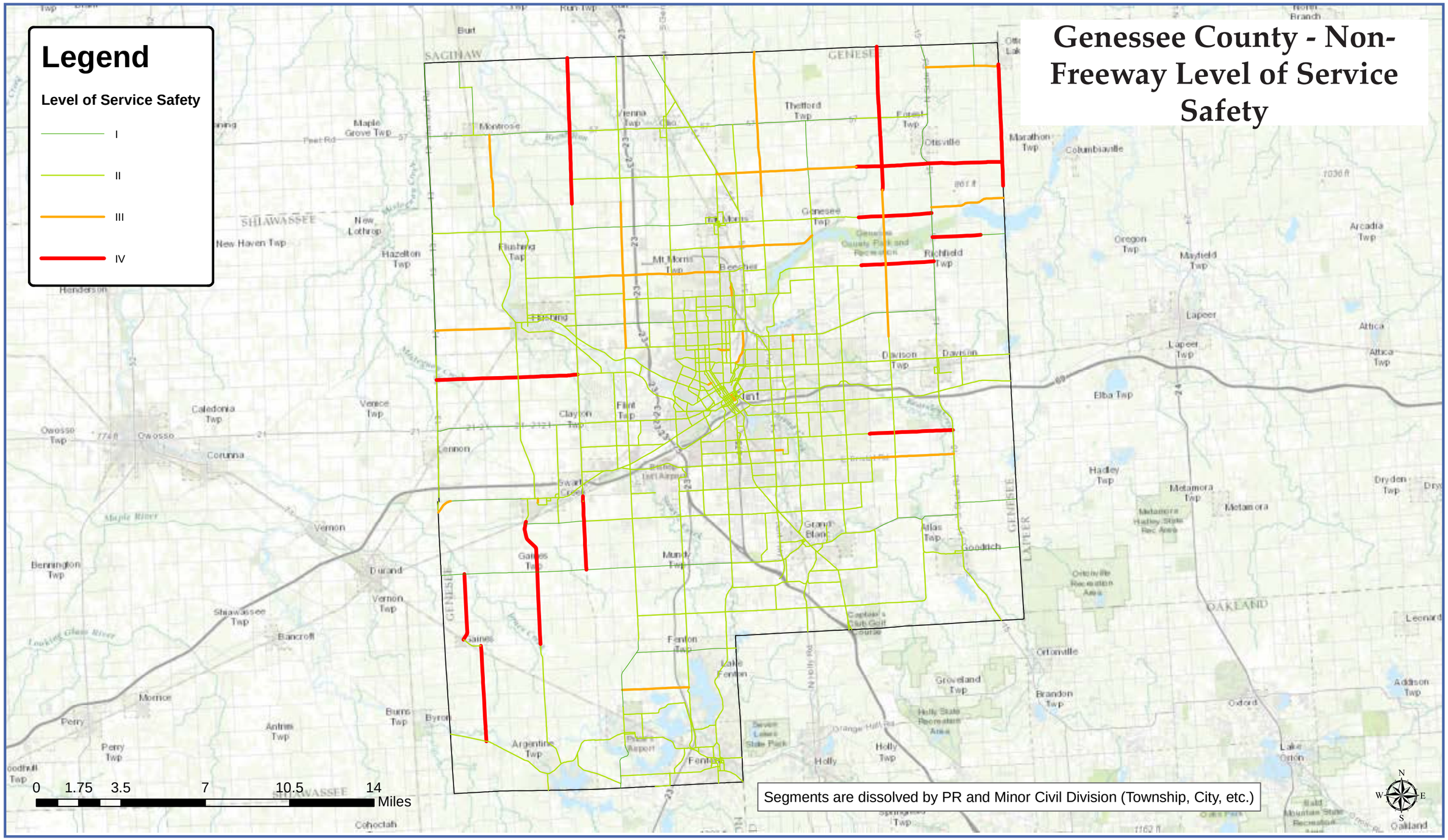
0 2 4 8 12 16 Miles

Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

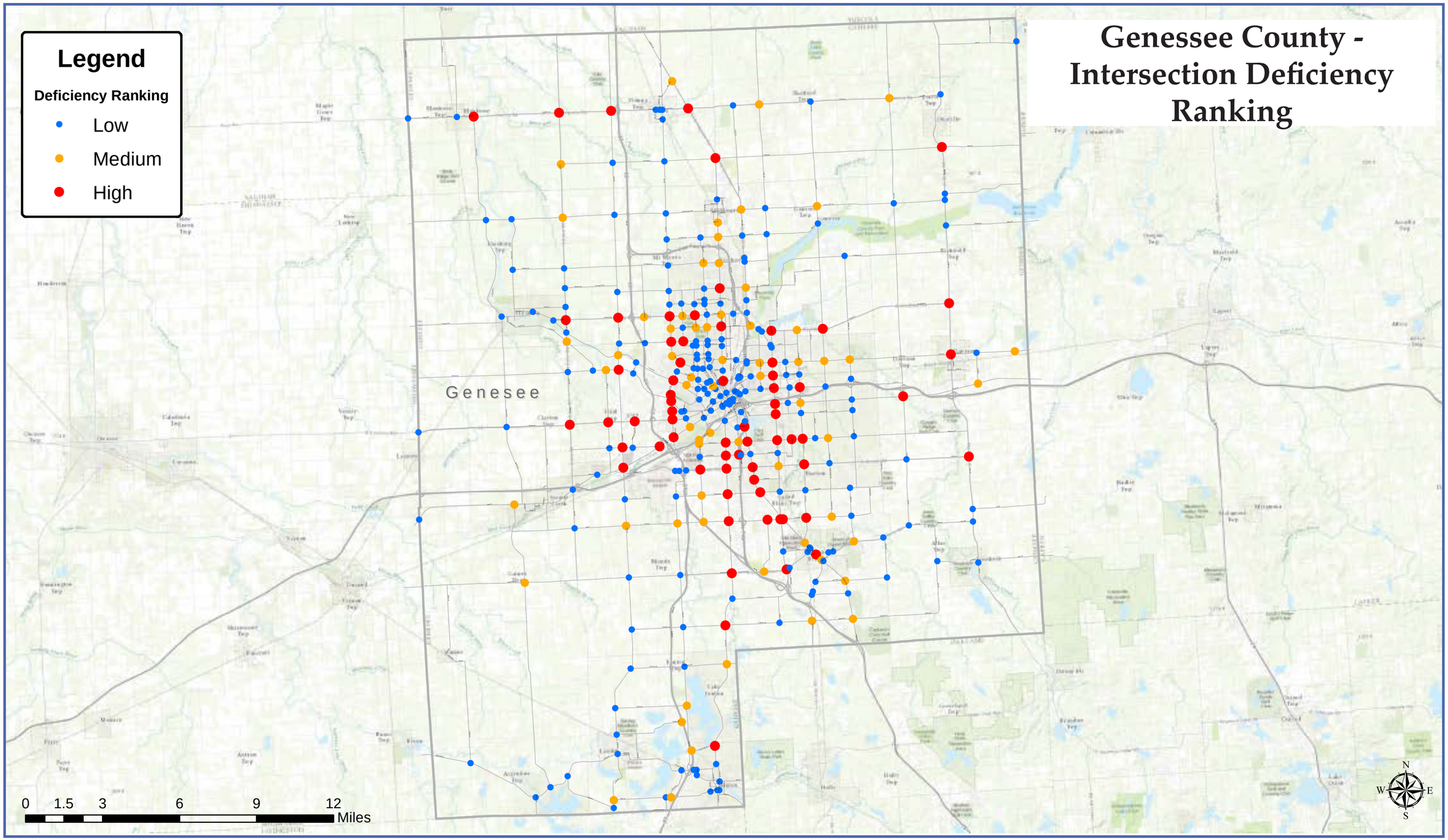
Genessee County - Non-Freeway Deficiency Ranking



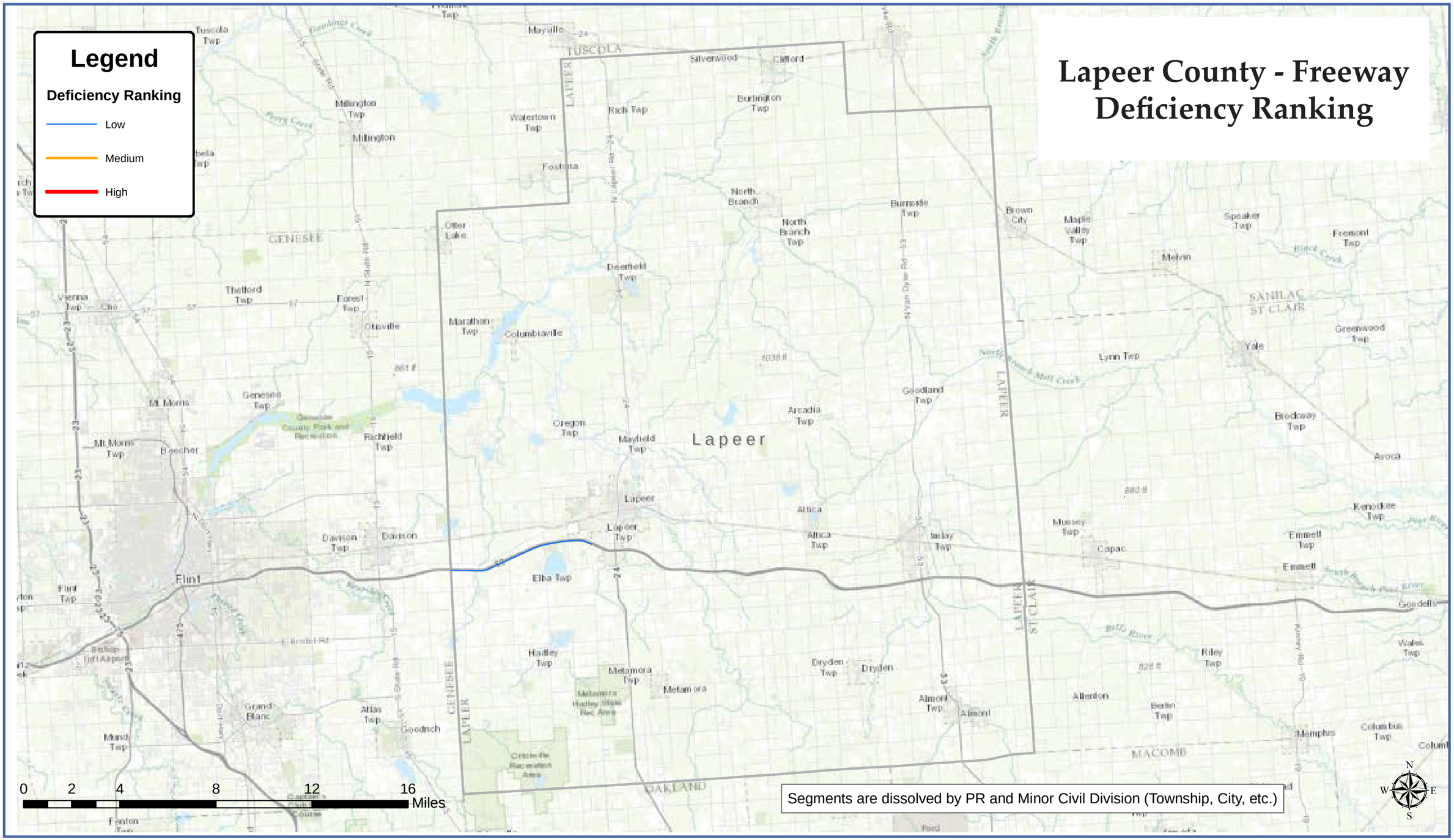
Genessee County - Non-Freeway Level of Service Safety



Genessee County - Intersection Deficiency Ranking



Lapeer County - Freeway Deficiency Ranking



Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

Lapeer County - Freeway Level of Service Safety

Legend

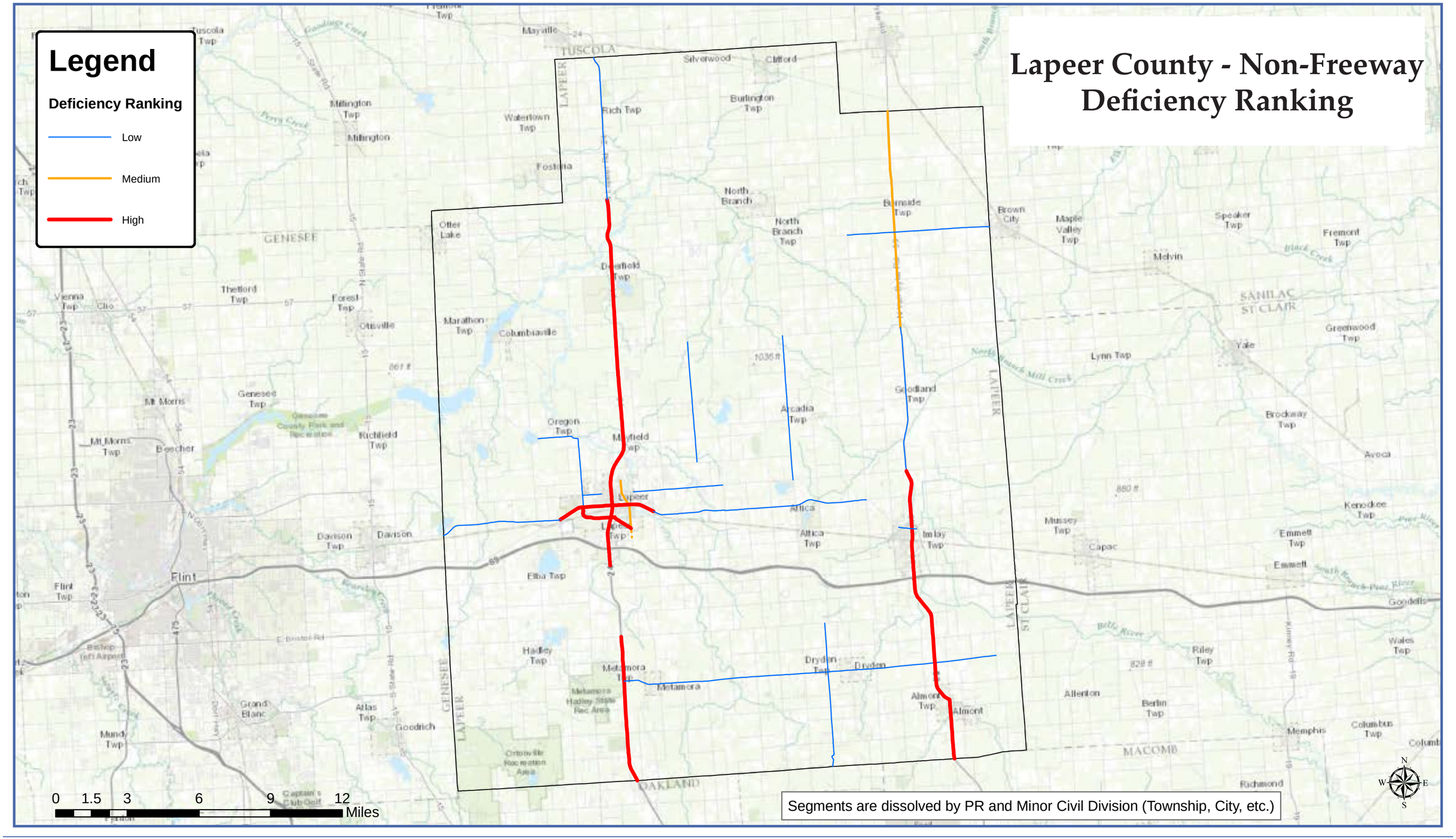
Level of Service Safety

- I
- II
- III
- IV

0 1.75 3.5 7 10.5 14 Miles

Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

Lapeer County - Non-Freeway Deficiency Ranking



Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

Lapeer County - Non-Freeway Level of Service Safety

Legend

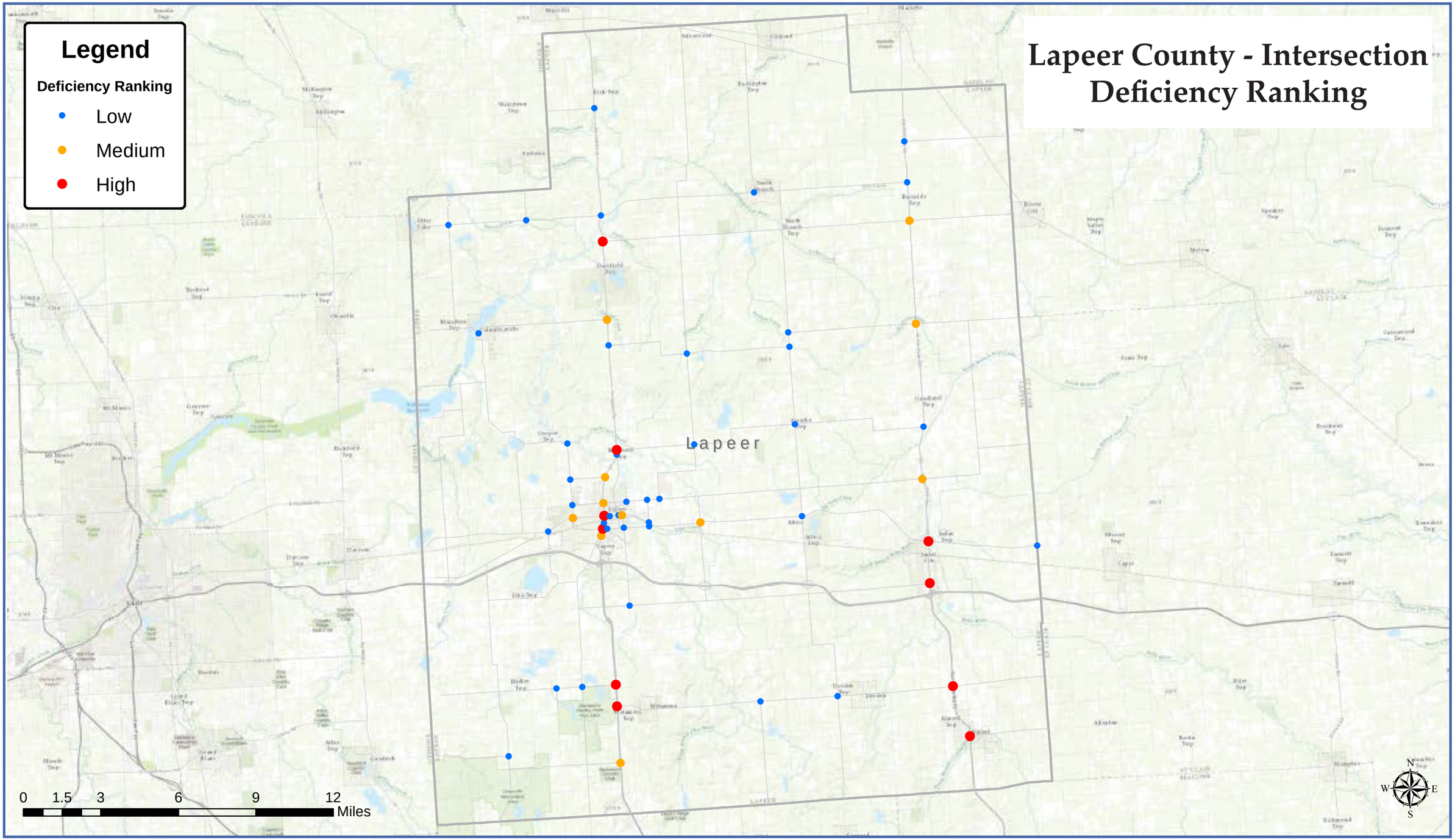
Level of Service Safety

- I
- II
- III
- IV

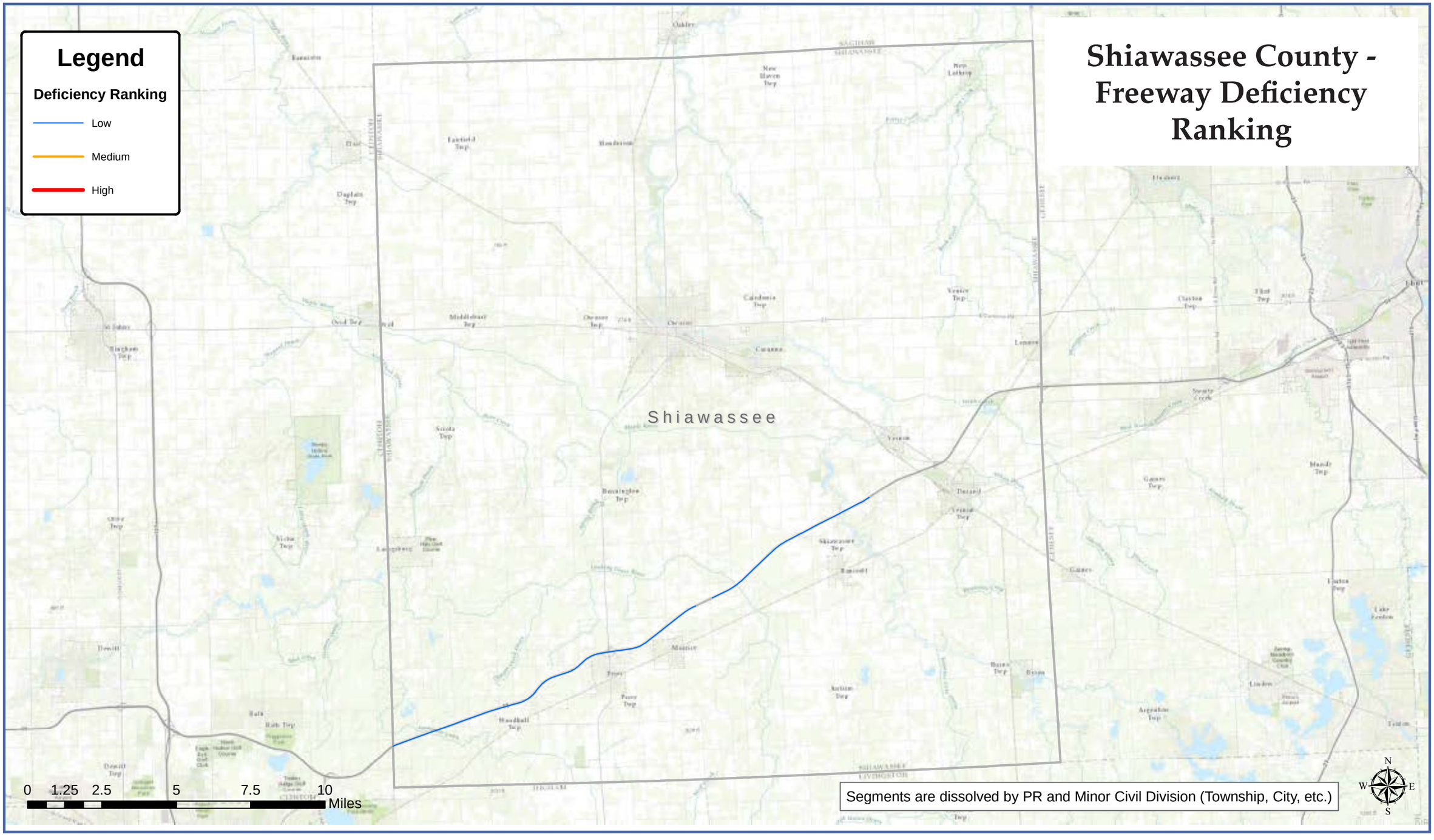
0 1.75 3.5 7 10.5 14 Miles

Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

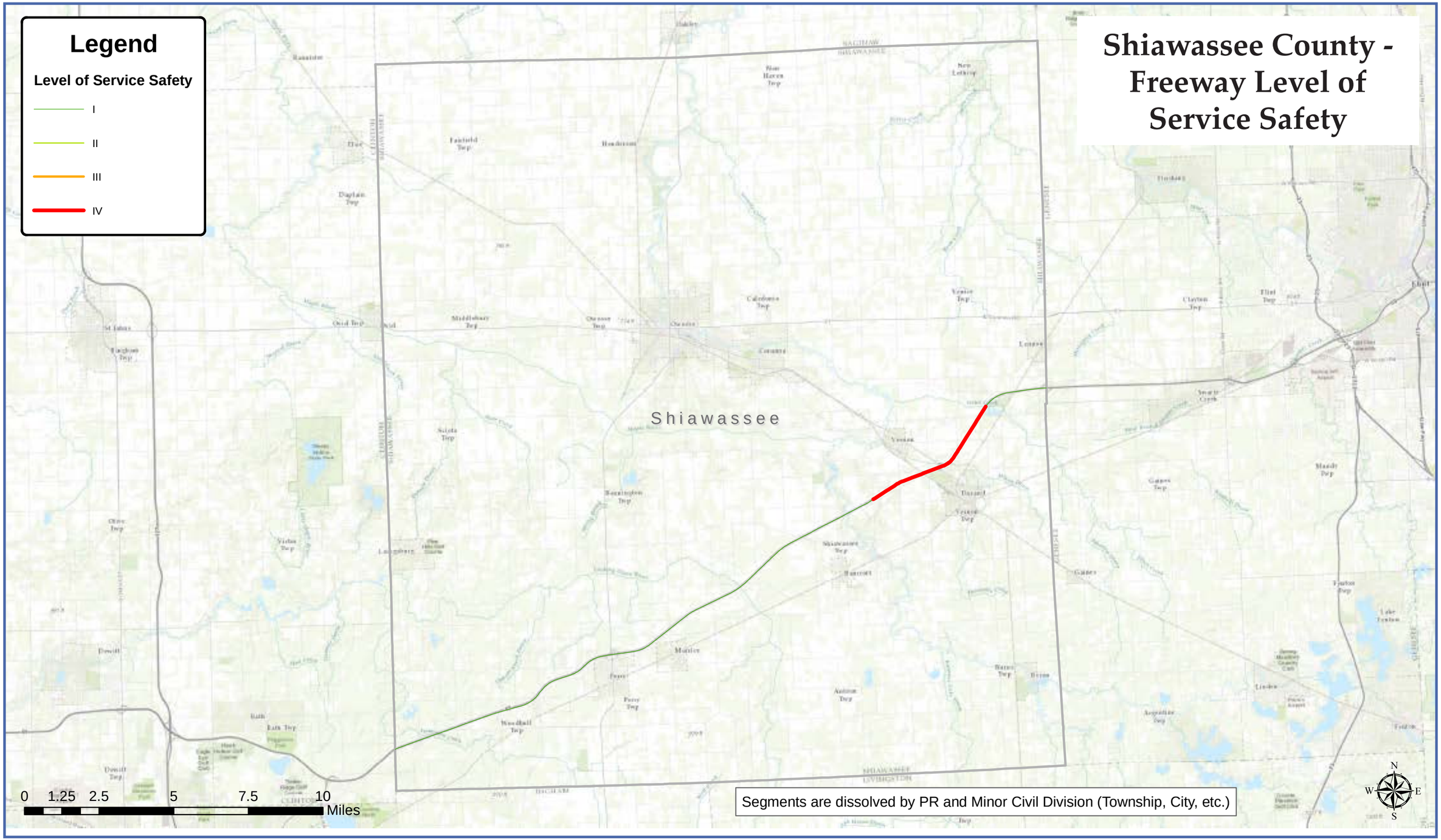
Lapeer County - Intersection Deficiency Ranking



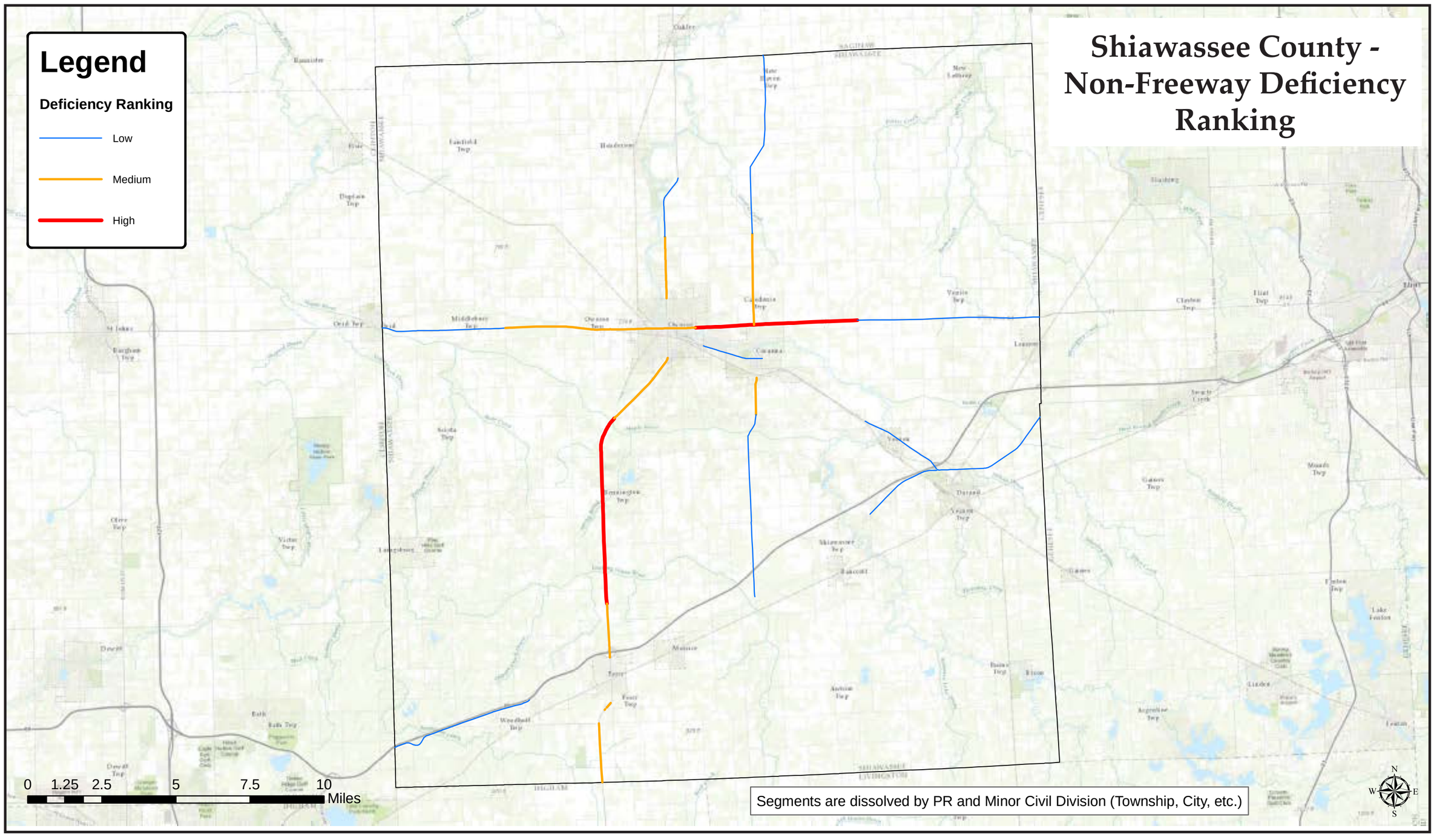
Shiawassee County - Freeway Deficiency Ranking



Shiawassee County - Freeway Level of Service Safety



Shiawassee County - Non-Freeway Deficiency Ranking



Shiawassee County - Non-Freeway Level of Service Safety

Legend

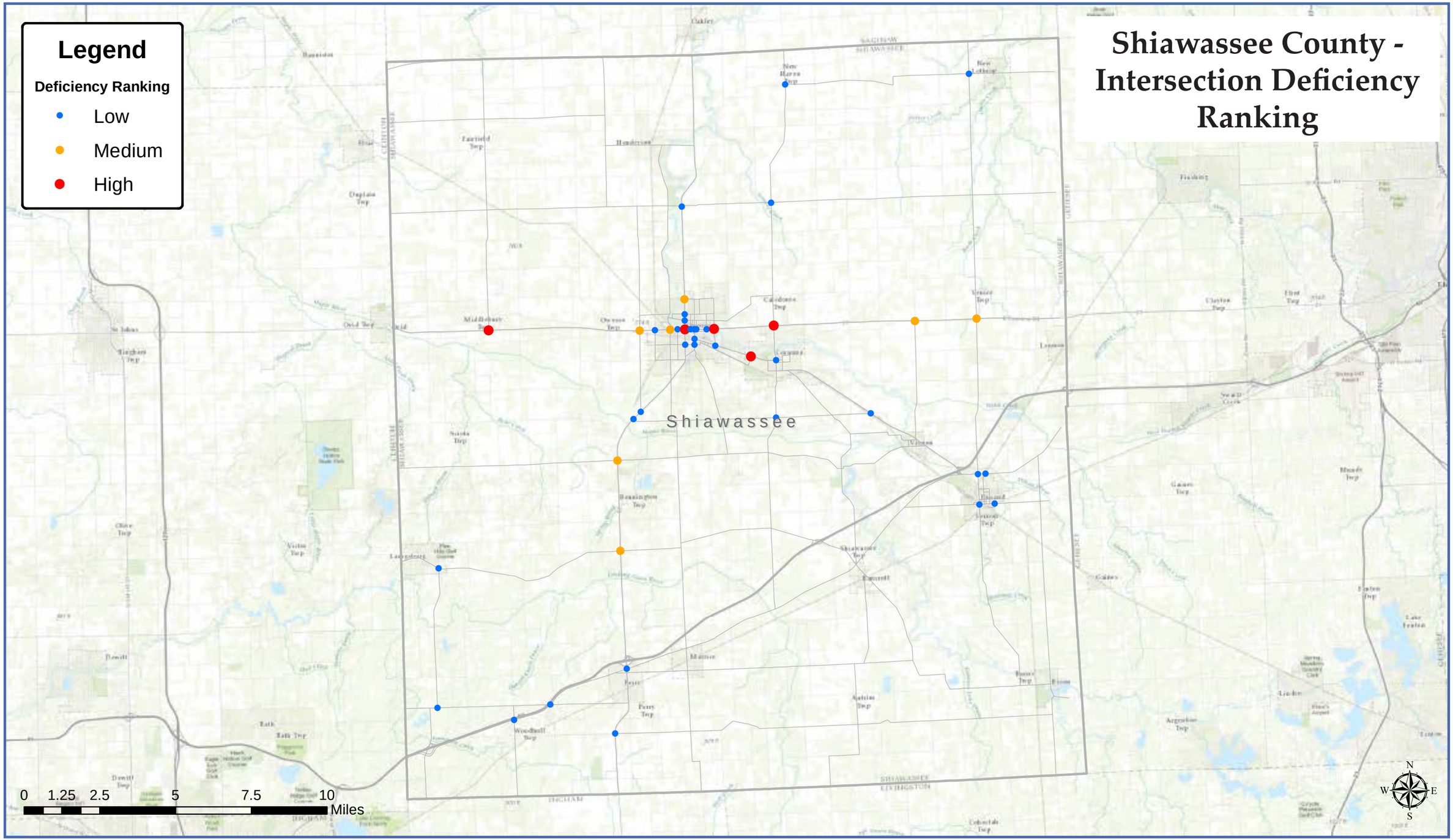
Level of Service Safety

- I
- II
- III
- IV

0 1.25 2.5 5 7.5 10 Miles

Segments are dissolved by PR and Minor Civil Division (Township, City, etc.)

Shiawassee County - Intersection Deficiency Ranking



Appendix C: Prioritized List of Locations for Implementation

Table C-1 Priority Urban Intersection List

Rank-ing	Name1	Name2	Legs	County	Latitude	Longitude	AADT_ Maj	AADT_ Min	Fatal_ Injury Crash	PDO	Excess per Year
1	Corunna	Linden	4	Genesee	43.00	-83.77	28,623	20,178	117	409	21.49
2	Miller	Lennon	3	Genesee	42.99	-83.74	30,790	13,371	75	209	14.47
3	Newark	VanDyke	4	Lapeer	43.01	-83.07	16,086	4,325	81	181	13.74
4	Fenton	Hill	4	Genesee	42.94	-83.69	25,020	14,161	70	202	13.45
5	Corunna	Corunna	3	Genesee	43.00	-83.76	28,623	7,420	68	150	13.07
6	Bristol	Fenton	4	Genesee	42.97	-83.69	19,856	10,807	69	158	12.19
7	Cedar	Capac	4	Lapeer	43.03	-83.07	11,285	6,631	74	316	12.11
8	Corunna	S I 75/Corunna	3	Genesee	43.00	-83.75	28,623	4,418	67	180	12.00
9	Atherton	Dort	4	Genesee	42.99	-83.65	19,499	13,969	64	188	11.33
10	Atherton	Fenton	4	Genesee	42.99	-83.69	12,066	2,712	70	206	11.24
11	M 21	Gould	4	Shiawassee	43.00	-84.16	19,682	8,000	62	157	10.87
12	Court	Dort	4	Genesee	43.02	-83.65	21,079	7,982	59	148	10.40
13	Corunna	Ballenger	4	Genesee	43.00	-83.73	18,700	10,550	59	195	10.35
14	Saint Clair	Main	4	Lapeer	42.92	-83.05	13,949	3,140	54	253	10.14
15	Ballenger	Flushing	4	Genesee	43.02	-83.73	21,053	11,302	57	166	10.11
16	Flint	State	4	Genesee	43.03	-83.52	24,622	20,114	54	181	9.76
17	Vienna	Vienna/N I 75	4	Genesee	43.18	-83.77	22,324	5,919	50	165	9.54
18	Hill	Dort	4	Genesee	42.94	-83.65	22,703	14,924	51	180	9.12
19	Hill	Saginaw	4	Genesee	42.94	-83.65	16,833	13,014	52	157	9.06
20	Atherton	Saginaw	4	Genesee	42.99	-83.68	12,066	11,003	53	89	8.87
21	Bristol	Van Slyke	4	Genesee	42.97	-83.71	20,883	12,108	48	145	8.50
22	Richfield	Genesee	4	Genesee	43.05	-83.62	13,772	10,795	50	185	8.49
23	Miller	Linden	4	Genesee	42.98	-83.77	21,640	11,486	47	146	8.34
24	Pierson	Dupont	4	Genesee	43.06	-83.71	13,470	7,188	49	69	8.22
25	Grand Blanc	Fenton	4	Genesee	42.91	-83.69	14,471	11,876	47	136	8.04

Table C-2 Priority Rural Intersection List

Ranking	Name1	Name2	Legs	County	Latitude	Longitude	AADT_Maj	AADT_Min	Fatal Injury Crash	PDO	E/P	E-P	Excess per Year
1	Pierson	Linden	4	Genesee	43.06	-83.77	22,078	10,057	68	180	107.00	60.50	12.10
2	Dryden	Lapeer	3	Lapeer	42.94	-83.31	16,822	6,639	49	227	100.78	42.06	8.41
3	Vienna	Seymour	4	Genesee	43.18	-83.88	10,407	3,026	50	156	161.61	39.26	7.85
4	Bristol	State	4	Genesee	42.98	-83.51	10,659	2,326	41	116	214.20	37.97	7.59
5	Dryden	VanDyke	4	Lapeer	42.95	-83.06	14,115	4,591	45	249	111.07	37.47	7.49
6	Vienna	Elms	4	Genesee	43.18	-83.81	15,222	2,377	38	119	159.40	35.65	7.13
7	Burnside	Lapeer	4	Lapeer	43.20	-83.31	11,739	2,029	45	116	142.14	35.52	7.10
8	Dodge	State	4	Genesee	43.15	-83.52	8,148	2,640	31	99	187.70	28.35	5.67
9	Lapeer	Pratt	3	Lapeer	42.96	-83.31	16,822	5,061	29	183	104.98	27.34	5.47
10	M 21	Carland	3	Shiawassee	43.00	-84.30	5,565	1,167	40	243	214.17	25.95	5.19
11	Bennington	M 52	4	Shiawassee	42.94	-84.22	9,645	915	25	212	153.84	22.80	4.56
12	Grand River	M 52	4	Shiawassee	42.89	-84.22	10,188	1,337	30	172	110.27	22.65	4.53
13	Bowers	VanDyke	4	Lapeer	43.07	-83.07	8,482	666	24	146	165.03	21.67	4.33
14	Vienna	Bray	4	Genesee	43.18	-83.66	6,438	2,493	24	64	168.19	21.63	4.33
15	Davison	Baxter	3	Genesee	43.04	-83.47	6,517	5,092	22	78	141.58	19.97	3.99
16	Imlay City	Wilder	4	Lapeer	43.05	-83.25	5,392	2,620	22	121	170.13	19.62	3.92
17	M 21	Durand	4	Shiawassee	43.00	-83.99	6,869	1,506	27	63	124.47	18.78	3.76
18	Davis Lake	Lapeer	4	Lapeer	43.07	-83.32	17,167	4,945	22	91	46.75	18.60	3.72
19	Vienna	Irish	4	Genesee	43.18	-83.56	6,538	2,546	20	52	138.58	18.03	3.61
20	M 21	Vernon	4	Shiawassee	43.00	-84.03	6,869	570	27	78	140.21	17.77	3.55
21	Burnside	VanDyke	4	Lapeer	43.21	-83.08	6,011	2,709	25	85	115.79	17.35	3.47
22	Dodge	Elms	4	Genesee	43.15	-83.81	3,758	1,870	20	59	197.20	17.28	3.46
23	Lapeer	Brocker	4	Lapeer	42.91	-83.31	16,822	446	20	113	61.82	15.77	3.15
24	Lapeer	Columbiaville	3	Lapeer	43.16	-83.31	12,181	1,895	20	152	62.35	15.73	3.15
25	Clear Lake	VanDyke	4	Lapeer	43.15	-83.08	6,380	924	23	145	117.52	15.25	3.05

Table C-3 Priority Freeway Segments Systemic List

Ranking	RD-NAME	MCD	PR	aadt_vn	Lanes	County	Length_Mi	Unique-ID	Calib FI	Nobs FI	Nexp	E/P	E-P	Deviation	LOSS
1	N I 475	City of Flint	1497903	26,347	6	Genesee	6.99	32	0.66	283	30.59	4.24	23.38	1.83	IV
2	N US 23	Mundy Township	1502907	54,921	4	Genesee	6.04	39	0.27	96	15.52	2.96	10.28	1.02	IV
3	N US 23	City of Fenton	1502907	52,566	4	Genesee	2.79	37	0.27	83	10.89	4.70	8.57	1.06	IV
4	E I 69	Davison Township	1494005	37,710	4	Genesee	6.11	21	0.27	68	7.94	2.21	4.35	0.50	IV
5	N I 75	Mundy Township	1497804	30,165	4	Genesee	2.76	29	0.27	32	2.80	2.16	1.51	0.26	IV
6	N I 475	Genesee Township	1497903	25,000	6	Genesee	1.81	33	0.66	20	3.19	1.80	1.42	0.35	IV
7	E I 69	Flint Township	1494005	39,293	4	Genesee	1.57	24	0.27	18	2.18	2.27	1.22	0.27	IV
8	E I 69	City of Flint	1494005	39,293	4	Genesee	0.41	18	0.27	15	1.30	5.17	1.05	0.33	IV
9	E I 69	Vernon Township	550708	24,432	4	Shiawassee	5.09	6	0.27	26	2.82	1.44	0.87	0.18	IV
10	N I 475	City of Burton	1497903	36,900	4	Genesee	1.50	31	0.27	14	1.72	2.00	0.86	0.22	IV
11	E I 69	City of Swartz Creek	1494005	19,748	4	Genesee	2.48	19	0.27	33	1.64	2.09	0.85	0.16	IV
12	N I 475	Grand Blanc Township	1497903	24,000	4	Genesee	2.81	34	0.27	11	1.41	1.33	0.35	0.12	IV
13	N I 475	Mt Morris Township	1497903	21,700	4	Genesee	1.67	35	0.27	6	0.74	1.29	0.16	0.08	IV
14	E I 69	City of Imlay City	756502	15,349	4	Lapeer	0.52	9	0.27	3	0.18	1.40	0.05	0.04	IV
15	E I 69	City of Lapeer	756502	24,648	4	Lapeer	0.88	10	0.97	8	1.56	1.46	0.49	0.24	III
16	E I 69	City of Flint	1494005	49,000	6	Genesee	4.83	17	0.66	218	49.01	5.40	39.94	3.63	II
17	E I 69	Flint Township	1494005	58,600	6	Genesee	0.46	22	0.66	13	3.89	3.72	2.84	0.92	II
18	E I 69	City of Flint	1494005	58,600	6	Genesee	0.03	0	0.66	1	0.29	4.49	0.22	0.28	II
19	E I 69	Imlay Township	756502	17,578	4	Lapeer	1.49	13	0.97	7	1.57	1.15	0.20	0.19	II

Note: The remaining freeway segments are LOSS I resulting in a list of only 29 segments.

Table C-4 Priority Freeway Segments Spot List

Ranking	RD-NAME	MCD	PR	aadt_vn	Lanes	County	Length_Mi	Unique-ID	Nobs FI	Years	Nexp	E/P	E-P	LOSS
1	N I 75	Flint Township	1497804	72,193	6	Genesee	5.55	26	243	5	83.58	5.33	67.92	I
2	E I 69	City of Flint	1494005	49,000	6	Genesee	4.83	17	218	5	49.01	5.40	39.94	II
3	N I 475	City of Flint	1497903	26,347	6	Genesee	6.99	32	283	5	30.59	4.24	23.38	IV
4	N I 75	Grand Blanc Township	1497804	59,029	6	Genesee	6.36	27	103	5	35.96	2.49	21.49	I
5	N I 75	Vienna Township	1497804	69,100	8	Genesee	6.07	30	83	5	39.18	2.06	20.14	I
6	N I 75	Mt Morris Township	1497804	62,600	6	Genesee	6.14	28	93	5	29.14	2.09	15.19	I
7	N US 23	Mundy Township	1502907	54,921	4	Genesee	6.04	39	96	5	15.52	2.96	10.28	IV
8	N US 23	Fenton Township	1502907	52,329	4	Genesee	3.64	38	57	5	18.60	2.14	9.90	I
9	N US 23	City of Fenton	1502907	52,566	4	Genesee	2.79	37	83	5	10.89	4.70	8.57	IV
10	E I 69	City of Burton	1494005	59,200	6	Genesee	3.08	16	37	5	14.42	2.05	7.38	I
11	N I 75	City of Flint	1497804	105,600	8	Genesee	0.50	25	17	5	9.19	3.69	6.70	I
12	E I 69	Flint Township	1494005	47,700	6	Genesee	2.11	23	37	5	10.04	2.60	6.18	I
13	N I 75	Flint Township	1497804	105,600	8	Genesee	0.50	1	14	5	7.84	3.15	5.35	I
14	E I 69	Davison Township	1494005	37,710	4	Genesee	6.11	21	68	5	7.94	2.21	4.35	IV
15	E I 69	Flint Township	1494005	58,600	6	Genesee	0.46	22	13	5	3.89	3.72	2.84	II
16	E I 69	Shiawassee Township	550708	31,401	4	Shiawassee	6.31	4	37	5	12.07	1.28	2.65	I
17	E I 69	Elba Township	756502	27,729	4	Lapeer	6.13	11	38	5	10.61	1.29	2.39	I
18	E I 69	Woodhull Township	550708	31,401	4	Shiawassee	4.83	7	28	5	9.21	1.28	2.00	I
19	E I 69	Clayton Township	1494005	30,997	4	Genesee	3.97	20	26	5	7.79	1.33	1.93	I
20	N I 75	Mundy Township	1497804	30,165	4	Genesee	2.76	29	32	5	2.80	2.16	1.51	IV
21	N I 475	Genesee Township	1497903	25,000	6	Genesee	1.81	33	20	5	3.19	1.80	1.42	IV
22	E I 69	Flint Township	1494005	39,293	4	Genesee	1.57	24	18	5	2.18	2.27	1.22	IV
23	E I 69	Perry Township	550708	31,401	4	Shiawassee	6.59	3	23	5	10.94	1.11	1.10	I
24	E I 69	City of Flint	1494005	39,293	4	Genesee	0.41	18	15	5	1.30	5.17	1.05	IV
25	E I 69	Vernon Township	550708	24,432	4	Shiawassee	5.09	6	26	5	2.82	1.44	0.87	IV

Table C-5 Priority Non- Freeway Segments Spot List

Rank	Name	PR	Label	aadt_vn	Lanes	County	Length_ Mi	Unique-ID	Nobs FI	Nexp	E/P	E-P
1	Lapeer Rd	1495003	Davison Township	8,265	2	Genesee	5.99	286	62	52.50	14.85	48.96
2	Linden Rd	3251558	Flint Township	21,861	4	Genesee	5.59	644	50	41.63	11.25	37.93
3	N Dort Hwy	1497008	City of Flint	15,761	4	Genesee	6.87	305	47	38.78	12.40	35.66
4	E Hill Rd	1519809	Mundy Township	12,264	4	Genesee	6.02	518	43	33.41	16.17	31.34
5	Miller Rd	1519805	Flint Township	11,806	4	Genesee	2.81	515	50	31.87	34.42	30.94
6	S VanDyke Rd	755909	City of Imlay City	16,096	4	Lapeer	2.27	192	48	31.40	29.62	30.34
7	Clio Rd	1497102	Grand Blanc Township	16,805	4	Genesee	5.36	314	36	28.86	10.99	26.24
8	State Rd	1501502	Davison Township	13,570	2	Genesee	4.63	387	34	29.76	5.80	24.64
9	E Grand Blanc Rd	1519606	Grand Blanc Township	13,521	2	Genesee	2.60	507	34	27.10	9.45	24.23
10	E Hill Rd	1519809	Grand Blanc Township	13,181	2	Genesee	5.53	517	33	29.47	5.01	23.59
11	Irish Rd	1522902	Davison Township	8,408	2	Genesee	5.99	538	29	24.92	6.92	21.32
12	N Belsay Rd	1495110	City of Burton	6,002	2	Genesee	5.99	288	29	23.42	9.39	20.93
13	W Imlay City Rd	3251545	City of Lapeer	11,717	4	Lapeer	4.12	631	31	22.03	16.38	20.68
14	Corunna Rd	1494107	Flint Township	18,494	4	Genesee	3.56	265	28	21.17	10.90	19.23
15	Clio Rd	1497102	City of Grand Blanc	27,292	4	Genesee	1.93	311	28	20.00	12.15	18.35
16	Genesee Rd	1520305	Genesee Township	9,542	4	Genesee	6.10	525	26	19.46	12.26	17.87
17	N Ballenger Hwy	1496104	City of Flint	20,405	4	Genesee	3.23	299	26	19.65	9.95	17.67
18	Vienna Rd	1494503	Vienna Township	22,324	4	Genesee	5.00	279	25	20.72	6.12	17.33
19	Lapeer Rd	754110	City of Lapeer	13,175	4	Lapeer	3.54	149	26	18.33	13.91	17.02
20	E Pierson Rd	1512407	Mt Morris Township	18,201	4	Genesee	4.04	484	36	23.16	3.64	16.80
21	M 21	551310	Caledonia Township	11,865	2	Shiawassee	5.47	27	44	16.41	6.95	14.05
22	S VanDyke Rd	755909	Imlay Township	8,482	2	Lapeer	3.97	194	20	16.13	6.68	13.71
23	N Dort Hwy	1497008	Genesee Township	10,268	4	Genesee	4.13	306	21	14.56	12.49	13.40
24	Torrey Rd	1503101	Mundy Township	3,757	2	Genesee	5.85	411	21	14.80	9.22	13.20
25	W Shiawassee Ave	1511005	City of Fenton	14,087	2	Genesee	2.12	473	20	15.60	6.31	13.12

Table C-6 Priority Non- Freeway Segments Systemic List

Rank	Name	PR	Label	aadt_vn	Lanes	County	Length_ Mi	E/P	E-P	Deviation	LOSS
1	Seymour Rd	1509803	Gaines Township	2,728	2	Genesee	5.26	3.31	1.20	0.37	IV
2	Dodge Rd	3250252	Forest Township	2,640	2	Genesee	6.06	2.82	1.06	0.32	IV
3	State Rd	552701	New Haven Township	2,545	2	Shiawassee	6.16	2.80	1.03	0.31	IV
4	Elms Rd	1523901	Vienna Township	2,377	2	Genesee	6.05	2.68	0.88	0.28	IV
5	Byron Rd	555909	Vernon Township	2,563	2	Shiawassee	4.51	2.79	0.75	0.27	IV
6	Newark Rd	3441599	Lapeer Township	2,198	2	Lapeer	4.96	2.87	0.74	0.25	IV
7	Byron Rd	555909	Burns Township	2,563	2	Shiawassee	3.46	3.05	0.66	0.26	IV
8	Genesee Rd	755010	Elba Township	1,722	2	Lapeer	4.77	3.00	0.60	0.20	IV
9	Washburn Rd	1514409	Forest Township	1,681	2	Genesee	5.04	2.90	0.58	0.19	IV
10	E Coldwater Rd	1512801	Richfield Township	2,075	2	Genesee	3.01	3.44	0.55	0.22	IV
11	Columbiaville Rd	760209	Marathon Township	1,895	2	Lapeer	2.89	3.57	0.51	0.20	IV
12	Durand Rd	556307	Vernon Township	2,272	2	Shiawassee	4.59	2.32	0.50	0.20	IV
13	Marathon Rd	758901	Oregon Township	1,745	2	Lapeer	2.65	3.83	0.48	0.19	IV
14	Burnside Rd	761802	Deerfield Township	2,029	2	Lapeer	3.99	2.55	0.46	0.18	IV
15	S Byron Rd	552002	Burns Township	1,842	2	Shiawassee	2.64	3.41	0.43	0.18	IV
16	E Atherton Rd	1497208	Davison Township	1,830	2	Genesee	3.45	2.83	0.42	0.17	IV
17	N Delaney Rd	555102	Owosso Township	1,824	2	Shiawassee	5.78	2.06	0.41	0.16	IV
18	Durand Rd	556307	Hazelton Township	1,386	2	Shiawassee	6.08	2.23	0.38	0.13	IV
19	N Chipman Rd	555105	Owosso Township	1,312	2	Shiawassee	4.20	2.81	0.36	0.13	IV
20	Durand Rd	556307	Burns Township	2,272	2	Shiawassee	2.31	2.77	0.34	0.17	IV
21	Lippincott Rd	761309	Elba Township	1,774	2	Lapeer	3.67	2.42	0.34	0.15	IV
22	Baldwin Rd	761305	Metamora Township	1,169	2	Lapeer	6.06	2.25	0.32	0.11	IV
23	Durand Rd	556307	Venice Township	1,165	2	Shiawassee	6.11	2.24	0.32	0.11	IV
24	E Stanley Rd	1501908	Richfield Township	1,593	2	Genesee	1.99	3.71	0.31	0.15	IV
25	E Mount Morris Rd	1500910	Richfield Township	2,068	2	Genesee	3.02	2.35	0.31	0.15	IV

Table C-7 Priority Pedestrian Safety List

Rank	Unique_ ID	Name1	Name2	Legs	County	Latitude	Longitude	AADT_ Maj	AADT_ Min	Pedestrian Predicted Excess Per Year
1	724	Ballenger	Beecher	4	Genesee	43.01	-83.73	20,405	9,536	0.0811
2	1355	Court	Dort	4	Genesee	43.02	-83.65	21,079	7,982	0.0799
3	1382	Davison	Center	4	Genesee	43.03	-83.64	16,500	9,882	0.0760
4	146	Washington	Main	4	Shiawassee	43.00	-84.17	16,495	3,362	0.0652
5	595	Bristol	Fenton	4	Genesee	42.97	-83.69	19,856	10,807	0.0612
6	1280	Perry	Saginaw	4	Genesee	42.92	-83.63	30,160	9,916	0.0534
7	1658	Genesee	Main	4	Lapeer	43.05	-83.32	24,415	11,717	0.0511
8	1283	Perry	Perry	3	Genesee	42.93	-83.62	15,100	4,324	0.0488
9	1223	Vienna	Mill	4	Genesee	43.18	-83.73	16,814	5,575	0.0484
10	1035	Pierson	Fleming	4	Genesee	43.06	-83.72	14,152	3,782	0.0472
11	1057	Pierson	Saginaw	4	Genesee	43.06	-83.69	20,000	9,632	0.0468
12	359	Leroy	Silver Lake	4	Genesee	42.80	-83.70	17,821	6,529	0.0427
13	607	Atherton	Fenton	4	Genesee	42.99	-83.69	12,066	2,712	0.0426
14	1340	Atherton	Dort	4	Genesee	42.99	-83.65	19,499	13,969	0.0418
15	719	Court	Ballenger	4	Genesee	43.01	-83.73	20,405	11,928	0.0415
16	129	Shiawassee	Main	4	Shiawassee	43.00	-84.18	19,697	11,238	0.0407
17	720	Corunna	Ballenger	4	Genesee	43.00	-83.73	18,700	10,550	0.0397
18	715	Corunna	N I 75/ Corunna	3	Genesee	43.00	-83.75	24,059	11,493	0.0383
19	662	Corunna	Corunna	3	Genesee	43.00	-83.76	28,623	7,420	0.0381
20	1033	Clio	Pierson	4	Genesee	43.06	-83.73	14,526	12,613	0.0375
21	812	5th	Saginaw	4	Genesee	43.01	-83.69	13,715	9,156	0.0351
22	296	Broad	Bridge	4	Genesee	42.81	-83.78	125,034	10,972	0.0347
23	125	Main	Chipman	4	Shiawassee	43.00	-84.19	17,440	4,249	0.0341
24	1037	Pierson	Dupont	4	Genesee	43.06	-83.71	13,470	7,188	0.0338
25	743	Pasadena	Clio	4	Genesee	43.05	-83.73	12,256	8,565	0.0335

Table C-8 Priority Bicycle Safety List

Ranking	Unique_ID	Name1	Name2	Legs	County	Latitude	Longitude	AADT_Maj	AADT_Min	Excess Per Year
1	129	Shiawassee	Main	4	Shiawassee	42.99758765	-84.17685967	19,697	11,238	0.1045
2	1283	Perry	Perry	3	Genesee	42.92519955	-83.61643061	15,100	4,324	0.0509
3	1360	Davison	Dort	4	Genesee	43.03290536	-83.65531265	15,191	7,144	0.0441
4	1658	Genesee	Main	4	Lapeer	43.0507647	-83.3186247	24,415	11,717	0.0434
5	1223	Vienna	Mill	4	Genesee	43.17737822	-83.73458927	16,814	5,575	0.0402
6	149	Main	Park	4	Shiawassee	42.99749681	-84.16939105	16,495	2,908	0.0299
7	1339	Lippincott	Dort	4	Genesee	43.00375093	-83.65402112	19,444	4,422	0.0290
8	993	N I 475	Robert T Longway	4	Genesee	43.02553279	-83.68080396	54,100	11,075	0.0265
9	146	Washington	Main	4	Shiawassee	42.99752506	-84.17064278	16,495	3,362	0.0261
10	928	Court	N I 475	4	Genesee	43.01504923	-83.68235248	58,200	8,955	0.0261
11	326	Poplar	Silver Lake	3	Genesee	42.80158688	-83.72203754	9,824	9,092	0.0235
12	611	Atherton	N I 475	4	Genesee	42.9888652	-83.68244748	47,100	12,066	0.0223
13	1280	Perry	Saginaw	4	Genesee	42.92410553	-83.6259661	30,160	9,916	0.0220
14	561	Miller	S I 75/I 69	4	Genesee	42.98949592	-83.73903114	30,790	20,475	0.0216
15	188	River	Corunna	4	Shiawassee	42.9840965	-84.13417682	6,600	1,983	0.0209
16	1496	Flint	State	4	Genesee	43.03467064	-83.51801782	24,622	20,114	0.0202
17	1057	Pierson	Saginaw	4	Genesee	43.06097378	-83.69382875	20,000	9,632	0.0194
18	604	Hemphill	N I 475	4	Genesee	42.98154114	-83.68211094	35,250	8,526	0.0193
19	1562	Genesee	Millville	4	Lapeer	43.05018445	-83.34257487	13,396	5,966	0.0187
20	1340	Atherton	Dort	4	Genesee	42.98916231	-83.65341421	19,499	13,969	0.0176
21	573	Bristol	Van Slyke	4	Genesee	42.97379776	-83.71283569	20,883	12,108	0.0176
22	735	Ballenger	Flushing	4	Genesee	43.0244731	-83.73174238	21,053	11,302	0.0174
23	1665	Genesee	Saginaw	4	Lapeer	43.05092238	-83.30503502	13,469	8,640	0.0169
24	1300	Hill	Center	4	Genesee	42.94501317	-83.63271444	13,103	8,631	0.0168
25	599	Bristol	Grand Traverse	4	Genesee	42.97426829	-83.68128584	25,007	6,684	0.0167

Appendix D: GLS Region V Countermeasures Benefits

GLS Region V – Countermeasure Benefits

Intersection Countermeasures

Strategy	Combined CMF	No. of Intersections	F-I Crashes Prevented Each Year	Fatal (K)	Serious Injury (A)	Crash Cost Benefits per Year	Benefits per Site per Year	Countermeasure Cost per Site	15-Year B/C Ratio
Signal Optimization and Timing Updates[1]	*0.9*	*554*	*28*	*0.3*	*1*	*$2,846,500*	*$5,138.09*	*$3,610*	*21.3*
Lighting	*0.91*	*297*	*14*	*0.1*	*1*	*$1,432,921*	*$4,824.65*	*$5,000*	*14.5*
Signal Backplates	*0.85*	*554*	*43*	*0.5*	*2*	*$4,465,267*	*$8,060.05*	*$2,400*	*50.4*
Combined - Lighting, Supplemental Signal Heads, Signal per Lane, Overhead Street Name Signs, Backplates	*0.71 (Flint/Grand Blanc) / 0.65 (All)*	*554*	*113*	*1.2*	*6*	*$11,641,828*	*$21,014.13*	*$20,028*	*15.7*
Conversion to Box Span Configuration - 2/3rds of the Existing Signals	*0.897*	*370*	*20*	*0.2*	*1*	*$2,033,506*	*$5,495.96*	*$50,000*	*1.6*
Pedestrian Countdown Signals - 1/3rd of Existing Signals	*0.927*	*183*	*7*	*0.1*	*0*	*$699,048*	*$3,819.94*	*$5,000*	*11.5*
Total			**225**	**2**	**12**	**$23,119,070**	**48,353**	**$86,038**	**8.4**

Assumptions:

- For Left-Turn Phasing and Interval Recalculation, a total project budget of $500k was assumed for the region.
- For Signal Optimization and Timing Updates a total project budget of $2 Million was assumed for the region.
- MDOT's 2016 Average Unit Prices were used to estimate signal related upgrades.
- Flint and Grand Blanc were assumed to have lighted intersections.

Intersection Characteristics:

- Total Intersections: 560 (excess expected crashes >1)
- Outside of Flint or Grand Blanc: 297
- 3-Legged: 201

GLS Region V – Countermeasure Benefits

Non-Freeway Segment Countermeasures

Strategy	Combined CMF	Miles of Roadway	Overall F-I Prevented Each Year	Fatal (K)	Serious Injury (A)	Crash Cost Benefits per Year	Benefits per Mile per Year	Countermeasure Cost per Mile	15-Year B/C Ratio
Rumble Strips									
Centerline Rumble Strips (Applied to LOSS III & IV Segments)	*0.85*	*490.95*	*11*	*0.2*	*1*	*$1,086,030*	*$2,212.10*	*$1,000*	*33.2*
Centerline Rumble Strips (Local Agency Federal-Aid Roadways)	*0.85*	*770.21*	*22*	*0.4*	*2*	*$2,295,434*	*$2,980.27*	*$1,000*	*44.7*
Centerline and Shoulder Rumble Strips (Local Agency Federal-Aid Roadways)	*0.771*	*770.21*	*105*	*2.1*	*8*	*$10,841,618*	*$14,076.19*	*$5,000*	*42.2*
Signing									
Clearview Font & Fluorescent Sign Sheeting	*.711 (Urban) / .927 (Rural)*	*1559.01*	*134*	*2.6*	*10*	*$13,760,542*	*$8,826.46*	*$900*	*147.1*
Fluorescent Sign Sheeting (Rural Local Agency Federal-Aid Roadways)	*0.972*	*770.21*	*4*	*0.1*	*0*	*$419,482*	*$544.63*	*$900*	*9.1*
Clearview Font & Fluorescent Sign Sheeting (Rural Local Agency Federal-Aid Roadways)	*0.927*	*770.21*	*11*	*0.2*	*1*	*$1,102,116*	*$1,430.93*	*$900*	*23.8*
Geometric									
*Safety Edge (Rural Only)**	*0.932*	*944.76*	*18*	*0.4*	*1*	*$1,859,477*	*$1,968.20*	*-*	*-*
Increase Pavement Marking Retroreflectivity (Rural Areas Only)	*0.717*	*944.76*	*79*	*1.6*	*6*	*$8,146,453*	*$8,622.78*	*$15,840*	*0.5*
20% Reduction in Access Point Density (Urban Only)	*F(x)*	*614.25*	*26*	*0.5*	*2*	*$3,396,690*	*$5,529.82*	*-*	*-*
5% Mean Speed Reduction (All Roadways)	*0.929*	*1559.01*	*43*	*0.8*	*3*	*$4,430,114*	*$2,841.62*	*$5,000*	*8.5*
10% Mean Speed Reduction (All Roadways)	*0.85*	*1559.01*	*94*	*1.9*	*7*	*$9,710,492*	*$6,228.63*	*$5,000*	*18.7*
15% Mean Speed Reduction (All Roadways)	*0.78*	*1559.01*	*143*	*2.8*	*11*	*$14,746,359*	*$9,458.80*	*$5,000*	*28.4*
Total			**453**	**9**	**35**	**$47,337,957**	**49,033**	**$30,540**	**24.1**

Assumptions:

- Sign Upgrade Costs: 6 signs per mile at $150 per sign
- Pavement Marking Costs: 3 per linear foot of roadway at $3 per foot
- CLRS and SRS cost assumed at least triple with buffer compared to CLRS only.

Non-Freeway Roadway Characteristics:

- Mileage by Level of Service Safety Category:
  - LOSS I – 256.06

GLS Region V – Countermeasure Benefits

- LOSS II – 807.92
- LOSS III – 100.57
- LOSS IV – 394.46

- Mileage by Area Type:
  - Rural – 944.76
  - Urban – 614.25
- By Jurisdiction
  - MDOT – 252.54
  - Federal-Aid Local Agency – 1306.47
  - Rural Federal-Aid Local Agency – 770.21

Appendix E: Potential Funding Sources

Congestion Mitigation and Air Quality (CMAQ)

The CMAQ program funds transportation projects or programs that will contribute to the attainment or maintenance of the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide (CO), or particulate matter (PM). These projects will typically include:

- Transit investments, including transit vehicle acquisitions and construction of new facilities or improvements to facilities that increase transit capacity.
- Projects that improve traffic flow, including efforts to provide signal systemization, construct HOV lanes, streamline intersections, add turning lanes, and improve transportation systems management and operations that mitigate congestion and improve air quality.
- Non-recreational bicycle transportation and pedestrian improvements that provide a reduction in single-occupant vehicle travel.
- Establishment or operation of a traffic monitoring, management, and control facilities.

Highway Safety Implementation Program

The HSIP is a core Federal-aid program. The goal of the program is similar to RTSP is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. Safety infrastructure-related improvements, as well as non-infrastructure safety projects, are eligible for HSIP funds if identified through a data-driven process.

The Federal share for highway safety improvement projects is 90 percent, certain types of highway safety improvement projects to be funded at 100 percent (i.e., traffic control signalization, traffic circles, safety rest areas, pavement marking, commuter carpooling and vanpooling, rail-highway crossing closure, or installation of traffic signs, traffic lights, guardrails, impact attenuators, concrete barrier end treatments, breakaway utility poles, or priority control systems for emergency vehicles or transit vehicles at signalized intersections). MAP-21 added two project types to this list that are eligible for 100 percent Federal share: (1) maintaining minimum levels of retroreflectivity of highway signs or pavement markings, and (2) shoulder and centerline rumble strips and stripes.

MDOT Safety Program

MDOT announces the solicitation of applications each year in June. Local Safety Program which uses federal funds for high safety improvements on local roadway system. All locally controlled roadways, regardless of National Functional Classification, are eligible for the Local Safety Program. Agencies may submit more than one project application for consideration.

Rural Task Force Program

The Rural Task Force Program provides federal dollars to rural counties with a population under 400,000 (78 out of 83 counties). These dollars must be spent in their geographic areas and both road and transit capital projects are eligible.

The money is provided within two funding sources:

Surface Transportation Program (STP) Rural for improving the federal aid system; and Transportation Economic Development Fund (TEDF) Category D for building an all-season network.

All project selection is through the Rural Task Force which is comprised of equal representation from the county road commission, the cities and villages under 5,000 population within the county, and the rural transit provider. http://www.michigan.gov/mdot/0,4616,7-151-9621_17216_54903-227096--,00.html.

Transportation Alternatives Program (TAP)

TAP is a competitive grant program that funds projects such as bike paths, streetscapes, and historic preservation of transportation facilities that enhance Michigan's intermodal transportation system, promote walkability, and improve quality of life for Michigan citizens. Eligible applicants include incorporated cities and villages, county road commissions, and public transit agencies. Other organizations can apply, but they must be sponsored by one of the eligible applicants as described.

Safe Routes to School (SRTS) Program

Safe Routes to School is combined with the Transportation Enhancements and Recreational Trails programs under Transportation Alternatives. Safe Routes to School activities are eligible for funding under Transportation Alternatives. Safe Routes to School (SR2S/SRTS) funds both infrastructure and non-infrastructure projects.

The purpose of the Safe Routes to School program is:

- To enable and encourage all children to walk or bike to school.
- To make bicycling and walking to school safer and more appealing alternative modes of transportation.
- To develop projects and encourage activities that will improve student health and safety while reducing traffic, fuel consumption, and air pollution in the vicinity of schools.

Small Urban

The Small Urban Program provides federal Surface Transportation Program (STP) funding to areas with populations between 5,000 and 49,999. Road and transit capital projects are eligible for STP funds.

Transportation Economic Development Fund (TEDF)

TEDF provides funding for transportation improvements that enhance the state's ability to compete in a global economy, promote economic growth and improve the quality of life in the State of Michigan.

Congestion Mitigation and Air Quality (CMAQ)

The CMAQ program funds transportation projects or programs that will contribute to the attainment or maintenance of the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide (CO), or particulate matter (PM). These projects will typically include:

- Transit investments, including transit vehicle acquisitions and construction of new facilities or improvements to facilities that increase transit capacity.
- Projects that improve traffic flow, including efforts to provide signal systemization, construct HOV lanes, streamline intersections, add turning lanes, and improve transportation systems management and operations that mitigate congestion and improve air quality.
- Non-recreational bicycle transportation and pedestrian improvements that provide a reduction in single-occupant vehicle travel.
- Establishment or operation of a traffic monitoring, management, and control facilities.

Source: https://www.fhwa.dot.gov/map21/guidance/guidecmaq.cfm

Appendix F: Summary of Stakeholder Meetings 1 and 2

GLS Region V Stakeholder Meeting # 1

Group Summaries

1. How do your traffic safety concerns align with the data presented?
    1) Lower early morning KA crashes – More B,C & PDO crashes
    2) Alcohol related crashes really high
    3) Under reported – distracted driving

2. What are the three most important concerns facing the region?
    1) Distracted driving – Young Drivers
    2) Road conditions
    3) Reactive system of funding
    4) Intersection Safety
    i. Signal timing review
    ii. Crash reduction
    5) Distracted driving
    6) Impaired Driving (drugs, alcohol)
    7) Inexperienced drivers
    8) Speeding

3. What do we need to be doing to address the safety issues of the future?
    1) Education / Outreach
    2) Funding
    3) Proactive system of funding
    4) Intersection Realignment of Skewed Intersections
    5) Driver Education (Young drivers)
    6) $$$ for engineering and enforcement
    7) Tech incentives used for safe driving

List of Concerns from Stakeholders

- Teen pedestrians
- Bus (Transit) Safety
- Distracted driving (7 checkmarks)
- Training for responders
- M-15 + Green Rd
- Roundabouts
- We need $ - systemic
- Freeway crashes
- Intersections
- Trucks on M-57 (near landfill)
- Work Zone safety (1 checkmark)

- Pavement conditions
- School bus safety
- Teen drivers
- Intoxicated drivers (1 checkmark)
- Senior drivers
- M-24 / Teri
- Dark signals
- Lack of funding
- Reactive nature of funding
- Bike / Ped safety
- Autonomous vehicles
- M-15 – passing on shoulder
- Red light on school districts
- Speeding / traffic calming
- Fixed objects
- Intersections

GLS Region V Stakeholder Meeting # 2

Group 1

1. Identify top three high priority emphasis areas

    1) Intersection
    2) Lane departure
    3) Young drivers (16-24)

2. What strategies have you applied and worked in your area?

    1) Sidewalk M-54
    2) Pedestrian crashes
    3) More lights at intersections
    4) Long yellow signal at intersection
    5) Cable median barrier
    6) Removing unwarranted signals
    7) Centerline and shoulder rumble strips
    8) TZD presentations to local stakeholders
    9) Getting into communications schools to educated
    10) County notifications – proper reporting
    11) Public awareness of crashes
    12) More trainings, laws, education for young drivers
    13) Driver education training
    14) Traffic enforcement zones
    15) Radar trailers
    16) TIM responder training
    17) New technology at signalized intersections
    18) Lollipops/rumble strips at non-signalized intersections

3. What strategies have you applied and didn't work in your area?

    1) Posting same safety message all month
    2) UD 23 Lee Rd roundabout
    3) Multi-lane roundabout

4. Identify top ten strategies for the plan

    1) Rumble strips
    2) Sidewalk along U54
    3) Signals – more longer yellows
    4) TIM responder training
    5) Traffic enforcement zones
    6) Radar trailers – speed
    7) Public awareness of crashes
    8) Driver education training – increase crash awareness education
    9) Cable median barrier
    10) Remove unwarranted signals

Group 2

1. Identify top three high priority emphasis areas

    1) Intersection
    2) Lane departure
    3) Young drivers (16-24)

2. What strategies have you applied and worked in your area?

    1) Traffic lights
    2) Intersection
        i. High cost – roundabouts
        ii. Low cost – flashers, signs
    3) Better lighting at intersections stop signs
    4) Posted speed limits
    5) Promo videos to younger drivers – high school
    6) High school drunk driving
    7) Social media norms
    8) Increase visibility
    9) Officer training (ouid drugs)
    10) Review application for liquor license
    11) Increased signage

3. What strategies have you applied and didn't work in your area?

    1) Traffic control devices, signal placement, timing
    2) Alcohol
        i. Liquor control commission did not practice due diligence
    3) Roundabout
    4) Distracted driving targeted enforcement (jury still out)

4. Identify top ten strategies for the plan

1) Intersection (Roundabout, flasher signs/markings)
2) Traffic lights
3) Intersection lighting
4) Increased signage
5) Social media – Young drivers
6) Increase visibility
7) Better review application for liquor license
8) DUI training for officers
9) Promo videos to younger drivers/prom drunk driving

Group 3

1. Identify top three high priority emphasis areas

1) Intersection
2) Lane departure
3) Pedestrian
4) Impaired driving crashes (Alcohol and Drug related)

2 What strategies have you applied and worked in your area?

1) Wide shoulder
2) Lighting
3) Rumble strips centerline and shoulder
4) Culvert and sections headwalls
5) Ditch slopes
6) Road diet
7) Signs
8) Solar flashers
9) Roundabouts
10) Signal timing
11) Signal removal
12) Pavement markings
13) Enforcement (alcohol, speed, red light running)
14) Increased patrol, select enforcement
15) License renewal testing
16) DMS signs with fatality counts
17) Increased statewide UD10 training
18) Mi-TIME training
19) 2 tier driver license

3. What strategies have you applied and didn't work in your area?

1) Jail over crowding
2) Raising the speed limit
3) Plea deals in court systems
4) Current laws don't work – enforcement
5) Lack of communication to partners

4. Identify top ten strategies for the plan

    1) Intersection
        i. Signs
        ii. Lighting
        iii. Pavement markings
        iv. Education on signal operation (e.g. flashing arrow)
        v. Signal warrants
        vi. Signal timing
    2) Rumble strips (centerline and shoulder)
    3) Drug recognition experts
    4) Targeted enforcement
    5) Education (young, senior, targeted)

Prioritize Strategies and Votes

1. Rumble strips (centerline and shoulder) -12
2. Social media – Young drivers - 11
3. Targeted enforcement - 11
4. Education (young, senior, targeted) - 11
5. Remove unwarranted signals – 9
6. Intersection lighting - 8
7. Promo videos to younger drivers/prom drunk driving - 7
8. Public awareness of crashes - 6
9. Traffic enforcement zones -5
10. Increase visibility - 5
11. Signals – more longer yellows -4
12. Cable median barrier - 4
13. TIM responder training - 4
14. Intersection (Roundabout, flasher signs/markings) - 4
15. Radar trailers – speed -3
16. Better review application for liquor license - 3
17. Drug recognition experts -3
18. Driver education training – increase crash awareness education - 2
19. Intersection

a. Signs -1
    b. Education on signal operation (e.g. flashing arrow) -3
    c. Signal warrants
    d. Signal timing

20. Traffic lights
21. Increased signage
22. DUI training for officers
23. Sidewalk along U54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REGION V
PLANNING & DEVELOPMENT COMMISSION