U.S. Department of Transportation
Federal Highway Administration

Chemung County, New York
Local Road Safety Plan

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- City of Elmira Fire Department
- Town of Elmira, Villages of Horseheads, and Elmira Heights Highway
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- Bicycle Pedestrian Advisory Council

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16. Abstract

This report was developed at the request of and in cooperation with Chemung County, New York. The Chemung County Local Road Safety Plan (LRSP) is a comprehensive plan that uses targeted countermeasures to reduce fatalities and serious injuries resulting from crashes that occur along the roadway system in the County. Chemung County developed the LRSP as a comprehensive effort to determine the priority locations for investing the County's safety project resources. As a safety stakeholder for developing and implementing New York's SHSP, Chemung County's investment in infrastructure, behavioral education, enforcement, and other transportation safety activities supports the State's vision of zero roadway deaths. Chemung County is dedicated to transportation safety efforts, and its mission is to ensure a safe and sustainable transportation system for all motorized and non-motorized users on public roads throughout the County. This LRSP will support that mission. While the LRSP proposes a 5-year implementation plan, the plan is a living document and can be amended if additional information and funds become available. The LRSP will enhance and guide the future of transportation safety efforts in Chemung County, reducing roadway fatalities and injuries and leading to zero deaths.

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Executive Summary

In Chemung County, NY, motor vehicle traffic injuries are the fourth leading cause of injury-related deaths. The county experienced 5 roadway fatalities in 2017. Between 2011 and 2015, which is the analysis period of this LRSP, there were 44 roadway fatalities in Chemung, with 21 of them occurring on county-owned roadways. The purpose of this local road safety plan (LRSP) is to serve as a guide and roadmap for Chemung County to improve roadway safety by reducing fatalities and serious injuries on their roadway network.

New York State's 2017 Strategic Highway Safety Plan (SHSP) commits to data-driven safety programs to reduce the 5-year moving averages for the number of fatalities and serious injuries by 2 percent annually during the 2017-2022 timeframe. This Local Road Safety Plan (LRSP) will make it possible for Chemung County to support New York State's SHSP goals as a partner, by planning and implementing effective safety projects.

The development of Chemung County's LRSP involved engagement of various stakeholders and consisted of multiple steps. This process included a kickoff meeting followed by:

- A document review of County and State safety plans, programs, policy information, and activities.
- Data analysis to identify focus crash types.
- A workshop to select potential safety countermeasures.
- Development of a project list of locations that exhibit focus crash types and planned safety projects.
- Compiling these findings to complete the LRSP.

The crash data for the years 2011 through 2015 were analyzed for the LRSP development. Using the data analysis results, as presented in Figure 1, and keeping in mind New York State's SHSP emphasis areas, Chemung County selected the following as the five main emphasis areas:

- Lane departure crashes.
- Intersection safety.
- Pedestrian and bicycle safety.
- Speeding and aggressive driving.
- Age-related crashes.

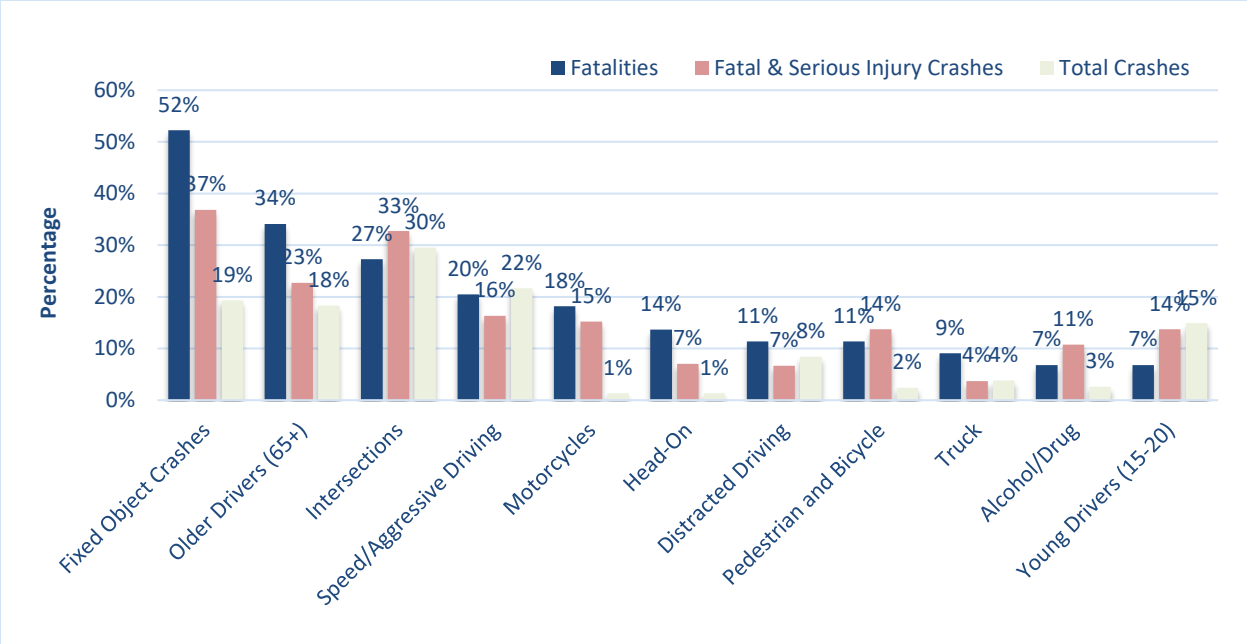

Figure 1. Crashes Occurring in Chemung County by Severity and by Type, 2011-2015.

Using resources from the FHWA's Office of Safety website, the PEDBIKESAFE website, the CMF Clearinghouse, and the National Highway Traffic Safety Administration (NHTSA), stakeholders reviewed, discussed, and approved potential groups of countermeasures based on 1) selected emphasis areas, 2) factors contributing to crashes and crash types, and 3) site observations.

Data analysis, including crash history details and systemic prioritization,[1] coupled with proposed safety improvements at specific locations and an assessment of projected cumulative project costs, guided the selection of safety projects included in this plan. By vetting the data analysis and site review findings and by engaging in extensive discussion with stakeholders, the County finalized a list of safety improvement targets that includes 33 urban segments, 45 rural segments, 32 urban unsignalized intersections, and 11 urban signalized intersections.

Chemung County plans to budget approximately $1,000,000 annually for prioritizing and addressing the improvements recommended in this plan over a 5 year period. In addition, the County may look for opportunities to incorporate recommended safety strategies into already planned projects such as regular maintenance projects or resurfacing projects.

Chemung County will establish and monitor performance measures to assess the effectiveness of the results as the plan is implemented. The County will engage and work together with partner agencies and safety stakeholders to move towards zero deaths. This partnership and collaboration is critical to achieving both New York State's SHSP and Chemung County's safety goals.

[1] A systemic approach to safety involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The proactive approach helps agencies broaden an agency's traffic safety efforts at relatively low cost and is effective in preventing crashes before they happen.

While the LRSP proposes a 5-year implementation plan, the plan is a living document and can be amended if additional information and funds become available. The LRSP will enhance and guide the future of transportation safety efforts in Chemung County, reducing roadway fatalities and injuries and leading to zero deaths.

Chemung County
Local Road Safety Plan

1. Introduction

In Chemung County, NY, motor vehicle traffic injuries are a serious public health problem: they are the fourth leading cause of injury-related deaths. Between 2011 and 2015, Chemung County experienced 44 roadway fatalities, with 21 of them occurring on county-owned roadways. These crashes, in addition to being a significant cause of death, pain, and suffering, are also an economic burden to Chemung County. In 2014, the crashes on Chemung County's roadways resulted in $1.8 million in hospitalization and emergency department (ED) costs.[2]

Figure 2. Map of Chemung County, New York. (© 2018 Google)

Statewide, motor vehicle traffic crashes are the leading cause of injury-related death, even though New York State has managed to lower the number of fatalities consistently over the past 10 years. In 2016, New York roadways experienced 965 fatal crashes that resulted in 1,025 deaths, 9 percent lower than the death toll of 1,121 in 2015, reversing the 8 percent increase that occurred from 2014 to 2015, a time

[2] New York State Dept. of Health. 2014. "Motor Vehicle Traffic Injuries Chemung County Roadways 2014." Available at: https://www.health.ny.gov/statistics/prevention/injury_prevention/traffic/county/chemung/2014/chemung_co_crash_fs.pdf

period in which the number of fatalities on Chemung County local roads saw an increase, as shown in Figure 3.

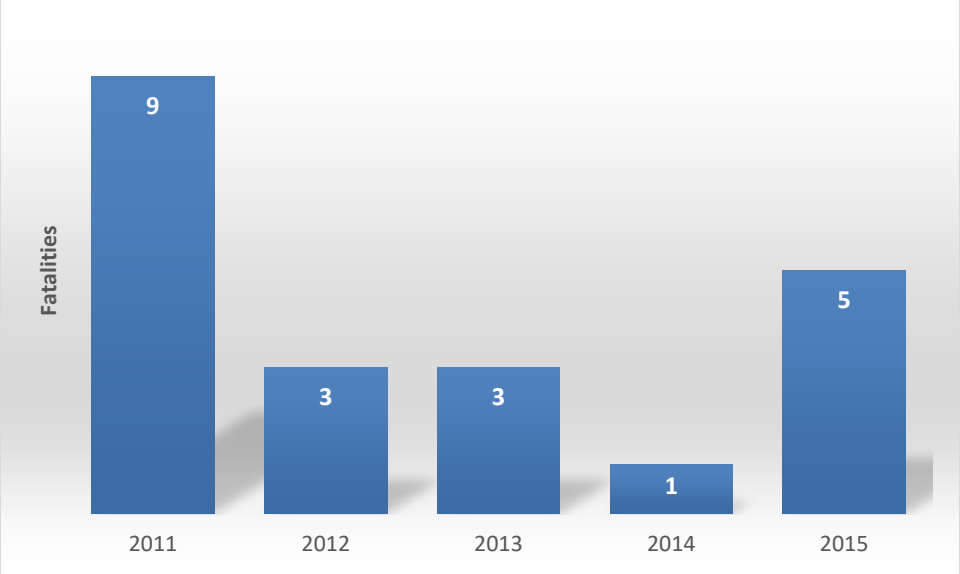

Figure 3. Number of Fatalities Occurring on Local Roads in Chemung County, New York, 2011-2015.

New York State's 2017 Strategic Highway Safety Plan (SHSP)[3] explains the State's planning process and the strategies that led to a decrease in fatalities and fatal crash rates over the past decade. Yet, the SHSP also acknowledges that there is room for improvement, given the fact that one death is too many when it comes to roadway fatalities. New York State's SHSP commits to data-driven safety programs to decrease the number of injuries and fatalities on New York's roadways and invites all partners to work in coordination, to communicate and collaborate with shared responsibility, and to leverage resources among the group. The 2017 New York State SHSP's vision is to ensure that roadway safety is a top priority in all 4Es of safety—engineering, education, enforcement, and emergency medical service activities. To support this vision, the SHSP establishes five clear targets that are aligned with the Highway Safety Improvement Program (HSIP). The State plans to achieve these targets over the next five years, or by the end of 2022. During the 2017-2022 timeframe, New York State is seeking to reduce the 5-year moving averages for the number of fatalities and serious injuries by 2 percent annually.

[3] NYSDOT. n.d. "New York State, Strategic Highway Safety Plan 2017-2022." Available at: https://www.dot.ny.gov/divisions/operating/osss/highway-repository/NYS_SHSP_TotalReport.pdf.

Table 1. 2017 New York State SHSP Goals.

Target Area	5-year moving average in 2015	SHSP Target for 5-year moving average in 2022
Number of Fatalities	1,143	992
Rate of Fatalities per 100 million vehicle miles traveled	0.89	0.78
Number of Serious Injuries	11,547	10,024
Rate of Serious Injuries	8.99	7.81
Number of Non-motorized Fatalities and Non-motorized Serious Injuries	2,872	2,493

Historically, State departments of transportation (DOT) have led efforts related to safety management and implementing safety improvement strategies, but in order to continue to reduce traffic fatalities, it is imperative that county and local agencies become involved in developing strategies and deploying appropriate safety countermeasures on their roadway networks as well.

This Local Road Safety Plan (LRSP) will serve as a roadmap for Chemung County to achieve their safety-related goals—discussed in the following *Background* section—which align with New York State's SHSP goals to reduce traffic fatalities and serious injuries.

1.1 Background

1.1.1 Nationwide Focus on Road Safety

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) established the requirement for States to develop SHSPs and to report fatality and serious injury data on both State and local roadway systems. The provisions of the Moving Ahead for Progress in the 21st Century (MAP-21) Act continued to require that States develop SHSPs and use the basic plan elements established in SAFETEA-LU, such as accounting for all roads, focusing on data-driven approaches, and involving multidisciplinary stakeholders. MAP-21 also established roadway safety as a national goal, required the Secretary of Transportation to establish national safety performance measures, and mandated that State DOTs determine targets for those performance measures. The latest reauthorization bill – Fixing America's Surface Transportation (FAST) Act, continues these performance measure requirements. States collaborate with their regional planning partners (a Federal requirement) to establish targets for the safety performance measures: number and rate of fatalities, number and rate of serious injuries, and number of bicycle plus pedestrian fatalities.

As an integral safety stakeholder for developing and implementing the State's SHSP, Chemung County's investment in infrastructure, behavioral education, enforcement, and other transportation safety activities support the State's roadway safety targets and long-term vision to integrate the safety culture into all 4-E's.

1.1.2 Chemung County

Chemung County comprises a few urban areas surrounded by more rural settings. The county has approximately 88,000 residents, and Elmira is the largest city with approximately 30,000 residents. The County maintains 250 miles of roads—most having two lanes—with the vast majority being paved or otherwise hard surfaced. The County also maintains urban corridors that have up to four lanes and that intersect several major roads. These corridors are generally signed for 40 mph speed limits, and cross streets typically have large volumes and heavy pedestrian/bicycle traffic.

The Town of Big Flats, a retail area, is mostly served by the county road system, which includes two roads with the highest traffic volume in the county. Overall, the transportation system for the town was mainly designed for and carries motor vehicle traffic, although some bicycle traffic is also present. In some cases, right of way and clear zones are extremely limited, with most houses being approximately 10 feet from the edge of the road.

The Elmira-Chemung Transportation Council (ECTC), the region's metropolitan planning organization (MPO), plays a significant role in the County's transportation planning and project selection activities. The *Elmira-Chemung Transportation Plan 2035*[4] is a 20-year, long-range transportation plan developed by the ECTC in 2015. "Using a system-driven approach to ensure the safety and security of the transportation system for all users" is one of the goal statements to guide the implementation of the ECTC's long range plan.

Relevant objectives under this ECTC goal, stated in the *Elmira-Chemung Transportation Plan 2035,* align closely with the State's SHSP targets:[5]

- Objective 1.1: Reduce the number of fatalities and serious injuries resulting from motor vehicle crashes in each 5-year period from 2020 to 2035, using 2015 to 2019 as the base 5 years.
- Objective 1.2: Maintain the low number of pedestrian crashes that result in death or personal injury in each 5-year period from 2020 to 2035, using 2015 to 2019 as the base 5 years.
- Objective 1.3: Maintain the low number of bicycle crashes that result in death or personal injury in each 5-year period from 2015 to 2035, using 2010 to 2014 as the base 5 years.
- Objective 1.6: Improve work zone safety by reducing the number of work zone motor vehicle crashes in each 5-year period from 2020 to 2035, after establishing a base in the period 2015 to 2019, and providing work zone safety training for all workforce employees that operate the system.

Upon review of SHSP goals and ECTC goals, attendees at the Chemung County LRSP development workshop determined the **mission, vision,** and **goals** for this LRSP as shown below:

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[4] Elmira-Chemung Transportation Council. 2015. *Elmira-Chemung Transportation Plan 2035*. Available at: https://www.3riverscorp.com/sites/default/files/pictures/Elmira-Chemung%20County%20Transportation%20Plan%202035.pdf

[5] NYSDOT. n.d. "New York State, Strategic Highway Safety Plan 2017-2022." Available at: https://www.dot.ny.gov/divisions/operating/osss/highway-repository/NYS_SHSP_TotalReport.pdf

Vision: Chemung County will work toward zero deaths.

Mission: To implement and maintain a data-driven 4E (engineering, enforcement, education, and emergency medical services) approach to safety that will provide a safer and more sustainable transportation system for all motorized and non-motorized users on all public roads in the County, and to improve infrastructure and assist with behavior change by focusing efforts in those areas where the greatest opportunity for reductions in traffic-related fatalities and severe injuries exist.

Goal: The goal of Chemung County's LRSP is to

1) Contribute to the New York SHSP in meeting their 2022 targets, and;

2) Achieve the long-term vision of zero fatalities and serious injuries on the public roadways in the County.

1.2 State SHSP, Regional Safety Plan, and County LRSP Connection

The 2017 New York State Strategic Highway Safety Plan (SHSP) organized their emphasis areas in seven main groups with the greatest potential to reduce roadway fatalities and injuries. The project team referenced these seven areas when identifying the County's LRSP emphasis areas:

- Intersection safety.
- Lane departure crashes.
- Vulnerable user (including pedestrians, bicyclists, motorcyclists, and individuals working in a work zone) safety.
- Age-related crashes.
    - Young drivers.
    - Older drivers.
- Road user behavior (including alcohol and drug impairment, distracted driving, cell phone usage, and drowsy driving).
- Speeding and aggressive driving.

The 2017 SHSP also discusses cross-cutting considerations and emerging areas. Emergency medical services, traffic incident management, connected and autonomous vehicles, and improvements to data systems (collection, management, analysis, and evaluation) are included as cross-cutting considerations that span all emphasis areas and have associated emerging issues.

New York's roadways, a network of approximately 115,000 lane miles, are made up of both a State- and locally-owned system. The State-owned system is approximately 15,000 miles, making up just 13 percent of the system, and is the responsibility of New York State Department of Transportation (NYSDOT). The remaining 87 percent of lane miles are locally owned by cities, counties, towns, and other municipalities. Of the locally owned roads, around 18 percent belong to the counties, while cities, and towns own 67 percent.

1.3 Other Local Efforts

This section summarizes some existing efforts relating to transportation planning and roadway safety that directly or indirectly affects the development and implementation of the Chemung County Local Road Safety Plan.

Analyzing the performance of a County's current roadway safety activities is critical to determining whether a practice is successful and should be continued or unsuccessful and should be modified or discontinued. Such analysis can also provide insight on potentially innovative approaches for the county to undertake in implementation of this plan and ensures that the proposed projects do not overlap with any already planned and funded improvements. They also support efforts to identify opportunities to integrate proposed projects into ongoing or already planned projects, offering the opportunity to leverage economies of scale and other cost and time efficiencies.

Elmira-Chemung Transportation Plan 2035: The objective of the ECTC's Elmira-Chemung Transportation Plan 2035**,** is to ensure the safety and security of the transportation system for all users. To reach this objective, each year, the ECTC helps to develop emphasis areas for the Chemung County Traffic Safety Board (CCTSB) and compiles grant applications to the Governor's Traffic Safety Committee (GTSC). Previously, GTSC funding was used to develop the Geographic Information System (GIS) Crash Reporting System and to fund police overtime costs related to enforcement of child safety seat and bicycle helmet use laws. This LRSP assumes that such funding may be available in the future for the enforcement countermeasures proposed in this plan. ECTC also makes equipment purchases that improve safety, such as bicycle helmets, safety strobes, and equipment for bicycle rodeos[6] and provides the conduit for purchasing speed feedback signs. Local agencies, including Chemung County, may purchase these signs using Federal, State, and local funding.

Traffic Signals: Routinely inspecting and maintaining traffic signals at signalized intersections as well as other traffic control devices can help ensure a safe, efficient transportation system. Under a formal shared services agreement, the City of Elmira maintains the County's traffic signals. NYSDOT owns and operates three traffic signals on the County roadway system due to the proximity of these intersections to State highways. The Chemung County Department of Public Works owns and operates 12 traffic signals, 2 permanently mounted speed feedback signs, 2 portable speed feedback signs, and 6 portable variable message signs. These devices are deployed at intersections and corridors throughout the county road network, with the locations of portable equipment varying based on need (e.g., maintenance work, public complaints about speeding on specific roadways, etc.).

[6] A bicycle rodeo is a skills event that gives children the opportunity to practice and develop skills that will help them to become better bicyclists and avoid the most common types of crashes among children. These include riding out of a driveway without stopping, failing to stop for stop signs, and suddenly swerving out into the street without first checking for cars. Other common causes include riding on the wrong side of the street and riding at night without proper lighting and reflective clothing.

In June of 2012, Chemung County completed a Traffic Signal Evaluation of all signals owned by both the County and the Villages of Elmira Heights and Horseheads.[7] This study, funded by the Elmira-Chemung Transportation Council, served as a blueprint for improvements and provided a conduit to obtain State and Federal funding. In early 2017, Chemung County updated this report by including an evaluation of what has been implemented since 2012 and an update to previously provided phased cost estimates to update the signals to current standards. It obtained funding for phase 1 in 2017. During the development of this LRSP, the improvements proposed by this evaluation were taken into account to avoid duplication.

Chemung County does not currently own or operate any street or intersection lighting. The towns, villages, and City are responsible to install and operate any street lighting.

The projects on non-County local roads are fine provided the locality formally agrees to operate and maintain the improvements after installation. (The County will seek funding for installation.)

Roundabouts: New York has recently begun implementing roundabouts. Both roundabouts and mini roundabouts are effective at reducing vehicle speeds and addressing intersection crash problems when deployed at appropriate locations, but public education and outreach is important for success.

The City of Elmira recently installed several mini roundabouts. Although the city faces continuing public opposition, the installations have been operating well and have successfully calmed traffic on a corridor that is only one block away from a school. The City will also be installing a full-sized roundabout in its downtown area in 2019.

NYSDOT has installed four roundabouts in Chemung County on the State road system. These roundabouts have been functioning well, although additional driver education may be needed. Chemung County plans to install two additional full-sized roundabouts by 2020: one on a County road and the other on a State road between two existing roundabouts.

NYSDOT Pedestrian Safety Action Plan: Like the State as a whole, Chemung County has a strong focus on pedestrian safety. One of the challenges associated with pedestrians in the County is that pedestrians do not always take the necessary safety precautions or abide by common traffic laws. NYSDOT developed a pedestrian safety action plan using a systemic approach and local data, but it is targeted to State roads only.[8] However, drawing from this plan, the County currently considers and experiments with various types of safety countermeasures, including pedestrian countdown timers, crosswalk installations or improvements, edge line striping, realignment of roadways (curves) and intersections, and alternative manhole and catch basin designs (to address bicycle crashes). Additionally, Chemung

[7] Traffic Signal Evaluation Study, Elmira-Chemung Transportation Council, Fisher Associates, June 2012. Available at: https://www.chemungcountyny.gov/document_center/DPW/2012%20Traffic%20Signal%20Evaluation.pdf

[8] New York State Dept. of Transportation, Dept. of Health, and Governor's Traffic Safety Committee. 2016. *New York State Pedestrian Safety Action Plan*. Available at: https://www.ny.gov/sites/ny.gov/files/atoms/files/pedestriansafetyactionplan.pdf

County acknowledges that educating bicyclists and pedestrians on proven traffic safety practices and laws will be beneficial.

Data Collection and Analysis: The County is interested in employing systemic data analysis to proactively identify locations that have a greater risk of experiencing a fatal or severe crash. To complete this approach, Chemung County has a variety of available data, including crash data, roadway inventories in GIS, and traffic volume counts. All New York State Department of Motor Vehicles crash records are geo-located, including those within Chemung County, and many local roads have had traffic volumes collected. Municipalities within Chemung County have extensive geographic information (GIS) records for assets such as bridges and signals. The County periodically submits its data and inventory to the State. The County has experienced a relatively small number of fatalities and crashes, but a higher percentage of crashes per VMT (vehicle miles traveled) than many other areas. The ECTC maps and GIS website provides an overview of the roadway system, including maps for all contractual location-specific work, maps used in the last two Long Range Plans (2004 & 2009), and GIS versions of all maps provided on the website. This wide range of data also comprises the primary data sources and types for developing emphasis areas, focus crash types, focus facility types, and systemic risk factors for this LRSP.

The Elmira-Chemung Transportation Plan 2035 indicates Chemung County is using systemic analysis to identify project locations based on roadway crashes, lane departure crashes, and pedestrian and bicycle crashes.[9] The plan also includes a set of recommendations for improving mobility on highways and among bicyclists and pedestrians.

Safety Projects in the Transportation Improvement Program (TIP): The ECTC Transportation Improvement Program (TIP) contains the list of projects being considered for implementation in the County for a 5-year period in each of several Federal-aid funding categories. Local project selection is largely a result of activities prescribed in the Unified Planning Work Program and the *Elmira-Chemung Transportation Plan 2035*. The project selection process will result in programming several pavement marking projects that can improve roadway safety. Other projects listed in the TIP includes bridge maintenance and repair, pavement re-surfacing, culvert work, and airport-related activities.[10]

These existing efforts of the County and its stakeholders acknowledge their commitment to road safety and paves the way for the development and implementation of this LRSP. These efforts also provide insights on the type of countermeasures and policies that can fit better into the current situation and maximize the safety benefits by functioning in harmony with on-going efforts.

[9] Elmira-Chemung Transportation Council. 2014. "Elmira-Chemung Transportation Plan 2035, Challenges and Opportunities," pp. 101-111. Available at: https://www.3riverscorp.com/sites/default/files/pictures/Elmira-Chemung%20County%20Transportation%20Plan%202035.pdf

[10] Elmira-Chemung Transportation Council. n.d. "Transportation Improvement Program FFY 2017 – FFY 2021." Available at: https://www.chemungcountyny.gov/document_center/Transportation%20Council/TIP%202017-2021.pdf

1.4 Safety Partners/Stakeholders

To create an actionable plan that covers all 4Es of safety, a diverse group of stakeholders from these areas was consulted during the development of the LRSP. The extensive list of Chemung County's safety partners and stakeholders include:

- Federal Highway Administration (FHWA)
- Federal Transit Administration (FTA)
- National Highway Traffic Safety Administration (NHTSA)
- The New York State Department of Transportation (NYSDOT)
- The Governor's Traffic Safety Committee (GTSC)
- The Institute for Traffic Safety Management and Research (ITSMR)
- The New York State Police (NYSP)
- Chemung County Sheriff's Office (CCSO)
- Elmira Police Department (EPD)
- The NYS Department of Health (NYSDOH)
- Elmira-Chemung Transportation Council
- Cornell Local Roads Program
- The NYS Department of Motor Vehicles (NYSDMV)
- Bicycle Advisory Council and Pedestrian Advisory Council (BACPAC),
- City of Elmira's Lackawanna Rail Trail Committee
- New York State Association of Metropolitan Planning Organizations (NYSAMPO),
- Empire State Development Corporation
- New York State Department of Environmental Conservation
- Elmira-Corning Regional Airport
- Chemung County Transit System
- Erway Ambulance

2 Methodology and Approach

Local road safety plan (LRSP) development is a methodical, repeatable process designed to verify that a variety of stakeholder needs and inputs are considered, the plan is actionable, and the results are measurable. The overall steps of the LRSP development process shown below guided development of the Chemung County plan.

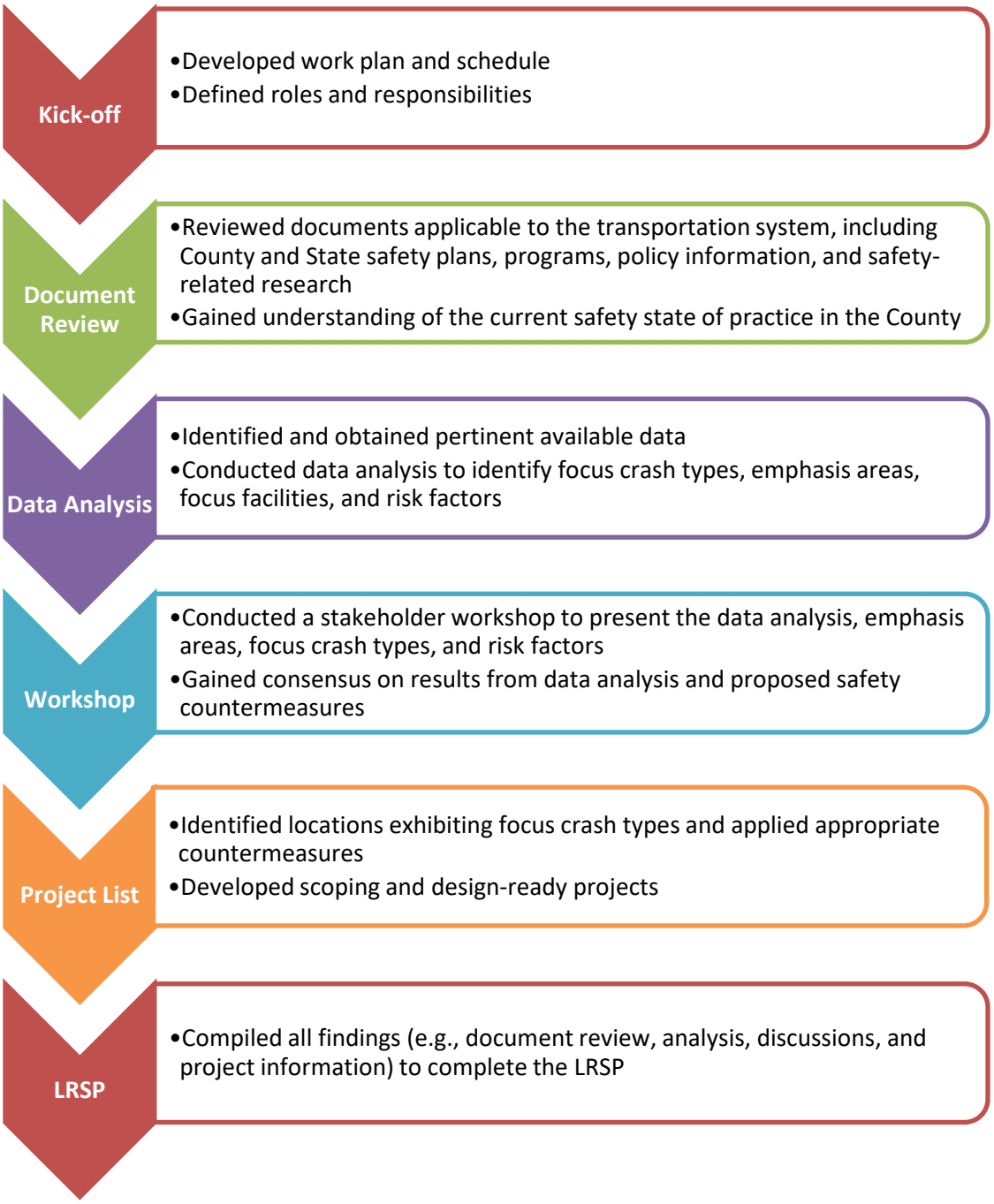

Figure 4. Development Steps for the Chemung County Local Road Safety Plan.

2.1. Data and Analysis

Data and their analysis play a crucial part in LRSP development and are is used to identify existing and emerging safety issues, determine potential improvement locations, and prioritize and address the locations and issues within budget. However, the effectiveness of the analysis results greatly depend on the comprehensiveness, quality, and the accessibility of the available data.

The available data sources and types analyzed for this LRSP include:

- NYSDOT Crash Database (GIS)
- County Maintained Roadway Inventory (GIS)
- County Master Intersection Snapshot (GIS)

The crash data supplemented with the roadway and intersection inventory data was analyzed to gain insight into the distribution and characteristics of the crashes that have occurred in Chemung County. Crash data for 2011-2015 (the most recent 5-year period at the time) on non-State owned (locally-owned) roads in Chemung County was analyzed for the LRSP development.

2.1.1 Crash Summary

In Chemung County, 69 percent of crashes occurred on locally owned roads. Intersections accounted for 33 percent of the total crashes by type on roads owned by the county from 2011-2015 (Figure 5). Nineteen percent of total crashes resulted from speeding and aggressive driving, while older drivers also accounted for 19 percent of total crashes. Fixed object crashes followed closely behind, accounting for 18 percent of crashes, and young drivers contributed to 16 percent of total crashes on county roads.

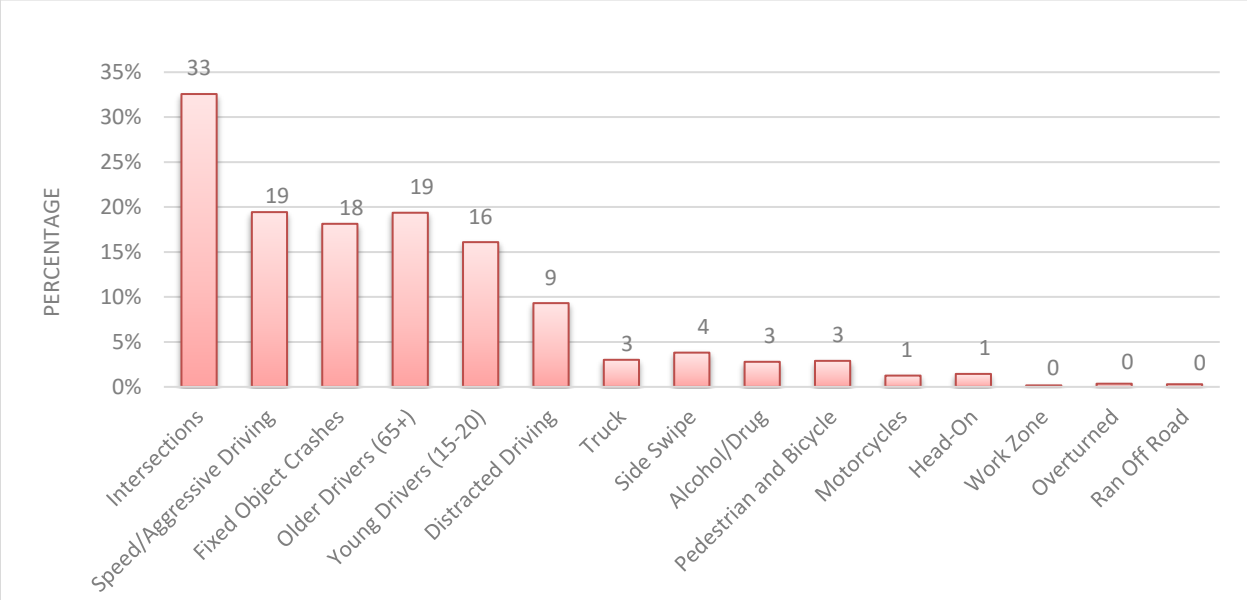

Figure 5. Distribution of Total Crashes on Chemung County Local Roads by Emphasis Area, 2011-2015.

In Chemung County, 47 percent of fatalities occurred on locally owned roads. Crashes in which the vehicle hit a fixed object accounted for 81 percent of all fatalities on roads owned by Chemung County (Figure 6) and 52 percent of all fatalities within the county. Speeding and aggressive driving accounted

for 29 percent of fatalities on locally owned roads, while intersections and motorcycle crashes accounted for 24 percent of fatalities. Nineteen percent of fatalities involved older drivers, and 14 percent resulted from distracted driving.

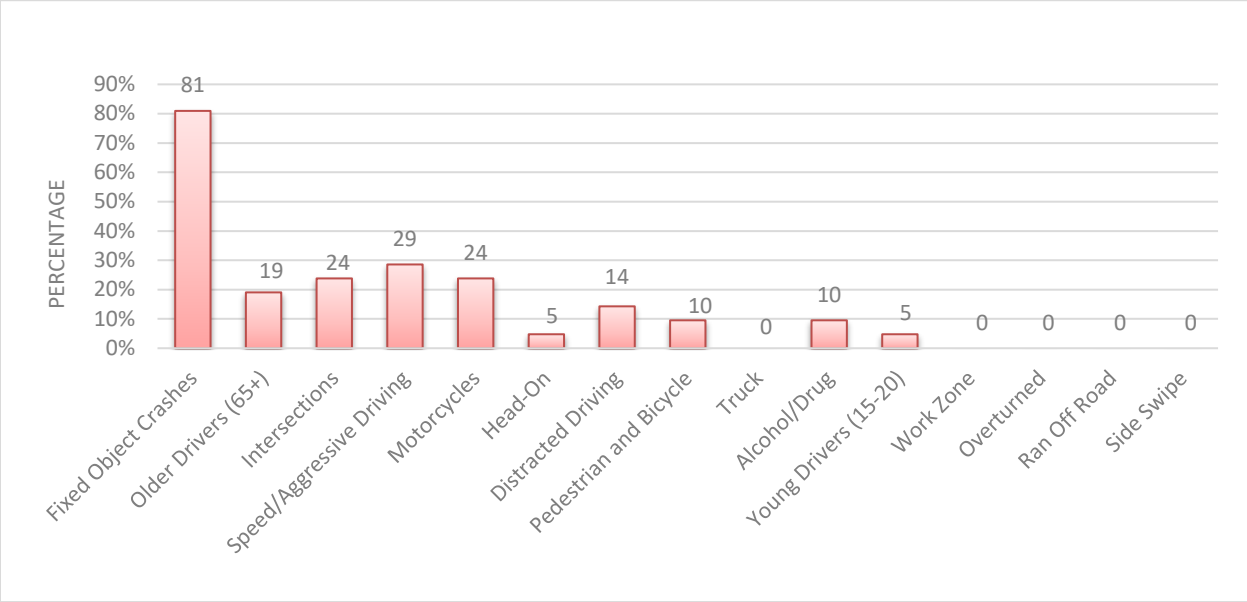

Figure 6. Fatalities by Crash Type on Chemung County Local Roads, 2011-2015 (n = 21).

In Chemung County, 62 percent of fatal and serious injury crashes occurred on locally owned roads. As depicted in Figure 7, 40 percent of fatal and serious injury crashes occurred on locally owned roads in the County are fixed object crashes, while 37 percent occurred at intersections and 19 percent involved older drivers. Crashes involving speeding and aggressive driving, motorcycles, and young drivers each accounted for 17 percent of fatal and serious injury crashes.

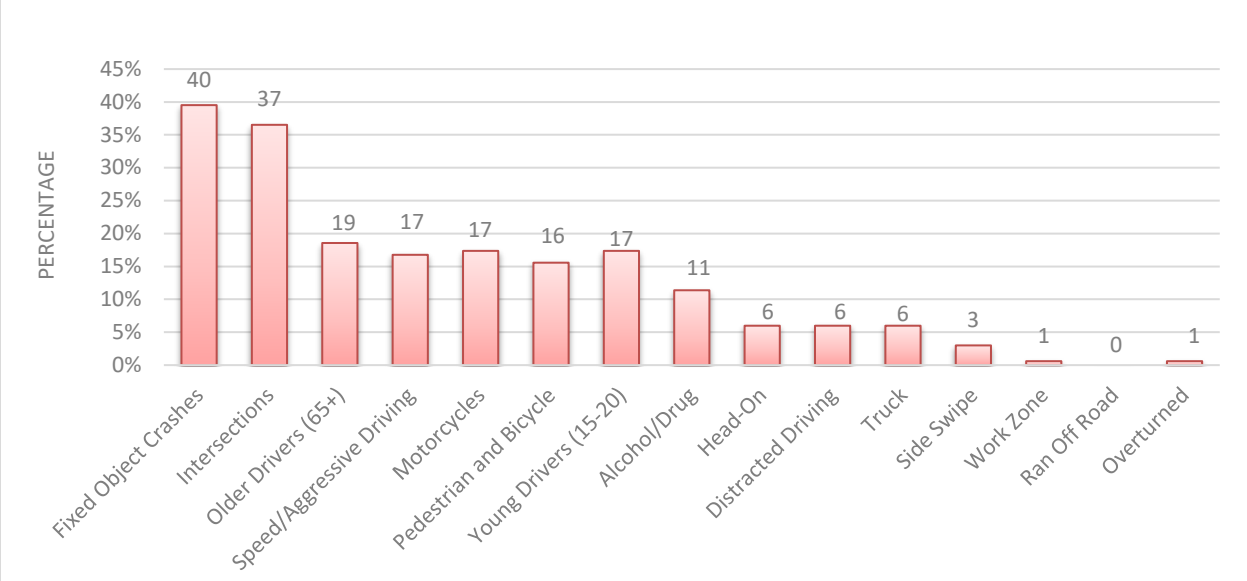

Figure 7. Distribution of Roadway Fatality and Serious Injury Crashes on Chemung County Local Roads by Type, 2011-2015 (n = 167).

3 Emphasis Areas, Focus Crash Types, and Risk Factors

To develop an actionable and comprehensive plan, a multi-step process was followed as depicted in Chapter 2 Methodology section of this plan. The data analysis and literature review findings lead to identification of 1) emphasis areas, 2) focus facilities and 3) the types of crashes that were overrepresented on each. The process followed with 4) identifying high-risk factors for these crash types and 5) analysis of the roadway data inventory to locate sites with high risk factors for each of the focus crash types (within the selected emphasis areas) among the determined focus facilities.

Figure 8 presents the distribution of crash types for all three severity categories (fatalities, fatal + serious injury crashes, total crashes) in a single combined chart. These crash type categories are not mutually exclusive; some crashes may fall into more than one category, so the total distribution shown does not equal 100 percent. The top five crash types for each severity category are ranked and labeled in Figure 8.

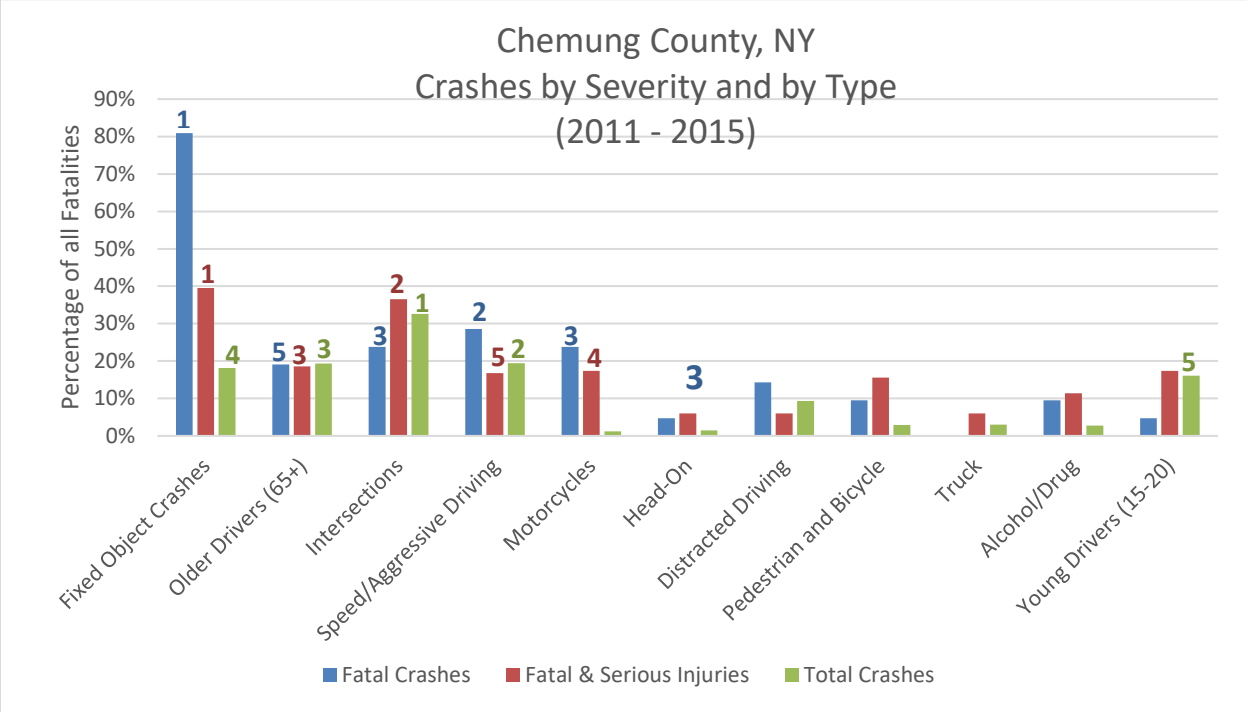

Figure 8. Crashes by Severity and Type on Chemung County Local Roads, 2011-2015.

3.1 Determining Emphasis Areas

Whether looking at all roads or local roads, the top emphasis areas generally remain the same regardless of crash severity. The most notable difference is that crashes involving motorcycles rank higher when considering local roads. Also, speeding and aggressive driving is not in the top three emphasis areas for contributing to severe crashes for all the roads in the County regardless of ownership; however, it emerges as an important contributor to roadway fatalities and injuries on local

roads only. Whether looking at all roads or local roads, the lane departure emphasis area (fixed object, head-on, and run off-road) accounts for a majority of fatal and serious injury crashes.

Table 2 compares the Chemung County data results with statewide data. The green highlighted emphasis areas were selected during the emphasis area meeting. The yellow-shaded cells denote the top emphasis areas based on crash frequency (fatal + serious injury) for Chemung County, while the gray-shaded cells denote emphasis areas identified in the New York State SHSP.

Although motorcycles are in the top five potential emphasis areas, the County opted not to include it. Chemung County stakeholders believe that the countermeasures applied to reduce lane departures, speeding, and intersection crashes will likewise improve motorcycle safety as well. The County selected pedestrians and bicycles as an emphasis area because safety among these road users has become an important issue for communities in Chemung County.

Table 2. Chemung County Road Safety Emphasis Area Analysis.

	New York State		Chemung County		Chemung County Locally Owned Roads	
Emphasis Area	**F + SI Crashes**	**Percentage of Total**	**F + SI Crashes**	**Percentage of Total**	**F + SI Crashes**	**Percentage of Total**
Lane Departure	15,804	29%	120	45%	76	46%
Intersections*	25,990	48%	88	33%	61	37%
Older Drivers (65+)	8,289	15%	61	23%	31	19%
Speeding/Aggressive Driving	10,044	19%	44	16%	28	17%
Motorcycles	5,866	11%	41	15%	29	17%
Young Drivers (15-20)	6,879	13%	18	7%	29	17%
Pedestrian and Bicycle	13,826	26%	37	14%	26	16%
Alcohol/Drug	8,135	15%	29	11%	19	11%
Distracted Driving	10,547	20%	18	7%	10	6%
Truck	2,165	4%	10	4%	2	1%
Side Swipe			5	2%	5	3%
Work Zone	205	0%	5	2%	1	1%
Fatal (F) + Serious Injury (SI) Crash TOTAL	**53,614**		**269**		**167**	
* Data for separating signalized and unsignalized intersections was not available.						

Using the data analysis results and keeping in mind New York State's SHSP emphasis areas, Chemung County and its stakeholders selected the following as the five main emphasis areas for its LRSP:

- Lane departure crashes.
- Intersection safety.
- Pedestrian and bicycle safety.
- Speeding and aggressive driving.
- Age-related crashes.

3.2 Determining Focus Facilities

After identifying and confirming the emphasis areas, the team developed "crash trees", to determine the high risk locations for these emphasis areas, using a two-step approach:

1. Break down the distribution of crashes by facility to identify focus facilities where the number of crashes, serious injuries, and fatalities were overrepresented.
2. Identify the issues at these focus facilities by taking a closer look at predominant crash types within the established emphasis areas.

Developing a crash tree involves dividing the total number of fatalities, injuries, and crashes into smaller and smaller categories. A crash tree can have a number of different formats, depending on agency capabilities and data availability. At a minimum, the crash tree analysis should include separation by urban and rural, ownership (state and local), segment and intersection, segment type, and intersection control type. This minimum level of detail allows for the refinement of facility types, which is useful to focus the identification of risk factors (i.e., characteristics associated with the locations where the focus crash types are occurring) and select relevant countermeasures. FHWA's Systemic Safety project Selection Tool discusses development of crash trees in detail.[11] **In this LRSP, the crash trees start with dividing fatalities, injuries, and crashes by facility type to identify focus facilities that experience the highest percentage of crash severities and then differentiating among crash types on the focus facilities to pin point the most common**. This approach allows a more precise risk factor analysis that focuses on each overrepresented crash type at each facility type, thus leading to solutions tailored to the predominant issues specific to each focus facility.

Figures 9, 10, 11, and 12 illustrate the focus facilities and crash types for rural and urban areas in the county. Figure 9 shows the breakdown of the rural crashes on local roads by crash type, while Figure 10 focuses on urban intersection crashes. Figure 11 and Figure 12 shows the distribution of crashes on urban segments, and the crash tree for urban segments is separated into these two figures for ease of display.

For example, Figure 9 first identifies all crashes within County limits (12,400 crashes and 269 fatal and serious injury crashes) and further subdivides that number into those that occur on the County's local network (8,535 crashes and 167 fatal and serious injury crashes) and then those occurring in rural and urban areas. Since Figure 9 focuses on the County's rural system, the urban crashes were disregarded for further analysis and the focus facilities within the rural network were determined. The rural crashes were then categorized into whether they occurred on intersections or segments. During this step, animal crashes were also identified and excluded from further analysis. This exclusion can also be performed in earlier steps.

Following the segments path, two-lane undivided segments are where 99 percent of crashes and 98 percent of fatal and serious injury crashes occur on rural segments.

[11] Preston, H., R. Storm, B. Dowds, and B. Wemple. 2013. "Systemic Safety Project Selection Tool," FHWA-SA-13-019, Washington, DC: FHWA. Available at: https://safety.fhwa.dot.gov/systemic/fhwasa13019/sspst.pdf

Analyzing crash types attributed to one or more emphasis areas for rural two-lane undivided segments showed that lane departures (run-off-road, fixed object, sideswipe, overturn, and head-on crashes) are overrepresented on this facility type.

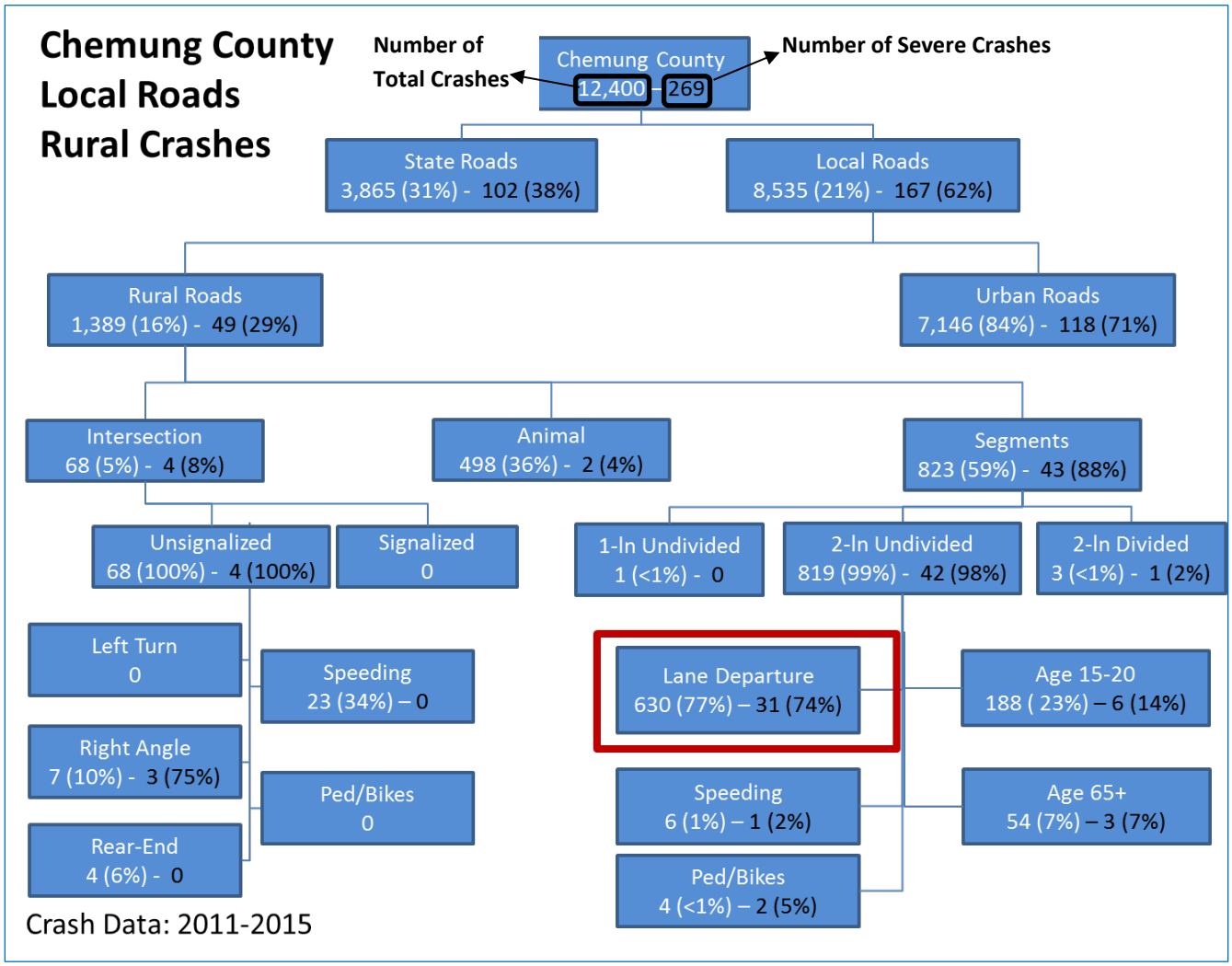

Figure 9. Crash Tree for Chemung County's Rural Local Road Crashes, 2011-2015.

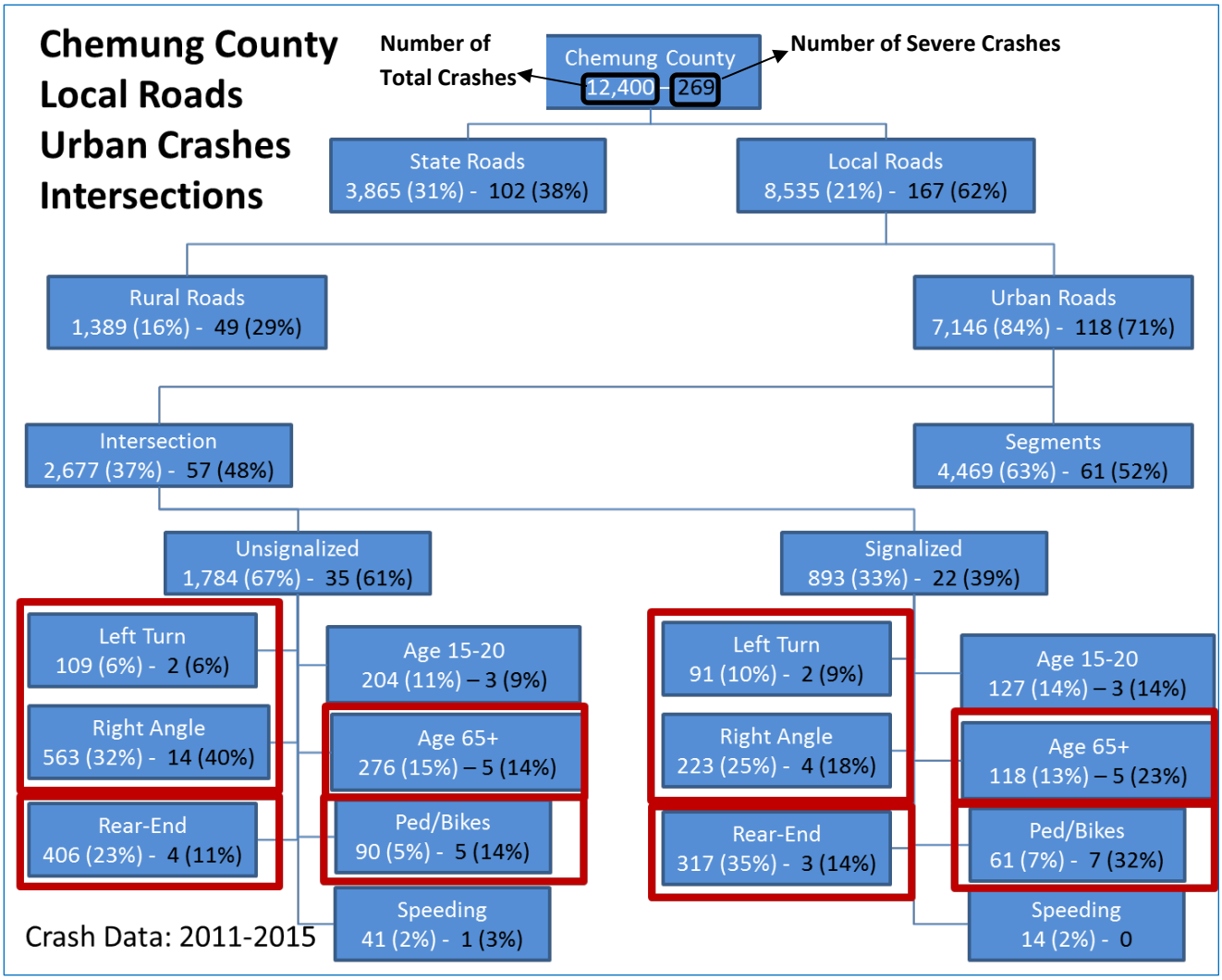

Figure 10. Crash Tree for Chemung County's Urban Local Intersections, 2011-2015.

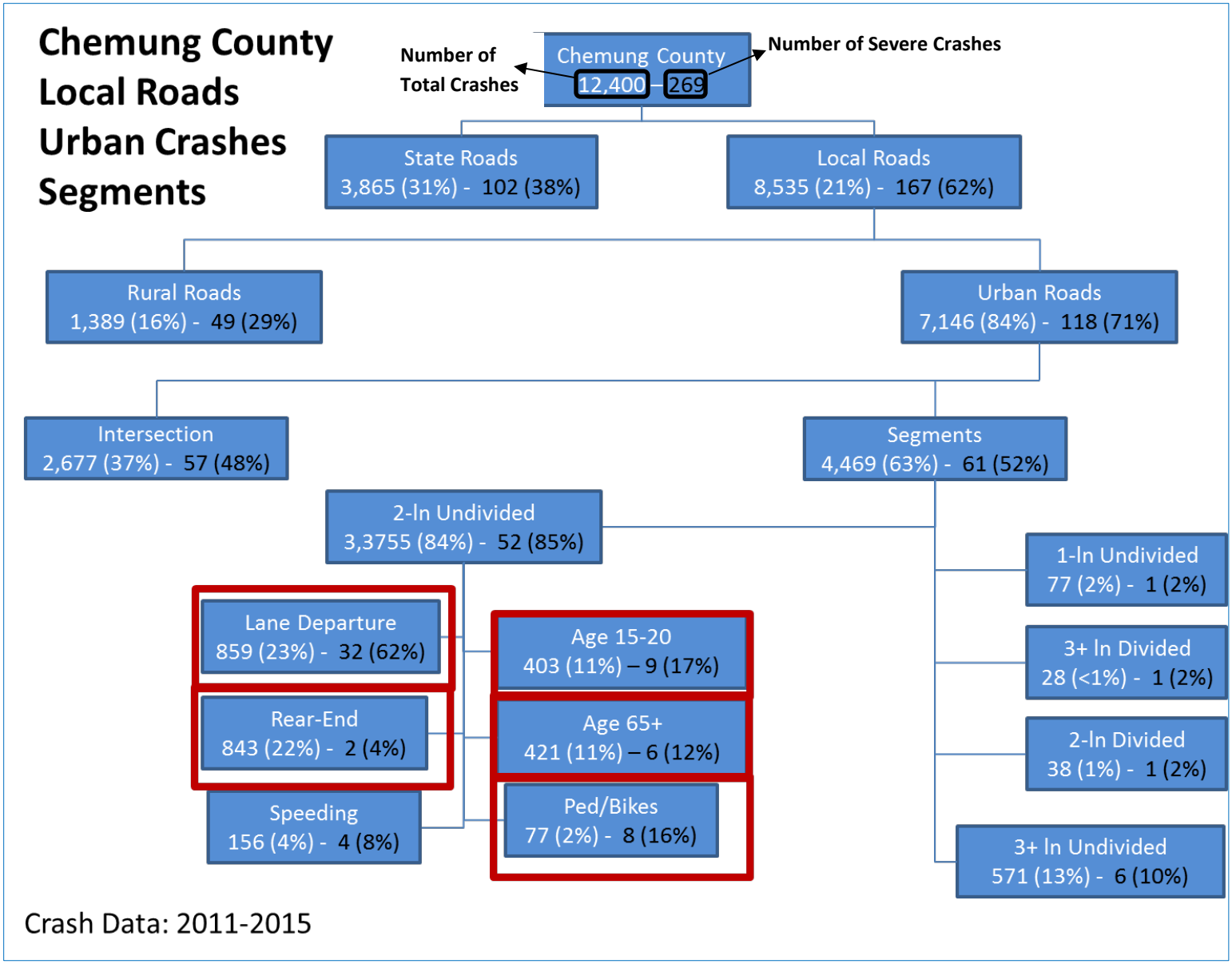

Figure 11. Crash Tree for Chemung County's Urban Local Road Segments, 2011-2015 (1 of 2).

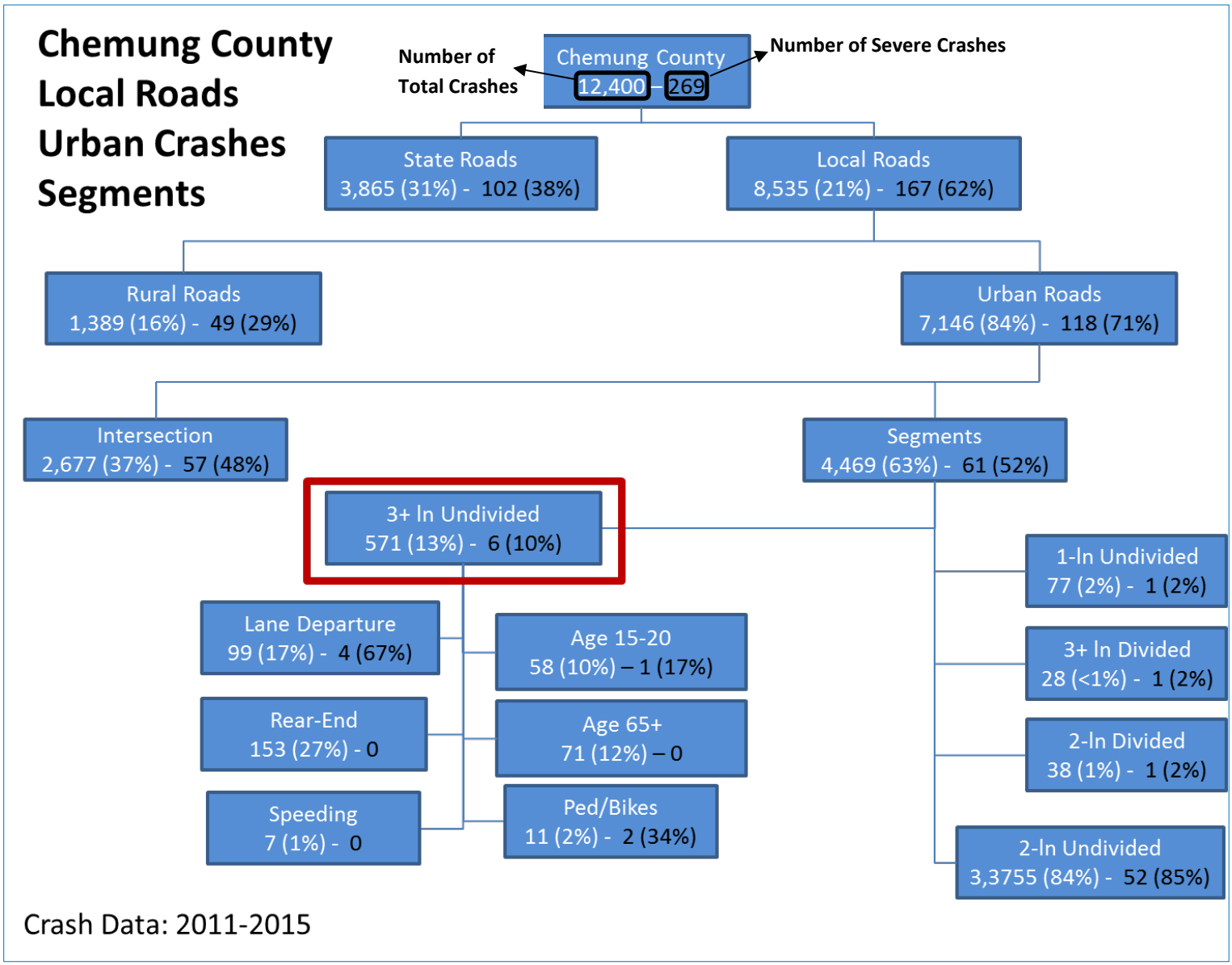

Figure 12. Crash Tree for Chemung County's Urban Local Road Segments, 2011-2015 (2 of 2).

3.3 Determining Risk Factors

The next step of the analysis focuses on determining the high risk factors at the facility types selected through crash trees by documenting the most common characteristics of the locations where crashes of specific type occurred. The analysis of each risk factor determining overrepresentation for a crash type at a focus facility indicates its level of risk. Chemung County and the stakeholders provided data sets which allowed for risk factor analysis on speed limits, number of lanes, AADT, shoulder width, and road width. The resulting applicable risk factors and application for each focus facility is detailed in Chapter 4.

The example in Figure 13 shows how average annual daily traffic (AADT) varies for pedestrian and bicycle crashes on two-lane, urban, undivided segments, and reveals an overrepresentation of crashes at locations with an AADT between 6,501 to 8,000 and 2,401 to 3,500.

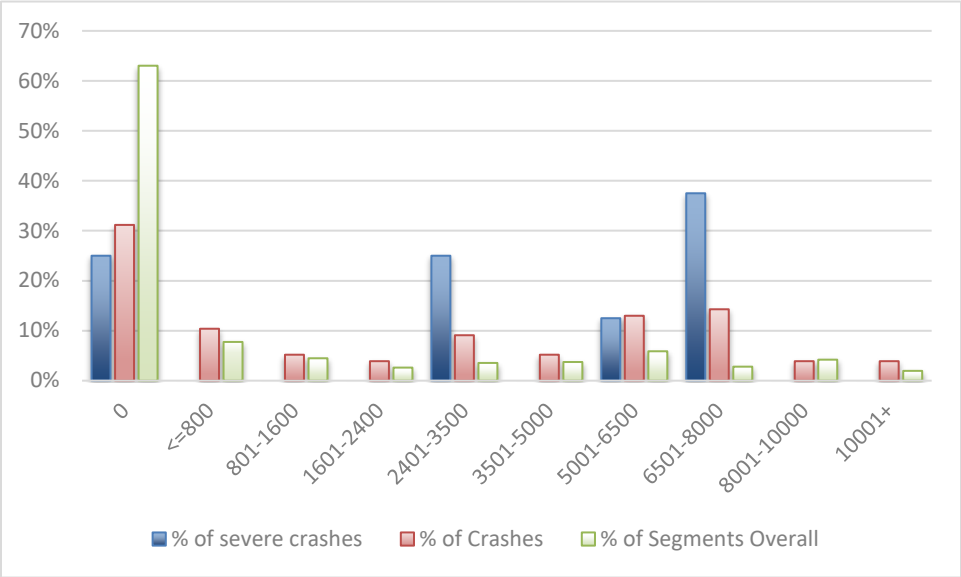

Figure 13. Example Risk Factor Analysis for AADT.

Upon completion of risk factor analysis for each available data element, a three-tiered approach was used to rate the level of risk associated with each risk factor as "Low", "Moderate", or "High"; based on the significance of the risk factor through analysis and expert opinion. During the stakeholder workshop, participants reviewed, discussed, and vetted the applicability of these risk factors to the County and finalized the risk factors for each crash type at each focus facility.

Table 3 depicts the identified risk factors for crossing path (left-turn or right-angle) crashes, age-related crashes, and pedestrian and bicycle crashes on **unsignalized intersections on undivided urban roads**:

Table 3. Risk Factors for Unsignalized Intersections on Urban Roads.

Crash type:	*Crossing Path*	*Age-related*	*Pedestrian and Bicycle*
Number of Lanes	2	2	-
Speed Limit	-	30	30
AADT	>3,000	>3,000	>5,000

Table 4 indicates the identified risk factors for crossing path crashes, age-related crashes, and pedestrian and bicycle crashes on **signalized intersections on urban roads**:

Table 4. Risk Factors for Signalized Intersections on Urban Roads.

Crash type:	*Crossing Path*	*Age-related*	*Pedestrian and Bicycle*
Number of Lanes	-	-	3 or 4
Speed Limit	30 to 45 mph	30	-
AADT	<=6,500	<1,200 or >6,500	<1,200 or >5,000

Table 5 contains the identified risk factors for lane departure crashes, age-related crashes, and pedestrian and bicycle crashes on **two-lane undivided segments on urban roads**:

Table 5. Risk Factors for Two-lane Undivided Segments on Urban Roads.

Crash type:	*Lane Departure*	*Age-related*	*Pedestrian and Bicycle*
Speed Limit	>=30 mph	30 to 45 mph	30 to 45 mph
AADT	2,400 to 3,5000	>5,000	6,500 to 8,000
Lane Width	20 to 25 ft.	>26	>=26
Shoulder Width	1 to 4 ft.	0	0

Table 6 shows the identified risk factors for lane departure crashes and pedestrian and bicycle crashes on **rural two-lane undivided segments** of local Chemung County roads:

Table 6. Risk Factors for Two-Lane Undivided Segments on Rural Roads.

Crash type:	*Lane Departure*	*Pedestrian and Bicycle*
Speed Limit	55 mph	55 mph
AADT	<=2,000	<=800
Lane Width	20 ft.	20 to 22 ft.
Shoulder Width	3 ft.	4 to 5 ft.

3.4 Identifying Project Locations

Upon identification of risk factors, the project team screened the county road network to identify locations with the highest number and level of risk factors. The resulting list of locations were then ranked and prioritized by their crash history and also reviewed and vetted by the stakeholder group. Although crash history is not typically included in site prioritization during a typical systemic analysis, the County does take crash history into account in order to be responsive to public requests for improvement at high-crash sites. As a result, the County does use crash history, upon completion of risk factor analysis, to rank and prioritize the high-risk locations that were identified through risk factors.

3.5 Selecting Countermeasures

The findings from the facility type and crash type breakdown through crash trees, and risk factor analysis, and the subsequent location identification process described above for each crash type and facility were vetted through a stakeholder working group, which helped to ensure the development of an actionable plan that covers the broad range of disciplines involved in transportation safety.

A review of the project locations and follow-up discussions revealed site-specific crash types (e.g., left-turn, head-on, fixed object), contributing factors (e.g., nighttime, wet pavement), crash history, and site characteristics that helped the team appropriately pair effective countermeasures for each specific location. Following the determination of high-risk locations and their prioritization using crash history, the list of projects selected for this plan based on the available budget, consistent with the level of funding directed by the County.

When selecting project locations, other contributing factors—for example, site-specific characteristics such as insufficient sight distance, skewed intersection, drainage issues, etc.— can also be identified and used in selecting appropriate countermeasures based on both the crash types and location characteristics.

Using Google Maps and Google Maps Street View to record site observations and other contextual characteristics of the surrounding area deficiencies related to road geometry, signalization, or both for each site were identifies and examined. Revisiting some project limits ensured consistency between each site and its adjacent facilities.

Using resources from the FHWA's Office of Safety website, the PEDBIKESAFE website, the CMF Clearinghouse, and the National Highway Traffic Safety Administration (NHTSA), stakeholders chose potential groups of countermeasures for each emphasis area. During the development of the LRSP, stakeholders reviewed, discussed, and approved potential countermeasures for each emphasis area. These countermeasures are described in the respective emphasis area sections below. The countermeasures for each section represent an array of solutions that address crash types within each emphasis area. With the exception of the countermeasures and strategies to address age-related crashes, Chemung County approved the countermeasures to be stratified and grouped into Tiers, as shown in Appendix A. In general, Tier 1 countermeasures are to be considered first, as they are typically lower cost, easier to implement, and have proven safety benefits. If Tier 1 countermeasures are already in place or do not address the situation, Tier 2 countermeasures are the next to be considered. This progression continues through the numbered tiers following the same process and rationale. Tables 7 through 11 display the countermeasures specific to each emphasis area of this plan. Stakeholders considered these countermeasures in the development of the project list.

3.5.1 Lane Departure

Background

Figure 6 in Chapter 2 shows that, from 2011 through 2015, fatal injury crashes involving roadway departures (lane departure), which includes fixed object, head-on, and run-off-road crashes, accounted for 86 percent of all roadway fatalities on Chemung County local roads. Lane departure crashes

accounted for 46 percent of fatal and serious injury crashes and 19 percent of all crashes on the local county roads as well, resulting in the leading crash type in severe crash categories. The stakeholders also identified the placement of utility poles, young driver population, and speeding as contributing factors to the number of severe lane departure crashes on local roads. Figure 14 shows the variation in lane departure crashes that resulted in a fatality or serious injury on local Chemung County roads over the analysis period.

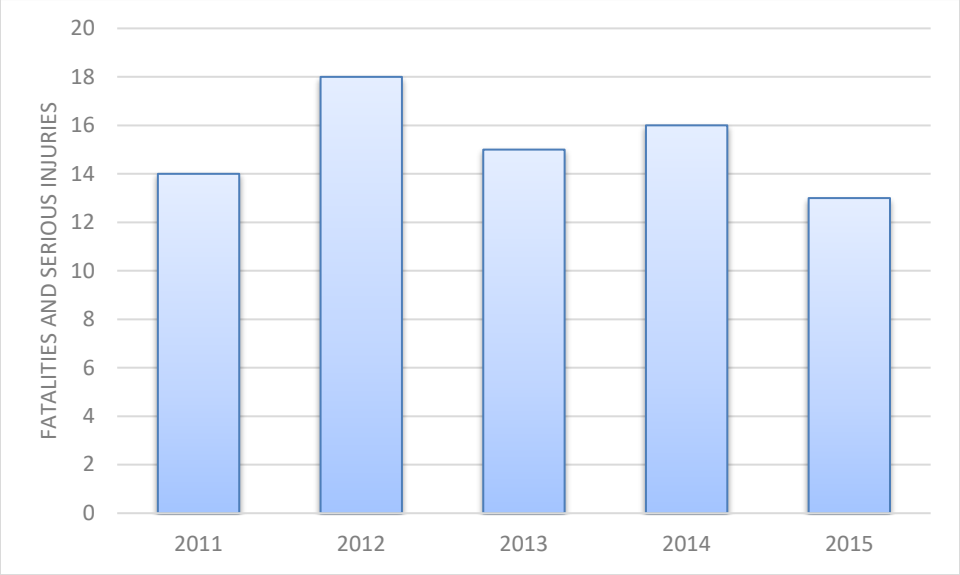

Figure 14. Distribution of Fatal and Serious Injury Lane Departure Crashes on Local County Roads, 2011-2015.

Stakeholders indicated that placement of utility poles contributed to high number of severe lane departure crashes on local roads; therefore, further data analysis on crashes between 2011 and 2015 was conducted. This revealed that 10 percent of all fatalities on Chemung County local roads were due to crashes that involved utility poles. Utility poles accounted for 15 percent of the fixed-object crashes and 17 percent of fatalities resulting from fixed-object crashes on local county roads during this time period.

Objective

The objective for this emphasis area is to address lane departure crashes by deploying proven countermeasures that will reduce specific types of crashes at high-risk locations. By identifying high-risk locations and treating them with appropriate countermeasures, the County plans to proactively address lane departure crashes.

As shown in the crash tree in Figure 11, two-lane undivided urban segments experience most of the County's lane departure crashes, while severe crashes are equally crucial on both rural and urban two-lane undivided segments. Fixed object crashes are the major crash type contributing to the high number of severe lane departure fatalities in Chemung County. Specifically addressing this subset of lane departure crashes will enable the County to reach a significant crash reduction for the overall lane

departure emphasis area. Figure 15 shows segments (highlighted in red) that exhibit high risk factors for lane departure crashes on the urban road network within Chemung County.

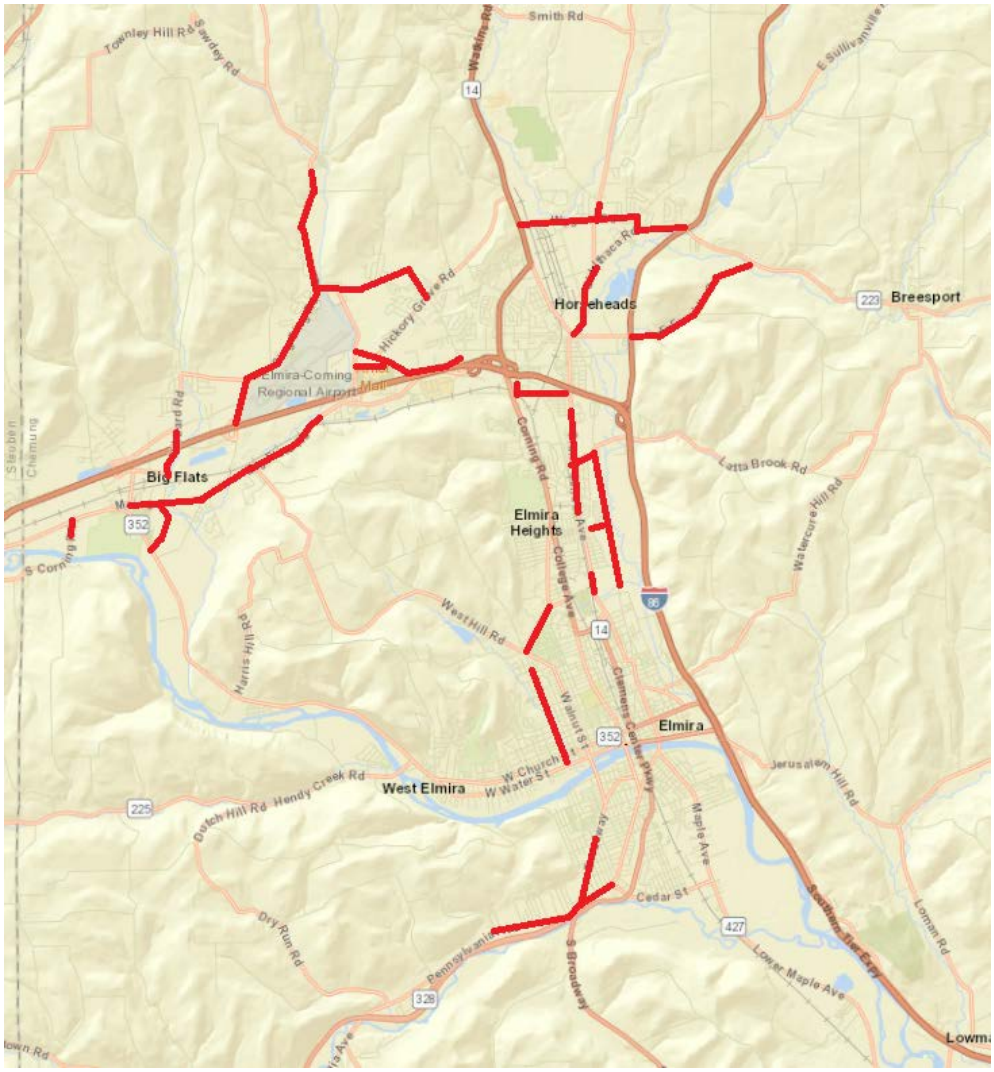

Figure 15. Urban Locations with High Risk of Lane Departure Crashes on the County Road Network. (© 2018 ESRI)

Strategies and Approved Countermeasures

The stakeholder group identified the placement of utility poles as contributing to the severe lane departure crashes on local roads; therefore, the recommendation is for Chemung County to consider developing a policy for utility pole relocation as well as for safely locating future pole installations out of the clear zone.

Chemung County approved the countermeasures to be stratified and grouped into Tiers, as shown in Table 7. The workshop discussions in Chemung County led to the approval of the following list of countermeasures to address lane departure crashes. However, the County may also consider

implementing other countermeasures based on specific location needs as plan implementation proceeds.

The effectiveness, implementation, and further information on these countermeasures are listed in the Appendix.

Table 7. Tiered Countermeasures for Lane Departure Crashes.

TIER 1	
Fundamental signing and marking for curves[1]	Wider edge line markings
Wider centerline pavement markings	Pavement wedge/SafetyEdge$_{SM}$
Low noise rumble strips (mumble strips)	Fixed object delineation, including delineators on guiderail
Standard edge line markings	Policy development for utility pole relocation
TIER 2	
Enhanced signs and markings for curves	Alignment delineation
Improve superelevation	Tree removal / utility pole relocation
Optical speed bars	Lighting
TIER 3	
High friction surface treatment	Enhanced signing and marking for curves plus dynamic curve warning system
Enhanced signing and marking for curves plus flashing beacons	Shield fixed objects
TIER 4	
Center line rumble stripes	Curve flattening or other major reconstruction
Edge Line Rumble Stripes or Shoulder Rumble Strips	Improved recovery areas, slope flattening (possibly with water permeable material)
Raised thermoplastic centerline rumble strips	Alternate passing lanes (2+1 design)
Raised thermoplastic edge line rumble strips	Four to three lane conversions
Wider shoulders	Median buffer
Paved shoulders	Corridor 3E improvements[2]
Reconstruct Curve, minor to intermediate	Area-Wide 3E Improvements[3]

[1] Fundamental signing and marking for curves include longitudinal pavement markings, advance warning signs, advisory speed plaque, and combination curve/intersection signs. For further information, see FHWA's guide on "Low-Cost Treatments for Horizontal Curve Safety 2016" at: https://safety.fhwa.dot.gov/roadway_dept/countermeasures/horicurves/fhwasa15084/fhwasa15084.pdf

[2] law enforcement units provide enhanced, planned enforcement while County Public Works, Public Health, and/or advocacy groups provide education efforts on a corridor. The County is responsible of the arrangement, coordination, and synergy of these efforts.

[3] Implementation of engineering countermeasures, along with enhanced, planned enforcement and education efforts in a certain area. The County is responsible of the initiation, coordination and synergy of these efforts.

3.5.2 Intersections

Background

From 2011 through 2015, intersection crashes were the leading crash type, accounting for 33 percent of all crashes on the local roads of Chemung County. Fatal crashes at signalized and unsignalized

intersections accounted for 24 percent of crashes on Chemung County local roads. Looking across all fatal and serious injury crashes, intersection crashes accounted for 37 percent of all severe crashes, being among the top three leading crash types in all severity categories. Figure 16 shows the variation in intersection crashes that resulted in a fatal or serious injury on local Chemung County roads over the analysis period.

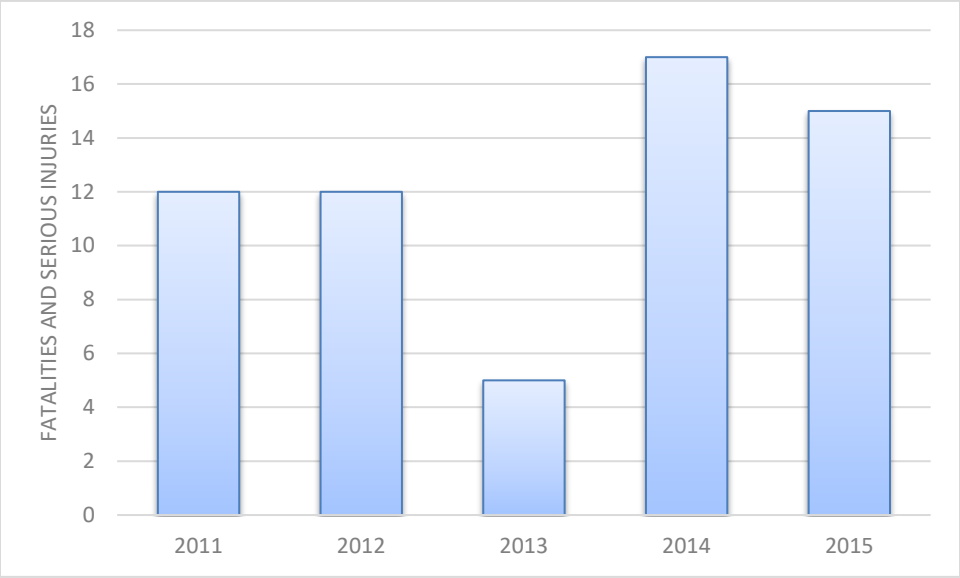

Figure 16. Distribution of Fatal and Serious Injury Intersection Crashes on Local County Roads, 2011-2015.

With 86 total and 12 county-owned signalized, and numerous unsignalized, intersections, Chemung County experiences a high number of rear-end and angle crashes at intersections. Stakeholders noted that intersections are often skewed, making them difficult to navigate, and located in congested urban areas.

Objective

The objective of this emphasis area is to address intersection crashes by identifying high-risk locations and treating them with countermeasures proven to be effective. Crash trees indicate that urban, unsignalized intersections account for a large proportion of intersection crashes, with right angle and rear-end crashes being overrepresented, followed by left-turn crashes and crashes involving older drivers. Pedestrian and bicycle crashes are also an important issue at intersections with their higher potential to result in a severe injury. By primarily addressing angle crashes, pedestrian and bicycle safety, and older driver issues, the County can effectively achieve an overall reduction in intersection crashes.

Strategies and Approved Countermeasures

Chemung County approved the countermeasures to be stratified and grouped into Tiers, as shown in Table 8. The County and stakeholders approved the following list of countermeasures to address intersection crashes. However, the County may consider and implement other countermeasures based on specific location needs as plan implementation proceeds.

The effectiveness, implementation, and further information on these countermeasures are listed in the Appendix.

Table 8. Tiered Countermeasures for Intersection Crashes.

TIER 1	
Basic set of sign and pavement marking improvements – stop, stop ahead, signal ahead and/or intersection ahead signs; pavement marking - stop bar, crosswalk (as appropriate)	Advance cross street name signs for high-speed approaches on arterial highways
Clear sight triangles	Pedestrian ladder or cross-hatched crosswalk and advanced pedestrian warning signs
Lane narrowing using pavement marking	Enforcement-assisted lights
"Slow" pavement markings	Signal coordination
Basic set of signal improvements – all-red clearance, improve signal timing.	No Turn On Red restrictions
Backplates with retroreflective borders	Automated red-light enforcement
Flashing yellow arrow signal	Reflective posts
TIER 2	
Either a) flashing solar powered LED beacons on advance intersection warning signs and STOP signs or b) flashing overhead intersection beacons (red/red)	Restricted Crossing U-Turn modifications on high-speed divided arterials
Dynamic warning sign which advises through traffic that a stopped vehicle is at the intersection and may enter the intersection	Pedestrian countdown signals
Lane narrowing using pavement marking and shoulder rumble strips	Separate pedestrian phasing
Peripheral transverse pavement markings	Bicycle boxes
Dynamic speed warning sign to reduce speed	Change of permitted and protected left-turn phase to protected-only
High-friction surface treatment	Advance detection control systems
Installation of a 6 ft. or greater raised divider on stop approach (installed separately as a supplemental countermeasure)	
TIER 3	
New or upgraded lighting	Install right-turn lane
Install left-turn lane	If intersection has skew, reduce or eliminate skew or create offset T-intersections

TIER 4	
Roundabouts	Municipal-wide 3E improvements in municipalities with high frequencies of severe intersection crashes[2]
Corridor engineering, education, and enforcement (3E) improvements on high-speed arterials with very high frequencies of severe intersection crashes[1]	

[1] Law enforcement units provide enhanced, planned enforcement while County Public Works, Public Health, and/or advocacy groups provide education efforts on a corridor. The County is responsible of the arrangement, coordination, and synergy of these efforts.

[2] Implementation of engineering countermeasures, along with enhanced, planned enforcement and education efforts in a certain municipality. The agency is responsible of the initiation, coordination and synergy of these efforts.

3.5.3 Pedestrian and Bicycle

Background

From 2011 through 2015, crashes involving pedestrians and bicycles resulted in 10 percent of all roadway fatalities in the county, although these crashes make up only 1 percent of all crashes on the County's roads. Crashes involving pedestrians and bicycles accounted for 16 percent of all fatal and serious injury crashes on the local roads of Chemung County during this period. Figure 17 shows the variation in the number of pedestrian and bicycle crashes that resulted in a fatal or serious injury on local Chemung County roads.

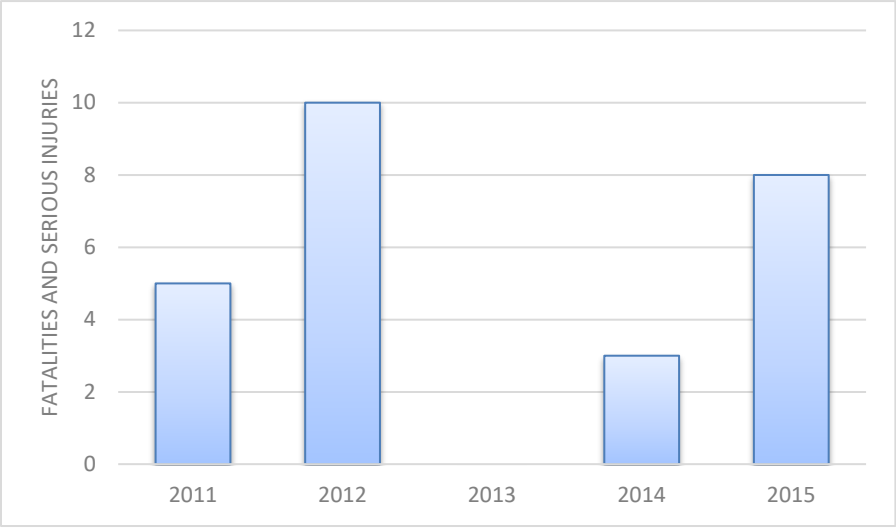

Figure 17. Distribution of Pedestrian and Bicycle Crashes Resulting in Fatality or Serious Injury on Local County Roads, 2011-2015.

Objective

The objective for this emphasis area is to address crashes involving pedestrians and bicycles by recommending crash type-specific countermeasures at high-risk locations. With ever-increasing pedestrian and bicycle traffic in urban areas, the County is interested in a proactive approach to improving safety among these vulnerable users.

The crash trees show that unsignalized intersections in urban areas are where the pedestrian and bicycle crashes occur most often, while signalized urban intersections experience the highest percentage of severe crashes involving pedestrians and bicycles.

Strategies and Approved Countermeasures

Chemung County stakeholders discussed the merits of addressing bicycle and pedestrian-related crashes using a tiered countermeasure approach. The following list of countermeasures were approved to address pedestrian and bicycle crashes; however, the County may consider and approve other countermeasures for implementation based on specific location needs as plan implementation proceeds. In addition, Chemung County stakeholders identified a desire to research the concept and benefits of a protected intersection[12] design and determine its applicability in Chemung County.

The effectiveness, implementation, and further information on these countermeasure are listed in the Appendix.

Table 9. Tiered Countermeasures for Pedestrian and Bicycle Crashes.

TIER 1	
Crosswalk visibility enhancements, including markings and signs[1]	Curb extensions
Rectangular Rapid Flashing Beacon (RRFB)	Pedestrian refuge islands
Add pedestrian push button actuation to existing traffic signals	Bicycle lanes
Leading pedestrian interval	
TIER 2	
Sidewalks, walkways, and paved shoulders	Separated bicycle lanes
Pedestrian hybrid beacons	Bike boulevard
Raised crosswalk and speed tables	School zone improvements
TIER 3	
Road diets	

[1] For information and examples on crosswalk visibility enhancements, see: https://safety.fhwa.dot.gov/ped_bike/step/docs/TechSheet_VizEnhancemt_508compliant.pdf

[12] A protected intersection is an at-grade road junction in which cyclists and pedestrians are physically separated from vehicles. This is generally an uncommon design in the United States. For additional information, see http://www.protectedintersection.com/.

3.5.4 Speeding and Aggressive Driving

Background

Speeding and aggressive driving were responsible for 19 percent of all crashes, almost one-third (29 percent) of all roadway fatalities, and 17 percent of fatal and serious injury crashes on the County's roads during the 2011–2015 period. Speeding-related crashes are second only to intersection crashes in crash type frequency on local county roads in Chemung County. While exploring the reasons behind these high percentages, law enforcement speculates speed-related crashes also includes those crashes that occur when the vehicle is going too fast for conditions, but not over the speed limit. Such crashes are considered for analysis in this plan, since a vehicle going too fast for conditions still poses a danger that needs to be addressed. Figure 18 shows the variation in the number of speeding and aggressive driving crashes that resulted in a fatality or serious injury on locally owned roads in Chemung County.

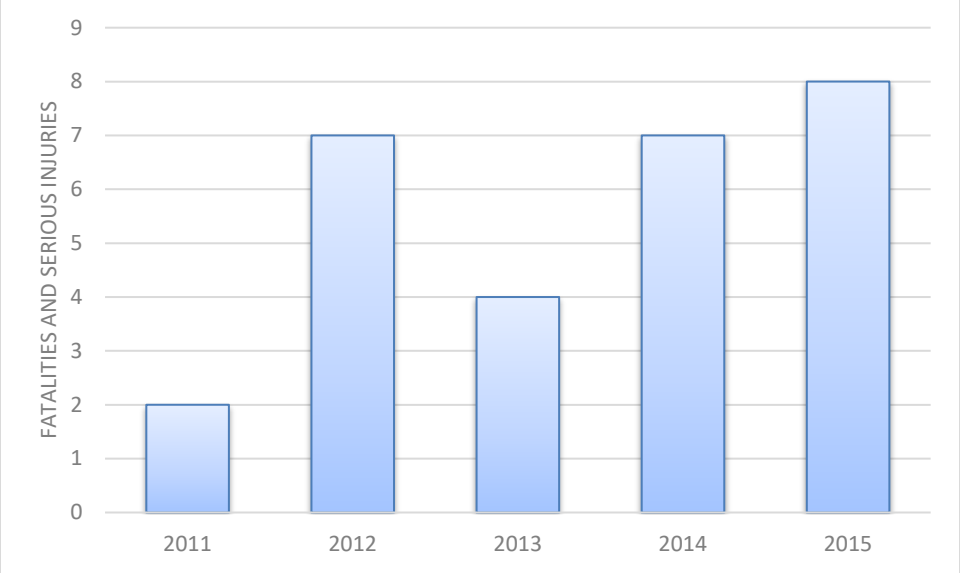

Figure 18. Distribution of Speeding and Aggressive Driving Crashes Resulting in Fatality or Serious Injury on Local County Roads, 2011-2015.

Objective

The objective of this emphasis area is to address speeding-related crashes across the County in a systemic manner. As indicated in the crash trees, speeding has been observed most frequently at crashes occurring on two-lane, undivided segments in urban areas within Chemung County, resulting in 156 crashes on these roads. With an approach to address these types of crashes, the County can achieve an overall crash reduction more effectively.

Strategies and Approved Countermeasures

The County and stakeholders approved the following list of countermeasures to address speeding and aggressive driving-related crashes. However, the County may consider and approve other countermeasures for implementation based on specific location needs as plan implementation proceeds.

The effectiveness, implementation, and further information on these countermeasures are listed in the Appendix.

Table 10. Tiered Countermeasures for Speeding and Aggressive Driving-related Crashes.

Tier 1	Tier 2
Basic Curve Signing (advanced warning, chevrons, speed plates)	Add flashers to existing curve warning signs
Speed feedback signs	Add flags to existing curve warning signs
Converging chevron marking pattern	Enhanced signing/delineation
Transverse markings	Sequential dynamic curve warning system
Optical Speed Bars	Speed activated warning sign
Add shoulder markings to narrow lane	Speed limit sign with LED
Enhanced pavement marking (e.g., Speed Limit XX Pavement Legend, "Slow" pavement legend, "XX MPH" + Curve Symbol)	In-roadway warning lights
"Radar Enforced" signs	Internally illuminated raised pavement markers
Automated enforcement	High friction surface treatment
Policy related: Speed Limit Setting Guidelines	Speed hump, cushion, or table
Policy related: Speed Limit Reviews	Gateway treatment
Policy related: USLIMITS2	Basic motorist education marketing/outreach materials
High-visibility enforcement	One-time or smaller-area wide education initiatives
	One direction large arrow sign (W1-6)
	Delineator Posts
	Longitudinal rumble strips
	Transverse rumble strips
	Basic Curve Signing (advanced warning, chevrons, speed plates)
Tier 3	**Tier 4**
Roundabout	Corridor enforcement and education[1]
Raised intersection	Corridor 3-E Initiative (engineering, education, enforcement)[2]
Road diet	
Variable speed limit sign	
Red signal enforcement lights (tattletale lights)	
Speed Hump	
Speed Cushion	
Speed Table	
Choker	
Neckdown	
Chicane	
Lateral Shift	

Center Island	
Tubular channelizers	
Landscaping	

[1] Law enforcement units provide enhanced, planned enforcement while County Public Works, Public Health, and/or advocacy groups provide education efforts on a corridor. The County is responsible of the arrangement, coordination, and synergy of these efforts.

[2] Implementation of engineering countermeasures, along with enhanced, planned enforcement and education efforts in a certain municipality. The agency is responsible of the initiation, coordination and synergy of these efforts.

3.5.5 Age-Related (Young and Older Drivers) Crashes

Background

Younger (age 15-20) and older drivers (age 65+) were involved in 35 percent of all crashes on the local county roads from 2011 through 2015. Crashes involving these drivers accounted for 24 percent of all roadway fatalities on local Chemung County roads during this period, and they were involved in 36 percent of fatal and serious injury crashes. During discussions with County stakeholders, distracted driving has been identified as a potential contributing factor to the high number of crashes that involve younger and older drivers. Figure 19 shows the variation in the number of age-related crashes that resulted in a fatality or serious injury on local Chemung County roads.

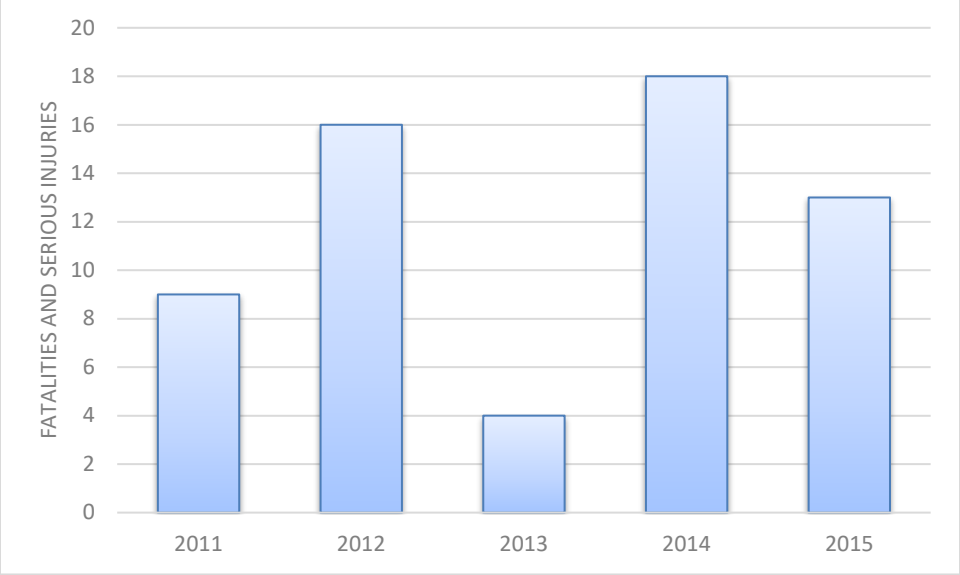

Figure 19. Distribution of Fatal and Serious Injury Crashes Involving Young (age 15-20) or Older (age 65+) Drivers on Local County Roads, 2011-2015.

Objective

The objective for this emphasis area is to address age-related crashes across the County by recommending crash type-specific countermeasures at high-risk locations. Crash trees show that the types of crashes that involve young and older drivers are overrepresented on two-lane, undivided segments on local urban roadways in the County, as are unsignalized urban intersections, although to a

lesser degree. This overrepresentation indicates that addressing the issues related to older and younger drivers in these locations would contribute to efforts to decrease the overall number of crashes and fatalities due to crashes that involve these drivers.

Strategies and Approved Countermeasures

The workshop discussions in Chemung County led to the approval of the following list of countermeasures or strategies to address age-related crashes. However, the County may consider and approve other countermeasures for implementation based on specific location needs as plan implementation proceeds.

Table 11. Strategies and Countermeasures for Age-related Crashes.

Young Driver
Conduct high visibility enforcement of graduated driver licensing (GDL), no cell and texting laws, underage drinking and driving, and seatbelt use laws. Conduct enhanced enforcement and public outreach for young driver safety. Publicizing is best done through community events to attract local media and a community public education campaign about young driver laws, enhanced enforcement, and the necessary parental involvement.
Adjust curfew to include 9 p.m. – 5 a.m., the hours when young driver serious injury and fatality crashes are highest. Currently, City of Elmira curfew hours is between 11 pm and 5 am.
Promote required parent education component of local driver education programs (private and public school providers) to educate parents about teen driving risks, GDL provisions and their protections, parental role in supervising teen driving skill development, encourage selection of safer vehicles for teen driver, and to facilitate parent/teen driving agreements.
Older Driver
Many of these strategies are listed in earlier sections. Examples from Desk Reference Handbook for Designing Roadways for the Aging Population include: • Intersecting angle (limiting the skew); • Channelization • Intersection sight distance • Offset left-turn lanes • Delineation of edge lines and curbs • Advanced and oversized street name signs • Oversized Stop and Yield signs; enhance striping • Intersection lighting • Pedestrian crossings islands and high visibility crosswalks • Roundabouts and Reduced Left-Turn-Conflict Intersections • Supplemental pavement markings for Stop and Yield signs • Accessible Pedestrian Signal (APS) treatments • Flashing yellow arrow Please see Desk Reference Handbook for Designing Roadways for the Aging Population for further information on these strategies.

4 Implementation Process and Project List

To develop each project identified in this plan a multi-step process was utilized as described in Chapter 3 of this document. Improving the overall safety of a local road network depends on both properly identifying sites with prevalent risk factors as well as applying appropriate safety countermeasures. Selecting appropriate and effective countermeasures at a specific site depends largely on the facility type and site characteristics. For each pre-identified project herein, the safety countermeasure selection process was based on three key elements: 1) pre-identified emphasis areas, 2) crash contributing factors and crash types, and 3) site observations. Crash contributing factors include those that have occurred as a result of impaired driving, speeding or aggressive driving, and/or involved vulnerable road users such as pedestrians or bicyclists. Projects developed for this LRSP focused on intersections and segments with known safety issues or which exhibit the determined risk factors (i.e., speed limit, lane width, AADT, shoulder width, and number of lanes) for different site categories (e.g., signalized intersection, unsignalized intersections, etc.), or both.

By vetting the data analysis results and site review findings and by engaging in extensive discussion with stakeholders, the County finalized a list of safety improvement targets that includes 33 urban segments, 45 rural segments, 32 urban unsignalized intersections, and 11 urban signalized intersections.

The project recommendations were cross-referenced with already planned and funded improvements listed in the County's Traffic Signal Evaluation Study (TSES) and Pedestrian Safety Action Plan (PSAP) to avoid overlaps. The improvements proposed in this LRSP were also adjusted accordingly to accommodate planned improvements through these two programs.

Chemung County plans to budget approximately $1,000,000 annually for prioritizing and addressing the improvements recommended in this plan over a 5 year period. Additional funding for projects may also be available through the following:

- The County can pursue grant or Federal funding for capital improvement projects. In New York, half of the State's Highway Safety Improvement Program funding, $48 million per year, is distributed statewide to local projects through a competitive grant-based program.
- The Elmira-Chemung Transportation Council has a budget of $207,000 for projects, some of which may be allocated to safety improvements.
- The Governor's Traffic Safety Committee provides funding through annual grants.

In addition, the County may look for opportunities to incorporate recommended safety strategies into already-planned projects such as regular maintenance or resurfacing projects.

Tables 12–18 provide a summary of each site's location description, proposed safety improvements, and total project cost. The project costs are determined using current cost estimates for each safety improvement implementation. The recommendations consist of low-cost countermeasures that can be applied to roadways systemically and on a large scale to address locations where similar risk factors are present. Proposed primary safety improvement projects for each location are packages of countermeasures effective as a combination; thus, there is no priority ranking among the countermeasures for that specific location. In addition to the proposed improvements, a list of optional projects was included for certain locations. Optional projects are potential solutions that 1) are expected

to improve long-term safety at a site, or 2) whose recommendation for implementation is dependent on a need for further analysis (e.g., traffic studies). Optional projects are ranked by priority for implementation, and highly ranked projects are noted as preferred. The total project cost does not include optional projects.

4.1 Urban Segments

Table 12. List of Projects for Urban Segments in Chemung County (1 of 2).

Seg No.	Road	Start	End	Length	Segment Strategies											Curve Strategies	
					Standard Edge Line Markings	Wider Edge Line	Wider Centerline Markings	Guiderail or Fixed Object Delineation	Utility Pole Relocation	Lane Narrowing with Pavement Markings	Sidewalks	Complete Streets	Road Diet or Add TWLTL	Bike Lane	Sharrow	Chevrons, Curve Warning Signs, Speed Plaque (Install or Upgrade) - Number of Curves	
1	CHEMUNG ST	Hwy 14	Grand Central Ave	0.94	X				X							X	3
2	COLLEGE AVE	Center Street	McCanns Blvd	0.98													
3	DAVIS ST	Tompkins Street	Bancroft Rd/Crete Ave	0.81										X			
4	E SECOND ST	Hwy 14	Judson Street	0.74											X		
5	E WATER ST	Hwy 14	I-86	1.08													
6	GARDNER RD	West Avenue	Hwy 14	0.45							X						
7	GRAND CENTRAL AVE	E 13th Street	I-86	1.94				X	X				X				
8	HIBBARD RD	Winters Rd	Daniel Zenker Dr	0.61		X	X	X								X	2
9	HOFFMAN ST	W Water St	W 1st Stt	0.21								X					
10	JUDSON ST	E Water St	E Church St	0.38						X							
11	LAKE RD	Clemens Center Parkway Extension	Lattabrook Rd	2.00		X		X	X								
12	LAKE ST	E Washington St	Clemens Center Parkway Extension	1.09						X							
13	MADISON AVE	E Church St	Harper St	0.58										X			
14	MAIN ST S	Lattabrook	I-86	0.67													
16	MT ZOAR ST	Pines St	S Main St	0.61						X							
18	ROE AVE	Hoffman St	Walnut St	0.29						X							
19.A	S MAIN ST	Cedar St	Allen St	0.75		X	X	X	X								
19.B	S MAIN ST	Boardmand St	Main Street Bridge	0.29						X							
21	SING SING RD	Kahler Rd N	Hickory Grove Rd	3.38		X	X	X	X							X	5
23	W CHURCH ST	Guinnip Ave	College Ave	1.06						X							
24	W MILLER ST	Pennsylvania Ave	S Main St	0.22													
25	W SECOND ST	Hwy 14	Elm St	0.58											X		
26	W WATER ST	Hwy 14	Dininny Pl	1.28						X							
27	WYGANT RD	Hwy 14	Veteran Hill Rd	1.59		X	X	X	X								
28	Colonial Drive	CR 35 Chambers Rd S	I-86 Off Ramps	0.76		X	X	X	X								
29	Arnot Road	CR 35 Chambers Rd S	Colonial Drive	0.46		X	X	X	X							X	1
30	Chambers Rd	CR 64 Big Flats Rd	Colonial Drive	0.73					X				X				
31	Park Place	W Third Street	W. Washington Ave	0.48											X		
32	E Church Street	Hwy 14	I-86	1.00						X							
33	N Main Street	Main Street Bridge	W Third Street	0.40						X							
				26.8	**0.94**	**9.55**	**7.55**	**11.49**	**12.55**	**6.4**	**0.45**	**0.21**	**2.67**	**1.39**	**1.8**		**11**
					$ 1,410	**$ 9,550**	**$ 7,550**	**$ 28,725**	**Est by project**	**$ 32,000**	**$ 22,500**	**Est by project**	**$ 133,500**	**$ 13,900**	**$ 3,600**		**$ 38,500**

Table 13. List of Projects for Urban Segments in Chemung County (2 of 2).

Seg No.	Road	Start	End	Length	Spot Improvements						4E Projects	Cost			
					Speed Feedback Signs - Number of Locations		Crosswalk Enhancements - Number of Locations		School Zone Improvements / Curb Extensions / Speed Tables - Number of Locations		Corridor Enforcement	Segment	Curve	Spot	Corridor Total
1	CHEMUNG ST	Hwy 14	Grand Central Ave	0.94								$ 1,410	$ 10,500	$ -	**$ 11,910**
2	COLLEGE AVE	Center Street	McCanns Blvd	0.98	X	2					X	$ -	$ -	$ 30,000	**$ 30,000**
3	DAVIS ST	Tompkins Street	Bancroft Rd/Crete Ave	0.81	X	2					X	$ 8,100	$ -	$ 30,000	**$ 38,100**
4	E SECOND ST	Hwy 14	Judson Street	0.74			X	2	X	1		$ 1,480	$ -	$ 31,000	**$ 32,480**
5	E WATER ST	Hwy 14	I-86	1.08	X	2			X	2	X	$ -	$ -	$ 80,000	**$ 80,000**
6	GARDNER RD	West Avenue	Hwy 14	0.45			X	2				$ 22,500	$ -	$ 6,000	**$ 28,500**
7	GRAND CENTRAL AVE	E 13th Street	I-86	1.94	X	2	X	3			X	$ 101,850	$ -	$ 39,000	**$ 140,850**
8	HIBBARD RD	Winters Rd	Daniel Zenker Dr	0.61								$ 2,745	$ 7,000	$ -	**$ 9,745**
9	HOFFMAN ST	W Water St	W 1st Stt	0.21			X	3				$ -	$ -	$ 9,000	**$ 9,000**
10	JUDSON ST	E Water St	E Church St	0.38			X	1				$ 1,900	$ -	$ 3,000	**$ 4,900**
11	LAKE RD	Clemens Center Parkway Extension	Lattabrook Rd	2.00	X	2					X	$ 7,000	$ -	$ 30,000	**$ 37,000**
12	LAKE ST	E Washington St	Clemens Center Parkway Extension	1.09	X	1						$ 5,450	$ -	$ 15,000	**$ 20,450**
13	MADISON AVE	E Church St	Harper St	0.58			X	3	X	3		$ 5,800	$ -	$ 84,000	**$ 89,800**
14	MAIN ST S	Lattabrook	I-86	0.67	X	1					X	$ -	$ -	$ 15,000	**$ 15,000**
16	MT ZOAR ST	Pines St	S Main St	0.61					PSAP			$ 3,050	$ -	$ -	**$ 3,050**
18	ROE AVE	Hoffman St	Walnut St	0.29			X	4				$ 1,450	$ -	$ 12,000	**$ 13,450**
19.A	S MAIN ST	Cedar St	Allen St	0.75	X	2	X	2	X	1		$ 3,375	$ -	$ 61,000	**$ 64,375**
19.B	S MAIN ST	Boardmand St	Main Street Bridge	0.29			X	4				$ 1,450	$ -	$ 12,000	**$ 13,450**
21	SING SING RD	Kahler Rd N	Hickory Grove Rd	3.38								$ 15,210	$ 17,500	$ -	**$ 32,710**
23	W CHURCH ST	Guinnip Ave	College Ave	1.06	X	2	X	6				$ 5,300	$ -	$ 48,000	**$ 53,300**
24	W MILLER ST	Pennsylvania Ave	S Main St	0.22			X	2				$ -	$ -	$ 6,000	**$ 6,000**
25	W SECOND ST	Hwy 14	Elm St	0.58			X	5				$ 1,160	$ -	$ 15,000	**$ 16,160**
26	W WATER ST	Hwy 14	Dininny Pl	1.28	X	2						$ 6,400	$ -	$ 30,000	**$ 36,400**
27	WYGANT RD	Hwy 14	Veteran Hill Rd	1.59								$ 7,155	$ -	$ -	**$ 7,155**
28	Colonial Drive	CR 35 Chambers Rd S	I-86 Off Ramps	0.76								$ 3,420	$ -	$ -	**$ 3,420**
29	Arnot Road	CR 35 Chambers Rd S	Colonial Drive	0.46								$ 2,070	$ 3,500	$ -	**$ 5,570**
30	Chambers Rd	CR 64 Big Flats Rd	Colonial Drive	0.73								$ 36,500	$ -	$ -	**$ 36,500**
31	Park Place	W Third Street	W. Washington Ave	0.48	X	2	X	6	X	1	X	$ 960	$ -	$ 73,000	**$ 73,960**
32	E Church Street	Hwy 14	I-86	1.00	X	1			X	2		$ 5,000	$ -	$ 65,000	**$ 70,000**
33	N Main Street	Main Street Bridge	W Third Street	0.40	X	1	X	2	X	2		$ 2,000	$ -	$ 71,000	**$ 73,000**
				26.8		**22**		**45**		**12**					
						$ 330,000		**$ 135,000**		**$ 300,000**					**$ 1,056,235**

4.2 Rural Segments

Table 14. List of Projects for Rural Segments in Chemung County (1 of 2).

					Segment Strategies									Curve Strategies							
Seg No.	Road	Start	End	Length	Standard Edge Line Markings	Standard Centerline Markings	Wider Edge Line	Wider Centerline Markings	Guiderail or Fixed Object Delineation	Edge Line or Shoulder Mumble Strips	Centerline Mumble Strips	Widen Shoulders	Tree Removal in Clearzone	Chevrons, Curve Warning Signs, Speed Plaque (Install or Upgrade)	No. Curves	One Direction Large Arrow	No. Curves	SLOW Message, Transverse Markings, OR Optical Speed Bars	No. Curves	HFST	No. Curves
1	DEMUNN RD	Chambers Road	County Line	1.30	X	X								X	1						
2	DRY RUN RD	Penna Avenue	Dutch Hill Road	3.88	X			X						X	15	X	2	X	1		
3	E SULLIVANVILLE RD	Old Sullivanville Road	Lesky Rd	1.76			X	X						X	3						
4	FAIRVIEW RD	Breesport Rd	Marsh Rd	1.18	X			X						X	4						
5	HARRIS HILL RD	Hwy 352	W Hill Rd	2.09			X	X						X	7					X	4
6	HOFFMAN HOLLOW	Lowman Rd	Norway Road	1.86	X			X						X	1	X	1				
7	JERUSALEM HILL RD	I-86 Interchange	Bowlby Rd	0.83			X	X	X				X	X	3						
8	KING RD	Johnson Hollow Road	County Line	2.18	X			X						X	7						
9	LANGFORD CREEK RI	Hwy 224	McDuffy Hollow Rd	4.33			X	X						X	10						
10	LATTA BROOK RD	Crane Rd	CR 1 Breesport Chemun	3.48			X	X	X				X	X	17						
11	LOWMAN RD	Oneida Rd	Jerusalem Hill Rd	3.32			X	X	X				X	X	7						
12	MCFAIL RD	Murphy Hill Rd	Stitts Hill Road	1.32	X			X						X	2						
13	MIDDLE RD	Smith Rd	Ridge Road	4.78			X	X	X				X	X	19						
14	MILLPORT HILL RD	Hwy 14	Middle Rd	1.31	X			X	X				X	X	3						
15	NORTH ST	Main St	Rotary Rd	0.72	X	X								X	2						
16	RIVER RD	Main St	END	1.81	X	X			X				X	X	5						
17	SAGETOWN RD	County Line	Kinner Hill Road	3.49			X	X	X				X	X	20						
18	SAWDEY RD	Chambers Road	Backer Rd	3.45	X			X						X	10						
19	SNAKE HILL	Prospect Hill Rd	Hwy 14	1.43	X	X			X				X	X	9						
20	WYNCOOP CREEK RD	Mallory Rd	Cross Rd	9.88			X	X						X	30						
21	Barnes Hill Road	Larchmont Ave	PROSPECT HILL	1.75	X	X							X	X	8						
22	Breed Hollow Road	Eacher Hollow Road	TOWNLEY HILL	4.37	X			X					X	X	11						
23	Breesport N Chemu	Lattabrook Road	Federal Road	5.12			X	X	X				X	X	14						
24	Briar Hill Road	END	CR11 Murphy Hill Rd	0.70	X	X							X	X	1						
25	Brown Road	HIBBARD RD	Chambers Road	1.99	X	X							X	X	9						
26	Callahan Road	BEAVERS DAM RD	END	0.38	X	X															
27	Moss Hill Road	CR 20/E FRANKLIN ST	CR 51/LATTA BROOK RD	3.76	X			X	X				X	X	12						
28	Townley Hill Road	County Line	Sawdey Road	2.90	X	X							X	X	11						
29	Catlin Hill Road	Chambers Road	County Line	1.43	X			X					X								
30	Culver Hill Road	Catlin Hill Road	CR 12	0.88	X			X					X	X	5						
31	Dunn Road	Murphy Hill Rd	Pine Valley Road	3.36	X			X					X	X	20						
32	Forker Road	Demunn Road	END	0.53	X	X															
33	Hibbard Road	Eacher Hollow Road	Post Creek Road	5.30	X			X						X	11						
34	Kimble Road	Backer Road	CR 35	0.87	X			X						X	1						
35	Kingsley Road	Stitts Hill Road	Pine Valley Road	0.88	X	X								X	3						
36	Langford Hill Road	Gentry School Lane	Hwy 135	1.53	X	X							X	X	10						
37	Prospect Hill Road	Horsehead T/L	Stitts Hill Road	1.35	X			X					X	X	4						
38	Saylor road	Demunn Road	Catlin Hill Road	1.01	X	X															
39	Seeley Road	Bif Flats T/L	Swamp School Road	0.61	X	X								X	3						
40	Sturdivant Road	Chambers Road	Saylor Road	1.19	X	X								X	1						
41	Swamp School Road	Breed Hollow Road	County Line	1.45	X			X					X	X	4						
42	Vanderhoff Road	Johnson Hollow Road	County Line	2.75	X	X								X	12						
43	W. Dry Brook Road	Rotary Road	CR 23 / Dry Brook Road	1.60	X			X						X	3						
44	Gunderman Road	90-degree Curve																		X	1
45	Steege Hill Road	90-degree Curve																		X	1
				54.4	61.03	21.48	39.08	78.63	29.33	0	0	0	51.04		318		3		1		6
					$ 91,545	$ 25,776	$ 68,390	$ 110,082	$ 73,325	$ -	$ -	$ -	$ 1,786,400		$ 1,113,000		$ 3,000		$ 5,000		$ 300,000

Table 15. List of Projects for Rural Segments in Chemung County (2 of 2).

Seg No.	Road	Start	End	Length	Intersections		Cost			
					Intersection Signing/Marking Improvements	No. Intersections	Segment	Curve	Intersection	Corridor Total
1	DEMUNN RD	Chambers Road	County Line	1.30			$ 3,510	$ 3,500	$ -	**$ 7,010**
2	DRY RUN RD	Penna Avenue	Dutch Hill Road	3.88			$ 11,252	$ 59,500	$ -	**$ 70,752**
3	E SULLIVANVILLE RD	Old Sullivanville Road	Lesky Rd	1.76			$ 5,544	$ 10,500	$ -	**$ 16,044**
4	FAIRVIEW RD	Breesport Rd	Marsh Rd	1.18			$ 3,422	$ 14,000	$ -	**$ 17,422**
5	HARRIS HILL RD	Hwy 352	W Hill Rd	2.09			$ 6,584	$ 224,500	$ -	**$ 231,084**
6	HOFFMAN HOLLOW	Lowman Rd	Norway Road	1.86			$ 5,394	$ 4,500	$ -	**$ 9,894**
7	JERUSALEM HILL RD	I-86 Interchange	Bowlby Rd	0.83			$ 33,740	$ 10,500	$ -	**$ 44,240**
8	KING RD	Johnson Hollow Road	County Line	2.18	X	1	$ 6,322	$ 24,500	$ 5,000	**$ 35,822**
9	LANGFORD CREEK RI	Hwy 224	McDuffy Hollow Rd	4.33			$ 13,640	$ 35,000	$ -	**$ 48,640**
10	LATTA BROOK RD	Crane Rd	CR 1 Breesport Chemun	3.48			$ 141,462	$ 59,500	$ -	**$ 200,962**
11	LOWMAN RD	Oneida Rd	Jerusalem Hill Rd	3.32			$ 134,958	$ 24,500	$ -	**$ 159,458**
12	MCFAIL RD	Murphy Hill Rd	Stitts Hill Road	1.32	X	3	$ 3,828	$ 7,000	$ 15,000	**$ 25,828**
13	MIDDLE RD	Smith Rd	Ridge Road	4.78			$ 194,307	$ 66,500	$ -	**$ 260,807**
14	MILLPORT HILL RD	Hwy 14	Middle Rd	1.31			$ 52,924	$ 10,500	$ -	**$ 63,424**
15	NORTH ST	Main St	Rotary Rd	0.72			$ 1,944	$ 7,000	$ -	**$ 8,944**
16	RIVER RD	Main St	END	1.81			$ 72,762	$ 17,500	$ -	**$ 90,262**
17	SAGETOWN RD	County Line	Kinner Hill Road	3.49			$ 141,869	$ 70,000	$ -	**$ 211,869**
18	SAWDEY RD	Chambers Road	Backer Rd	3.45			$ 10,005	$ 35,000	$ -	**$ 45,005**
19	SNAKE HILL	Prospect Hill Rd	Hwy 14	1.43	X	3	$ 57,486	$ 31,500	$ 15,000	**$ 103,986**
20	WYNCOOP CREEK RD	Mallory Rd	Cross Rd	9.88			$ 31,122	$ 105,000	$ -	**$ 136,122**
21	Barnes Hill Road	Larchmont Ave	PROSPECT HILL	1.75	X	3	$ 65,975	$ 28,000	$ 15,000	**$ 108,975**
22	Breed Hollow Road	Eacher Hollow Road	TOWNLEY HILL	4.37	X	4	$ 165,623	$ 38,500	$ 20,000	**$ 224,123**
23	Breesport N Chemu	Lattabrook Road	Federal Road	5.12			$ 208,128	$ 49,000	$ -	**$ 257,128**
24	Briar Hill Road	END	CR11 Murphy Hill Rd	0.70	X	2	$ 26,390	$ 3,500	$ 10,000	**$ 39,890**
25	Brown Road	HIBBARD RD	Chambers Road	1.99	X	5	$ 75,023	$ 31,500	$ 25,000	**$ 131,523**
26	Callahan Road	BEAVERS DAM RD	END	0.38	X	2	$ 1,026	$ -	$ 10,000	**$ 11,026**
27	Moss Hill Road	CR 20/E FRANKLIN ST	CR 51/LATTA BROOK RD	3.76	X	5	$ 151,904	$ 42,000	$ 25,000	**$ 218,904**
28	Townley Hill Road	County Line	Sawdey Road	2.90	X	3	$ 109,330	$ 38,500	$ 15,000	**$ 162,830**
29	Catlin Hill Road	Chambers Road	County Line	1.43	X	3	$ 54,197	$ -	$ 15,000	**$ 69,197**
30	Culver Hill Road	Catlin Hill Road	CR 12	0.88	X	2	$ 33,352	$ 17,500	$ 10,000	**$ 60,852**
31	Dunn Road	Murphy Hill Rd	Pine Valley Road	3.36	X	3	$ 127,344	$ 70,000	$ 15,000	**$ 212,344**
32	Forker Road	Demunn Road	END	0.53	X	1	$ 1,431	$ -	$ 5,000	**$ 6,431**
33	Hibbard Road	Eacher Hollow Road	Post Creek Road	5.30	X	6	$ 15,370	$ 38,500	$ 30,000	**$ 83,870**
34	Kimble Road	Backer Road	CR 35	0.87	X	3	$ 2,523	$ 3,500	$ 15,000	**$ 21,023**
35	Kingsley Road	Stitts Hill Road	Pine Valley Road	0.88	X	3	$ 2,376	$ 10,500	$ 15,000	**$ 27,876**
36	Langford Hill Road	Gentry School Lane	Hwy 135	1.53			$ 57,681	$ 35,000	$ -	**$ 92,681**
37	Prospect Hill Road	Horsehead T/L	Stitts Hill Road	1.35	X	3	$ 51,165	$ 14,000	$ 15,000	**$ 80,165**
38	Saylor road	Demunn Road	Catlin Hill Road	1.01	X	3	$ 2,727	$ -	$ 15,000	**$ 17,727**
39	Seeley Road	Bif Flats T/L	Swamp School Road	0.61	X	1	$ 1,647	$ 10,500	$ 5,000	**$ 17,147**
40	Sturdivant Road	Chambers Road	Saylor Road	1.19	X	2	$ 3,213	$ 3,500	$ 10,000	**$ 16,713**
41	Swamp School Road	Breed Hollow Road	County Line	1.45	X	3	$ 54,955	$ 14,000	$ 15,000	**$ 83,955**
42	Vanderhoff Road	Johnson Hollow Road	County Line	2.75	X	3	$ 7,425	$ 42,000	$ 15,000	**$ 64,425**
43	W. Dry Brook Road	Rotary Road	CR 23 / Dry Brook Road	1.60			$ 4,640	$ 10,500	$ -	**$ 15,140**
44	Gunderman Road	90-degree Curve					$ -	$ 50,000	$ -	**$ 50,000**
45	Steege Hill Road	90-degree Curve					$ -	$ 50,000	$ -	**$ 50,000**
				54.4		**67**				**$ 3,911,518**
						$ 335,000				

4.3 Urban Unsignalized Intersections

Table 16. List of Projects for Urban Unsignalized Intersections in Chemung County (1 of 2).

Intersection No.	Intersection	Traffic Control	Location in Pedestrian Safety Action Plan (PSAP)	Install Basic or Upgrade Sign/Marking Improvements	Stop Bar Placement	Clear Sight Triangles	Apply Access Management (close int. app.)	Apply Access Management (driveways)	Add Pedestrian Crosswalk	Crosswalk Visibility Enhancements	Ped Refuge Island and/or RRFB	Improve Sidewalks / ADA
1	BROADWAY and LAUREL ST	TWSC	No		X					X		X
2	BROADWAY and CHAMBERLAIN ST	TWSC	Yes - 38			X	o			PSAP		X
3	BROADWAY and HAZEL ST	TWSC	No			X	o			X		X
4	BROADWAY and BENNETT ST	TWSC	No			X				X		X
5	BROADWAY and SYCAMORE ST	TWSC	No				o			X		X
6	BROADWAY and LAFAYETTE ST	TWSC	No			X		X		X		X
7	BROADWAY and LELAND ST	TWSC	Yes - 44			X				PSAP	o	X
8	BROADWAY and HASKELL ST	TWSC	Yes - 43			X				PSAP	o	X
9	BROADWAY and MANOR DR	TWSC	No		X					X		X
10	CHAMBERS RD S and Sing Sing Rd	TWSC	No	X		X						
11	COLONIAL DR and ARNOT RD	TWSC	No	X		X						
12	COLONIAL DR and Sing Sing Rd	Two STOP approaches	No	X		X						
13	GRAND CNTRL AVE and Cornell St	TWSC	No	X		X			X			
16	GRAND CNTRL AVE and FAIRVIEW RD	TWYC	Yes - 45	X		X			PSAP			
17	GRAND CNTRL AVE and Hemlock St	TWSC	No	X		X			X			
18	HICKORY GROVE RD and Colonial Dr	TWSC	No	X								
19	LOWMAN CROSSOVER and Front St	TWSC	No	X								
20	LOWMAN CROSSOVER and SOUTHERN TIER EXPRESSWAY	TWSC	No									
21	MAIN ST and Olcott Rd S	TWSC	No	X							o	
22	MAIN ST and River St	TWSC	Yes - 21	X								
23	MAIN ST and State Route 352	TWSC	No	X								
24	MAPLE ST and Canal St	AWSC	No	X								
25	OLD ITHACA RD and Level Acres Dr	TWSC	No	X			X					
26	PENNSYLVANIA AVE and Dalrymple Ave	TWSC	No	X		X						
27	RIDGE RD and GREENRIDGE DR	TWSC	No	X		X						
28	S CORNING RD and CR 10/SO.CORNING RD	TWSC	No	X								
29	WATKINS RD and BENTLEY PL	TWSC	No	X		X						
30	WYGANT RD and GREENRIDGE DR	TWYC	No	X								
31	WYGANT RD and MEADOWLARK RD	TWSC	No	X								
32	WYGANT RD and RIDGE RD	AWSC	No	X								
				20	**2**	**15**	**1**	**1**	**2**	**6**	**0**	**9**
Legend:				**$ 100,000**	**$ 1,000**	**$ 22,500**	**$ 50,000**	**$ 25,000**	**$ 3,000**	**$ 90,000**	**$ -**	**$ 225,000**
Preferred "Optional" if funding is available.												
"Optional" project to consider if problem persists after base project constructed												

Table 17. List of Projects for Urban Unsignalized Intersections in Chemung County (2 of 2).

Intersection No.	Intersection	Traffic Control	Location in Pedestrian Safety Action Plan (PSAP)	Bike Lane	Intersection Lighting	Left-Turn Lane OR Intersection Reconfiguration	Offset Right-Turn Lane	Optical Speed Bars OR Lane Narrowing	Dynamic Mainline Warning Signs	Overhead or Sign Mounted Flashers	Roundabout	Cost
1	BROADWAY and LAUREL ST	TWSC	No									$ 40,500
2	BROADWAY and CHAMBERLAIN ST	TWSC	Yes - 38									$ 26,500
3	BROADWAY and HAZEL ST	TWSC	No									$ 41,500
4	BROADWAY and BENNETT ST	TWSC	No									$ 41,500
5	BROADWAY and SYCAMORE ST	TWSC	No									$ 40,000
6	BROADWAY and LAFAYETTE ST	TWSC	No									$ 66,500
7	BROADWAY and LELAND ST	TWSC	Yes - 44									$ 26,500
8	BROADWAY and HASKELL ST	TWSC	Yes - 43									$ 26,500
9	BROADWAY and MANOR DR	TWSC	No									$ 40,500
10	CHAMBERS RD S and Sing Sing Rd	TWSC	No		X							$ 16,500
11	COLONIAL DR and ARNOT RD	TWSC	No								o	$ 6,500
12	COLONIAL DR and Sing Sing Rd	Two STOP approaches	No		X						o	$ 16,500
13	GRAND CNTRL AVE and Cornell St	TWSC	No	X								$ 33,000
16	GRAND CNTRL AVE and FAIRVIEW RD	TWYC	Yes - 45	X		o						$ 31,500
17	GRAND CNTRL AVE and Hemlock St	TWSC	No	X		o						$ 33,000
18	HICKORY GROVE RD and Colonial Dr	TWSC	No		X		X		o			$ 65,000
19	LOWMAN CROSSOVER and Front St	TWSC	No		X			X	o			$ 17,500
20	LOWMAN CROSSOVER and SOUTHERN TIER EXPRESSWAY	TWSC	No		X							$ 10,000
21	MAIN ST and Olcott Rd S	TWSC	No					X				$ 7,500
22	MAIN ST and River St	TWSC	Yes - 21					X				$ 7,500
23	MAIN ST and State Route 352	TWSC	No		X				o			$ 15,000
24	MAPLE ST and Canal St	AWSC	No									$ 5,000
25	OLD ITHACA RD and Level Acres Dr	TWSC	No		X							$ 65,000
26	PENNSYLVANIA AVE and Dalrymple Ave	TWSC	No									$ 6,500
27	RIDGE RD and GREENRIDGE DR	TWSC	No		X							$ 16,500
28	S CORNING RD and CR 10/SO.CORNING RD	TWSC	No		X				o			$ 15,000
29	WATKINS RD and BENTLEY PL	TWSC	No					X				$ 9,000
30	WYGANT RD and GREENRIDGE DR	TWYC	No		X							$ 15,000
31	WYGANT RD and MEADOWLARK RD	TWSC	No									$ 5,000
32	WYGANT RD and RIDGE RD	AWSC	No							X		$ 15,000
				3	10	0	1	4	0	1	0	
Legend:				$ 75,000	$ 100,000	$ -	$ 50,000	$ 10,000	$ -	$ 10,000	$ -	$ 761,500
Preferred "Optional" if funding is available.												
"Optional" project to consider if problem persists after base project constructed												

4.4 Urban Signalized Intersections

Table 18. List of Projects for Urban Signalized Intersections in Chemung County.

Intersection No.	Intersection	Traffic Control	Location in Traffic Signal Evaluation Study (TSES)	Location in Pedestrian Safety Action Plan	Install Basic Signal Sign/Marking Improvements	NTOR	Backplates w/ Retroreflective Borders	FYA	Protected Left-Turns	Apply Access Management (driveways)	Add Pedestrian Push Button	Crosswalk Visibility Enhancements	Overhead Mast Arms	Intersection Lighting	Turn Lane Improvements	Cost
1	ARNOT RD and Chambers Rd	TRAFFIC SIGNAL	Yes	No	TSES		X	X	o		X	X	o	X		$ 48,000
2	CHAMBERS RD S and County Road 64	TRAFFIC SIGNAL	Yes	No	X	X	X	X			X	X		X		$ 54,000
3	CHAMBERS RD S and Arnot Mall Entrance	TRAFFIC SIGNAL	Yes	No	TSES	X	X			TSES	X	X	o	X	o - LT Lane	$ 39,000
4	CHAMBERS RD S and Eastbound I-86 Ramp Terminal	TRAFFIC SIGNAL	No	No	X		X				X	X		X		$ 43,000
5	MAPLE AVE and CEDAR ST	FLASHING LIGHT	No	No	X		X						o		o	$ 8,000
6	GRAND CNTRL AVE and E MCCANNS BLVD	TRAFFIC SIGNAL	Yes	No	TSES	X	X				X	X	o			$ 29,000
7	KAHLER RD N and KAHLER RD N TO I86 WB (RAMP)	TRAFFIC SIGNAL	No	No	X		X		o		X	X	o	X		$ 43,000
9	LAKE RD and FAIRVIEW RD	TRAFFIC SIGNAL	Yes	No	TSES		X	X	o	TSES	X	X	o		TSES - Longer RT Lan	$ 38,000
10	LAKE RD and E 14TH ST	TRAFFIC SIGNAL	Yes	No	TSES	X	X	X	o	TSES	X	X	o	X		$ 49,000
11	WYGANT RD and Watkins Rd	TRAFFIC SIGNAL	No	No	X		X		o		X	X	o			$ 33,000
					5	4	10	4	0	0	9	9	0	6	0	
Legend:					$ 25,000	$ 4,000	$ 30,000	$ 40,000	$ -	$ -	$ 90,000	$ 135,000	$ -	$ 60,000	$ -	$ 384,000
Preferred "Optional" if funding is available.																
"Optional" project to consider if problem persists after base project constructed																

5 Evaluation

Chemung County Public Works Department will be the lead agency implementing the plan and coordinating with stakeholders, depending on individual projects.

Safety improvements identified in this plan depend on a program of data driven priorities and proven effective strategies. As the County implements the projects and strategies outlined in this plan, evaluation will help achieve the goals by analyzing LRSP process and performance and determining whether current activities deserve enhancement, revision, or replacement. Recurring evaluation will also ensure the accuracy of data and proposed strategies. Evaluation is intended to take the place of trial and error, guesswork based on anecdotal evidence, and intuition.

5.1 Performance Measures

It is critical that performance measures be established, targets set, and progress monitored regularly. Annually and for the life of the plan, the County will review implemented projects and evaluate each in terms of changes in the following performance metrics:

- Crashes, fatalities, and injuries.
- Crash types at the project locations.

Besides crash data, another suite of data may be useful. For example, adjudication data may provide an understanding of the outcome of speed citations, and a public survey about attitudes toward safety efforts may provide critical insight into public perception.

5.2 Evaluation Process

For a comprehensive performance evaluation of this plan's outputs and outcomes, at a minimum, the County can assign champions to complete each item outlined in table below, on an annual basis. Upon completion of all items each year, the County will be able to monitor and track their roadway safety performance, identify impact of the improvements implemented, and explore opportunities for improvement in the performance.

Table 19. Performance Evaluation Recommended Action Items.

#	Recommended Annual Action Items	Champion/Responsible
1	Assemble data for assessing output and outcome performance measures for each emphasis area.	
2	Document baseline data.	
3	Identify missing data which may prevent assessment of performance measures.	
4	Determine if other performance measures can be used to determine progress for each emphasis area.	
5	Determine the output and outcome measures for each emphasis area.	
6	Compare output performance measures with baseline data.	
7	Compare outcome performance measures with baseline data.	
8	Compare observation and/or telephone survey results to measure changes in awareness, attitudes, and behaviors.	
9	Collect and review the data available for benefit/cost analyses.	
10	Conduct program-level benefit/cost analyses where feasible.	
11	Identify emphasis areas that perform 1) Better than expected, 2) Worse than expected, and; 3) As expected.	
12	Investigate the emphasis areas that perform worse than expected and identify opportunities to improve performance.	
13	Investigate the emphasis areas that perform better than expected and identify opportunities to implement same practices more frequently, as adequate.	

The FHWA's "Evaluation Process Model" designed for evaluating States' the Strategic Highway Safety Plans provides guidance that can be scaled for an LRSP evaluation.[13] If the County desires to implement a further detailed evaluation process, which would be helpful especially when renewing the plan upon completion of the 5-year period that this plan was designed for, the County engineers can refer to this document and implement applicable steps to the above-mentioned evaluation process.

[13] FHWA. 2013. "Strategic Highway Safety Plan – Evaluation Process Model," FHWA-SA-12-035, Washington, DC. Available at:
https://safety.fhwa.dot.gov/shsp/epm/index.cfm

6 Next Steps

This safety plan identifies implementable countermeasures related to engineering infrastructure projects, educational opportunities, and enforcement. The Chemung County should work with their safety stakeholders to collaboratively identify priority safety projects to advance in order to reduce fatalities and serious injuries on the roadways.

The County will implement this safety plan over a 5-year period and will adjust it according to emerging needs and priorities. The County anticipates that it will vet and implement projects that will cost approximately $1,000,000 annually.

Chemung County has opportunities to compete for project funding to improve transportation safety on the local system. The countermeasures and locations identified in this plan can be used to aid in developing safety projects on the County's road network.

Recommended next steps include:

- **Verify and Develop Projects.** The projects developed under this LRSP are based on data-analysis results, stakeholder input, and field examination through online Maps. The County will need to **field-verify** roadway information and countermeasure selection, and conduct further studies, if field visits indicate a need. Upon the verification, the county can assess and refine the costs associated with each project, using the estimates given in this plan as a starting point.
- **Schedule and Budget Projects.** The County should determine specific timelines for development and construction of each project and accordingly develop budget allocation plans. To minimize total costs, the county can plan to phase or bundle the project development and construction, based on similar countermeasure purchase/installation, regional proximity, contractor crew costs, or any other factor that can help optimizing the use of total budget.
- **Improve Data Integration and Analysis.** Chemung County has an opportunity to further improve current safety data analysis and integration capabilities by taking advantage of the emerging technologies in safety data collection, and analysis, and b the technical assistance opportunities available through NYSDOT, FHWA, and other resources as a means of enhancing future transportation safety efforts through data-driven approaches.
- **Conduct Road Safety Audits.** The County should consider performing road safety audits (RSA) for corridors that are often reported by public for unsafe attributes or near-miss crashes. An RSA is a formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. The Federal Highway Administration's Road Safety Audit website [14] gives guidance as to how to conduct an RSA, who should be involved, and the potential benefits associated with RSAs.
- **Develop a Policy on Utility Pole Removal/Replacement.** Given that utility poles accounted for 15 percent of the fixed-object crashes on local county roads and accounted for 17 percent of fatalities in fixed-object crashes, Chemung County has an opportunity to work with utility companies to relocate current utility poles outside the clear zone and develop a policy for safely locating future pole installations. The stakeholder group identified the placement of utility poles

[14] FHWA Road Safety Audit website: https://safety.fhwa.dot.gov/rsa/guidelines/

as contributing to the severe lane departure crashes on local roads and the data analysis results confirmed their concerns. The study team recommends that Chemung County consider developing a policy for utility pole removal and relocation to address severe roadway departure crashes that involve such fixed objects. The County can refer to policies developed by other agencies as examples and develop policy tailored to address the issue in Chemung County.[15,16,17]

- **Engage Partner Agencies.** Although one agency may be ultimately responsible for managing the local road safety plan, successfully implementing it will require continued participation by supporting stakeholders who may have access to additional data that will support development of accurate performance measurement as well as other resource to facilitate the transition from plan development to implementation.
- **Monitor Performance Closely.** It is important to assign responsibility for collecting and reporting performance measurements. It is equally important to assign accountability for the measures at the appropriate level. In addition, a schedule for performance reporting will need to be established. Annual performance measures are common, but in some cases a more frequent measure may help a program adjust direction if early indicators show a need to deviate from the original plan. Having a responsible party and an expected schedule will ensure performance measurements are actually taken and that they occur on a regular basis. Accountability ensures that the efforts to improve are continuous.
- **Explore Opportunities to Advance Performance Measures and Targets.** Rather than relying solely on measures chosen because the data is readily available, the County should identify performance measures that would prove helpful for decision makers and program managers. This may mean implementing performance measurement using a phased-in approach—initially using measures based on available data while working toward acquiring the desired measures. Once it has solidified the performance measures it will use, the County can then establish performance targets and consistent evaluation periods. An important element of setting performance goals that should be taken into account during this process is understanding what each stakeholder considers "successful" performance.

[15] Kansas LTAP. 2007. "Guide for Accommodating Utilities Within Right-of-Way For Counties & Small Cities in Kansas." Available at: https://kutc.ku.edu/sites/kutc.ku.edu/files/docs/pdf/ROWguide2007.pdf
[16] Lincoln County Highway Department. n.d. "Accommodation of Utilities on County Highway Right-of Way." Available at: https://www.lincolncountysd.org/userfiles/file/Highway/LincolnCountyUtilityPermitingPolicyGuidelines.pdf
[17] Pierce County Public Works Department. 2016. "Manual on Accommodating Utilities in Pierce County Rights-of-Way." Available at: https://www.co.pierce.wa.us/ArchiveCenter/ViewFile/Item/4710

APPENDIX. Chemung County Final Countermeasure List

This appendix records the approved countermeasures for Chemung County's Local Road Safety Plan (LRSP). At the Task 4 Countermeasure Workshop, stakeholders discussed potential countermeasures to apply at high-risk locations within the emphasis areas listed below. The following documents the results of this conversation and a subsequent review of the tiered list of countermeasures.

Tier 1 countermeasures are basic, fundamental strategies with proven safety benefits, many of which are low-cost and easily implemented. The tiered levels of countermeasures within each emphasis area reflect an increasing difficulty of implementation, costs, or both. If identified, typical values or ranges of countermeasure effectiveness are shown throughout the charts, although it is recommended to review the CMF Clearinghouse for more specific information.

Emphasis Areas:

- Lane departure
- Intersections
- Pedestrians and bicycles
- Speeding and aggressive driving
- Age-related

A.1. Lane Departure

Table 20. Lane Departure Countermeasures.

Countermeasure	Targeted Crashes	Crash Reduction[a]	Comments
TIER 1			
Fundamental Signs and Markings for Curves	All curve crashes	10%	Standard advanced curve warning sign plus advisory speed plaque and curve center and edge lines; chevrons per MUTCD.
Wider Centerline Pavement Markings	Head-on crashes	5% [b]	Apply where center line rumble stripes cannot be installed.
Low Noise Rumble Strips (mumble strips)	Lane departure crashes		Tested in several states. Uses a sinusoidal pattern that reduces road side noise levels.
Standard Edge Line Markings	Lane departure crashes	10% [b]	
Wider Edge Line Markings	Lane departure crashes	5% [b]	Apply in problem sections where edge or shoulder rumble strips cannot be applied. May include application of VisiMax Tape.
Pavement Wedge/SafetyEdge$_{SM}$	Lane departure crashes	NA	Apply during paving operations or in areas of recurring edge drop-off.
Fixed Object Delineation, including delineators on guiderail	Night fixed object crashes	10% [b]	
TIER 2			
Enhanced Signs and Markings for Curves	All curve crashes	30%	Oversized, left, and right fluorescent yellow, advance warning signs; chevrons; slow and XX mph pavement markings; center and edge lines.
Improve superelevation	All curve crashes		Correct superelevation during resurfacing projects (amount by which the outer edge of a curve on a road is banked above the inner edge)
Optical Speed Bars	All curve crashes		
Lighting	Dark, dusk, or dawn crashes	50% (night only)	To improve isolated locations, such as sharp horizontal curves.
Alignment Delineation	Night lane departure crashes	15% [b]	Post-mounted delineation (flexible or rigid) along the roadside. It is different than post sleeve delineation through curves.

Countermeasure	Targeted Crashes	Crash Reduction[a]	Comments
Tree Removal / Utility Pole Relocation	Tree /utility pole crashes	Varies between 17% to 100%	
TIER 3			
High Friction Surfaces	Wet pavement crashes	50% (wet) 25% (all)	Requires high initial pavement quality.
Enhanced Signs and Markings for Curves Plus Flashing Beacons	All curve crashes	49% combined	Same as enhanced signs and markings for curves plus solar powered flashing beacons added to warning signs.
Enhanced Signs and Markings for Curves Plus Dynamic Curve Warning System	All curve crashes	51% combined	Same as enhanced signs and markings for curves plus dynamic advanced warning signs added.
Shield Fixed Objects	Fixed object crashes	Varies between 14% to 100%	Apply when removal is not feasible. Risk analysis will provide CRF.
TIER 4			
Center Line Rumble Stripes	Head-on crashes	20%	
Edge Line Rumble Stripes or Shoulder Rumble Strips	Lane departure crashes	13% (all) 18% (Injuries)	
Raised Thermoplastic Centerline Rumble Strips	Head-on crashes	20%	Apply as an alternative to centerline rumble stripes. Can be applied in urban areas where noise is a concern.
Raised Thermoplastic Edge Line Rumble Strips	Lane departure crashes	20%	Apply as an alternative to edge line rumble strips.
Wider Shoulders	Lane departure crashes	Varies between 0 and 70%	CRF dependent on initial and final shoulder width. See Toolbox or Roadside Design Guide to determine.
Paved Shoulders	Lane departure crashes	Varies between 15% and 86%	CRF dependent on initial and final shoulder width. $100K to $350K per mile (5 to 6-ft paved shoulder)
Reconstruct Curve, Minor to Intermediate	All curve crashes	Varies between 0 and 86%	High friction surface, shoulder widening; increased recovery zone. CRF depends on type of improvement.
Curve Flattening or Other Major Reconstruction	Curve crashes	38%	

Countermeasure	Targeted Crashes	Crash Reduction[a]	Comments
Improved Recovery Areas, Slope Flattening (possibly with water permeable material)	Run-off-road and fixed object crashes	Varies between 10% and 90%	CRF dependent on initial and final recovery zone and extent of fixed objects removed.
Alternate Passing Lanes (2+1 design)		25% [b]	Missouri data indicates reductions as high as 55 percent possible.
Four to Three Lane Conversions	All crashes	37%	
Median Buffer	Head-on crashes		For two-lane roads with paved shoulders, narrow shoulders to provide a flush median with rumble strips and tubular delineators. No passing allowed.
Corridor 3E Improvements	Severe (fatal and severe injury) lane departure crashes	25%	CRFs are applied to all crashes.
Area-Wide 3E Improvements	Severe (fatal and severe injury) lane departure crashes	10% [b]	CRFs are applied to all crashes.

[a] FHWA-SA-08-011 - "Desktop Reference for Crash Reduction Factors", FHWA, September 2008. Available at: https://safety.fhwa.dot.gov/tools/crf/resources/fhwasa08011/fhwasa08011.pdf

[b] CRF estimate is based on unpublished studies, since there is no reliable information publicly available.

A.2. Intersection

Resources:

- Intersection Safety Strategies Brochure - https://safety.fhwa.dot.gov/intersection/conventional/signalized/FHWA-SA-15-085_Strategies_2.pdf
- Low-Cost Safety Enhancements for Stop-Controlled and Signalized Intersections https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa09020/chap_2.cfm

Table 21. Intersection-related Countermeasures.

Countermeasure	Crash Reduction[a]	Additional Implementation Factors	Typical Implementation Cost Range per Intersection
TIER 1			
Basic set of sign and marking improvements	30%		$5,000 to $8,000
Clear sight triangles	Varies between 23% and 51%		
Lane narrowing using pavement marking	Varies between 15% and 56%	Single through lane	$5,000 to $10,000

Countermeasure	Crash Reduction[a]	Additional Implementation Factors	Typical Implementation Cost Range per Intersection
"Slow" pavement markings	Unknown		$2,000 to $5,000
Basic set of signal and sign improvements	30%		$5,000 to $30,000
Backplates with retroreflective borders	15% reduction for total crashes		
Flashing Yellow Arrow signal	up to 25% reduction in fatal and injury left turn crashes		
Advance cross street name signs for high-speed approaches on arterial highways	Unknown	High-speed approaches on four or more lane arterial highways	$1,000 to $5,000
Pedestrian ladder or cross-hatched crosswalk and advanced pedestrian warning signs	15% (pedestrian crashes) for signs Unknown for crosswalk	None	$1,000 to $3,000
Enforcement-assisted lights	15% of angle crashes	Enforcement commitment required	$1,000
Signal coordination	32%	Arterials with closely spaced (about 1/2 mile maximum) signals	$5,000 to $50,000
No Turn On Red restrictions			$1,000
Automated red-light enforcement	25% of angle crashes	Enabling legal authority required	Normally 0 if operated by contractor
TIER 2			
Either a) flashing solar powered LED beacons on advance intersection warning signs and STOP signs or b) flashing overhead intersection beacons (red/red)	10% (13% for right angle crashes)		$5,000 to $15,000
Dynamic warning sign which advises through traffic that a stopped vehicle is at the intersection and may enter the intersection	Unknown		$10,000 to $25,000
Lane narrowing using pavement marking and shoulder rumble strips	31%	Free of noise and bicycle issues-single through lane	$20,000 to $40,000

Countermeasure	Crash Reduction[a]	Additional Implementation Factors	Typical Implementation Cost Range per Intersection
Peripheral Transverse pavement markings	Unknown		$10,000
Dynamic speed warning sign to reduce speed	30%		$10,000
High-friction surface	25% (All crashes) 50% (wet pavement crashes only)		$20,00 to $50,000
Installation of a 6 ft. or greater raised divider on stop approach (installed separately as a supplemental countermeasure)	15%	Widening required to install island	$25,000 to $75,000 (pavement widening but no ROW required)
Change of permitted and protected left-turn phase to protected-only	41-48% of left turn crashes	None	$5,000 to $10,000
Advance detection control systems	40% (injuries)	Isolated high-speed (45mph or greater) signalized intersections	$15,000
RCUT modifications on high-speed divided arterials	100% cross path, 72-84% frontal impact, 43-53% all crashes	Ability to make U-turn within about ¼ to ½ mile of intersection	$5,000 to $50,000
Pedestrian countdown signals	25% (pedestrian crashes)	None	$5,000 to $15,000
Separate pedestrian phasing	34% pedestrian crashes)	None	$5,000 to $15,000
Bicycle boxes			
TIER 3			
New or upgraded lighting	50% (NEW), 25% (UPGRADED) of night crashes		$5,000 to $15,000
Install left-turn lane	28-48% reduction in total crashes (2-way stop controlled intersections) 13-24% reduction for left turn crashes (signalized)	Right of way restrictions; individual intersection analysis required	$350,000 to $400,000 each
Install right-turn lane	14-26% reduction in total crashes (2-	Right of way restrictions; individual	

Countermeasure	Crash Reduction[a]	Additional Implementation Factors	Typical Implementation Cost Range per Intersection
	way stop controlled intersections)	intersection analysis required	
If intersection has skew, reduce or eliminate skew or create offset T-intersections			
TIER 4			
Roundabouts	72% to 87% (injuries and fatalities)	Right of way restrictions; individual intersection analysis required	$500,000 to $1 million each
Corridor engineering, education, and enforcement (3E) improvements on high-speed arterials with very high frequencies of severe intersection crashes	25% of corridor intersection fatal and incapacitating injury crashes	Length of corridor should be in the 5-10 mile range	$1,000,000 per corridor + $100,000 education and enforcement annually per corridor
Municipal-wide 3E improvements in municipalities with high frequencies of severe intersection crashes	10% of all intersection crashes	Consider density of severe crashes per capita	$500,000 to 1,000,000 + $100,000 to 200,000 (dependent on the size of the city) education and enforcement annually per municipality

[a] FHWA. 2008. Desktop Reference for Crash Reduction Factors," FHWA-SA-08-011. Available at: https://safety.fhwa.dot.gov/tools/crf/resources/fhwasa08011/fhwasa08011.pdf

A.3. Pedestrians and Bicycles

Resources:

- EDC-4 STEP initiative technical sheets - https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step_tech_sheet.pdf
- PEDSAFE countermeasures website - http://www.pedbikesafe.org/PEDSAFE/countermeasures.cfm
- BIKESAFE countermeasure website - http://www.pedbikesafe.org/BIKESAFE/countermeasures.cfm

Table 22. Pedestrian and Bicycle Countermeasures.

Countermeasure	Description	Crash Reduction[a]	Costs
TIER 1			
Crosswalk visibility enhancements	This group of countermeasures includes improved lighting, advance or in-street warning signage, pavement markings, and geometric design elements	23-48% reduction in crashes	
Rectangular Rapid Flash Beacon (RRFB)	Warning device designed to help pedestrians roadways at midblock crossings and uncontrolled intersections.		Avg cost - $20,000
Add pedestrian push button actuation to existing traffic signals	Upgrade existing traffic signals with countdown timers and push buttons that meet ADA requirements		Avg cost - $10,000
Leading Pedestrian Interval	Gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left.	60% reduction in pedestrian-vehicle crashes at intersections	Staff time to adjust timing
Curb extensions	Curb extensions—also known as bulb-outs or neckdowns—extend the sidewalk or curb line out into the parking lane, which reduces the effective street width.		$2,000 to $20,000
Pedestrian refuge islands	Raised island, located between opposing traffic lanes at intersection or midblock locations, which separate crossing pedestrians from motor vehicles.	56% reduction in pedestrian crashes	$535 to $1,065 per foot; total construction costs range from $3,500 to $40,000, depending on the design,

Countermeasure	Description	Crash Reduction[a]	Costs
			site conditions, etc.
Bicycle lanes	Preferential or exclusive space for bicycle travel along a street. Bike lanes are typically 4 to 6 ft. wide and are designated by striping and symbols placed within the lane.		
TIER 2			
Sidewalks, walkways, and paved shoulders	Defined space or pathway for use by a person traveling by foot or using a wheelchair	Sidewalks – 65-89% reduction in crashes involving pedestrians walking along roadways Paved shoulders – 71% reduction in crashes involving pedestrians walking along roadways	Sidewalk - $35-150/linear ft. 5-6 ft. paved shoulder - $100,000-350,000 per mile
Pedestrian hybrid beacons	Traffic control device designed to help pedestrians safely cross busy or higher-speed roadways at midblock crossings and uncontrolled intersections.	69% reduction in pedestrian crashes; 29% reduction in total crashes; and 15% reduction in serious injury and fatal crashes.	Avg cost - $58,000
Raised crosswalk and speed tables	raised pedestrian crossing can reduce vehicle speeds and enhance the pedestrian crossing environment		$2,000 - $20,000
Separated bicycle lanes	Bicycle facilities that run alongside a roadway separated from automobile traffic by a physical barrier, such as parked cars, bollards, a landscaped buffer, or a curb.		
Bike boulevard	Low-speed, low-volume street which has been optimized for bicycle traffic		
School zone improvements	Sidewalks or separated walkways and paths; trained adult crossing guards equipped with a bright and reflective safety vest and a STOP paddle; police enforcement in school zones; enhanced signs and markings.		
TIER 3			
Road Diets	Converting an existing four-lane undivided roadway to a three-lane	19-47% reduction in total crashes	Restriping for a road diet-

Countermeasure	Description	Crash Reduction[a]	Costs
	roadway consisting of two through lanes and a center two-way left-turn lane (TWLTL). Benefits can include fewer lanes for pedestrian to cross; opportunity to install pedestrian refuge islands, transit stop enhancements, sidewalks, and bicycle lanes; traffic calming.		$25,000-40,000/mile. If completed as part of a regularly scheduled resurfacing (that would include striping anyway), costs are minimal.

[a] FHWA. 2008.Desktop Reference for Crash Reduction Factors. FHWA-SA-08-011 Available at: https://safety.fhwa.dot.gov/tools/crf/resources/fhwasa08011/fhwasa08011.pdf

A.4. Speeding and Aggressive Driving

Since speeding is crosscutting into many safety areas, many countermeasures listed here are also within the lane departure, intersections, and bicycle section. For additional details on CMFs, speed reductions, and studies: https://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/eng_ctm_crsh_14.pdf

Table 23. Speeding and Aggressive Driving-related Countermeasures.

Countermeasure	Description	Urban/Rural Applicability	Roadway environment
TIER 1			
One direction large arrow sign (W1-6)		Rural	Curves
Curve Treatment Level 1: Basic Curve Signing (advanced warning, chevrons, speed plates)	Installing basic curve signing to meet MUTCD minimum	Rural	Curves
Delineator Post		Rural, Urban	Any roads; curves
Longitudinal rumble strips	Raised or grooved patterns installed on both inside edges of normal travel lane to narrow effective width	Rural	
Converging chevron marking pattern	Type of transverse pavement markings forming chevron shape to create the illusion of travelling faster as well as the impression of narrower lanes	Rural, Urban	Local street, collector, arterial; exit ramps; curves on directional interchange ramps
Transverse markings	Series of white lines placed across the center of the lane and spaced progressively closer to create the illusion of travelling faster	Rural	Horizontal curves; Work zone
Optical Speed Bars	Series of white rectangular markings typically 1 foot wide placed just inside both edges of the lane and spaced progressively closer to create the illusion of travelling faster as well as the impression of narrower lane.	Rural	Local street, collector, arterial; curves
Add shoulder markings to narrow lane		Rural, Urban	2 lane road through small town; exit ramp

Countermeasure	Description	Urban/Rural Applicability	Roadway environment
Add on-street parking	Increase friction and encourages drivers to reduce speed	Urban	Local roads, collectors
Speed Limit XX Pavement Legend	Speed limit painted on roadway	Rural, Urban	Any road
"Slow" pavement legend	Slow painted on roadway	Rural, Urban	Local roads, collector, arterial; curves
"XX MPH" + Curve Symbol	Painted on roadway prior to curve		
"Radar Enforced" signs	Sign to remind drivers that a corridor is being monitored for speed on an unannounced basis.	Urban, Rural	
Automated enforcement	Use of cameras to enforce speed limits	Urban, Rural	Any road
Speed Limit Setting Guidelines			
Speed Limit Reviews			
USLIMITS2			
TIER 2			
Flashers	Add flashers to existing curve warning signs	Rural	Curves
Flags	Add flags to existing curve warning signs	Rural	Curves
Curve Treatment Level 2: Enhanced signing/delineation	Installing enhanced signing/delineation (oversized signs, florescent sheeting, full post delineation, etc.)	Rural	Curves
Sequential Dynamic Curve Warning System	Series of blinking chevron signs installed throughout a curve, flashes sequentially through the curve to warn speeding drivers	Urban, Rural	Curves
Speed feedback signs	Sign that dynamically displays speed of passing vehicles with the message, "YOUR SPEED XX". Signs may include temporary deployment using portable signs or installed permanent signs.	Rural, Urban	Any roads; school zones, advance of signalized intersection; work zones
Speed activated warning sign	Sign that displays warning messages to speeding drivers	Rural, Urban	Any roads; work zones; curves
Speed Limit Sign with LED	Speed limit sign enhanced with LED lights	Rural	Community entrance
Transverse rumble strips	Raised or grooved patterns installed on the roadway travel lane or shoulder pavements,	Rural	Local; stop-controlled approaches

Countermeasure	Description	Urban/Rural Applicability	Roadway environment
	perpendicular to the direction of travel		
In-Roadway Warning Lights	Flashing lights installed in the roadway to warn users that they are approaching a condition on or adjacent to the roadway that might not be apparent and require the driver to slow down	Rural, Urban	Any roads; pedestrian crossing; school zones, curves
High friction surface treatment	Pavement treatment addresses friction demand issues, such as those associated with reduction in pavement friction during wet conditions, and/or a high friction demand due to vehicle speed and/or roadway geometrics	Rural, Urban	Curves, intersections
Gateway Treatment	Placed at community entrance to remind drivers of changing roadway character	Rural	Community entrance
TIER 3			
Roundabout	Type of circular intersection configuration that safely and efficiently moves traffic through an intersection; feature channelized approaches and a center island that results in lower speeds and fewer conflict points	Urban, Rural	Local street, collector, arterial; ramp terminals
Road diet	Restripe road to reduce the number of lanes from 2 lanes in each direction to 1 lane in each direction with a center turn lane	Urban	Arterial road
Variable speed limit sign	Signs that allow speed limit to change according to conditions	Urban	Principal arterial, interstate
Red signal enforcement lights (tattletale lights)	Auxiliary lights connected to a traffic signal to help law enforcement officers more efficiently and safely issue citations for drivers who violate the red phase of the signal.	Urban	
Speed Hump	Rounded raised area across the road, typically 12-14 feet in length and 3-4 inches high	Urban, Suburban	Local street
Speed Cushion	Speed hump typically 6-7 feet wide that allows most emergency vehicles to straddle the hump	Urban	Local street

Countermeasure	Description	Urban/Rural Applicability	Roadway environment
Speed Table	Long speed hump typically 22 feet in length with a flat section in the middle and ramps on the ends	Urban	Local street
Raised Intersection	Raised plateau, with ramps on all approaches, where roads intersect	Urban	Local street
Choker	Mid-block curb extensions that narrow a road by extending the sidewalk or widening the planting strip	Urban	Local street
Neckdown	Intersection curb extensions that narrow a road by extending the width of a sidewalk	Urban	Local street
Chicane	Curb extensions that alternate from one side of the street to the other, forming S-shaped curves	Urban	Local street
Lateral Shift	Curb extensions that shifts travel lanes to one side of road for extended distance and then back to the other side	Urban	Local street
Center Island	Raised island along the centerline of a street that narrows the travel lanes	Urban	
Tubular channelizers	Tubes used to create island in center of roadway	Rural, Urban	Local, collector, arterial
Landscaping	Roadside plantings used to create vertical friction	Urban	Collector
TIER 4			
Internally illuminated raised pavement markers	Steadily illuminated lights installed in the roadway surface	Rural, Urban	Any roads; pedestrian crossing; school zones, curves
Corridor Enforcement and Education	Law enforcement units provides enhanced, planned enforcement while County Public Works, Public Health, and/or Advocacy groups provide education efforts on a corridor. The County is responsible of the arrangement, coordination, and synergy of these efforts.	Urban, rural	Any road
Corridor 3-E Initiative (engineering, education, enforcement)	Implementation of engineering countermeasures, along with	Urban, Rural	Any road

Countermeasure	Description	Urban/Rural Applicability	Roadway environment
	enhanced, planned enforcement and education efforts on a corridor The County is responsible of the initiation, coordination and synergy of these efforts.		

A.5. Age-related

Table 24. Strategies and Countermeasures for Age-related Crashes.

Young Driver
Conduct high visibility enforcement of GDL, no cell and texting laws, underage drinking and driving, and seatbelt use laws. Conduct enhanced enforcement and public outreach for young driver safety. Publicizing is best done through community events to attract local media and a community public education campaign about young driver laws, enhanced enforcement, and the necessary parental involvement.
Adjust curfew to include 9 p.m. – 5 a.m., the hours when young driver serious injury and fatality crashes are highest.
Promote required parent education component of local driver education programs (private and public school providers) to educate parents about teen driving risks, Graduated Driving License (GDL) provisions and their protections, parental role in supervising teen driving skill development, encourage selection of safer vehicles for teen driver, and to facilitate parent/teen driving agreements.
Older Driver
Many of these strategies are listed in earlier sections. Examples from Desk Reference Handbook for Designing Roadways for the Aging Population include: • Intersecting angle (limiting the skew); • Channelization • Intersection sight distance • Offset left-turn lanes • Delineation of edge lines and curbs • Advanced and oversized street name signs • Oversized Stop and Yield signs; enhance striping • Intersection lighting • Pedestrian crossings islands and high visibility crosswalks • Roundabouts and Reduced Left-Turn-Conflict Intersections • Supplemental pavement markings for Stop and Yield signs • Accessible Pedestrian Signal (APS) treatments • Flashing yellow arrow Please see Desk Reference Handbook for Designing Roadways for the Aging Population for further information on these strategies.