SOUTH CAROLINA

STATEWIDE TSMO MASTER PLAN

PREPARED FOR:

SCDOT
South Carolina Department of Transportation

PREPARED BY:

Kimley»Horn

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STATEWIDE TSMO MASTER PLAN

Prepared for:

South Carolina Department of Transportation
Traffic Engineering
955 Park Street
Columbia, South Carolina 29201

Prepared by:

Kimley-Horn
115 Fairchild Street, Suite 250
Charleston, South Carolina 29492
(843) 779-1604

In association with:

ICF Incorporated, LLC

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Project Team

Brent Dillon, SCDOT Director of Traffic Engineering

Daniel Halsted, SCDOT TSMO, Project Leader

Rick Reiff, Kimley-Horn, Project Manager

Jeff Dale, Kimley-Horn, Deputy Project Manager

Natalie Smusz-Mengelkoch, ICF, Project Engineer

TSMO Plan Team

Jennifer Rhoades, SCDOT Traffic Management

Melissa Edmonds, SCDOT Traffic Signals and Systems

Chowdhury Siddiqui, SCDOT Planning

Charlie Zeberlein, SCDOT Information Technology Systems

Lori Campbell, SCDOT District 1 Traffic Engineer

Brandon Wilson, SCDOT District 3 Traffic Engineer

Vic Edwards, SCDOT District 4 Traffic Engineer

Joey Skipper, SCDOT District 5 Traffic Engineer

Josh Johnson, SCDOT District 6 Traffic Engineer

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List of Acronyms

- AADT – Annual Average Daily Traffic
- ATMS – Advanced Traffic Management System
- CMM – Capability Maturity Model
- COG – Council of Government
- DMS – Dynamic Message Sign
- ED – Engineering Directive
- EVP – Emergency Vehicle Pre-Emption
- FAST Act – Fixing America's Surface Transportation Act
- FHWA – Federal Highway Administration
- HTF – Highway Trust Fund
- IIJA – Infrastructure Investment and Jobs Act
- IMTF – Infrastructure Maintenance Trust Fund
- IT – Information Technology
- ITS – Intelligent Transportation Systems
- LOTTR – Level of Travel Time Reliability
- MAC – Multi Agency Coordination
- MAP-21 Act – Moving Ahead for Progress in the 21st Century Act
- MOU – Memorandum of Understanding
- MPO – Metropolitan Policy Organization
- NCDOT – North Carolina Department of Transportation
- NPMRDS – National Performance Management Research Dataset
- SCDOT – South Carolina Department of Transportation
- SOP – Standard Operating Procedure
- STIP – Statewide Transportation Improvement Program
- TG – Traffic Engineering Guideline
- TI – Traveler Information
- TIM – Traffic Incident Management
- TMC – Traffic Management Center
- TMP – Transportation Management Plan
- TSM – Traffic Signal Management
- TSMO – Transportation Systems Management and Operations
- WZM – Work Zone Management

EXECUTIVE SUMMARY

The TSMO Master Plan is intended to help guide SCDOT and stakeholders through the deployment of TSMO strategies, projects, and programs. This plan is the first statewide technology-focused plan in South Carolina and will be the first step in creating the momentum to ultimately educate and inform stakeholders to key challenges and improvements.

TSMO is defined as an integrated set of strategies leveraged to improve performance of the existing transportation network. Benefits of TSMO include smoother and more reliable traffic flow, improved safety, decreased fuel consumption, cleaner air, increased economic vitality, and more efficient use of resources. **States and other operating agencies utilize TSMO to optimize existing infrastructure and expand capacity with significantly lower investment costs, essentially, making best use of the existing infrastructure.**

TSMO strategies leverage collaboration, performance measurement, and technology to promote optimized transportation networks. Examples of TSMO strategies include the following.

- **Traffic Incident Management**
- **Work Zone Management**
- **Special Event Management**
- **Road Weather Management**
- **Transit Management**
- **Freight Management**
- **Traffic Signal Coordination**
- **Traveler Information**
- **Ramp Management**
- **Congestion Pricing**
- **Integrated Corridor Management**
- **Access Management**
- **Improved Bicycle and Pedestrian Crossings**
- **Active Transportation and Demand Management**
- **Connected/Automated Vehicle Deployment**

Business Case

SCDOT manages the fourth-largest state transportation network, and the South Carolina highway system forms the backbone of the state's connectivity as an integral part of the state's economy and wellbeing of its population. The transportation network consists of over 41,000 miles of roadways and more than 8,400 bridges interconnecting ports with urban centers and commercial hubs, and enabling efficient transfer of people and goods within the state and across the interstate corridors.

Transportation agencies throughout the country, including SCDOT, are turning to TSMO strategies to optimize existing investments to gain significant mobility, safety, and environmental benefits. TSMO strategies have demonstrated impressive returns on investment (ROI) when compared with traditional roadway capacity expansion. In particular, optimized traffic signal timing, integrated corridor management, and active traffic management strategies provide significantly higher ROIs as compared to traditional roadway expansion projects.

Transportation agencies, particularly state DOTs, are increasingly recognizing the need to incorporate TSMO strategies to support optimized operations; not to replace capacity expansion, but as a complement and best practice to extend the value of the transportation network. The South Carolina Statewide TSMO Master Plan will provide the foundation for SCDOT to integrate TSMO practices and strategies within the agency and successfully realize the associated mobility, safety, and environmental benefits.

TSMO Vision and Goals

The development of the TSMO Master Plan was coordinated with numerous individuals through a TSMO Plan Team to steer the plan and stakeholders from around South Carolina providing input regarding existing TSMO activities and gaps. As part of the coordination, a Capability Maturity Model assessment was conducted and vision and goals for the plan were developed and refined. Based upon the engagement with the Plan Team and stakeholders, the SCDOT vision for TSMO and the eight TSMO goals are:

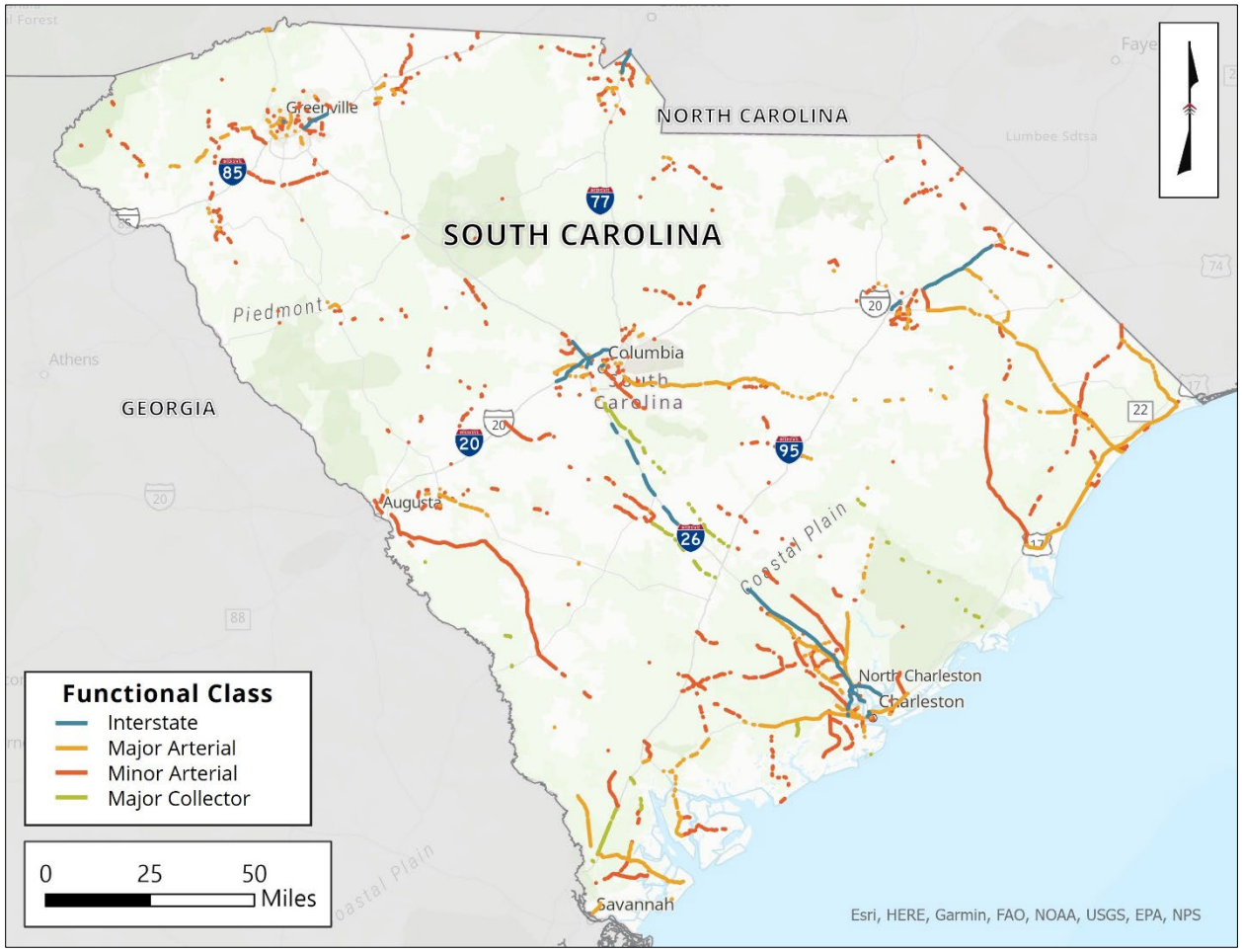
Optimize the South Carolina transportation network through the deliberate integration of transportation systems management and operations principles and practices that enhance mobility, reduce carbon emissions, and improve safety.

- **Improve mobility and reliability** by maximizing the existing transportation infrastructure to provide efficient, predictable, and safe transportation services for the movement of people and goods in the Palmetto state.
- **Enhance safety** by implementing TSMO strategies that reduce congestion-related crashes.
- **Integrate performance management** to support SCDOT's day-to-day decisions around the use of TSMO strategies to improve operations.
- **Reduce carbon emissions** by implementing strategies that reduce congestion.
- **Strategically employ innovation** by integrating emerging technologies to achieve impactful operational improvements.
- **Leverage collaboration** with internal and external stakeholders to ensure decisions related to TSMO initiatives balance statewide and local needs.
- **Encourage equitable solutions** that fairly distribute investments to improve operations by considering geographic diversity, historic inequities, and socioeconomic inclusivity.
- **Invest in resources** that support a sustainable commitment to the operations and maintenance of TSMO strategies.

Traffic Analyses

Traffic data for interstates, major arterials, minor arterials, and major collectors in South Carolina were mapped and analyzed to define the current state of traffic conditions. This data was used to then identify transportation needs and gaps along critical corridors and inform plan recommendations and potential projects.

To evaluate a roadway's suitability for the application of TSMO strategies, evaluation criteria were developed considering measures of congestion, reliability, and safety. Based upon the scoring criteria, all roadways were scored for the level of suitability for application of TSMO strategies by functional class. A summary map illustrating the top 10% highest scores in each functional class is shown below.



TSMO Recommendations

Based on discussions with stakeholders, TSMO best practices, and industry knowledge and experience, TSMO recommendations were developed and categorized into two types described further herein. **The TSMO recommendations are not intended to be implemented all at once; establishing a TSMO program and demonstrating the value that can be gained through use of TSMO strategies will take time.**

Programmatic recommendations are intended to strengthen the collaboration and coordination efforts, and to build the culture of TSMO throughout the state. Three categories of Programmatic recommendations were considered: Collaboration and Partnership, Resources (Funding and Staffing), and Policy and Procedures which are summarized below. The **bolded** recommendations are proposed to be undertaken as part of the initial steps of the plan implementation.

ID	Title	ID	Title
Programmatic – Collaboration and Partnerships			
PC-1	**Establish Statewide TSMO Council**	PC-7	Formalize Interagency Agreements
PC-2	Establish Regional TSMO Task Forces	PC-8	Develop Incident and Emergency Management MOUs
PC-3	FHWA Coordination	PC-9	Participate in Interagency Training Exercises
PC-4	Conduct Annual TSMO Briefing	PC-10	Participate in After-Action Briefings
PC-5	Conduct Annual Peer State TSMO Meetings	PC-11	Prepare TSMO Informational Material
PC-6	Facilitate TSMO Discussion at Transportation Industry Meetings		
Programmatic – Resources (Funding and Staffing)			
PR-1	**Define Program Budget Needs**	**PR-3**	**Develop Staffing Plan**
PR-2	Establish TSMO Program - Funding Resources	PR-4	Establish TSMO Program - Staffing Resources
Programmatic – Policy and Process			
PP-1	Establish TSMO Standards and Guidelines	PP-8	Develop Data Sharing Agreements
PP-2	Modify Existing SCDOT Planning and Project Development Directives	PP-9	Investigate Efficient Data Investment Strategies
PP-3	Encourage External Stakeholders to Integrate TSMO	PP-10	Develop Performance Measures Dashboard
PP-4	Conduct TSMO Training	PP-11	Develop Performance Measure Targets and Tools
PP-5	Develop SCDOT TSMO Website	PP-12	Manage TIM and TSM Performance
PP-6	Develop TSMO Informational Materials	PP-13	Leverage Data to Inform Operations and Investments
PP-7	Establish TSMO Data Review Subcommittee		

Deployment recommendations provide a framework for the types of TSMO strategies ready for implementation. Three categories of Deployment recommendations were considered: Traffic Management Centers, ITS Networks, and Corridor Management and are summarized below. The **bolded** recommendations are proposed to be undertaken as part of the initial steps of the plan implementation.

ID	Title	ID	Title
Deployment – Traffic Management Centers			
DTMC-1	**TMC Facility Upgrades**	DTMC-4	Common Data Platform
DTMC-2	**Integrated TMC Concept of Operations**	DTMC-5	Planned and Unplanned Event Management
DTMC-3	Statewide ATMS Software Upgrade		
Deployment – ITS Networks			
DITS-1	**Develop Statewide ITS Network Communication Strategic Plan**	**DITS-3**	**Expand Off-Interstate ITS Networks**
DITS-2	**Expand Interstate ITS Networks**		
Deployment – Traffic Signal Improvements			
DCM-1	**Traffic Signal Timing Upgrades**	DCM-10	Queue Warning Systems
DCM-2	Traffic Signal Upgrades	DCM-11	Ramp Metering
DCM-3	Automated Incident Detection Systems	**DCM-12**	**Real-Time Traveler Information**
DCM-4	**Dynamic/Variable Message Signs**	DCM-13	Social Media
DCM-5	Dynamic Speed Limits	**DCM-14**	**Transit Signal Priority**
DCM-6	Emergency Operations Plans	DCM-15	Traveler Information Portals
DCM-7	Emergency Vehicle Preemption	DCM-16	Truck Parking Systems
DCM-8	**Integrated Corridor Management**	DCM-17	Vehicle Detection
DCM-9	In-Vehicle Services		

1 INTRODUCTION

The South Carolina Department of Transportation's (SCDOT) Statewide Transportation Systems Management and Operations (TSMO) Master Plan will provide a framework for a more sustainable, efficient, and safer transportation network for South Carolina. The TSMO Master Plan includes a strategic level that will be congruent with SCDOT's strategic vision, goals and objectives while providing direction toward incorporating TSMO principles into SCDOT programs. The TSMO Master Plan assesses existing conditions through stakeholder engagement and data to match recommendations and improvements with demonstrated problems.

1.1 Background and Purpose

The TSMO Master Plan is intended to help guide SCDOT and stakeholders through the deployment of TSMO strategies, projects, and programs. This plan is the first statewide technology-focused plan in South Carolina and will be the first step in creating the momentum to ultimately educate and inform stakeholders to key challenges and improvements.

1.2 TSMO Overview

TSMO is defined as an integrated set of strategies leveraged to improve performance of the existing transportation network. Benefits of TSMO include smoother and more reliable traffic flow, improved safety, decreased fuel consumption, cleaner air, increased economic vitality, and more efficient use of resources. **States and other operating agencies utilize TSMO to optimize existing infrastructure and expand capacity with significantly lower investment costs, essentially, making best use of the existing infrastructure.**

What is TSMO?

TSMO is a set of integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system.

FAST Act (23 U.S.C. 101(a)(30))

The importance of TSMO is recognized throughout Federal legislation as lawmakers recognize and encourage its use to realize benefits more efficiently. The MAP-21 Act was the first federal initiative that recognized the importance of TSMO which included an enhanced definition of TSMO. The FAST Act further supported and promoted TSMO as an efficient and performance-based program designed to improve transportation safety, mobility, and reliability. And most recently, the IIJA (Public Law 117-58, also known as the "Bipartisan Infrastructure Law") – signed November 15, 2021 – encourages the use of TSMO strategies throughout its many Formula and Competitive Grant Programs.

TSMO strategies leverage collaboration, performance measurement, and technology to promote optimized transportation networks. Examples of TSMO strategies include the following.

- **Traffic Incident Management**
- **Work Zone Management**
- **Special Event Management**
- **Road Weather Management**
- **Transit Management**
- **Freight Management**
- **Traffic Signal Coordination**
- **Traveler Information**
- **Ramp Management**
- **Congestion Pricing**
- **Integrated Corridor Management**
- **Access Management**
- **Improved Bicycle and Pedestrian Crossings**
- **Active Transportation and Demand Management**
- **Connected/Automated Vehicle Deployment**

The implementation of these and other TSMO strategies require a focus on efficient management and operations. Furthermore, TSMO goes beyond technology solutions—implementing an effective TSMO approach requires not only a focus on efficient management and operations, but also improved communication and collaboration with internal and external transportation partners. This can necessitate a cultural shift within most departments. Shifting culture can be an arduous task; however, the benefits of implementing a TSMO approach have proven to provide significant returns.

1.3 Business Case for TSMO

South Carolina is home to a thriving community of 5.2 million residents, is the 10th fastest growing population in the country, and is known for its beautiful landscapes and a flourishing tourism industry. SCDOT manages the fourth-largest state transportation network, and the South Carolina highway system forms the backbone of the state's connectivity as an integral part of the state's economy and wellbeing of its population. The transportation network consists of over 41,000 miles of roadways and more than 8,400 bridges interconnecting ports with urban centers and commercial hubs, and enabling efficient transfer of people and goods within the state and across the interstate corridors.

The financial underpinning of SCDOT's endeavors largely relies on federal funds and state revenue garnered through Motor Fuel User Fees and other driver/vehicle-related charges, constituting 80% of SCDOT's total revenues. Federal funds, though significant, are not enough to meet the expanding infrastructure needs. Motor Fuel User Fees constitute a substantial portion of this funding structure, with a diverse revenue stream for road and bridge projects.

While the federal excise tax on motor fuels is dedicated to the HTF, the state motor fuel fees are dedicated to the IMTF. Enacted through Act 40 of 2017, IMTF operates as a safeguard repository. Within the IMTF, the funds are primarily allocated to pavement maintenance projects with less than 10% allocated to addressing the State's congestion challenges.

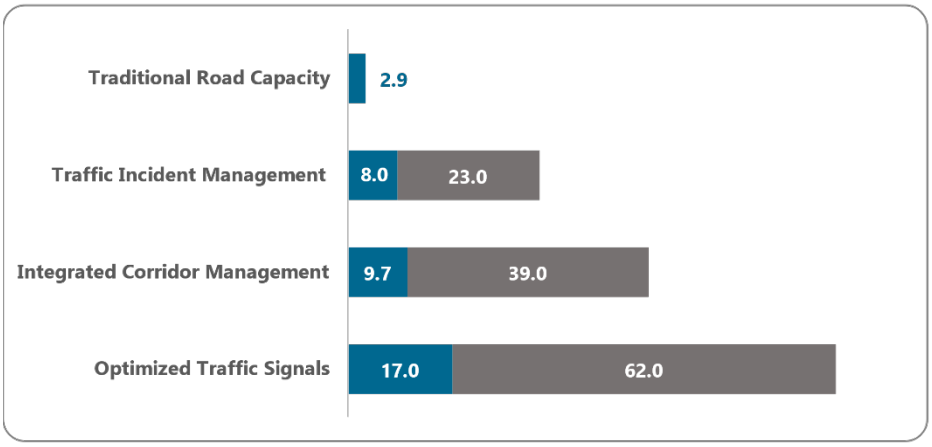
In fiscal year 2022-2023, the state dedicated $500 million to expedite SCDOT's road and bridge projects supplemented by a recurring investment of $100 million in state funds to leverage significant federal infrastructure investment and increase SCDOT's federal revenues by approximately $250 million per year over the next five years. The intention behind this is to mitigate urban congestion, spur economic growth and address mobility needs in rural domains.

However, even with the significant increased investment through the IMTF, SCDOT faces mobility challenges that threaten the sustainability of its approach to managing and operating the transportation network.

- **Decline in motor fuel tax:** According to the American Petroleum Institute of Motor Fuel Taxes, the state motor fuel user fees in South Carolina in January 2022, was recorded as 28.75 cents per gallon. Despite the increase in motor fuel user fees in South Carolina from 2017, the fuel taxes remain significantly lower than other states and much lower than the national average. As vehicles become more fuel-efficient and alternative energy sources gain traction, the revenue generated from motor fuel taxes will decline, posing a challenge to maintaining infrastructure investments.
- **Inflation:** The rising costs of construction and maintenance have outpaced the growth of traditional funding sources, making it difficult to address critical infrastructure needs effectively.
- **Population Growth and Increased Road Usage:** South Carolina's population growth has led to increased demand for the transportation system, necessitating further investments in capacity and safety.

South Carolina has focused on new location and capacity expansion infrastructure-based projects. This approach is becoming increasingly more difficult with the rising use and costs of construction compounded with the effective decline of funding. This is further exasperated in South Carolina's coastal areas where the natural environment limits construction and increases network reliance on bridges. Agencies are looking to optimize the existing transportation network to do more with what they have.

Transportation agencies throughout the country—including SCDOT—are turning to TSMO strategies to optimize existing investments to gain significant mobility, safety, and environmental benefits. TSMO strategies have demonstrated impressive returns on investment (ROI) when compared with traditional roadway capacity expansion. In particular, optimized traffic signal timing, integrated corridor management, and active traffic management strategies provide significantly higher ROIs as compared to traditional roadway expansion projects as is shown in Figure 1.



Source: Economic Benefits of Road Widening, Centre for Transport Studies, 2021; ITS for Traffic Incident Management, USDOT, 2007; ITS Benefits, Costs, Deployment, and Lessons Learned Desk Reference: 2011 Update, USDOT, 2011; ITS for Traffic Signal Management, USDOT, 2007

Figure 1 – Return on Investment Comparison

Transportation agencies—particularly state DOTs—are increasingly recognizing the need to incorporate TSMO strategies to support optimized operations; not to replace capacity expansion, but as a complement and best practice to extend the value of the transportation network. State agencies throughout the nation are establishing TSMO programs in which agency collaboration and technology are strategically leveraged to maximize performance. The South Carolina Statewide TSMO Master Plan will provide the foundation for SCDOT to integrate TSMO practices and strategies within the agency and successfully realize the associated mobility, safety, and environmental benefits.

2 TSMO PLAN DEVELOPMENT

The development of the TSMO Master Plan was coordinated with numerous individuals through a TSMO Plan Team to steer the plan and stakeholders from around South Carolina providing input regarding existing TSMO activities and gaps. As part of the coordination, a Capability Maturity Model (CMM) assessment was conducted and vision and goals for the plan were developed and refined.

2.1 TSMO Plan Team

To help steer the development of the TSMO Master Plan, representatives from various SCDOT offices were engaged as Plan Team members. The plan team met four times throughout the project to guide vision and goals development, identify statewide needs and gaps, develop program recommendations, and review the final plan document. The Plan Team representatives are summarized below.

- Jennifer Rhoades, SCDOT Traffic Management
- Melissa Edmonds, SCDOT Traffic Signals
- Chowdhury Siddiqui, SCDOT Planning
- Charlie Zeberlein, SCDOT Information Technology Systems
- Lori Campbell, SCDOT District 1 Traffic Engineer
- Brandon Wilson, SCDOT District 3 Traffic Engineer
- Vic Edwards, SCDOT District 4 Traffic Engineer
- Joey Skipper, SCDOT District 5 Traffic Engineer
- Josh Johnson, SCDOT District 6 Traffic Engineer

2.2 Stakeholder Team

Three workshops were held with stakeholders from around South Carolina to gather technical information, local experiences, and feedback throughout the development of the TSMO Master Plan. The stakeholders were structured around the Upstate, Midlands, and Lowcountry regions of South Carolina and consisted of representatives from SCDOT offices, FHWA, local governments, and metropolitan planning organizations (MPOs) as summarized in Appendix A.

Workshop #1 – Introduction

The first stakeholder workshop was held on December 13, 2022, and was focused on introducing TSMO, the plan development process, and an initial discussion of local challenges and opportunities around South Carolina. Project stakeholders identified their greatest challenges as limited staffing and resources and managing public expectations. Challenges related to changing technology and training, traffic safety, travel reliability, and congestion were also identified. Project stakeholders also indicated that the TSMO strategies they would prioritize in

their roles would be arterials and traffic signal management, intersection congestion improvements, and ITS communication upgrades.

Workshop #2 – CMM

Workshops were held the week of March 27, 2023, with each of the Upstate, Midlands, and Lowcountry regions to review their existing TSMO infrastructure and traffic conditions, and to identify preliminary needs and gaps in the respective regions. In addition, the results of the CMM process were discussed with the stakeholders and are detailed in the next section.

Workshop #3 – Project Recommendations Review

The final workshop was held on October 24, 2023, and was focused on presenting a summary of the project recommendations and gathering initial feedback on the value of the recommendations from the stakeholders. The project recommendations are detailed in Section 4.

2.3 Capability Maturity Model Assessment

A CMM assessment is a self-evaluation of effectiveness developed by FHWA that promotes a process-driven approach to assessing and improving TSMO programs. The CMM assessment framework focuses on the role of agencies to improve program business processes and management, allows for improvement of consistent institutional issues, and promotes the adoption and success of TSMO programs. The CMM assessment is based on the following six areas of capability.

1) **Business processes**, including formal scoping, planning, programming, and budgeting.
2) **Systems technology**, including the use of systems engineering, systems architecture standards, interoperability, and standardization.
3) **Performance measurement**, including measure definition, data acquisition, and data use.
4) **Culture**, including technical understanding, leadership, outreach, and program legal authority.
5) **Organization and workforce**, including programmatic status, organizational structure, staff development, and recruitment and retention.
6) **Collaboration** – including working relationships with public and private sector agencies.

For each of the areas, four levels of capability are used to determine agency strengths and weaknesses. These levels are defined from *Level 1 – Performed*, where activities are informal or ad hoc to *Level 4 – Optimized*, that indicate a core program priority. The six areas of capability were evaluated at the March workshops for the following eight services, which were developed based upon feedback from the Plan Team, on a regionwide level and statewide level.

- **Work Zone Management**
- **Traffic Management Centers**
- **Traffic Incident Management**
- **Traffic Signal Management**
- **ITS Communications**
- **Emergency Response and Resiliency**
- **Data Management**
- **Traveler Information**

Figure 2 provides the overall average of the six capability areas by region and statewide. Generally, the state is operating with similar capability across the six areas. It should be noted that the lower capability levels should not be interpreted as negative, but as a tool to identify where resources should be focused to progress to the next level.

Capability Areas	Level 1, Performed Activities and relationships largely ad hoc, informal	Level 2, Managed Basic strategy applications understood; key processes support requirements; key technology under development	Level 3, Integrated Strategy applications implemented and managed; technical and business processes developed, documented, and integrated	Level 4, Optimized Full, sustainable core program priority; with top level management status; formal partnerships
Business Processes	Upstate Midlands Lowcountry	Statewide		
Systems & Technology	Upstate Midlands Lowcountry	Statewide		
Performance Measurement	Upstate Midlands Lowcountry	Statewide		
Culture	Upstate Midlands Lowcountry Statewide			
Organization & Staffing	Upstate Midlands	Lowcountry Statewide		
Collaboration	Upstate	Midlands Lowcountry Statewide		

Figure 2 – SCDOT CMM Self-Assessment

2.4 TSMO Vision and Goals

Based upon the engagement with the Plan Team and stakeholders, the SCDOT vision for TSMO is:

Optimize the South Carolina transportation network through the deliberate integration of transportation systems management and operations principles and practices that enhance mobility, reduce carbon emissions, and improve safety.

In addition, SCDOT's TSMO goals were developed through discussions with the Plan Team and stakeholders, and a review of other South Carolina planning documents.

Improve mobility and reliability by maximizing the existing transportation infrastructure to provide efficient, predictable, and safe transportation services for the movement of people and goods in the Palmetto state.

Enhance safety by implementing TSMO strategies that reduce congestion-related crashes.

Integrate performance management to support SCDOT's day-to-day decisions around the use of TSMO strategies to improve operations.

Reduce carbon emissions by implementing strategies that reduce congestion.

Strategically employ innovation by integrating emerging technologies to achieve impactful operational improvements.

Leverage collaboration with internal and external stakeholders to ensure decisions related to TSMO initiatives balance statewide and local needs.

Encourage equitable solutions that fairly distribute investments to improve operations by considering geographic diversity, historic inequities, and socioeconomic inclusivity.

Invest in resources that support a sustainable commitment to the operations and maintenance of TSMO strategies.

3 EXISTING CONDITIONS

Baseline conditions of TSMO activities were established to help shape the framework of the master plan. The following reviews and analyses were conducted to help define existing TSMO activities in South Carolina.

- An existing **Documentation Review** of SCDOT engineering directives, design manuals, and department policies was conducted to identify current TSMO activities and is summarized in Section 3.1.
- A review of **Existing Infrastructure** was conducted of existing communication systems, field devices, and operations-related information and infrastructure around South Carolina and is summarized in Section 3.2.
- An **Existing Traffic Conditions Analysis** was conducted to identify existing roadways in South Carolina that have challenges with congestion, reliability, and safety where TSMO strategies could make the biggest impacts. This analysis is summarized in Section 3.3.

3.1 Existing Documentation

For the TSMO program to be implemented, monitored, and maintained successfully, it should be fully integrated with the existing statewide plans and documents. A review of existing SCDOT engineering directives, design manuals, and department policies was conducted to evaluate and identify areas where TSMO strategies are currently integrated within SCDOT guidance.

SCDOT Engineering Directives

SCDOT has developed directives to provide engineering policy, procedures, and direction to the engineering divisions and providers of engineering services. Based upon this review, most of the existing engineering directives are related to construction processes and project prioritization/selection processes. There are several engineering directives that are related to TSMO activities which are listed herein.

- ED-2 – Fiscal and Maintenance Responsibilities for Traffic Signal Installations on the State Highway System
- ED-28 – Road Closures for Parades, Festivals, or Other Events
- ED-46 – Satellite Telephone Management, Testing and Reporting
- ED-49 – Use of Dynamic Message Boards
- ED-78 – Business Rules for District Traffic Signal Shop Operations

SCDOT Traffic Engineering Guidelines

SCDOT's traffic engineering guidelines provide general guidance that formalize procedures and processes primarily for special signs and pavement markings. Below is a list of traffic engineering guidelines related to TSMO activities.

- TG-29 – Late Night Flash (LNF) Operation of Traffic Signals
- TG-33 – Rectangular Rapid Flashing Beacons
- TG-35 – Business Rules for District Traffic Signal Shop Operations
- TG-36 – Shared Viewership of Closed-Circuit Television Traffic Monitoring Cameras

SCDOT Traffic Engineering Documents

Below is a list of traffic engineering documents related to TSMO activities.

- The SCDOT Traffic Signal Design Guidelines manual provides guidance, procedures, and specifications to promote uniformity in the design of traffic signals in South Carolina. The design guidelines include signal plan drafting guidance and specialized signal designs to ensure that plans properly convey the extent and character of the work to be performed, as well as the operation of the signal upon completion of the project.
- The SCDOT Rule of Work Zone Safety and Mobility document provides a framework for decision-makers when developing a TMP as it pertains to considering safety and mobility impacts of work zones.
- The SCDOT Procedures and Guidelines for Work Zone Traffic Control Design provides information of when to provide certain components, including a Traffic Operations plan and a Public Information plan, when developing a TMP. This document provides design guidelines for work zone devices.
- The SCDOT Traffic Management Center Standard Operating Guidelines Manual provides procedure guidelines for TMC operations, including monitoring radio communications, ITS, highway patrol dispatch, and traffic speed data. In addition, the manual identifies coordination guidelines between SHEP responders, highway patrol, dispatch, local law enforcement, local traffic operations, and other SCDOT offices. The manual defines the duties and responsibilities of TMC operators.
- The SCDOT Statewide ITS Architecture Plan was completed in 2015 to outline the existing ITS architecture in South Carolina and proposed ITS projects that can be implemented to enhance SC's traffic management infrastructure. The next iteration of the Statewide ITS Architecture should integrate the strategies within the Statewide TSMO Master Plan.

3.2 Existing Infrastructure

To develop a baseline condition of TSMO infrastructure in South Carolina, SCDOT and project stakeholders provided the following information and data.

- Existing communication systems (i.e., traffic signal interconnect, fiber/wireless networks, traveler information, other networks)
- Existing field devices (i.e., cameras, DMS, traffic detection devices and surveillance equipment, data collection devices, corridors with ATMS)
- Existing operations-related information (i.e., TMCs, event management, database systems, IT infrastructure)
- Technology-related documents, policies, etc.
- Existing traffic data

This data was used to develop a summary of existing infrastructure and data sources by region and to serve as a reference in identifying existing infrastructure needs statewide as a part of the development of the plan recommendations. The following summarizes the highlights of the existing infrastructure review.

- SCDOT uses ATMS.now as their traffic signal controller software statewide. The City of Charleston and Beaufort County use MaxTime and MaxView; the City of Columbia uses Tactics as their traffic signal controller software.
- Adaptive traffic signal timing systems and responsive traffic signal timing systems are used statewide, but most coordinated traffic signal systems operate with time-of-day schedule plans.
- EVP systems, where implemented, are operated and maintained by local municipalities, including the City of Greenville, City of Spartanburg, City of Columbia, Town of Lexington, City of Beaufort, Beaufort County, City of Charleston, Town of Hilton Head Island, Town of Mount Pleasant, and the Town of Myrtle Beach. SCDOT does not operate or maintain EVP systems.
- Fiber communication networks are preferred as a more reliable method of communications infrastructure. Cellular and radio communication devices are chosen where cost-benefit supports them as a preferred solution. The decision also can be driven where construction of fiber is deemed infeasible or as an interim method of temporary communication.
- In-pavement loops, video cameras, and radar are used for vehicle detection statewide. Several local municipalities are using advanced camera systems with data collection capabilities.
- The statewide SCDOT TMC is operational 24 hours a day, seven days a week, and can monitor ITS equipment, including DMS, from other regional SCDOT TMCs.

- Several local municipalities have dedicated TMCs (City of Charleston, City of Columbia); several have unofficial TMCs (Town of Lexington, Town of Mount Pleasant, City of Rock Hill); and the City of Greenville is in the process of developing a TMC.
- Local municipal TMCs are staffed during peak periods only, if at all.

Statewide Traffic Signal Inventory

Traffic signal inventory data was obtained from SCDOT's online traffic signal database, TEAMS. There are approximately 4,219 traffic signal locations in South Carolina, of which approximately 69% are maintained by SCDOT. The traffic signal locations are illustrated in Figure 3. The following municipalities maintain SCDOT signals within their municipal boundaries through a traffic signal maintenance agreement with SCDOT, in addition to maintaining their own traffic signals.

- **City of Aiken**
- **City of Anderson**
- **City of Beaufort**
- **Beaufort County**
- **City of Charleston**
- **City of Columbia**
- **City of Greenville**
- **Town of Hilton Head Island**
- **Town of Lexington**
- **Town of Mount Pleasant**
- **City of Myrtle Beach**
- **City of North Charleston**
- **City of Rock Hill**
- **City of Spartanburg**

There are approximately 325 coordinated traffic signal systems in South Carolina, which comprise almost half of all traffic signal locations. Of these systems, more than 90% of them have **not** been retimed in the past five years.

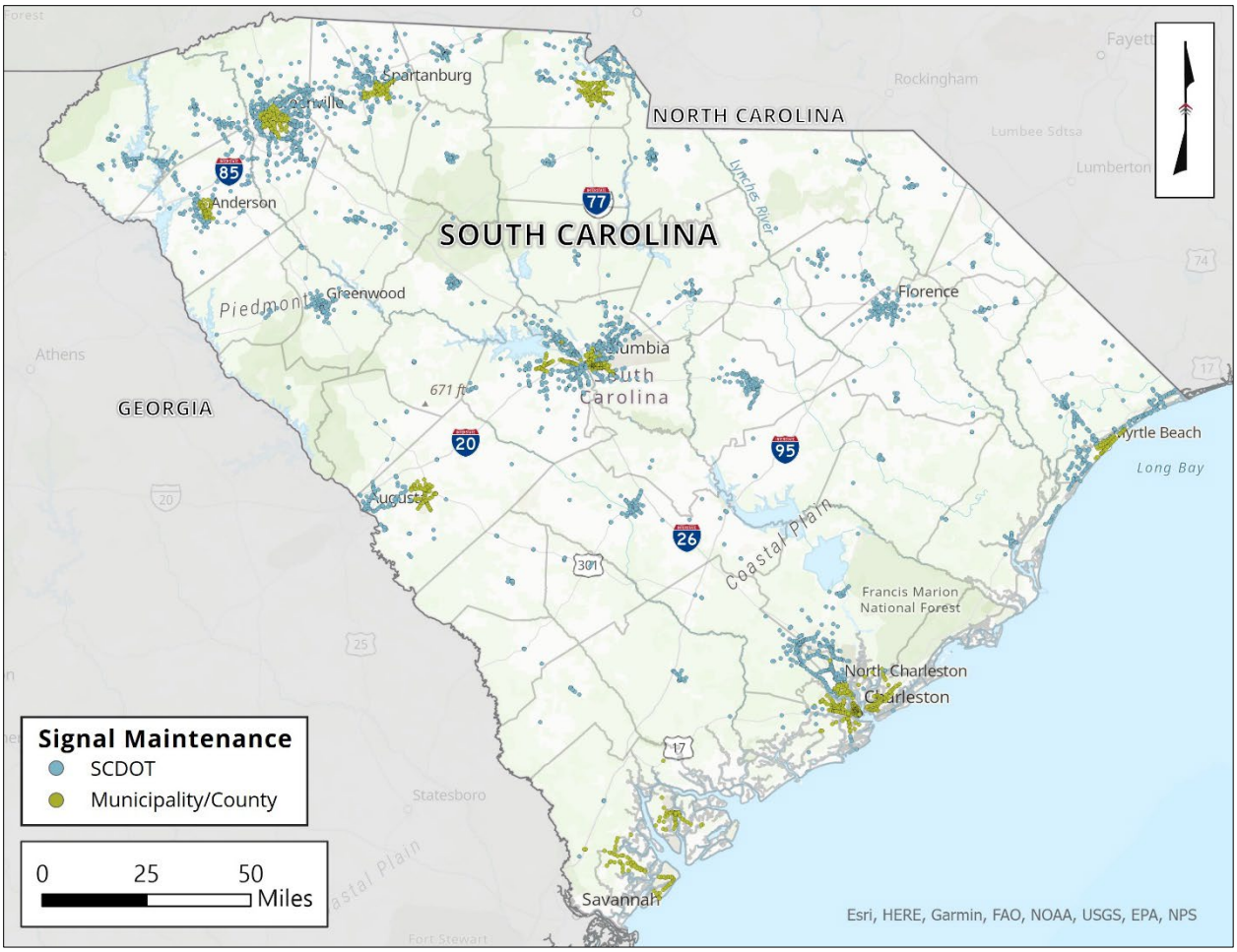


Figure 3 – Existing South Carolina Traffic Signal Locations

3.3 Existing Traffic Conditions

Traffic data for interstates, major arterials, minor arterials, and major collectors in South Carolina were mapped and analyzed to define the current state of traffic conditions. This data was used to then identify transportation needs and gaps along critical corridors and inform plan recommendations and potential projects.

3.3.1 Analysis Process

The traffic data was sourced from HERE data for the arterials, collectors, and local roadways, and the NPMRDS for interstates. The initial dataset considered 2019 pre-pandemic traffic conditions and included approximately 374,000 roadway links. Each link is associated with a unique link identification number, length, and the following performance measures:

- Delay (weekday AM peak period, weekday midday peak period, weekday PM peak period)
- Level of Travel Time Reliability (weekday AM peak period, weekday midday peak period, and weekday PM peak period)
- Estimated AADT
- Free-flow speed

In addition, supplemental SCDOT data for functional classification, crashes, truck routes, and evacuation routes were used in the analyses.

Figure 4 illustrates the primary analysis inputs and outputs of the traffic data analysis.

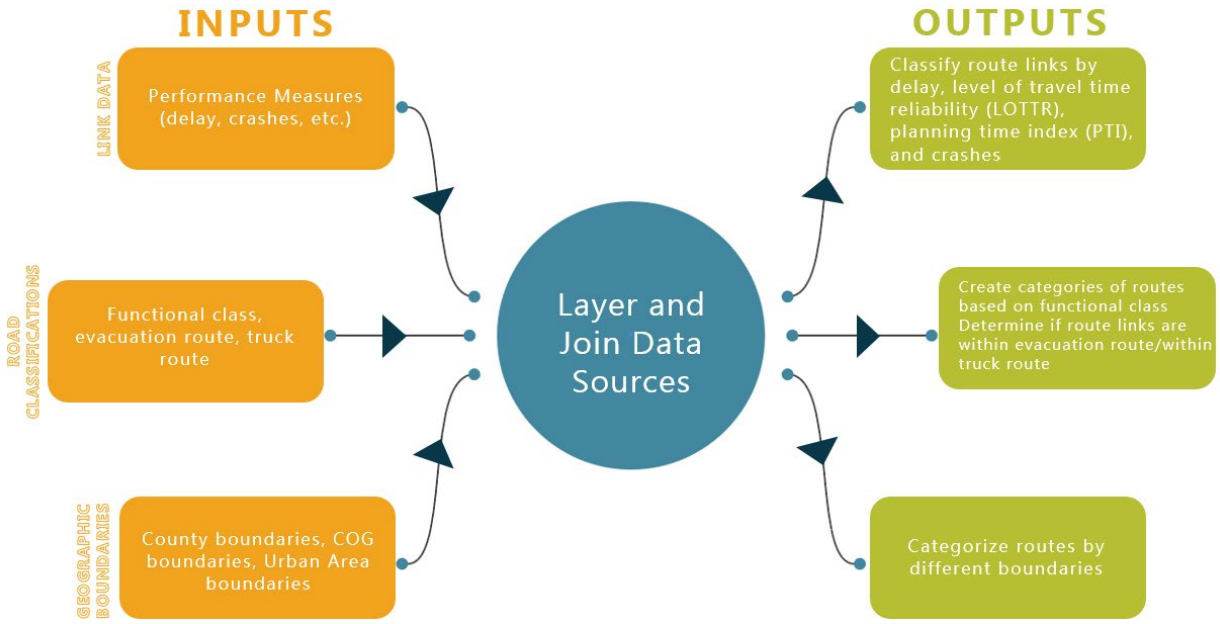


Figure 4 – Data Process

The first step in the analyses was to trim the link dataset to four roadway classification categories: interstates, major arterials, minor arterials, and major collectors that overlap with evacuation routes. These roadway classifications experience the most delay, crashes, and travel time reliability issues. Local roadways were excluded from the analysis, as well as major collectors that do not overlap with evacuation routes.

The combination of link data, road classification information, and geographic boundary information was layered using spatial selection tools and joined to output additional fields in the four datasets. Figure 5 depicts the spatial layering completed on each link to properly assign corresponding route designations and geographic boundaries. Datasets were prepared for each of the four functional classifications and each link within the datasets contains the following information.

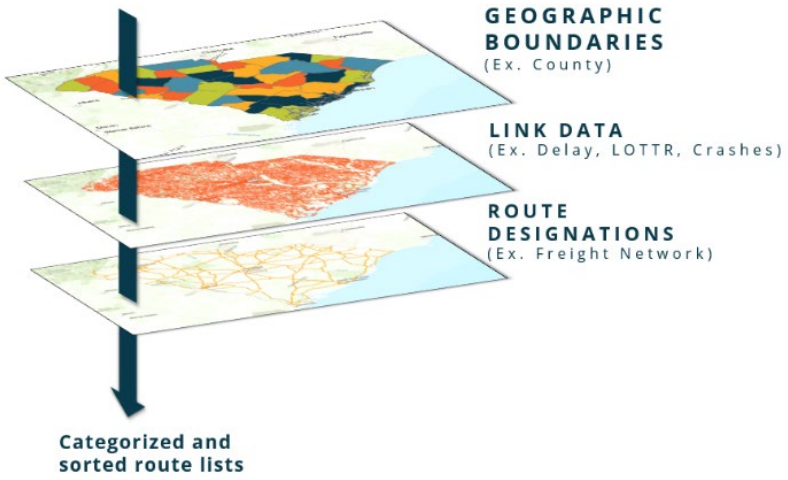


Figure 5 – Spatial Overlap Process

- **Link ID**
- **Length**
- **Delay**
- **LOTTR**
- **AADT**
- **Free-Flow Speed**
- **Crashes**
- **Evacuation Route**
- **Truck Route**
- **COG**
- **County**
- **Area Type**

3.3.2 Analysis Results

To evaluate a roadway's suitability for the application of TSMO strategies, evaluation criteria were developed based upon the plan's vision and goals and considers measures of congestion, reliability, and safety.

- **Mobility (out of 45 points)** was measured based upon three metrics in the dataset: Congestion, Freight Network Status, and Evacuation Route Status.
  - Congestion (out of 35 Points) was based on the maximum vehicle delay between the AM, midday, and PM peak hours. The maximum delay was calculated for each link and the link with the highest delay value in each functional class dataset was given the maximum score of 35.

  - Freight Network Status (out of 5 Points) was based on whether the link is part of the statewide freight network route. If a link is a designated freight network route, it receives a score of 5; if not, it received a score of 0.
  - Evacuation Route Status (out of 5 Points) was based on whether the link is part of an SCDOT evacuation route. If a link is on an evacuation route, it receives a score of 5; if not, it received a score of 0.
- **Reliability (out of 35 Points)** considered the maximum level of travel time reliability (LOTTR) between AM, midday, PM, and weekend peak hours. LOTTR considers the ratio of the frequency of longer travel times (80th percentile) and normal travel times (50th percentile). The maximum LOTTR was calculated for each link and the link with the highest LOTTR value in each functional class dataset was given the maximum score of 35.
- **Safety (out of 20 Points)** was based upon the total number of crashes on the link. The link with the highest number of crashes in each functional class dataset was given the maximum score of 20.

The scoring system is summarized in Table 1.

Table 1 – TSMO Suitability Evaluation Scoring

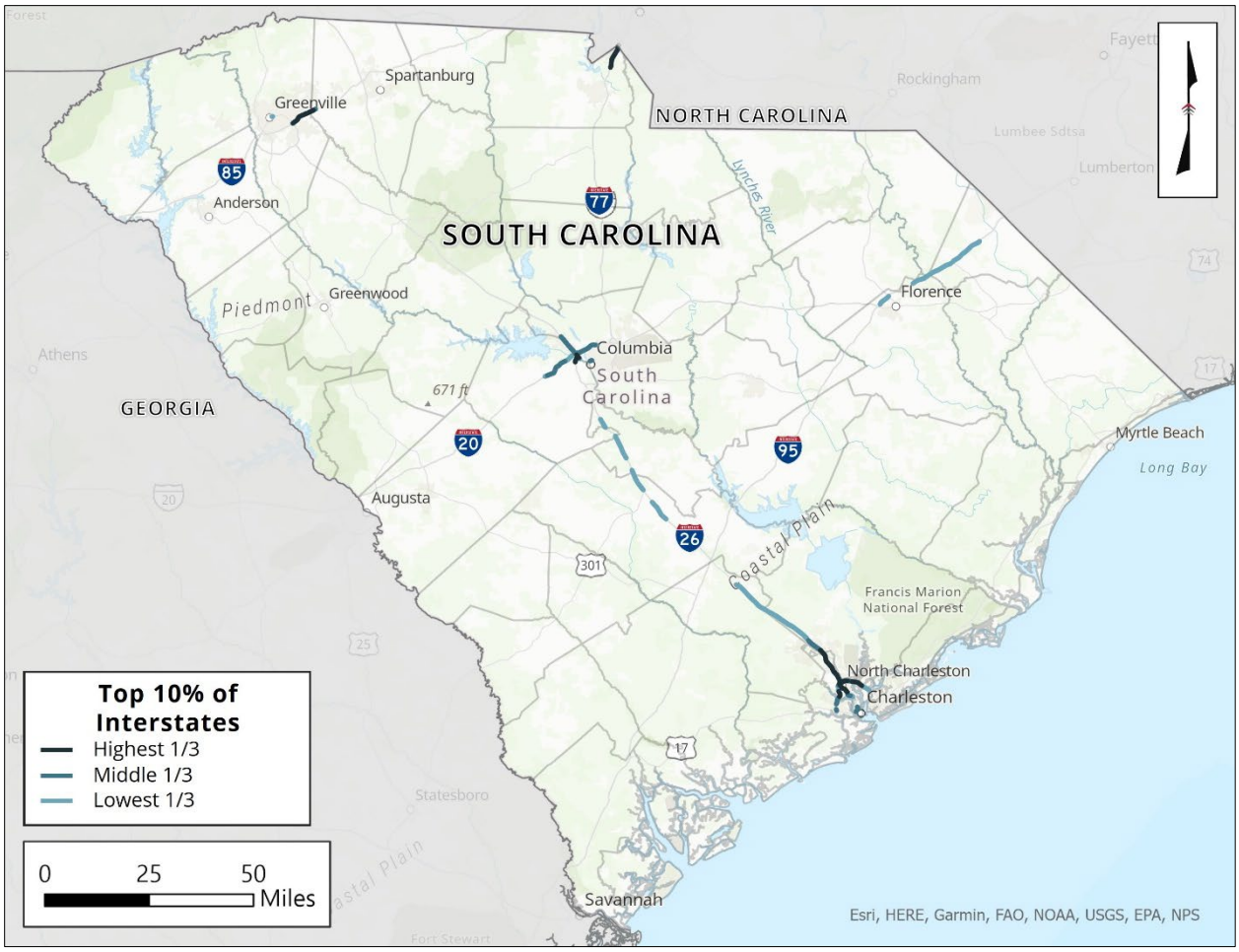
Criteria	Description	Score
Mobility	Sum of Congestion, Freight Network, and Evacuation Route Scores	**45**
Congestion	Maximum Delay of the AM, Midday, and PM Peak Hour	35
Freight Network	Is the link on the freight network?	5
Evacuation Route	Is the link on an evacuation route?	5
Reliability	Max LOTTR (AM, Midday, PM, and Weekend)	**35**
Safety	Total Crashes	**20**
	Total Potential Score	**100**

Based upon the scoring criteria, all roadways were scored for the level of suitability for application of TSMO strategies. The last step of analyses consisted of manually grouping corridors that ranked with the top 10% highest scores in each functional class dataset. This process involved selecting links that were adjacent along the same roadway and in the same county to create logical corridors where actionable solutions can be applied.

The following sections summarize the analysis results by functional class. Detailed maps showing the overall analysis results by urban area in South Carolina are included in **Appendix B**.

3.3.2.1 Interstate Results

Figure 6 illustrates the top 10% highest-scoring interstates in South Carolina and lists the top 10 highest-scoring interstate segments.

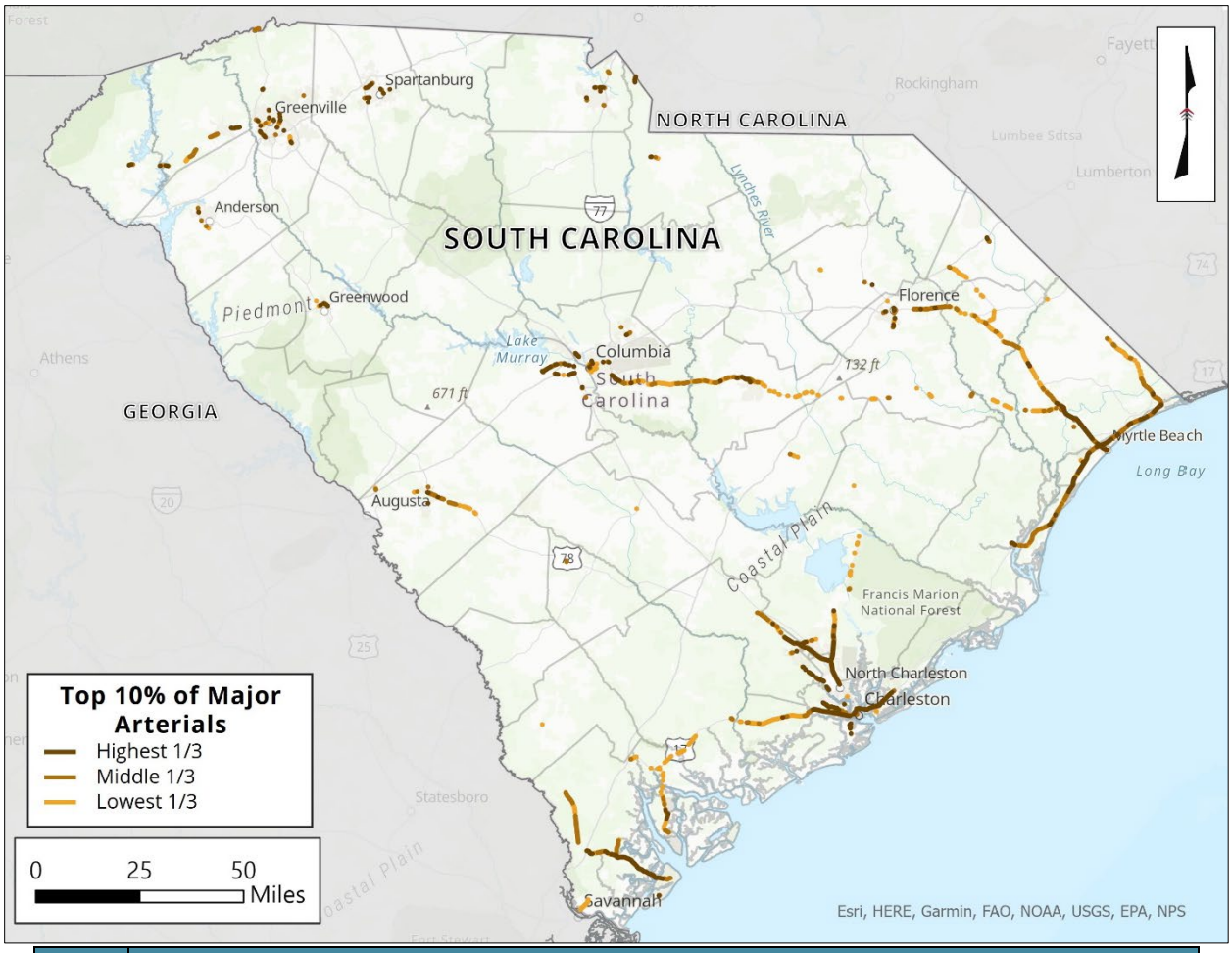


Rank	Interstate Segment
1	I-26 north of I-526 (MM 125 to MM 212)
2	I-77 in Fort Mill (MM 85 to MM 90)
3	I-85 East of Greenville (MM 51 to MM 58)
4	I-526 east of I-26 (MM 18 to MM 23)
5	I-126 south of I-26 and north of Greystone Boulevard
6	I-26 north of US 378 and south of I-20 (MM 102 to MM 107)
7	I-526 west of I-26 (MM 10 to MM 18)
8	I-26 south of I-526 (MM 212 to MM 216)
9	I-85 west of I-385 (Start of I-385 at E North St to MM 40)
10	I-26 north of I-20 (MM 107 to MM 110)

Figure 6 – Interstate Analysis Results

3.3.2.2 Major Arterial Analysis Results

Figure 7 illustrates the top 10% highest-scoring major arterials in South Carolina and lists the top 10 highest-scoring major arterial segments.

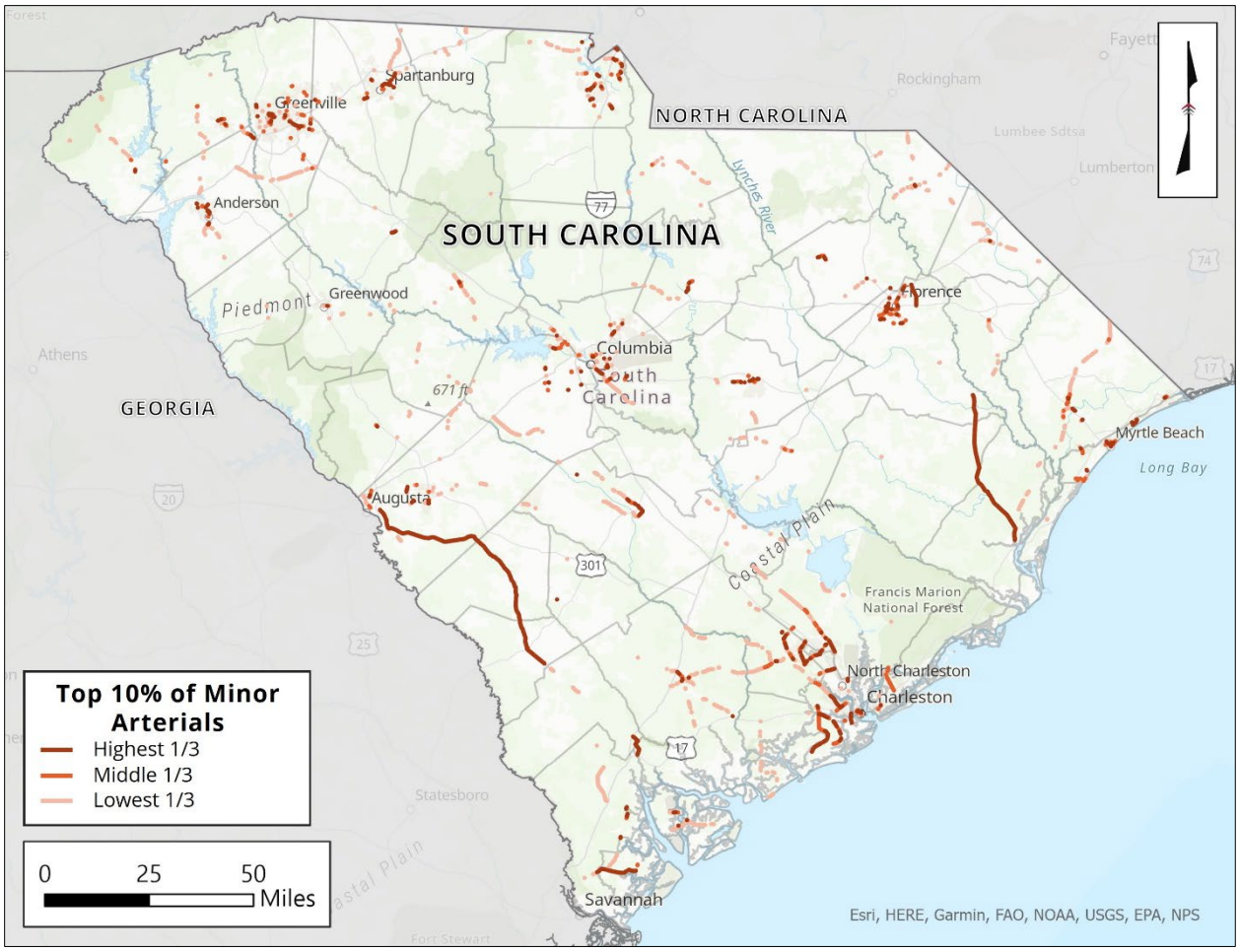


Rank	Major Arterial Segment
1	US 501 in Horry County from Horry/Marion County Line to US 17
2	US 17 in Mount Pleasant from the Ravenel Bridge to SC 41
3	US 78 in Charleston County from US 52 to Dorchester/Charleston County Line
4	US 17 in Horry County from US 501 to Horry/Georgetown County Line
5	US 78/ N Main Street from Dorchester/Charleston County Line to E Main Street
6	US 52 in Charleston County from I-526 to Charleston/Berkeley County Line
7	US 17 in Charleston County (West Ashley) from Colleton/Charleston County Line to SC 61
8	SC 61 in Charleston County from Wesley Drive to Glenn McConnell Parkway
9	US 52 in Lower Berkeley County from Charleston/Berkeley County Line to Gaillard Road
10	US 17 in Georgetown County from US 701 to Horry/Georgetown County Line

Figure 7 – Major Arterials Analysis Results

3.3.2.3 Minor Arterial Analysis Results

Figure 8 illustrates the top 10% highest-scoring minor arterials in South Carolina and lists the top 10 highest-scoring minor arterial segments.

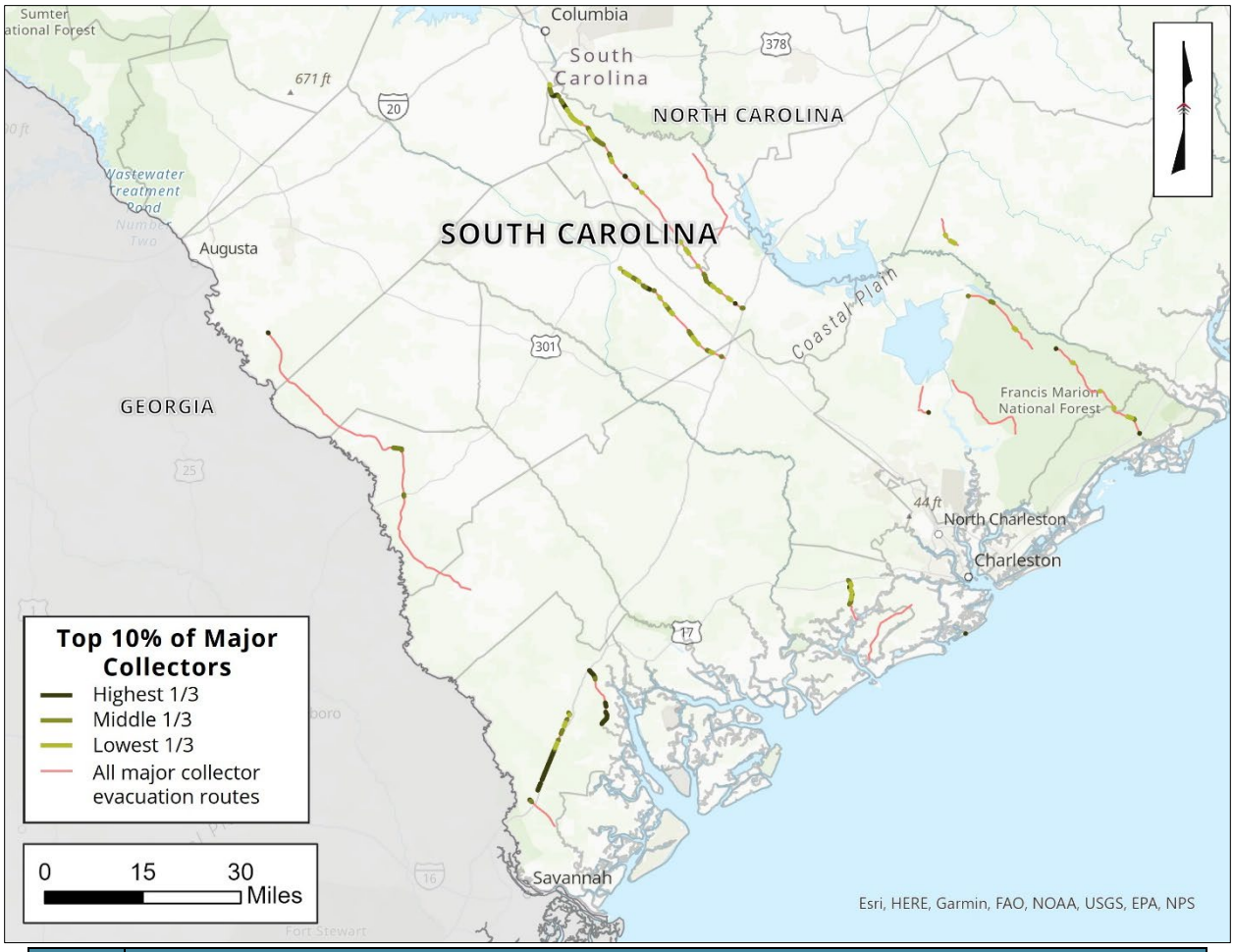


Rank	Minor Arterial Segment
1	Woodruff Road in Greenville County from Roper Mountain Road to Hwy 14
2	Cherokee Road in Florence County from W Evans Street to S Church Street
3	Carowinds Boulevard in York County from NC State Line to I-77
4	Ladson Road in Berkeley County between US 78 and Dorchester Road
5	SC 16 in Richland County from S Beltline Blvd to US 378
6	Bohicket Road/Main Road in Charleston County from River Road to Chisolm Road
7	Broad Street in Marlboro County from W Main Street to US 15
8	State Road in Berkeley County from Mudville Road to US 52
9	May River Road in Beaufort County from Beaufort/Japser County Line to Fording Island Rd
10	Ashley Phosphate Road in Charleston/Dorchester Counties from Dorchester Road to US 52

Figure 8 – Minor Arterials Analysis Results

3.3.2.4 Major Collector Analysis Results

Figure 9 illustrates the major collectors that are evacuation routes, which are all located in the lower half of the state, and lists the top 10 highest-scoring major collector segments.



Rank	Major Collectors Segment
1	Coosaw Scenic Drive in Jasper County from I-95 to SR 336
2	SC 46 in Jasper County from US 321 to east of US 17
3	Kato Bay Road in Jasper County from E Main Street to US 278
4	SC 165 in Charleston County from south of SC 162 to US 17
5	SC 45 in Charleston County from US 17 to north of Berkeley/Charleston County Line
6	Old State Road in Calhoun County from Lexington/Calhoun County Line to US 601
7	Gaillard Road in Berkeley County between US 17 and Old Highway 52
8	Atomic Road in Aiken County near SR-1
9	French Santee Road in Berkeley County from SC 41 to Charleston/Berkeley County Line
10	US 178 in Orangeburg County from I-95 to US 601

Figure 9 – Major Collectors Analysis Results

4 TSMO RECOMMENDATIONS

Based on discussions with stakeholders, the CMM assessment, best practices, and industry knowledge and experience, the following recommendations were developed for the Statewide TSMO Master Plan. These recommendations were developed to support the achievement of the project's vision and goals and have been categorized into the following two types.

- **Programmatic** recommendations are intended to strengthen the collaboration and coordination efforts, and to build the culture of TSMO throughout the state. These recommendations are further broken into the following sub-categories.
  - Collaboration and Partnership
  - Resources (Funding and Staffing)
  - Policy and Procedures
- **Deployment** recommendations provide a framework for the types of TSMO strategies ready for implementation. These recommendations are further broken into the following sub-categories.
  - Traffic Management Centers
  - ITS Networks
  - Corridor Management

The TSMO recommendations herein are not intended to be implemented all at once—establishing a TSMO program and demonstrating the value that can be gained through use of TSMO strategies will take time.

Section 5 provides an action plan for the implementation of the recommendations. The action plan provides the recommended implementation timeframe, approximate financial and staff resources, associated goals, and associated stakeholders.

4.1 Programmatic Recommendations

An established TSMO program is critical to achieving the SCDOT TSMO vision and goals and further supporting the Departments' mission of providing "…safe and efficient transportation services for the movement of people and goods in the Palmetto state." Establishing roles and responsibilities, standard practices, and promoting interagency collaboration allows for streamlined processes when proposing TSMO strategies. The recommendations made in this section are intended to promote the partnership between agencies and provide guidance on funding, staffing, and policy development.

4.1.1 Collaboration and Partnerships

4.1.1.1 TSMO Integration

Value: Integrating TSMO within business processes and organizational structures supports broader adoption and application of efficient practices.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, IT, Emergency Operations, Alternative Delivery, Planning, Preconstruction, Work Zone, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

Fully leveraging a successful TSMO approach requires that TSMO strategies be integrated at a statewide level. Integration of TSMO within SCDOT through a statewide TSMO Council, along with regional Task Forces, forms a critical framework for effective TSMO strategy implementation. The statewide TSMO Council serves as a centralized platform bringing together diverse stakeholders. The Council ensures coordination, collaboration, and oversight of TSMO initiatives across the state by encouraging the disparate offices responsible for generating and managing projects and programs to adopt a collective approach that embraces TSMO to optimize travel. It serves as a conduit for sharing resources, identifying efficiencies and opportunities to be leveraged, as well as sharing lessons learned and successes. Engaging these offices to embrace the TMSO mindset creates a unified approach towards integrating TSMO strategies within projects and programs and ensures that TSMO principles are consistently applied throughout the state. The Council should include SCDOT Headquarters staff from Traffic Engineering (including Traffic Signals and Traffic Management), IT Department, Planning, Preconstruction, Work Zone, and Construction offices. Representatives from SCDOT District office(s), MPOs/COGs, municipalities with signal maintenance agreements, and state highway patrol should be included as well. It is recommended that the SCDOT TSMO Engineer be responsible for organizing the meetings for this Council.

Complementing the statewide Council, regional Task Forces provide localized expertise and focus, addressing region-specific challenges and opportunities. The primary responsibility of the regional Task Forces is to support the regional/local TSMO project planning, project development, procurement, operations, and maintenance. Together, the statewide Council and regional TSMO Task Forces promote consistency and effective implementation of TSMO strategies.

TSMO Integration		
PC-1	Establish Statewide TSMO Council	Establish a TSMO Council to facilitate ongoing TSMO initiatives throughout the state. The council should be comprised of SCDOT HQ staff from Traffic Engineering (including Traffic Signals and Traffic Management), IT Department, Planning, Preconstruction, Work Zone, and Construction offices, representatives from SCDOT District office(s), MPOs/COGs, municipalities with signal maintenance agreements, representatives from each regional TSMO Task Force, and state highway patrol. The SCDOT TSMO Engineer shall be responsible for organizing the meeting of this council.
PC-2	Establish Regional TSMO Task Forces	Establish regional TSMO Task Forces comprised of staff from the SCDOT District Offices, MPOs/COGs, municipalities with signal maintenance agreements, local county and municipal police, fire, and offices of emergency management, and respective transit authorities. The primary responsibility of the regional Task Forces is to support the regional/local TSMO project planning, project development, procurement, operations, and maintenance.

4.1.1.2 Culture of Collaboration

Value: Supports knowledge sharing, efficient use of resources, and provides opportunities for strategic partnerships.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, IT, Emergency Operations, Alternative Delivery, Planning, Preconstruction, Work Zone, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

As previously mentioned, integration and coordination play a significant role in the success of TSMO. It is essential for SCDOT to foster a culture of collaboration to facilitate this integration and coordination. The collaborative culture should be developed both within the agency and externally with relevant stakeholders.

Regular coordination between the SCDOT TSMO Engineer, Director of Traffic Engineering, and FHWA representatives enables SCDOT to remain informed of emerging opportunities that can further advance the TSMO program. One of the primary benefits is the identification of forthcoming grant funding opportunities. Being informed of the available opportunities, SCDOT can strategically apply for funding to support various TSMO initiatives throughout South Carolina. Regular communication additionally keeps transportation agencies in the state updated on emerging technology trends, trends in performance measure metrics, and

procedures and policies that may evolve over time. By proactively engaging with FHWA, SCDOT can leverage available resources and expertise to continuously enhance the TSMO program.

Open communication and transparency within each department can help ensure that all stakeholders are aligned, leading to cohesive TSMO efforts and increased support from departments across the organization. It is recommended that the representatives of each department on the TSMO Council conduct an annual briefing with their respective departments. These briefings will cover a wide range of topics including program goals, objectives, activities, business processes and supporting policies, TSMO budgets, collaboration opportunities, project updates, lessons learned, evaluations, upcoming training sessions, and departmental updates. Holding these briefing meetings encourages a culture of support for TSMO initiatives within the organization. When departments are well-informed about the significance of TSMO and how it aligns with their specific functions, they are more likely to actively contribute to its successful implementation.

Collaboration with adjacent jurisdictions facilitates a better understanding of operations in neighboring states and provides an opportunity for knowledge exchange among transportation professionals. It is recommended that the SCDOT TSMO Engineer and Director of Traffic Engineering organize an annual coordination meeting with peer state TSMO engineers. These meetings create a platform for sharing experiences, lessons learned, and best practices providing the opportunity to discuss successful TSMO initiatives and projects that have been implemented in their respective states. This open exchange of experiences allows each state to gain insight and valuable knowledge that can be adapted and applied to their own transportation systems. By learning from each other's successes and challenges, states can implement effective TSMO strategies and avoid potential obstacles. Additionally, these meetings help identify training opportunities and workshops. This allows for states to continuously improve their capabilities and performance as the latest trends, tools, and TSMO-related techniques emerge. Participating in peer state TSMO meetings also opens doors to collaboration and partnership opportunities that can address regional transportation challenges more effectively.

To further foster a culture of support and collaboration, it is recommended that discussions—and potentially a session—be held during transportation industry events. Events such as the South Carolina Highway Engineers Conference, the ACEC-SC/SCDOT Conference, and others of similar nature offer an opportunity to gain support for TSMO from the transportation industry. These discussions should be led by the SCDOT TSMO Engineer and project representatives to provide updates on ongoing TSMO programs and highlight projects that demonstrate the positive impact of implementing TSMO strategies.

Culture of Collaboration		
PC-3	FHWA Coordination	Establish regular coordination with the SCDOT TSMO Engineer, Director of Traffic Engineering, and FHWA representative to identify forthcoming opportunities for grant funding, emerging technology trends, changes to procedures and policies, and trends in performance measure metrics.
PC-4	Conduct Annual TSMO Briefing	Representatives from each of the offices represented on the statewide TSMO Council shall conduct annual briefings with their respective departments regarding program goals, objectives, and activities, business processes and supporting policies, TSMO budgets, opportunities for collaboration and efficiencies, TSMO project updates and evaluations, upcoming TSMO training, and TSMO department updates.
PC-5	Conduct Annual Peer State TSMO Meetings	The SCDOT TSMO Engineer and Director of Traffic Engineering shall conduct annual coordination meetings with peer state TSMO engineers to share experiences, lessons learned; identify training opportunities and workshops; coordinate to better understand operations near adjacent jurisdictions; and seek opportunities for partnering.
PC-6	Facilitate TSMO Discussion at Transportation Industry Meetings	The SCDOT TSMO Engineer and project representatives shall facilitate TSMO discussions or sessions at South Carolina transportation industry events to provide program updates and project highlights. Additional TSMO discussions/sessions could be facilitated at maintenance, design, and construction conferences to foster support and an understanding of TSMO and its benefits.

4.1.1.3 Interagency Arrangements and Coordination

Value: Enhancing interagency arrangements and coordination increases the opportunity to share resources, work more efficiently and effectively, optimize operations, and gain support for TSMO across the state.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, IT, Emergency Operations, Alternative Delivery, Planning, Preconstruction, Work Zone, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

Formalizing Interagency Agreements

With the diverse range of agencies responsible for managing and operating transportation systems, establishing a formal framework for collaboration and coordination becomes essential. Interagency agreements establish clear guidelines, define roles and responsibilities, and facilitate resource sharing which strengthens integration of TSMO strategies across agencies. It is

recommended that SCDOT develop interagency agreements, policies, and standard procedures related to TSMO strategies with a focus not only on resource sharing but also optimization of the transportation network across jurisdictional boundaries or agencies. Specific examples of recommended interagency agreements include the following.

- **Traffic Incident Management Agreements.** Formalizing interagency agreements can enhance TIM if a culture of collaboration is established between state agencies, regional agencies, first responders, state highway patrol, etc. Through conversations with stakeholders from each region, region-specific recommendations regarding TIM should be considered. For example, it is recommended for agencies in the Lowcountry region to establish SOPs for incident management at bridge locations to determine interagency coordination, response, and detour routes. Additionally, it is recommended for Lowcountry agencies to coordinate BCDCOG MAC group meetings with the SCDOT TIM program. Leveraging existing coordination frameworks will allow for efficient use of resources and provide the opportunity for the performance and practicality of SOPs to be monitored and continually improved as partnerships evolve and further develop the use of tools over time.

  Furthermore, conversations with stakeholders from the Midlands region prompted the recommendation for statewide and regional TIM meetings and training that incorporates local agencies including municipalities and emergency responders. Further, it is recommended for all regions statewide to conduct after action plan reviews to assess incident management performance and document lessons learned.
- **Utility Company Standard Operating Procedures.** Discussions with stakeholders within the Upstate region prompted the recommendation for the development of SOPs for coordination with utility companies that designate roles and responsibilities when utility poles are impacted. Clearly defining and seeking agreement from all parties will increase the efficiency and quality of communication infrastructure design and construction, ultimately leading to reduced capital costs and schedule.
- **Traffic Signal Management.** TSM can benefit from formalized interagency agreements, especially during events. It is recommended that SOPs be developed based on MOUs that are developed with municipalities, SCDOT district offices, and SCDOT Headquarters to establish clear roles and responsibilities and partnerships. It is also recommended that detour routes be designated with the development of associated traffic signal timing response plans. TSM is further enhanced by establishing SOPs for interagency coordination that support coordinated responses with neighboring municipalities, resulting in a more seamless and less congested arterial network. The form and content of each agreement will vary based on partner agencies, however, TSM agreements typically include details such as:

  - Identifying all partner agencies.
  - Defining roles of each partner agency.
  - Documenting who is responsible for operating and maintaining infrastructure (i.e., traffic signals, detection devices, cameras, connected vehicle equipment, etc.).
  - Defining financial commitments of each partner agency.
  - Describing operational procedures, roles, and responsibilities for each partner agency for varied scenarios (i.e., normal operations, during an incident, evacuation, planned event, etc.)

- **Traveler Information and Work Zone Management.** Formalized interagency agreements should also be considered regarding TI and WZM. It is recommended that SCDOT develop standards and guidelines for the use of TI tools that are universal between agencies. These standards and guidelines should include guidance on when to use TI, the type of messaging that should be utilized, and the placement of messages. It is recommended that institutional arrangements, policies, and procedures be developed to support collaboration and optimization at work zones. This will help foster a culture of collaboration between state, regional, and local agencies including local enforcement agencies.
- **Emergency Response and Resiliency.** Interagency agreements are necessary to support the establishment of formal protocols and methodologies for Emergency Response and Resiliency activities. It is recommended that SCDOT, municipalities, first responders, and transit agencies coordinate on an EVP system to ensure interoperability on corridors crossing jurisdictional boundaries. Lastly, formalizing interagency agreements for data management allows for resource sharing between agencies (funding, staffing, and even physical infrastructure). Policies and procedures and the development of data sharing agreements with municipalities allows them to collaborate to identify data resource sharing opportunities and provides easy accessibility to data.

Incident and Emergency Management MOUs

The development of MOUs that are tailored to address incident and emergency management helps foster effective collaboration and coordination between agencies during unplanned events. Public safety agencies involved with incident management often experience more frequent staff movement and promotions. This creates a demand on all agencies involved to focus on continuous relationship building and education. MOUs help to mitigate gaps by formalizing roles and responsibilities around incident management and maturing relationships beyond handshakes and informal partnerships. It is recommended that Regional TSMO Task Forces facilitate the development of the interagency MOUs. These Task Forces can leverage existing relationships to bring together SCDOT, local government, and public safety agencies.

The MOUs are recommended to outline clear procedures, roles, and responsibilities, providing a blueprint for more seamless coordination during incidents and emergency situations. By defining specific protocols, the MOUs ensure that all involved agencies can act in a unified manner, responding promptly and efficiently during emergencies, and reduce the impact of incidents on the transportation network. It is especially critical for MOUs to specify roles and responsibilities which allow response teams to act quickly, reduce confusion and avoid unnecessary delays. MOUs also document mitigation strategies that address specific challenges or obstacles that could impact a safe and efficient response.

Interagency Training Exercises

Training exercises are critical to the effectiveness of implementing a TSMO program as it ensures that all involved staff are coordinated and prepared to respond to challenges and emergency situations. It is recommended that staff from multiple agencies actively participate and engage in hands-on problem solving and decision-making exercises to familiarize personnel with procedures and protocols. Through these training exercises, personnel can test concepts and identify strengths as well as areas of improvement in the existing processes. Additionally, interagency training exercises create a culture of continuous improvement and learning as they serve as feedback for agencies to refine their current practices and protocols continually. It is recommended that the SCDOT TSMO Engineer participate in interagency training exercises and share knowledge or available resources related to TSMO that may enhance the process. Furthermore, representatives from the statewide TSMO Council and Regional TSMO Task Forces should participate and provide access to local knowledge and existing systems to improve response and efficiency. Notable examples of existing SCDOT training exercises are the Hurricane evacuation exercises conducted in June in the Midlands and Lowcountry and the Winter Weather Response meetings/reviews conducted in the Upstate.

SCDOT should partner with community colleges, first responders, or local agencies that currently manage training facilities that could support multi-agency exercises. It is important to note that facilities could include sizable meeting rooms to accommodate tabletop exercises or outdoor facilities with adequate space for staging mock scenarios. Outdoor facilities could be as simple as large parking lots with controlled access or driving tracks that can support large emergency vehicles and staged crashes.

The NCDOT was successful in partnering with North Carolina State Highway Patrol to construct a large training facility that supports traffic incident management training scenarios. The TIM Training and Development Track provides a range of roadway characteristics and roadside elements that provide real world conditions to provide participants an environment that replicates true conditions without the risks associated with live traffic.

After-Action Briefings

Similar to training exercises, after-action briefings are essential to continuous improvement and learning from past experiences. It is recommended that the SCDOT TSMO Engineer and representatives from the statewide TSMO Council participate in after-action briefings following planned and unplanned events which serve as evaluations of roles, responsibilities, and procedures. These reviews can provide valuable insights into the effectiveness of TSMO strategies or provide opportunities to recommend TSMO strategies to improve system performance. The after-action briefings should be designed to be collaborative, involving key stakeholders from various entities including SCDOT Headquarters staff, SCDOT District staff, municipal staff, fire, police, emergency management, and other applicable responders. This additionally fosters a culture of collaboration and transparency among the agencies as they are provided with the opportunity to share their perspectives and feedback. It is recommended that the review group provide the briefings' reports to the Regional TSMO Task Forces, allowing them to proactively incorporate lessons learned during future project planning and project development. A few examples include the following.

- NCDOT Hurricane Florence After Action Report: NCDOT facilitated a large after-action review meeting with numerous agencies involved in the hurricane response. This session talked about the successes and challenges experienced from the perspective of each agency and documented actions that could be implemented in advance of the next storm.
- In August of 2023, the City of Durham facilitated an after-action review with NCDOT, North Carolina State Highway Patrol, and the Durham Fire Department in response to a 31-vehicle crash that occurred during a major thunderstorm. This review discussed how resources from multiple agencies were reallocated due to multiple power outages, minor crashes, and other incidents occurring at the same time as the multi-vehicle crash. Roles and responsibilities, coordination efforts, and resource allocation were all discussed to help agencies learn from this event.

Interagency Arrangements and Coordination		
PC-7	Formalize Interagency Agreements	Develop and implement interagency agreements, policies, and standard operating procedures related to TSMO strategies to include the following topics: traffic management centers, traffic incident management, traffic signal management, traveler information, ITS communications, work zone management, emergency response and resiliency, and data management.
PC-8	Develop Incident and Emergency Management MOUs	Regional TSMO Task Forces should facilitate the development of MOUs that define procedures, roles, and responsibilities with SCDOT, local government, and public safety agencies regarding incident and emergency management. The MOUs should address how to coordinate across jurisdictional boundaries, what procedures are implemented depending on the event scale and timing, etc.
PC-9	Participate in Interagency Training Exercises	Representatives from the statewide TSMO Council and Regional TSMO Task Forces should participate in interagency training exercises to test and improve concepts and familiarize personnel with procedures and protocols. Existing SCDOT examples include the hurricane evacuation exercise conducted in June and Winter Weather Response meetings/reviews.
PC-10	Participate in After-Action Briefings	The statewide TSMO Council should encourage and participate in after-action briefings for planned and unplanned events to review roles, responsibilities, and procedures. Briefings should identify procedures and protocols that would benefit from TSMO strategies. Collaboration should include SCDOT HQ staff, SCDOT District staff, municipal staff, fire, police, emergency management, and other applicable responders. The review group should provide briefing reports to the regional TSMO Task Forces for future project planning and project development.

Informational Material

Establishing trust between agencies as well as the public is essential to gaining support for the TSMO program. Building trust and engagement within the department requires clear and concise communication of valuable information that is easily accessible. Although TSMO is not a new concept, it is often misunderstood or disregarded. Providing informational material that clearly demonstrates the value and return on TSMO investments will be important to gain support and advance the program. It is recommended that the SCDOT TSMO Engineer lead the development of informational material and templates for TSMO-related information that can be shared broadly. TSMO professionals throughout the state should have access to these materials and be encouraged to share with stakeholders. Informational materials could include a "What is TSMO?" brochure, service layer brochures, TSMO Strategy Deployment Evaluation Summary, etc. Examples of informational materials that have been created by other agencies include the following.

- FHWA: **What is Transportation Systems Management and Operations (TSMO)? | Transportation Systems Management and Operations (TSMO) Plans | Organizing and Planning for Operations - FHWA Office of Operations (dot.gov)**
- Alabama Department of Transportation TSMO website with links to service layer brochures: **Transportation Systems Management and Operations (TSMO) (state.al.us)**
- Atlanta Regional Commission (ARC) TSMO Local Agency Deployment Guide: **arc-tsmo-local-agency-deployment-guide-final-1.pdf (atlantaregional.org)**

Informational Material		
PC-11	Prepare TSMO Informational Material	Prepare TSMO informational material to be shared broadly to clearly communicate the intent and value of TSMO. Informational materials could include: "What is TSMO?" brochure, service layer brochures, TSMO Strategy Deployment Evaluation Summary, etc.

4.1.2 Funding and Staffing Resources

4.1.2.1 Funding Resources

Value: Understanding TSMO funding resources and needs will define a path for investment in TSMO which will lead to achieving TSMO goals.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Emergency Operations, and Planning

States throughout the country have traditionally funded TSMO deployments through multiple funding sources depending on the specific project or opportunity. It is common for the primary funding for TSMO deployments to come from the maintenance budget or for TSMO-related deployments to be funded under larger transportation projects, special grants, or through other agencies. However, as the benefits of TSMO strategies are realized, some states have begun allocating dedicated funds to support TSMO-related programs and deployments.

Defining program budget needs is a first necessary step for deciding on a funding method. It is recommended that the SCDOT TSMO Engineer collaborate with the Deputy Secretary for Finance and Administration, the Director of Traffic Engineering, and the statewide TSMO Council to define the program budget needs while accounting for a wide range of considerations including operational budgets, potential funding sources, and resource sharing. Funding strategies must be carefully analyzed, taking into account various sources of funding that can sustain and support TSMO efforts. The budgeting process should include capital improvements, which involve the allocation of funds for upgrading and enhancing transportation infrastructure to accommodate TSMO technologies and systems. Similarly, operational and maintenance costs need to be accounted for in the budget plans to cover day-to-day expenses as well as the ongoing upkeep required for running TSMO-related assets. Budget plans should be reassessed on an annual basis to allow for flexibility and adaptability to changes.

Similar state TSMO programs have evolved through paths that include:

- Develop a statewide TSMO Plan
- Find internal champions to share the benefits of TSMO
- Determine annual TSMO Program budgetary needs (typically ranging from $10M to $45M) and expected return on investment
- Receive dedicated annual TSMO funding from the approval board (e.g. SCDOT Commission)
- Manage the dedicated funding stream, evaluate performance, and analyze return on investment to demonstrate fiscal responsibility on an annual basis.

It is recommended that SCDOT have allocated funding to increase TSMO representation in existing management, operations, and maintenance activities. Along with the allocation of dedicated funds, it is recommended that SCDOT continues to identify opportunities for joint funding as this strengthens the development of an integrated and collaborative TSMO culture and makes more efficient use of funds. To ensure TSMO engineers and staff stay informed about available funding opportunities, it is recommended to identify and define all funding sources such as state, federal, grants, and private partnerships, along with their respective allocation processes. It is expected that securing dedicated TSMO program funding may take time; as the TSMO program is being established, it is recommended that the SCDOT TSMO Engineer seek opportunities to partner with other departments and integrate TSMO into standing practices and procedures throughout the agency.

Funding Resources		
PR-1	Define Program Budget Needs	The SCDOT TSMO Engineer, in collaboration with the Deputy Secretary for Finance and Administration, the Director of Traffic Engineering, and the statewide TSMO Council, should define TSMO Program budget needs. Budgets should consider funding strategies (i.e., planning, staff development), capital improvements, operational, and maintenance costs on an annual basis.
PR-2	Establish TSMO Program - Funding Resources	Allocate funding to increase TSMO representation in existing management, operations, and maintenance considerations.

4.1.2.2 Staffing Resources

Value: Defining TSMO staffing resources and needs within the existing leadership and organizational structure will demonstrate the commitment to TSMO and further encourage the use of TSMO practices and strategies.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Emergency Operations, and Planning

The leadership and organizational structure of the SCDOT TSMO program will support TSMO efforts and will encourage a cultural shift from traditional capacity expansion to optimization of existing infrastructure and assets. The FHWA emphasizes the significance of a well-defined leadership and organizational structure to promote TSMO culture and strategies within a DOT or other transportation agency. This structure outlines roles, responsibilities, and facilitates formalized interactions between divisions and offices. By integrating TSMO practices and

defining a leadership and organizational structure at a statewide and regional level, SCDOT can further advance its TSMO program.

It is recommended that SCDOT develop a staffing plan for SCDOT HQ and SCDOT District offices to provide supporting organizational structure to the SCDOT TSMO Engineer. Leveraging the existing SCDOT TSMO Engineer position will allow SCDOT to better integrate TSMO into the culture of the department, promoting collaboration and a focus on management and operations to enhance the existing transportation network. It is not expected that an independent TSMO department is needed at the onset of TSMO program establishment – a dedicated department does not represent the establishment of the program and vice versa. It is recommended that staffing resources evolve over time based on opportunity and program needs. The first step should be to evaluate existing staffing positions and key TSMO champions to identify staff augmentation strategies. Existing roles within Construction, Traffic Engineering, Maintenance, and Emergency Operations should be identified and augmented to include engagement and coordination responsibilities with the TSMO program. Clear roles and responsibilities should be defined and agreed upon by staff and management. It is recommended that existing skills and interest drive the assignment of responsibilities rather than rigid expectations. For example, if an individual is particularly interested in data, they should be given the opportunity to leverage data resources to progress the TSMO program.

The SCDOT TSMO Engineer will share information and resources with these individuals and seek their input on key program decisions and deployments. As the program evolves and continues to demonstrate value, it is expected that additional staff positions will be needed to support TSMO program activities. It is recommended that SCDOT consider a TSMO department with a mix of dedicated staff and key partners within other departments.

In addition, it is recommended that each district engage and support the statewide TSMO program within their organizational structure. It is expected that each district's TSMO maturity and needs are unique, therefore the district organizational structure should be scalable and flexible.

SCDOT recognizes funding is limited and they may consider staff augmentation by contracting professionals and consultants as needed.

Staffing Resources		
PR-3	Develop Staffing Plan	Develop a staffing plan for SCDOT HQ and SCDOT District offices to provide supporting organizational structure to the SCDOT TSMO Engineer. Evaluate existing staffing positions to develop appropriate succession strategies and staff augmentation strategies.
PR-4	Establish TSMO Program - Staffing Resources	Hire staff to provide opportunities to increase TSMO representation; define roles and responsibilities based on the necessary knowledge, skills, and abilities. Consider existing staff skills, qualifications, and interest to augment roles where applicable.

4.1.3 Policy and Procedures

4.1.3.1 Standards, Guidelines, and Procedures

Value: Integrating TSMO strategies within SCDOT standards, guidelines, and procedures will encourage the consideration and implementation of TSMO strategies in a standard method, increasing quality, efficiency, and effectiveness while decreasing costs.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Alternative Delivery, Planning, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

Standards and Guidelines

It is typical for state and local agencies to deploy systems independently with little coordination or consideration of partner agency systems. This is currently the case throughout South Carolina where, due to the nature of procurement and the lack of a coordinated approach, each agency or even professionals within the same agency, will procure disparate, independent systems leading to a lack of interoperability, redundant effort of research and solicitation, increased resources required to operate and maintain different systems, and higher prices. Some states, like Georgia, have leveraged a standardized approach to selecting and procuring TSMO systems, software, and hardware such that local agencies throughout the state have access to the Georgia Department of Transportation (GDOT) maintained Qualified Product List (QPL) contract selection and pricing. Georgia state legislation was enacted to provide this contract mechanism. Even without a shared contract mechanism, establishing statewide TSMO standards and guidelines provides a framework to adopt strategies that maximize the performance of the transportation network throughout the state. Standards and guidelines will increase quality, efficiency, and interoperability of TSMO strategy deployments while decreasing cost.

It is recommended that statewide standards and guidelines be developed for TSMO strategies. Examples include the following.

- **ITS, Connected Vehicle, and Data Frameworks.** Technology-based deployments such as ITS, Connected Vehicle (i.e., EVP, transit signal priority [TSP]), and data frameworks can be challenging to integrate and operate within existing and partner systems. In addition, these systems can be challenging to operate and maintain as there may be limited staff familiar with the technologies. Standards and guidelines offer support and direction for staff navigating deployment of a system of this type for the first time. It is recommended that these standards and guidelines be shared with local agencies to increase the interoperability of TSMO strategy deployments which will support regional traffic management, reducing congestion and carbon emissions, while promoting effective use of existing infrastructure in a consistent manner.
- **TIM, TI, and WZM.** Defining standards and guidelines regarding the systems that support TIM, TI, and WZM will further enhance safety and reduce secondary crashes. It is recommended that standards and/or guidelines be developed to encourage TSMO strategies to be considered during the development of work zone management plans. In addition, it is recommended that standard contract language be revised to distinguish between permanent WZM equipment and temporary WZM equipment used within smart work zones such that investments may be leveraged on a more permanent basis where it makes sense (i.e., cameras used for WZM can be repurposed after construction for TIM).
- **TSM.** Providing standards and guidelines for TSM will provide a more efficient and consistent travel experience throughout the state. It is recommended that SCDOT develop parameters based on corridor characteristics and/or events to determine the need for traffic signal technology such as adaptive, responsive, or time-of-day signal timing. It is also recommended that an engineering directive for the consideration of ITS infrastructure be employed when programming new projects. In addition, guidelines for regional integration are recommended to support enhanced collaboration and seamless travel.
- **Network Communications.** Network communications provide the foundation for many TSMO strategy deployments and are often less familiar to staff particularly as it relates to cybersecurity and network architecture. Network communication standards and guidelines are recommended to provide a resource throughout the state to ensure a robust, secure network foundation. Examples of guidelines that would be helpful within SCDOT include defining conditions and characteristics in which various mediums should be used (i.e., lease lines, fiber optic cable, wireless modems, cellular modems).

TSMO Integration in Planning, Project Development, and External Stakeholders

Employing a TSMO approach – considering how to leverage strategies to maximize existing infrastructure and system performance – will require support from SCDOT Planning, Project Development, and external stakeholders. It is recommended that existing procedures within SCDOT be modified to include the consideration of TSMO strategies. It is recommended that a TSMO Departmental Directive be implemented to ensure that technology-based solutions are integrated into existing SCDOT practices and procedures. This includes incorporating TSMO strategies into the STIP to ensure their inclusion in transportation projects. In addition, multimodal long-range planning, traditional capacity expansion projects, and existing MPO/COG project evaluation criteria should be modified to consider and incorporate TSMO strategies where appropriate.

Achieving a fully integrated TSMO approach requires the collaboration and involvement of external stakeholders. Encouraging MPOs, COGs, and local agencies to actively incorporate TSMO strategies into their long-range transportation plans, transportation improvement programs, capital improvement plans, and corridor and intersection planning studies is crucial. This collaboration ensures that TSMO initiatives are aligned with regional and local transportation needs.

TSMO Training

Establishing a leadership and organizational structure that supports TSMO efforts requires that SCDOT develop clear expectations of the knowledge, skills, and abilities needed to perform each role. The TSMO departments and supporting staff will need to be provided with adequate training to effectively fulfil their respective roles and responsibilities.

It is recommended that the TSMO Council begin by leveraging TSMO training opportunities to further educate themselves. Example training opportunities include the Operations Academy, funded by the Eastern Transportation Coalition; webinars and resources provided by the National Operations Center of Excellence (NOCoE), FHWA, American Association of State Highway and Transportation Officials (AASHTO), and Institute of Transportation Engineers (ITE). As the members of the TSMO Council gain knowledge, it is recommended that they develop and implement a recurring TSMO training program. These training opportunities should be made available to applicable state, regional, and local agencies. It is recommended that SCDOT maintenance and private contractors be provided with continuing work zone training, including training on the use of smart work zone equipment.

In addition to targeted training for specific roles and functions, it is crucial to provide cross-training opportunities for TSMO staff. Cross-training facilitates the integration of TSMO practices

and ensures that the knowledge base remains even after staff turnover. Documenting standard operating procedures, key contracts, and lessons learned are essential to succession planning.

Standards, Guidelines, and Procedures		
PP-1	Establish TSMO Standards and Guidelines	Develop and implement statewide TSMO design standards and guidelines. Standards and guidelines should cover TSMO services such as traffic management centers, traffic incident management, traffic signal management, traveler information, ITS communications, and work zone management.
PP-2	Modify Existing SCDOT Planning and Project Development Directives	Modify existing SCDOT planning and project development directives to include consideration of TSMO strategies within the STIP, multimodal long-range planning, traditional capacity expansion projects, and existing MPO/COG project evaluation criteria.
PP-3	Encourage External Stakeholders to Integrate TSMO	Integrate TSMO strategies into the development of MPOs'/COGs' and local agencies' long range transportation plans, transportation improvement programs, capital improvement plans, and corridor and intersection planning studies.
PP-4	Conduct TSMO Training	Members of the TSMO Council should leverage available training opportunities to educate themselves prior to developing and implementing a reoccurring TSMO training program. Training should be made available to state, regional, and local agencies.

4.1.3.2 Public Outreach

Value: Sharing information about the benefits of TSMO strategies and methods with the public and broadly outside of the Department will increase the transparency and support for further TSMO investment.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Alternative Delivery, Planning, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

Promoting public engagement, transparency, and easily accessible information regarding TSMO initiatives is necessary to gain public support. In addition, sharing knowledge and resources with MPOs/COGs and local agencies can encourage support and collaboration. It is recommended

that SCDOT develop a dedicated TSMO website which will serve as a hub that provides users with a variety of resources. Some key features that should be included on the website are a program overview that highlights TSMO initiatives and updates to keep stakeholders informed about ongoing developments. The website should also include past project highlights and projects in development to demonstrate the impact and value of TSMO strategies. The website will also host essential planning documents that give an insight into SCDOT's long-term vision, and the strategies used to integrate TSMO principles into transportation operations. Additionally, the website will list TSMO committee contacts, as well as roles and responsibilities, allowing stakeholders to easily reach out and collaborate with relevant individuals. This encourages stakeholders to stay informed and promotes knowledge sharing. Educational resources and training opportunities will also be provided through the website to promote continuous learning and professional development for TSMO practitioners.

It is recommended that SCDOT develop TSMO informational materials such as brochures to establish the business case for TSMO strategies and communicate their benefits effectively. These brochures will provide insights into the advantages of TSMO initiatives and demonstrate their potential to enhance transportation efficiency. It is recommended that SCDOT work with agency leadership and public affairs to integrate TSMO-related content into the main SCDOT website and leverage social media platforms to effectively convey their commitment to advancing TSMO. Developing targeted TSMO informational material and strategically distributing them helps raise awareness and builds an understanding of the impacts of TSMO initiatives.

Public Outreach		
PP-5	Develop SCDOT TSMO Website	Develop a SCDOT TSMO website that includes program overview/initiatives and updates, past project highlights and projects in development, planning documents, TSMO committee contacts and roles/responsibilities, communication/outreach materials (i.e., brochures, presentations, committee meeting agendas/minutes), and educational resources and training opportunities.
PP-6	Develop TSMO Informational Materials	Develop SCDOT office-specific educational brochures to establish the business case and benefits of TSMO strategies. Work with agency leadership and public affairs to communicate information about TSMO successes in SCDOT communications, including SCDOT website and social media.

4.1.3.3 Data Management

Value: Establishing a strong data management practice will provide the opportunity to share resources, gain efficiency, encourage data-driven decisions, and ultimately, enhance operations.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Alternative Delivery, Planning, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

The statewide TSMO Council should establish a TSMO Data Review Subcommittee to help utilize available data to its full potential. The subcommittee's primary objective is to review existing data resources, including data currently being purchased, used, and identified as necessary or desired by various agencies. The subcommittee will be able to gain a better understanding of the available data, giving them the resources to identify opportunities for data sharing among different departments and stakeholders. It is recommended that the subcommittee assess data sharing possibilities and, where appropriate, assist agencies in developing data sharing agreements. By facilitating data sharing agreements, the subcommittee fosters a culture of cooperation and data-driven decision making across stakeholders. Another responsibility of the TSMO Data Review Subcommittee is exploring cost-effective data investment strategies. It is recommended that the subcommittee evaluate various options for procuring third-party data that can be shared more readily among state and local agencies. In doing so, the subcommittee ensures that agencies can access high-quality data without unnecessary duplication of effort or spending funds on invaluable data.

Data Management		
PP-7	Establish TSMO Data Review Subcommittee	TSMO Council should develop a data review subcommittee to identify what data is currently being purchased, used, and necessary/desired, and by whom.
PP-8	Develop Data Sharing Agreements	TSMO Data Review Subcommittee should identify opportunities for shared data use and assist agencies with the development of necessary data sharing agreements where applicable.
PP-9	Investigate Efficient Data Investment Strategies	TSMO Data Review Subcommittee should investigate cost-effective strategies for procuring third-party data that is more accessible to both state and local agencies.

4.1.3.4 Performance Measures

Value: Defining performance measures and establishing targets provides common, tangible goals and encourages enhanced operations while demonstrating the value of TSMO practices and strategies.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Alternative Delivery, Planning, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.

Performance Measures Dashboard

One of the primary tenets of TSMO is to actively manage and operate the transportation network through informed, data-driven decisions. Understanding and accessing key performance metrics is critical to achieving this goal. It is recommended that the TSMO Data Review Subcommittee in collaboration with the statewide TSMO Council, develop a statewide performance measures dashboard based on existing available data, which could include NPMRDS data, HERE data, detection data, and/or TrafficVision metrics. It is envisioned that as data accuracy and sources are improved over time, practitioners and decision makers will rely on the performance measures dashboard as a resource to monitor and drive operations throughout the state.

Performance Measure Targets and Tools

Successful performance measurement requires that SCDOT establish a culture of data-driven decision making, investments in resources to develop tools to measure the performance of assets, and determine how the performance data will be retrieved, analyzed, and processed to guide decisions. It is recommended that SCDOT develop performance measure targets and tools at a statewide level that will be shared with the district TSMO engineers to result in consistent, efficient, and high-quality data. This can be achieved by investing in live video analytics such as Microsoft Rocket, TrafxSAFE, and Microtraffic, as well as through the provision of real time data access and obtaining origin-destination data from a source like probe data or Blue-TOAD devices to guide road closure decisions. Determination of performance measure targets will rely heavily on the data available and its associated use agreements, quality, and granularity. Data needs should be coordinated closely with the TSMO Data Review Subcommittee.

District TSMO engineers should work toward developing regional performance measurement goals specific to their needs by establishing key focus areas and determining the performance metrics needed to measure progress toward their regional goals. Measurement of performance goals should be used in the process of project prioritization, evaluation, and development.

TIM and TSM Performance

Performance measures are essential to making informed, data-driven operations, planning, and programming decisions. It is recommended that SCDOT leverage data for operational decisions and establish performance measure targets and monitoring for TIM and TSM. Performance measures allow for decision makers to effectively monitor operations, identify areas for improvement, and make data-driven decisions that enhance traffic flow, safety, and efficiency on the roadways. Examples of TIM measures that should be monitored are response times, incident clearance times (ICT), roadway clearance time (RCT), secondary crashes, and back of queue crashes. TSM should consider performance metrics such as travel time, queue length, delay, and level of service which help industry professionals make improved timing decisions and provide valuable insights into the effectiveness of traffic signal management strategies. Furthermore, it is recommended that traffic signal performance measures such as traffic signal timing metrics (i.e., arrival on red) and Automated Traffic Signal Performance Measures (ATSPM), be collected and monitored to support data-driven decision making.

Leverage Data to Inform Operations and Investments

It is recommended that Regional TSMO Task Forces establish a culture of leveraging data to inform and demonstrate operational and investment decisions as a part of the project development and evaluation process. It is envisioned that representatives from the Regional TSMO Task Forces remain engaged and leveraged throughout the development of performance measure targets, data, tools, and processes. It is critical that regional data and operational needs are understood and addressed within this process such that SCDOT TSMO Engineers have the right resources and are confident in the data and tools to successfully inform operations and investments.

Performance Measures		
PP-10	Develop Performance Measures Dashboard	The TSMO Data Review Subcommittee, in collaboration with the statewide TSMO Council, should develop a statewide performance measures dashboard based on existing available data, which may include NPMRDS data, HERE data, TrafficVision metrics.
PP-11	Develop Performance Measure Targets and Tools	The TSMO Data Review Subcommittee, in collaboration with the statewide TSMO Council, should develop performance measure targets to aid in data driven decisions for traffic management centers, traffic incident management, traffic signal management, traveler information, ITS communications, work zone management, and emergency response.
PP-12	Manage TIM and TSM Performance	The TSMO Data Review Subcommittee, in collaboration with the statewide TSMO Council, should establish performance measure targets and monitoring for traffic incident management and traffic signal management to aid in data driven decisions.
PP-13	Leverage Data to Inform Operations and Investments	Regional TSMO Task Forces should establish a culture of leveraging data to inform and demonstrate operational and investment decisions as a part of the project development and evaluation process.

4.2 Deployment Recommendations

Establishing a plan prior to the deployment of TSMO strategies is important to the success and sustainability of the project. The recommendations made within this section provide guidance for the implementation of tactical deployment strategies.

4.2.1 Traffic Management Centers

TMCs operate as control centers for statewide, regional, and municipal transportation operations. They oversee operations such as traffic signal systems, traffic incident management, active work zone management, traveler information, and emergency management strategies to ensure that roadways operate smoothly. The collection of TMC functions within a single location supports more comprehensive, system-wide management of regional transportation.

4.2.1.1 TMC Modernization

Value: Investments in TMC facilities provide reliability and resiliency in agencies' ability to provide active traffic management. This investment increases efficiency in day-to-day operations, functionality to support multiagency integration, and heightened agility in integrating emerging technologies.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, IT Department, Emergency Operations, and the Districts

It is recommended that SCDOT evaluate their existing TMC facilities, TMC equipment, documentation for TMC processes and procedures. The assessment should focus on defining upgrades and expansions that support evolving technology and a growing demand for more proactive traffic management.

TMC Facility Upgrades

Like any physical building, TMC facilities can experience challenges as they continue to age and maintenance costs rise, requiring significant investments to upgrade or replace. SCDOT should invest in modernizing their facilities and equipment (i.e., workstations, video wall, building facility). Additionally, this investment should prepare for future traffic management needs to future proof the defined facility upgrades.

Several recommendations for TMC upgrades are detailed as part of the initial steps in Section 5.2.

Integrated TMC Concept of Operations

Proactive traffic management spans freeways and arterials, which often requires close coordination between multiple agencies. SCDOT should collaborate with local agencies to

develop regional Concepts of Operations integrating traffic management responsibilities to support a seamless experience for travelers. Depending on the region, this could involve municipal traffic management groups, law enforcement, emergency management, or other key agencies that are involved. The Concept of Operations should consider the following:

- Agencies involved in traffic management for the region and their roles and responsibilities.
- Potential locations that could physically support collocation and collaborative functions of all partner agencies.
- Potential equipment and facility functional requirements that meet the needs of all partner agencies.
- Standard operating procedures that support functions across jurisdictional boundaries for incident response, traffic signal management, and emergency response.

A regional integrated approach provides for potential resource sharing opportunities related to cost and staff. A recommendation to prepare an Integrated TMC Concept of Operations for the Charleston TMC is detailed as part of the initial steps in Section 5.2.

Statewide ATMS Software Upgrade

SCDOT is currently in the process of procuring and implementing a new statewide ATMS software. In parallel with the migration to the new ATMS software, TMCs should update and standardize TMC documentation related to systems, system interfaces, and current processes. Additionally, agencies should integrate accurate documentation of those technologies within other TMC processes and procedures. Strong documentation supports key knowledge transfer during staff transitions (whether agency or contractor staff).

Traffic Management Centers		
DTMC-1	TMC Facility Upgrades	Deploy upgrades to managing systems, facilities, and standard operating procedures (SOPs) to gain operational efficiency, reliability, and safety throughout the state.
DTMC-2	Integrated TMC Concept of Operations	Develop regional Concepts of Operations to review the potential for integrating TMCs between SCDOT and local agencies
DTMC-3	Statewide ATMS Software Upgrade	Update and standardize TMC documentation related to systems, system interfaces, and current processes in alignment with the new ATMS software.

4.2.1.2 Common Data Platform

Value: Consistency in data structure and format supports all facets of multiagency collaboration including common performance measures, enhanced operational decisions, and comprehensive multimodal traveler information for agencies and transportation users.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, IT Department, Emergency Operations, and the Districts

A common data platform allows multiple transportation stakeholders to view and share transportation data within South Carolina. An Open Data platform provides benefits to all users and standardizes data sharing APIs. It is recommended that SCDOT maintain the common data platform and make it available to state, regional, and local agencies.

Integrating data from various sources provides a unified platform to enhance TMC situational awareness, improve operational efficiency, and foster collaboration among different agencies.

Work zone data is one of the most challenging data sets to maintain. The impacts of work zones are constantly evolving based on status of the work, lanes impacted, and defined detour routes. This data is essential to helping travelers safely navigate through work zones. The data platform should include a lane closure reporting system that captures real time construction activity impacts to specific lanes. The federal Work Zone Data Exchange (WZDx) specification should be used for defining the data format for SC's work zone data.

The development of data standards should be incorporated into a common data platform. Additionally, a data management strategy should include the definition of existing data contracts, data sharing agreements, and standards for data collection, storage, and sharing.

Traffic Management Centers		
DTMC-4	Common Data Platform	Develop and implement a data platform that is maintained by SCDOT and made available to state, regional, and local agencies. The platform should manage incident data, traffic signal performance data, work zone data and lane closure reporting.

4.2.1.3 Planned and Unplanned Event Management

Value: Event-specific response plans align expectations of all stakeholders involved. Refining these based on lessons learned from real world applications streamline the commitment to roles and responsibilities, reduce redundancy, and increase the efficiency of agencies' abilities to actively manage traffic in response to these events.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, Public Safety agencies, local transportation agencies, Emergency Operations, and the Districts

Planned and unplanned events compromise the mobility and safety of transportation operations. SCDOT should implement active traffic management strategies to mitigate the impacts of those planned and unplanned events. Strategies spanning multiple jurisdictions should include the development of memorandums of understanding to establish clear roles and responsibilities and establish formalized partnerships.

Event management strategies include a wide range of technologies to support traveler information tools and active traffic management. Integrated traffic signals and specific signal timing plans can address recurring or planned events on arterials. DDMS, variable message signs , and dynamic wayfinding signs can provide location specific data and direct drivers to the most efficient routes.

Traffic Management Centers		
DTMC-5	Planned and Unplanned Event Management	Develop event-specific response plans to manage traffic impacts from extended lane closures related to work zone lane closures, traffic incidents, at-grade railroad crossings, weather events, and/or any defined special events.

4.2.2 ITS Networks

SCDOT has deployed a communications network that includes a combination of agency-owned and leased line communications infrastructure to provide high-bandwidth connectivity to vital ITS devices. Connectivity to traffic signals and ITS devices, like cameras and DMS, allows public agencies to maximize their investments into these technologies.

4.2.2.1 Develop Statewide ITS Network Communication Strategic Plan

Value: Developing the statewide ITS network architecture and the strategic plan for deployment will provide SCDOT with the opportunity to focus on highest priority locations while leveraging opportunities through other projects—increasing efficiency and decreasing the time required to provide the state with a robust, reliable network.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, IT Department, Emergency Operations, and the Districts

SCDOT should assess the existing infrastructure, future communications needs, and develop a statewide ITS network communications strategic investment plan. The plan should address varying needs across the state of South Carolina, challenges with existing infrastructure, readiness for emerging technologies, and a phased implementation plan for building out the defined infrastructure. The future build out should also address needs around redundancy and resiliency of the communications infrastructure.

ITS Networks		
DITS-1	Develop Statewide ITS Network Communication Strategic Plan	Develop a Statewide ITS Network Communication Strategic Plan which will define the infrastructure needs, gaps, and recommendations to ensure connectivity, redundancy, and resiliency.

4.2.2.2 Expand ITS Networks

Value: ITS communication networks are the foundation for connected TSMO strategy deployments. Expanding and maintaining a secure, robust ITS network will greatly increase the ability for SCDOT to leverage TSMO solutions to increase mobility, sustainability, and safety.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, IT Department, Emergency Operations, and the Districts

Expanding SCDOT's communications network supports the transportation management goals of SCDOT and other transportation agencies. SCDOT is planning to leverage past investments and expand the network with new builds. SCDOT and local agencies can collaborate on future expansions of the communications infrastructure to optimize resources to provide reliability and redundancy while increasing coverage and capacity.

The Interstate expansion includes continuous ITS coverage to effectively monitor and manage system performance in both urban and rural areas. This expansion includes the deployment of a statewide fiber and camera system along all Interstate corridors; systematically replacing and upgrading aging DMS; and upgrading locations that are dependent on portable DMS with permanent DMS.

The non-Interstate network expansion should focus technology on the statewide roadway system to effectively monitor and manage system performance. Specific attention should be focused on evacuation routes and completing the integration of state-maintained and locally maintained traffic signal systems via SCDOT's standardized colocation architecture so that centralized management of traffic signal systems can be achieved across South Carolina. Additionally, scheduled device upgrades help ensure equipment remains up to date and supported by the manufacturer to ensure security risks are minimized.

Several recommendations for ITS Expansion are detailed as part of the initial steps in Section 5.2.

ITS Networks		
DITS-2	Expand Interstate ITS Networks	Complete the deployment of a statewide fiber and camera system along interstate corridors, systematically replace aging overhead DMS and strategically install new DMS, and replace portable DMS with permanent DMS
DITS-3	Expand Off-Interstate ITS Networks	Ensure SCDOT traffic signals maintained by municipalities are networked via SCDOT's standard colocation architecture to ensure both municipal and SCDOT offices have access as well as to ensure corridors spanning multiple jurisdictions can be operated cohesively. Expand deployment of statewide fiber and wireless connections, cameras, DMS, and other ITS devices throughout the road network. Upgrade ITS network devices that have reached their manufacturer's end of support in order to ensure network security risks are minimized.

4.2.3 Corridor Management

Corridor management focuses on providing proactive operation, planning, and maintenance of roadways to deliver targeted solutions that improve efficiency, safety, and travel time reliability. These strategies are intended to be applied to roadways identified for transportation improvements, such as those identified in Section 3.3.2.

The corridor management strategies were separated into two categories, traffic signal improvements and other corridor management strategies.

4.2.3.1 Traffic Signal Improvements

Value: Proving to provide one of the highest rates of return on investment, traffic signal management provides significant mobility, sustainability, and safety benefits.

Goals Addressed:

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, IT Department, Emergency Operations, and the Districts

Traffic Signal Timing and Coordination

Traffic signal timing and coordination is a primary strategy that is typically a low-cost, high-return improvement that has many benefits.

- **Reduce Carbon Emissions**
- **Reduce Congestion and Travel Times**
- **Improve Safety**
- **Maximize Efficiency of the Existing Roadway Network**
- **Improve Air Quality**
- **Reduce Aggressive Driving Behavior**
- **Postpone or Eliminate the Need to Construct Additional Road Capacity**

Traffic signal timing programs can be implemented for long corridors with numerous traffic signals or for a single, isolated intersection. Coordination between traffic signals can be achieved through time-based signal timings plans; responsive plans that implement timing plans based upon prevailing traffic conditions; and adaptive traffic signal timing that adjusts signal timing based upon real-time detection data. Effective system operations require dedicated communication with the traffic signals, regular maintenance of all traffic signal equipment, and frequent performance monitoring of the signal system operations.

Several recommendations for Traffic Signal Timing and Coordination are detailed as part of the initial steps in Section 5.2.

Traffic Signal Upgrades

Agencies are challenged to ensure regular maintenance of the more than 4,000 traffic signal locations in South Carolina. Agencies should consider traffic signal infrastructure improvements such as traffic signal controller upgrades, vehicle detection upgrades, implementation of flashing yellow arrow signal heads, implementation of pedestrian signals and buttons, interconnection to nearby traffic signals, battery back-up systems, installation of ADA improvements, and installation of steel poles.

Corridor Management		
DCM-1	Traffic Signal Timing Upgrades	Implement or update traffic signal timing for corridors suitable for TSMO improvements.
DCM-2	Traffic Signal Upgrades	Implement traffic signal infrastructure improvements.

4.2.3.2 Other Corridor Management Strategies

Value: Active corridor management provides significant mobility, sustainability, and safety benefits.

Goals Addressed: 

Key Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, IT Department, Emergency Operations, and the Districts

The table below represents a toolbox of TSMO strategies beyond traffic signals. These strategies can be applied to a range of needs for Interstate and non-Interstate routes.

Corridor Management		
DCM-3	Automated Incident Detection Systems	Automated detectors including cameras and software that alert operators of atypical conditions on the roadway. This technology can decrease the incident detection time of TMC operators.
DCM-4	Dynamic/Variable Message Signs	Provide near real-time traveler information to drivers, including work zone locations, crash information, travel time speeds, and safety reminders. These signs can be portable or permanent.
DCM-5	Dynamic Speed Limits	Provide the ability to adjust speed limits based on downstream traffic speeds. These can be implemented in areas that experience frequent slowdowns, near work zones, or in advance of lane reductions to safely and gradually decrease speeds.
DCM-6	Emergency Operations Plans	Sets guidance for designing and planning for emergencies and encourages communication. Establishes a hierarchy between agencies involved in the Emergency Transportation Operations program.
DCM-7	Emergency Vehicle Preemption	Provides communication between emergency vehicles and traffic signals to decrease response time by providing green phases to approaching emergency vehicles.
DCM-8	Integrated Corridor Management	Optimizes capacity on freeway and parallel arterials in response to major incidents. Includes communication of an alternate route, dynamically navigates drivers to the alternate route, and optimizes arterial capacity through specific signal timing plans.
DCM-9	In-Vehicle Services	Use of connected vehicle technology to receive location-specific data that can be processed by the driver or vehicle to adjust in response to real time traffic conditions.
DCM-10	Queue Warning Systems	Alert motorists of slowed or stopped traffic downstream of a vehicle to reduce the risk of rear-end or other crashes.

Corridor Management		
DCM-11	Ramp Metering	Staggers the ingress of ramp traffic to reduce weaving and minimize impacts to the flow of freeway traffic.
DCM-12	Real-Time Traveler Information	Communicated to road users via message signs, connected vehicle applications, or traveler information portals. Information can include travel times, speeds, and incidents.
DCM-13	Social Media	Social media connects travelers to up-to-date traveler information and supports crowdsourcing of traffic performance data and impacts to the roadway.
DCM-14	Transit Signal Priority	Provides communications between transit vehicles and traffic signals. System can extend green times in response to transit vehicles that are behind schedule and improve the reliability of transit service.
DCM-15	Traveler Information Portals	Contain real-time statuses on road conditions, up-to-date weather, road, and bridge statuses, and provide self-reporting and service request capabilities.
DCM-16	Truck Parking Systems	Collects parking capacity data and communicates with commercial vehicle operators on locations with available parking spaces. System can also provide reservation system and other services to improve access to available parking.
DCM-17	Vehicle Detection	Technology to monitor vehicle presence on approaches to traffic signals. Technologies include inductive loops, radar, video, microwave, and wireless magnetometers. Granular detection is critical in adaptive and responsive signal timing, enhanced coordination, and collecting performance data.

4.2.3.3 Applicability

Table 2 summarizes the corridor management strategies and illustrates the varied services around South Carolina that they apply to.

Table 2 – Supporting TSMO Deployment Strategies

Strategy	Supported Services							
	TMCs	TIM	Traffic Signal Management	Traveler Information	ITS Comm.	Work Zone Management	Emergency Response and Resiliency	Data Management
Traffic Signal Timing	✓		✓		✓			
Traffic Signal Upgrades	✓		✓		✓			
Automated Incident Detection Systems	✓	✓					✓	
Dynamic Message Signs		✓		✓		✓	✓	
Dynamic Speed Limits		✓		✓		✓	✓	
Emergency Operations Plans		✓					✓	✓
Emergency Vehicle Preemption		✓	✓				✓	
Integrated Corridor Management	✓	✓	✓	✓	✓	✓	✓	
In-Vehicle Services				✓				
Queue Warning Systems		✓		✓		✓	✓	
Ramp Metering	✓		✓		✓	✓		
Real-Time Traveler Information		✓		✓		✓	✓	
Social Media				✓		✓		
Transit Signal Priority	✓			✓	✓			
Traveler Information Portals				✓				✓
Truck Parking Systems				✓				✓
Vehicle Detection	✓		✓					

5 ACTION PLAN

The TSMO recommendations have been developed to support the stated TSMO vision and goals and were based on consideration of existing conditions, Plan Team and stakeholder needs, the CMM assessment, professional experience, and industry best practices. Section 5.1 provides a recommended plan of action to implement the TSMO recommendations and Section 5.2 summarizes the recommended initial steps.

5.1 Overall Action Plan

Table 3 provides the action plan for the **Programmatic** recommendations and Table 4 provides the action plan for the **Deployment** recommendations. A chronological layout of the action plan is provided in **Appendix C**. The following information is included in the action plan.

- **Stakeholders** lists the proposed contacts that could be responsible for implementing the set of recommendations.
- **Goals** indicates which goals are addressed by the set of recommendations. As documented in Section 2.4, the plan goals are represented by the following.


Improve mobility and reliability


Strategically employ innovation


Enhance safety


Leverage collaboration


Integrate performance management


Encourage equitable solutions


Reduce carbon emissions


Invest in resources

- **Timeframe** indicates approximate time in which the recommendation is proposed to be implemented. **NEAR** represents one to two years, **MID** represents three to four years, and **LONG** represents five plus years.
- **Resource Need** indicates the relative investment of financial and staff resources that would be required to implement the recommendation. **$** represents low investment, **$$** represents medium investment, and **$$$** represents high investment.

As these recommendations are implemented, the SCDOT TSMO program will develop and mature, gaining benefits of increased efficiency, improved safety, and reduced carbon emissions across the statewide transportation network.

Table 3 – Programmatic Recommendations Action Plan

ID	Title	Timeframe	Level of Resources
Programmatic – Collaboration and Partnerships			
Goals Addressed:			
Key Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, IT, Emergency Operations, Alternative Delivery, Planning, Preconstruction, Work Zone, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.			
PC-1	Establish Statewide TSMO Council	NEAR	$
PC-4	Conduct Annual TSMO Briefing	NEAR	$$
PC-11	Prepare TSMO Informational Material	NEAR	$$
PC-9	Participate in Interagency Training Exercises	NEAR	$$
PC-3	FHWA Coordination	MID	$
PC-6	Facilitate TSMO Discussion at Transportation Industry Meetings	MID	$
PC-7	Formalize Interagency Agreements	MID	$
PC-8	Develop Incident and Emergency Management MOUs	MID	$
PC-10	Participate in After-Action Briefings	MID	$$
PC-2	Establish Regional TSMO Task Forces	LONG	$
PC-5	Conduct Annual Peer State TSMO Meetings	LONG	$$

ID	Title		Timeframe	Level of Resources
Programmatic – Resources (Funding and Staffing)				
Goals:				
Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Emergency Operations, and Planning				
PR-1	Define Program Budget Needs		**NEAR**	**$**
PR-3	Develop Staffing Plan		**NEAR**	**$**
PR-4	Establish TSMO Program - Staffing Resources		**LONG**	**$$$**
PR-2	Establish TSMO Program - Funding Resources		**LONG**	**$$$**

ID	Title	Timeframe	Level of Resources
Programmatic – Policy and Process			
Goals:			
Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Alternative Delivery, Planning, Intermodal & Freight Programs, District offices, MPOs, COGs, and local agencies.			
PP-3	Encourage External Stakeholders to Integrate TSMO	NEAR	$
PP-5	Develop SCDOT TSMO Website	NEAR	$
PP-7	Establish TSMO Data Review Subcommittee	NEAR	$
PP-1	Establish TSMO Standards and Guidelines	MID	$$
PP-2	Modify Existing SCDOT Planning and Project Development Directives	MID	$$
PP-8	Develop Data Sharing Agreements	MID	$$
PP-9	Investigate Efficient Data Investment Strategies	MID	$$
PP-10	Develop Performance Measures Dashboard	MID	$$$
PP-11	Develop Performance Measure Targets and Tools	MID	$$
PP-4	Conduct TSMO Training	LONG	$$
PP-6	Develop TSMO Informational Materials	LONG	$$
PP-12	Manage TIM and TSM Performance	LONG	$$
PP-13	Leverage Data to Inform Operations and Investments	LONG	$$

Table 4 – Deployment Recommendations Action Plan

ID	Title	Timeframe	Level of Resources
Deployment – Traffic Management Centers			
Goals:			
Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Alternative Delivery, Planning, Intermodal & Freight Programs, and the Districts			
DTMC-1	TMC Facility Upgrades	**NEAR**	$$$
DTMC-2	Integrated TMC Concept of Operations	**NEAR**	$
DTMC-3	Statewide ATMS Software Upgrade	**MID**	$$
DTMC-4	Common Data Platform	**MID**	$$
DTMC-5	Planned and Unplanned Event Management	**LONG**	$$
Deployment – ITS Networks			
Goals:			
Stakeholders: TSMO Engineer (lead), representatives from: Construction, Traffic Engineering, Maintenance, Emergency Operations, Planning, Intermodal & Freight Programs, and the Districts			
DITS-1	Develop Statewide ITS Network Communication Strategic Plan	**NEAR**	$
DITS-2	Expand Interstate ITS Networks	**MID**	$$$
DITS-3	Expand Off-Interstate ITS Networks	**MID**	$$$

ID	Title	Timeframe	Level of Resources
Deployment – Traffic Signal Improvements			
Goals:			
Stakeholders: TSMO Engineer (lead), representatives from: Traffic Engineering, Planning, the Districts, and municipalities			
DCM-1	Traffic Signal Timing Upgrades	NEAR	$
DCM-2	Traffic Signal Upgrades	NEAR	$$
DCM-3	Automated Incident Detection Systems	NEAR	$
DCM-4	Dynamic/Variable Message Signs	NEAR	$$
DCM-6	Emergency Operations Plans	NEAR	$
DCM-7	Emergency Vehicle Preemption	NEAR	$$
DCM-10	Queue Warning Systems	NEAR	$
DCM-12	Real-Time Traveler Information	NEAR	$
DCM-13	Social Media	NEAR	$
DCM-15	Traveler Information Portals	NEAR	$
DCM-17	Vehicle Detection	NEAR	$$
DCM-11	Ramp Metering	MID	$$
DCM-14	Transit Signal Priority	MID	$$$
DCM-16	Truck Parking Systems	MID	$$$
DCM-5	Dynamic Speed Limits	LONG	$$
DCM-8	Integrated Corridor Management	LONG	$$$
DCM-9	In-Vehicle Services	LONG	$$

5.2 Initial Steps

Based upon the Action Plan, Table 5 outlines proposed recommendations for the initial steps. For several deployment strategies, the steps reference the high-ranked corridors suitable for TSMO improvements that were identified in Section 3.3.2.

Table 5 – Initial Steps

ID	Title	Action
PC-1	Establish Statewide TSMO Council	Establish a TSMO Council to facilitate ongoing TSMO initiatives throughout the state. The SCDOT TSMO Engineer shall be responsible for organizing the meeting of this council.
PR-1	Define Program Budget Needs	The SCDOT TSMO Engineer, in collaboration with statewide Director of Traffic Engineering and statewide TSMO Council, should define TSMO Program budget needs.
DTMC-1	TMC Facility Upgrades	• Replace the existing Myrtle Beach TMC with a new modern TMC. • Expand the Statewide TMC in Columbia to provide space and resources to maintain seven-day, 24-hour operations. • Evaluate the Charleston TMC expansion and/or facilities for increased operations for the Lowcountry Bus Rapid Transit System.
DTMC-2	Integrated TMC Concept of Operations	Prepare an Integrated TMC Concept of Operations for the Charleston TMC for the potential integration of traffic management responsibilities with local municipalities.
PR-3	Develop Staffing Plan	Develop a staffing plan for SCDOT HQ and SCDOT District offices to provide supporting organizational structure to the SCDOT TSMO Engineer.
DITS-1	Develop Statewide ITS Network Communication Strategic Plan	Develop a Statewide ITS Network Communication Strategic Plan which will define the infrastructure needs, gaps, and recommendations to ensure connectivity, redundancy, and resiliency.
DITS-2	Expand Interstate ITS Networks	Complete the deployment of the statewide fiber and camera system along all Interstates.
DITS-3	Expand Off-Interstate ITS Networks	Ensuring SCDOT signals maintained by municipalities are networked via SCDOT's standard colocation architecture to ensure corridors spanning multiple jurisdictions can be operated cohesively. Initial focus areas are the following. • Myrtle Beach area • North Charleston area • Beaufort County • Evacuation routes

ID	Title	Action
DCM-1	Traffic Signal Timing Upgrades	From Section 3.3.2, the following corridors are recommended to be considered for traffic signal timing upgrades. • US 501 in Horry County (1st-ranked Major Arterial) • US 17 south of US 601 in Horry County (4th-ranked Major Arterial) • US 52 in Lower Berkeley County (9th-ranked Major Arterial) • US 17 in Georgetown County (10th-ranked Major Arterial) • Cherokee Road in Florence County (2nd-ranked Minor Arterial) • SC 16 in Richland County (5th-ranked Minor Arterial) • May River Road in Beaufort County (9th-ranked Minor Arterial)
DCM-4 **DCM-12**	Dynamic/Variable Message Signs Real-Time Traveler Information	From Section 3.3.2, the following corridors are recommended to be considered for implementation of real-time traveler information via DMS. • US 501 in Horry County (1st-ranked Major Arterial) • US 17 in West Ashley, Charleston County (7th-ranked Major Arterial), in conjunction with City of Charleston plans • Woodruff Road in Greenville County (1st-ranked Minor Arterial)
DCM-14	Transit Signal Priority	The following corridors are recommended to be considered for transit signal priority upgrades in relation to the implementation of the Lowcountry Bus Rapid Transit System. They both were identified in Section 3.3.2. • US 78 in Charleston County (3rd-ranked Major Arterial) • US 52 in Charleston County (6th-ranked Major Arterial)
DCM-8	Integrated Corridor Management	Identified in Section 3.3.2, I-85 from the I-385 interchange to the Spartanburg County Line (3rd-ranked Interstate) experiences daily congestion, high truck volumes, and high crashes. Integrated corridor management of I-85 with US 29 can be considered, in conjunction with other TSMO improvements such as additional cameras, adaptive traffic signal systems, and DMS.

APPENDIX A

Stakeholder List

Upstate

- SCDOT District 2 Traffic: Nicholas Rebovich
- SCDOT District 3 Traffic: Sean Knight
- City of Anderson: Lacrecia Bilbrey
- City of Spartanburg: Randall Farr
- City of Greenville: Nick DePalma, David Harding, Valerie Holmes
- ANATS: Michael Gay
- GPATS: Keith Brockington
- SPATS: Sherry Dull

Midlands

- FHWA: Carolyn Fisher
- SCDOT IT: Michael Chandler
- SCDOT Planning: Samantha Carr
- SCDOT Work Zone: Joey Lucas
- SCDOT District 7 Traffic: Ems Baskin, Chris Williams
- SC Department of Public Safety: Phil Riley
- City of Aiken: Brad Laird, Mike Pryzbylowicz, David Turno
- City of Columbia: David Brewer, Dana Higgins
- Town of Lexington: Randy Edwards
- City of Rock Hill: Mike Jolly, Steven Varnadore, Chris Hermann
- ARTS: Joel Duke
- COATS: Reginald Simmons
- FLATS: Ethan Brown
- SUATS: Kyle Kelly

Lowcountry

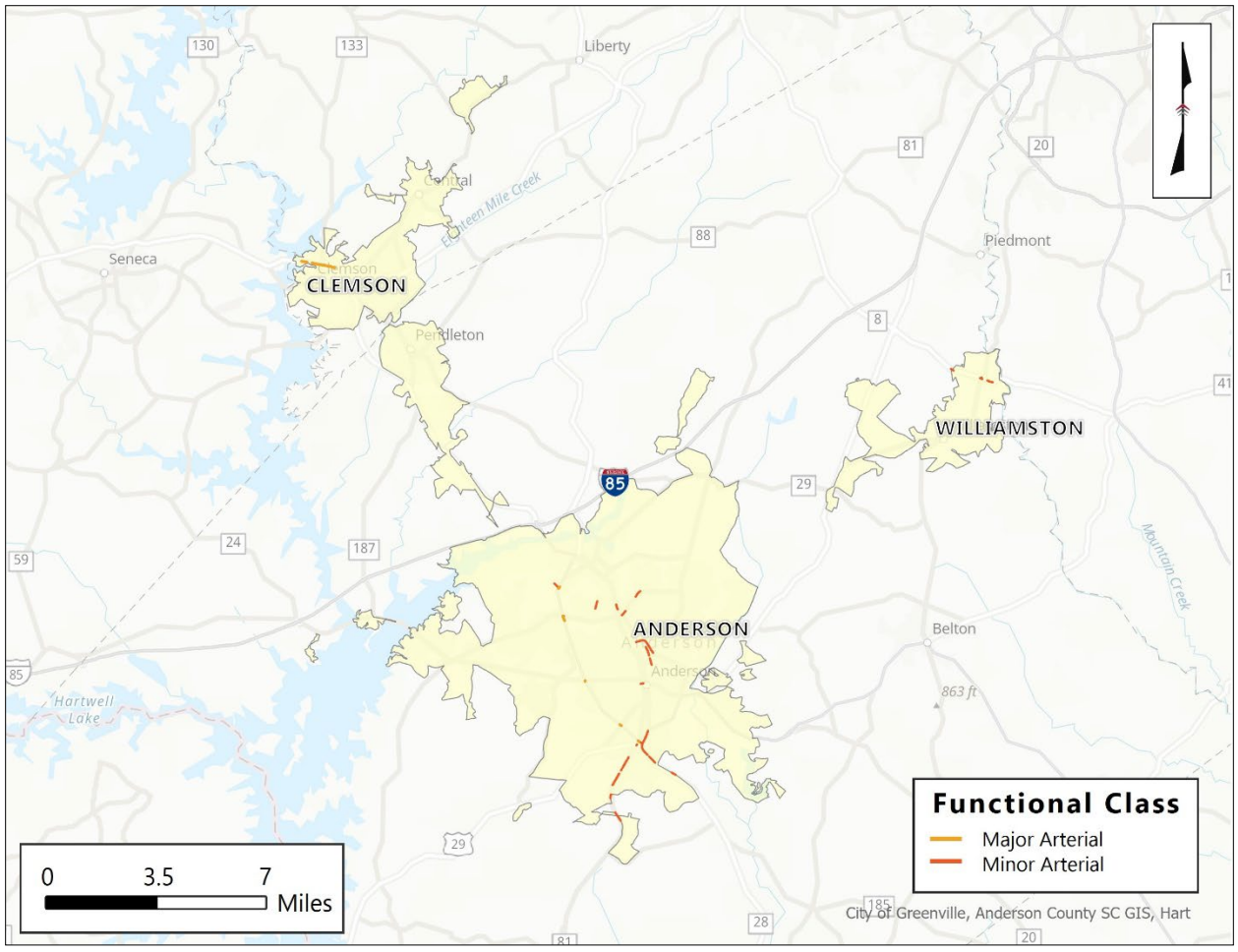
- SCDOT District 6 Traffic: Charles Abel
- Beaufort County: Eric Claussen
- City of Myrtle Beach: Chris Miller, Janet Curry, Phillip Canady
- City of Beaufort: Nate Farrow
- City of Charleston: Troy Mitchell
- City of North Charleston: Mike Dalrymple
- City of North Myrtle Beach: Kevin Blayton, John Bruton
- Town of Hilton Head Island: Jeff Buckalew, Theresa McVey, Darrin Shoemaker, Jim Iwanicki
- Town of Mount Pleasant: James Aton, Brad Morrison
- CHATS: Kyle James
- GSATS: Mark Hoeweler
- LATS: Stehpanie Rossi

APPENDIX B

Urban Area TSMO Suitability Maps

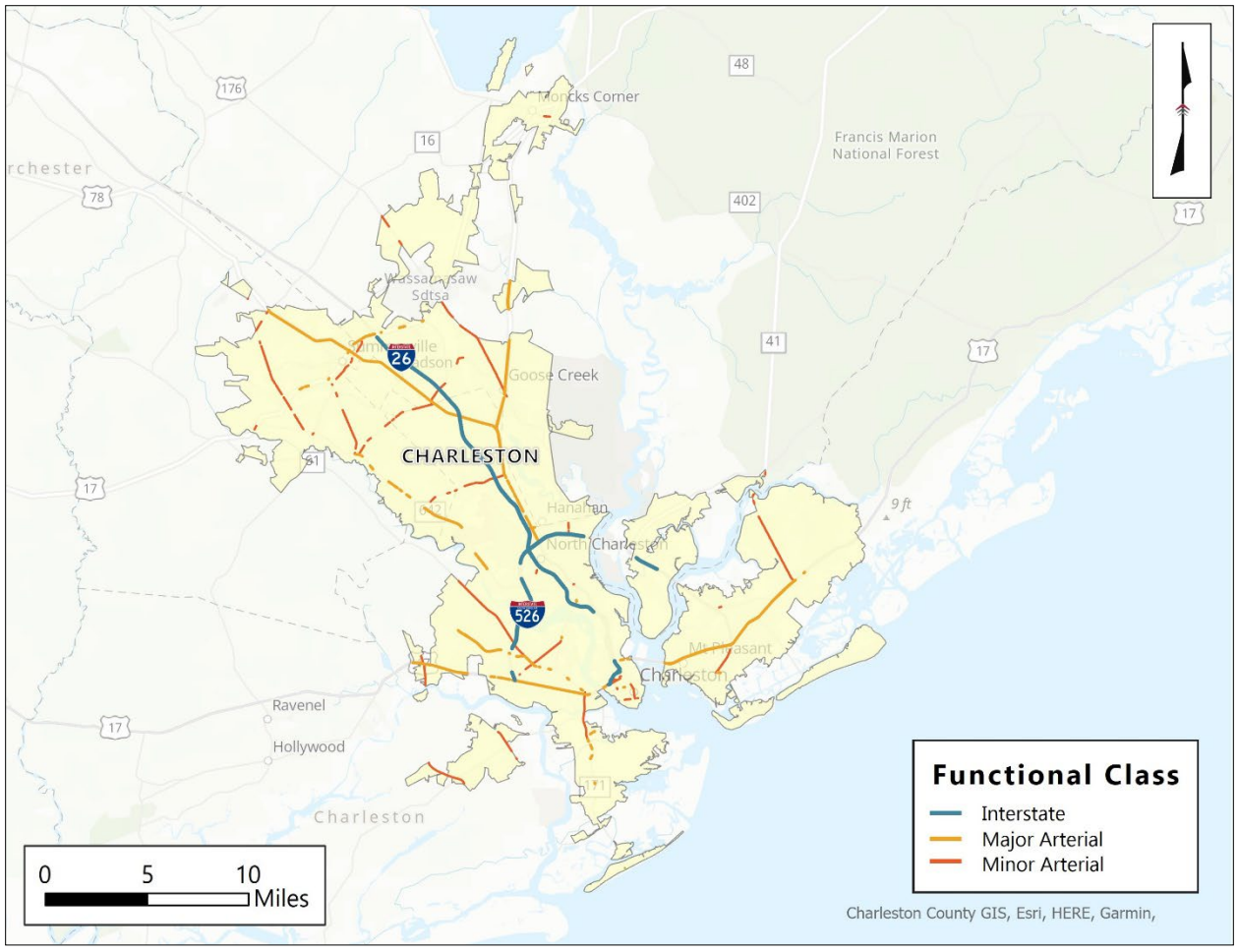
- Anderson
- Charleston/North Charleston
- Columbia
- Florence
- Greenville
- Hilton Head
- Mauldin/Simpsonville
- Myrtle Beach/Socastee
- North Augusta
- Rock Hill
- Sumter

Anderson Top Corridors



Major Arterials		
Corridor	**Rank**	**Score**
SC 28 in Anderson County	20/95	33.9%
US 123 in Pickens County	21/95	33.6%
Minor Arterials		
Corridor	**Rank**	**Score**
SC 28 in Anderson County	50/182	19.5%
SC 81 in Anderson County	139/182	14.5%
SC 8 in Anderson County	149/182	13.9%

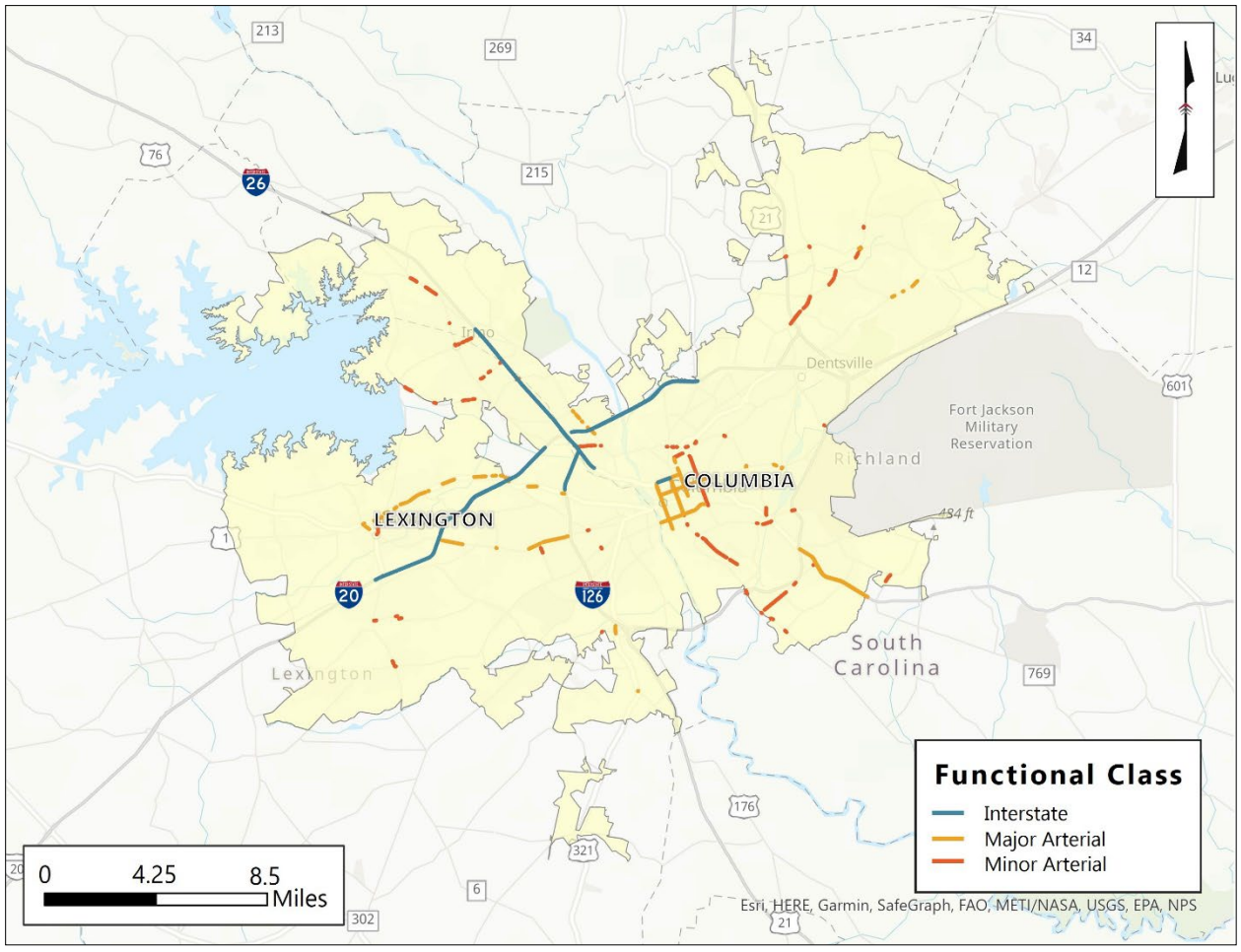
Charleston/North Charleston Top Corridors



Interstates		
Corridor	**Rank**	**Score**
I-26 north of I-526	1/20	61.7%
I-526 east of I-26	4/20	55.3%
I-526 west of I-26	7/20	48.2%
I-26 south of I-526	8/20	44.5%
Major Arterials		
Corridor	**Rank**	**Score**
US 17 in Charleston County/Mount Pleasant	2/95	65.8%
US 78 in Charleston County	3/95	48.3%
N Main St in Summerville	5/95	43.5%
US 52 in Charleston County	6/95	43.1%
US 17 in Charleston County/West Ashley	7/95	42.4%
SC 61 in Charleston County	8/95	41.7%
US 52 in Lower Berkeley County	9/95	40.3%
Dorchester Rd in Charleston County	11/95	39.5%
US 17 in Charleston County/Downtown	12/95	38.8%
Glenn McConnell Parkway in Charleston County	15/95	36.6%
US 78 in Dorchester County	17/95	35.8%
Dorchester Rd in Dorchester County	22/95	33.5%

Folly Rd in Charleston County	33/95	31.0%
Sam Rittenberg Blvd in Charleston County	46/95	28.1%
S 30 in Charleston County	47/95	28.0%
Calhoun St in Charleston County	84/95	24.1%
SC 703 in Charleston County	91/95	23.7%
Minor Arterials		
Corridor	**Rank**	**Score**
Ladson Rd in Berkeley Rd	4/182	33.9%
Bohicket/Main Rd S of River Rd in Charleston County	6/182	32.6%
State Rd in Berkeley County	8/182	30.7%
Ashley Phosphate Rd in Charleston Co. and Dorchester Co.	10/182	30.5%
Main Rd N of River Rd in Charleston County	11/182	30.1%
River Rd in Charleston County	12/182	30.0%
Folly Rd in Charleston County	13/182	29.0%
College Park Rd in Berkeley County	16/182	28.5%
Jedburg Rd in Dorchester County	25/182	26.0%
Sam Rittenberg in Charleston County	26/182	25.9%
Ashley River Rd in Charleston County	28/182	25.8%
Berlin G Myers Pkwy in Dorchester County	35/182	24.3%
Ladson Rd in Dorchester County	36/182	23.6%
Orangeburg Rd in Dorchester County	41/182	22.5%
Meeting St in Charleston County	55/182	21.5%
Old Trolley Rd in Dorchester County	57/182	21.4%
N Rhett Ave in Charleston County	62/182	21.0%
US 17 in Dorchester County	94/182	18.3%
Chuck Dawley in Charleston County	102/182	17.7%
Cannon St in Charleston County	104/182	17.6%
Spring St in Charleston County	114/182	16.6%
SC 41 in Charleston County	119/182	16.4%
SC 8 in Greenville County	133/182	14.9%
Broad St in Charleston County	137/182	14.6%

Columbia Top Corridors

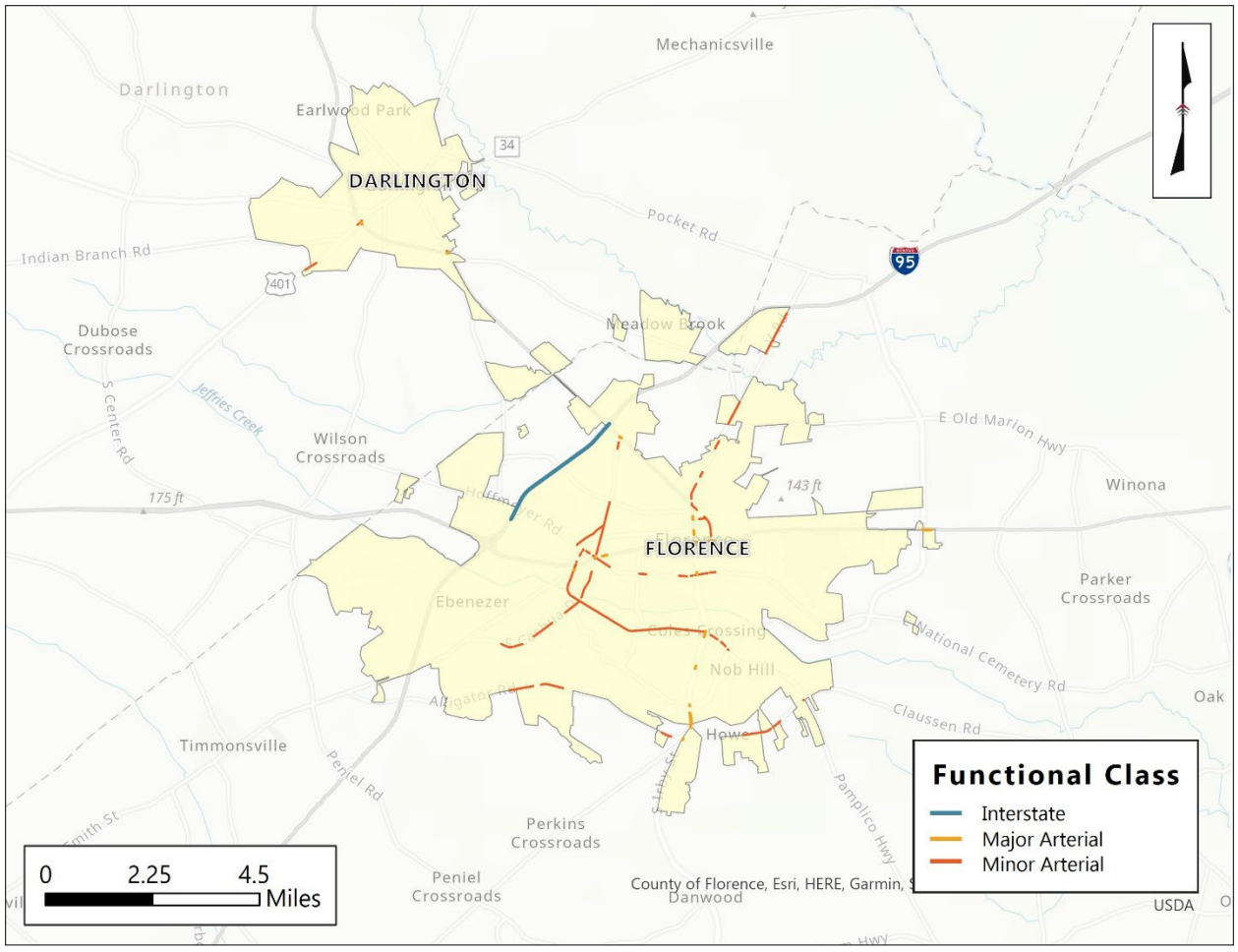


Interstates		
Corridor	**Rank**	**Score**
I-126 south of I-26 and north of Greystone Blvd	5/20	51.3%
I-26 north of US 378 and south of I-20 interchange	6/20	14.8%
I-20 from S Lake Dr (SC 6) to US 378	11/20	29.8%
I-20 from I-20 to US 321	12/20	27.5%
I-26 north of I-20	17/20	20.8%
I-20 between 378 and 20	20/20	20.7%
Major Arterials		
Corridor	**Rank**	**Score**
US 378 in Richland County	14/95	37.5%
Broad River Rd in Richland County	18/95	35.6%
US 378 in Lexington County	26/95	32.8%
US 176 in Lexington County	29/95	32.0%
SC 12 in Richland County	30/95	31.7%
Elmwood Avenue in Richland County	34/95	31.0%
Augusta Rd in Richland County	48/95	27.9%
SC 277 in Richland County	49/95	27.8%
US 176 in Richland County DT COL (Huger Street)	55/95	26.8%
Two Notch Rd in Richland County	61/95	25.8%

US 1 in Lexington County	62/95	25.7%
Clemson Rd in Richland County	76/95	24.8%
Assembly Street in Richland County	*	22.4%
Blossom Street in Richland County	*	21.6%
Bull Street in Richland County	*	21.5%
Taylor Street in Richland County	*	21.2%
Minor Arterials		
Corridor	**Rank**	**Score**
SC 16 in Richland County	5/182	33.8%
Shop Rd in Richland County	33/182	24.4%
W Beltline Blvd in Richland County	38/182	22.7%
Bush River Rd in Lexington County	65/182	20.8%
SC 555 in Richland County	72/182	20.2%
Trotter Rd in Richland County	74/182	20.0%
Atlas Rd in Richland County	77/182	19.9%
Harden St Ext in Richland County	80/182	19.4%
Lake Drive in Lexington County	92/182	18.4%
Woodrow St in Richland County	96/182	18.2%
Hard Scrabble Rd in Richland County	105/182	17.6%
Harbison Blvd in Lexington County	124/182	15.8%
Sunset Dr in Richland County	128/182	15.6%
Bush River Rd in Richland County	135/182	14.9%
Lake Murray Blvd in Lexington County	138/182	14.5%
Bluff Rd in Richland County	146/182	14.0%
Harden Street in Richland County	*	13.8%

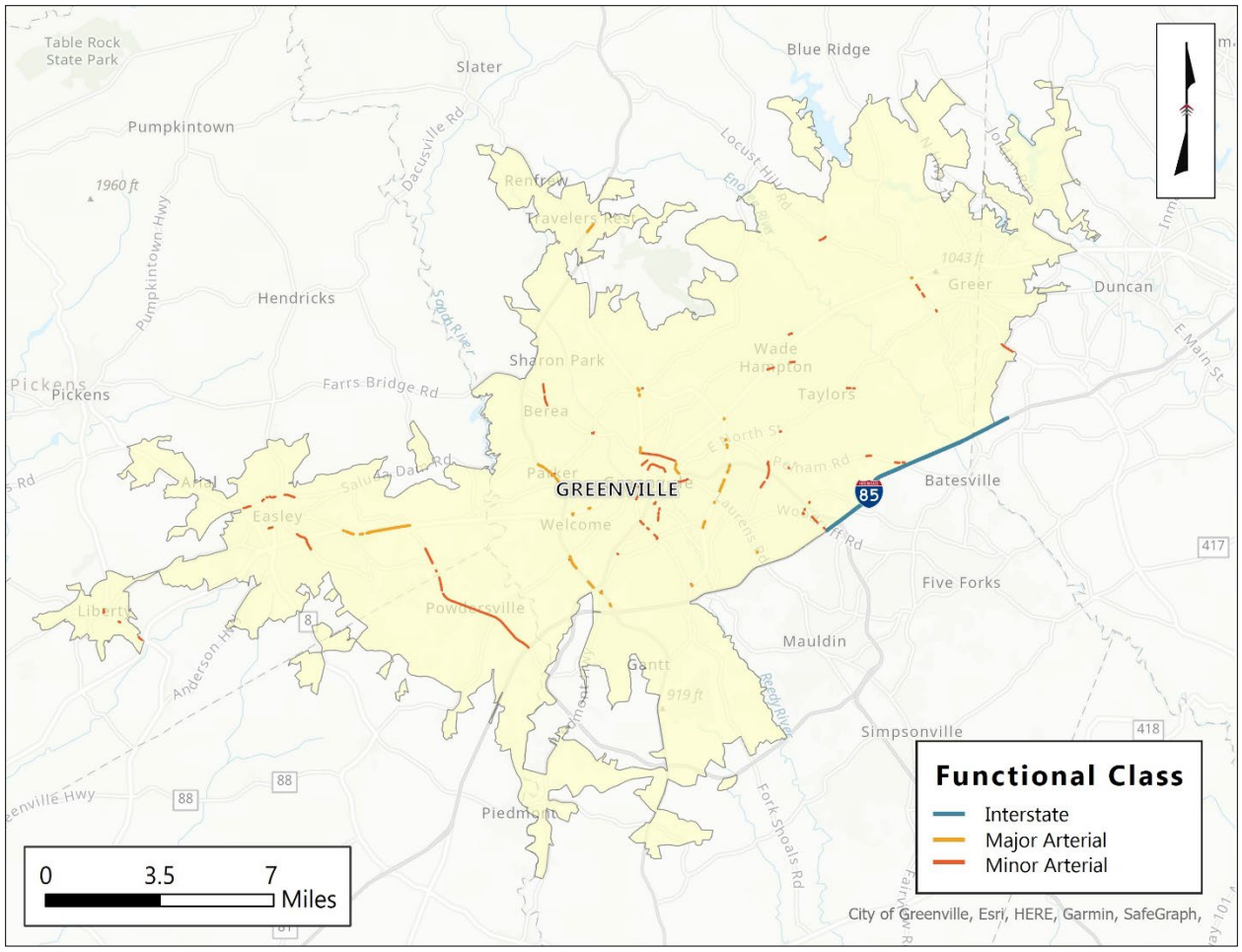
*Corridor included as a top segment for the Columbia area based upon analysis conducted for the South Carolina Statewide Carbon Reduction Strategy

Florence Top Corridors



Interstates		
Corridor	**Rank**	**Score**
I-95 between I-20 and W Lucas Street	17/20	20.8%
Major Arterials		
Corridor	**Rank**	**Score**
US 52 in Florence County	38/95	29.2%
US 76 in Florence County west of US 52	41/95	28.8%
US 76 in Florence County east of US 52	44/95	28.3%
US 52 in Darlington County	60/95	25.9%
Minor Arterials		
Corridor	**Rank**	**Score**
Cherokee Rd in Florence County	1/182	36.1%
Alligator Rd in Florence County	23/182	26.3%
Second Loop Rd in Florence County	29/182	25.1%
W Lucas St in Florence County	30/182	25.0%
N Irby St in Florence County	34/182	24.3%
TV Rd in Florence County	49/182	22.0%
W Darlington St in Florence County	59/182	21.2%
S Cashua Dr in Florence County	64/182	20.9%
US 401 in Darlington County	100/182	17.9%

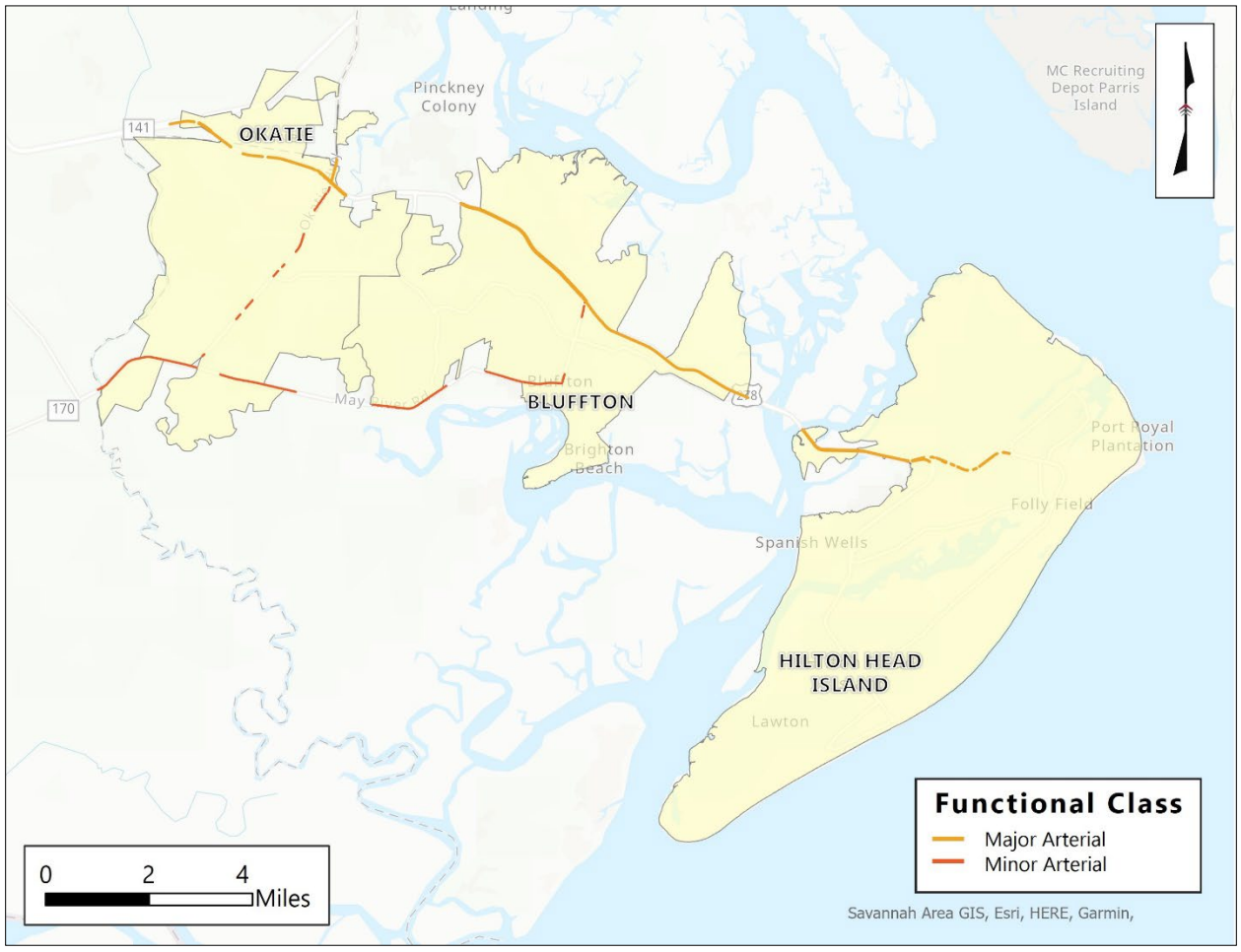
Greenville Top Corridors



Interstates		
Corridor	**Rank**	**Score**
I-85 E of Greenville	3/20	56.8%
I-85 W of I-385	9/20	38.8%
Major Arterials		
Corridor	**Rank**	**Score**
US 123 in Pickens County	21/95	33.6%
US 25 in Greenville County	28/95	32.1%
Poinsett Hwy in Greenville Hwy	32/95	31.1%
Laurens Rd in Greenville County	35/95	30.7%
US 291 in Greenville County	42/95	28.7%
Easley Bridge Rd in Greenville County	57/95	26.3%
US 25 in Travelers Rest Greenville County	59/95	26.2%
Minor Arterials		
Corridor	**Rank**	**Score**
Woodruff Rd in Greenville County	1/182	53.0%
SC 155 in Pickens County	15/182	28.7%
McDaniel Ave in Greenville County	39/182	22.7%
Stone Ave in Greenville County	45/182	22.3%
SC 155 in Anderson County	50/182	21.8%

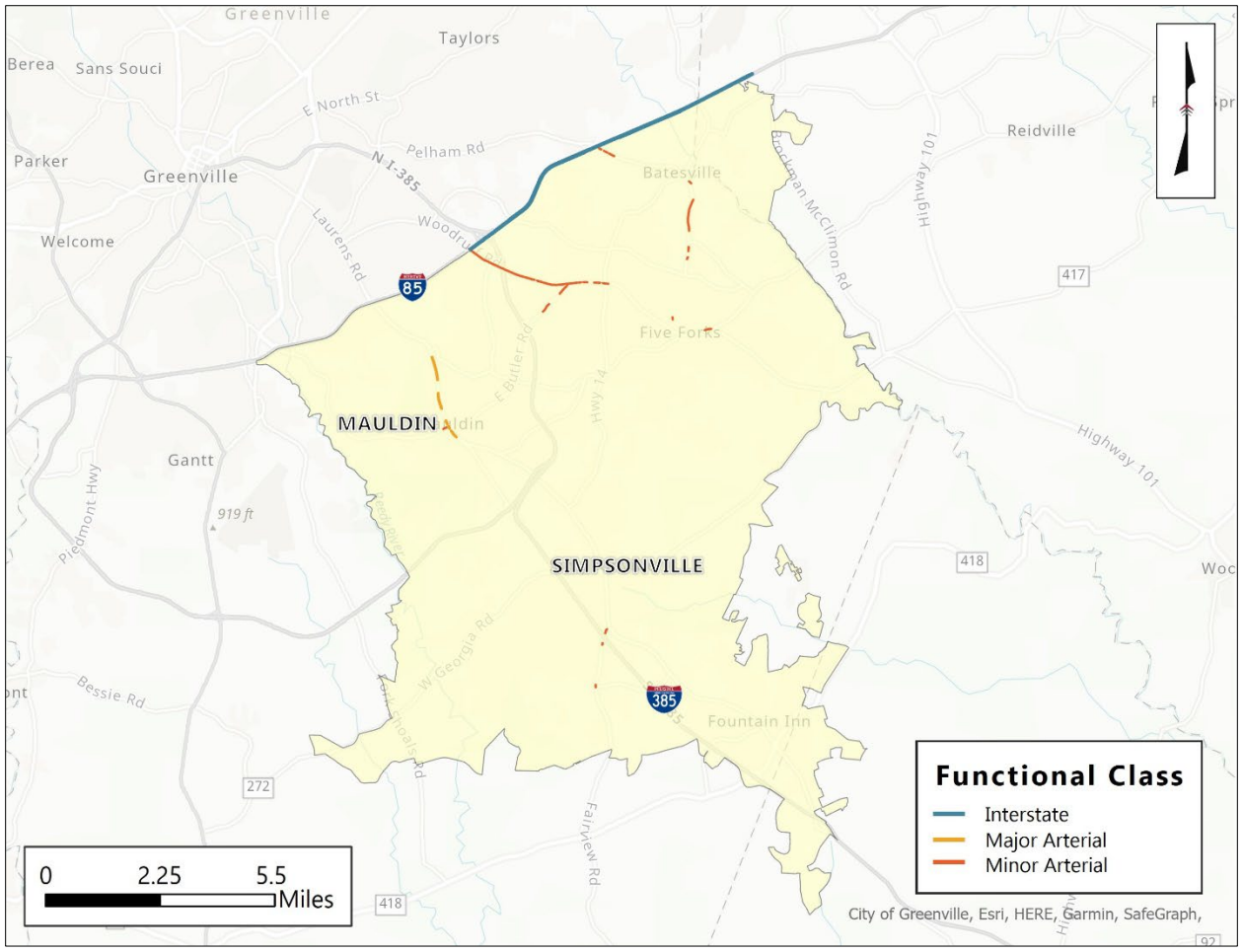
US 123 in Greenville County	61/182	21.2%
Haywood Rd in Greenville County	66/182	20.8%
Hunts Bridge Rd in Greenville County	67/182	20.6%
E Washington St in Greenville County	87/182	18.7%
E Lee St in Greenville County	91/182	18.5%
Brushy Creek Rd in Pickens County	103/182	17.7%
SC 101 in Spartanburg County	110/182	17.4%
Pelham Rd in Greenville County	113/182	16.6%
Atwood St in Greenville County	118/182	16.5%
S Buncombe Rd in Greenville County	123/182	16.0%
Augusta St in Greenville County	125/182	15.8%
US 178 in Pickens County	166/182	13.5%

Hilton Head Top Corridors



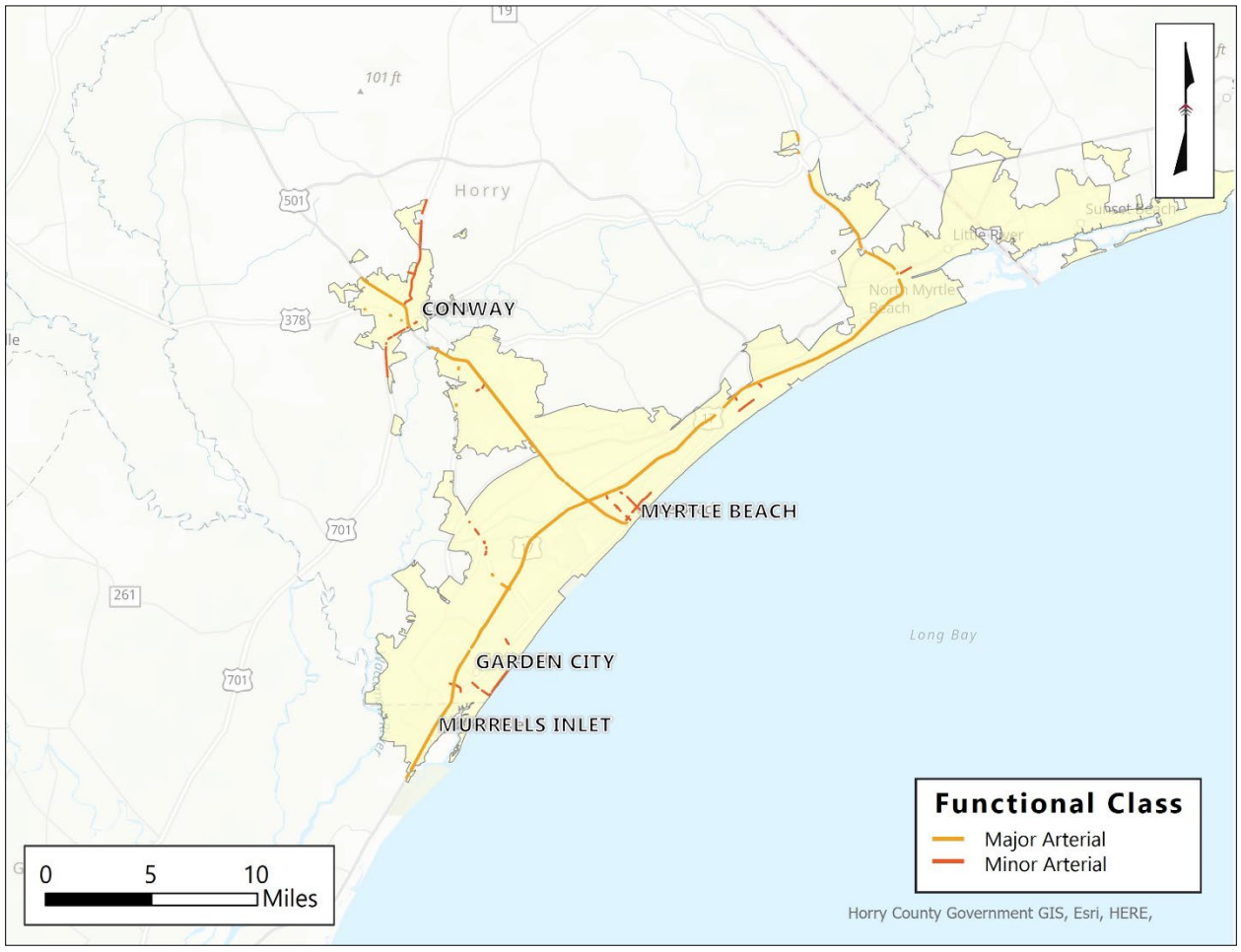
Major Arterials		
Corridor	**Rank**	**Score**
US 278 in Beaufort County	19/95	34.5%
US 278 in Jasper County	50/95	27.7%
Minor Arterials		
Corridor	**Rank**	**Score**
May River Road in Beaufort County	9/182	30.5%
Okatie Hwy in Beaufort County	162/182	13.5%

Mauldin/Simpsonville Top Corridors



Interstates		
Corridor	**Rank**	**Score**
I-85 E of Greenville	3/20	56.8%
I-85 W of I-385	9/20	38.8%
Major Arterials		
Corridor	**Rank**	**Score**
Laurens Rd in Greenville County	35/95	30.7%
Minor Arterials		
Corridor	**Rank**	**Score**
Woodruff Rd in Greenville County	1/182	53.0%
E Butler Rd in Greenville County	71/182	20.3%
Batesville Rd in Greenville County	82/182	19.2%
Fairview Rd in Greenville County	111/182	17.3%

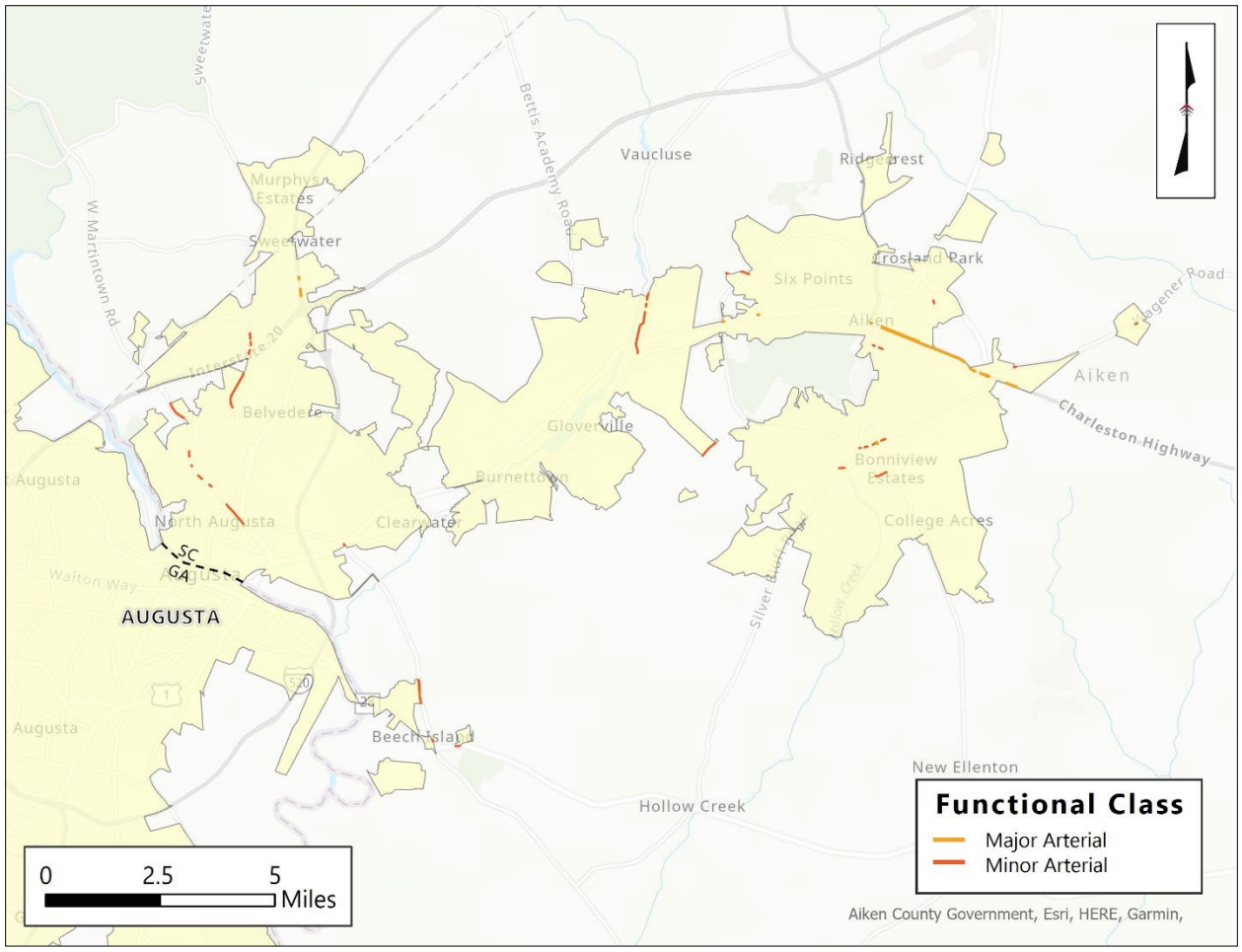
Myrtle Beach/Socastee Top Corridors



Major Arterials		
Corridor	**Rank**	**Score**
US 501 Horry County	1/95	70.3%
US 17 south of US 501 in Horry County	4/95	45.5%
US 17 in Georgetown County	10/95	40.3%
SC 9 Horry County	24/95	33.1%
US 17 north of US 501 in Horry County	31/95	31.5%
US 378 Horry County	45/95	28.2%
SC 544 in Horry County	54/95	27.3%
Minor Arterials		
Corridor	**Rank**	**Score**
Singleton Ridge Rd in Horry County	54/182	21.6%
Kings Rd in Horry County	76/182	19.9%
Mr Joe White Ave in Horry County	85/182	19.0%
SC 90 in Horry County	88/182	18.7%
Dick Pond Rd in Horry County	106/182	17.5%
21st Ave in Horry County	107/182	17.4%
N Oak St in Horry County	108/182	17.4%
US 701 N of US 501 in Horry County	109/182	17.4%
N Waccamaw Dr in Horry County	115/182	16.6%

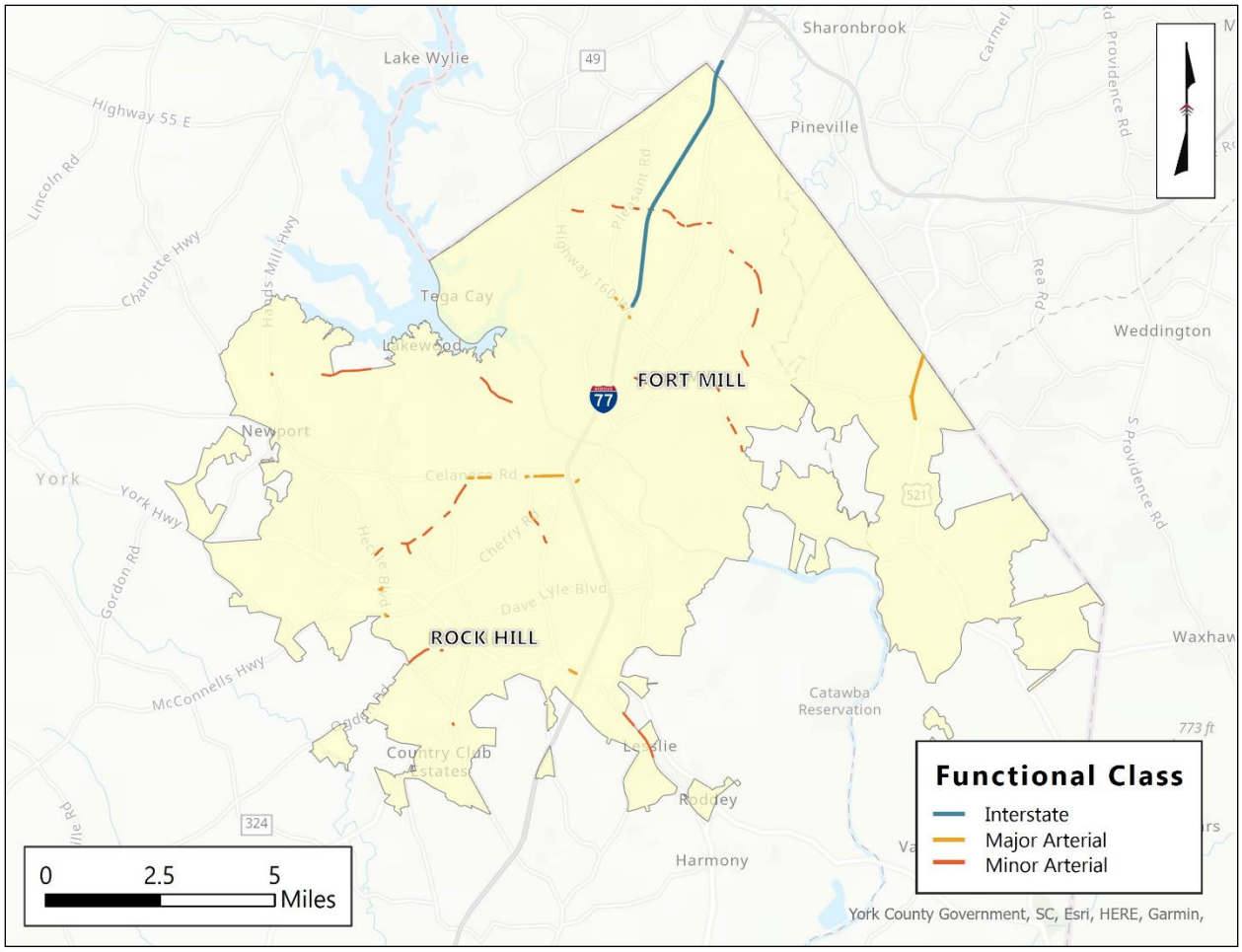
Inlet Square Dr in Horry County	120/182	16.2%
Atlantic Ave in Horry County	126/182	15.7%
US 701 S of US 501 in Horry County	134/182	14.9%

North Augusta Top Corridors



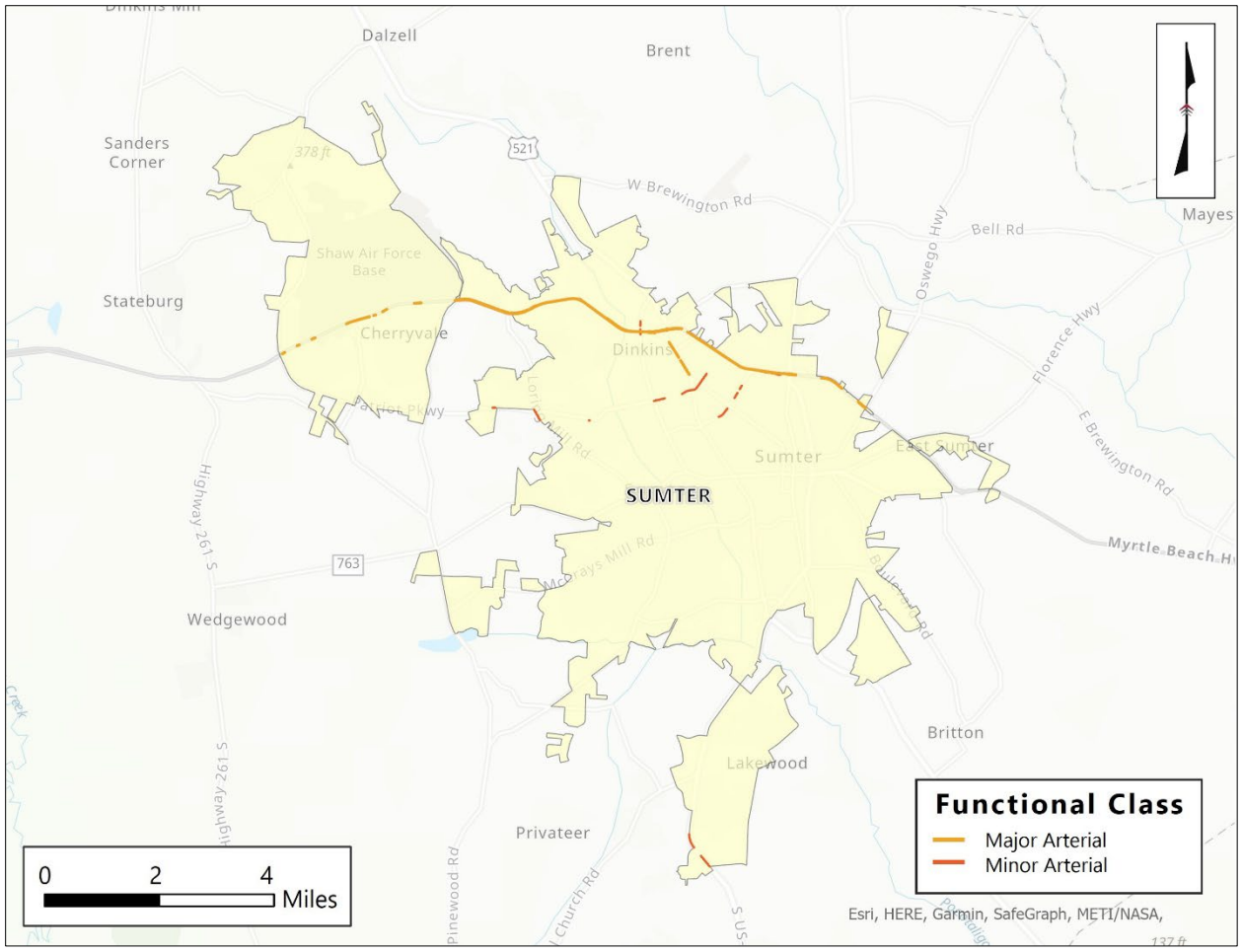
Major Arterials		
Corridor	**Rank**	**Score**
US 78 in Aiken County east of SC 19	39/95	29.0%
Whiskey Rd in Aiken County	58/95	26.2%
US 1 in Aiken County	73/95	24.8%
US 25 in Aiken County	79/95	24.5%
Minor Arterials		
Corridor	**Rank**	**Score**
Pine Log Rd in Aiken County	46/182	22.2%
Canal St in Aiken County	51/182	21.8%
West Five Notch Rd in Aiken County	56/182	21.5%
Dougherty Rd in Aiken County	58/182	21.2%
US 278 in Aiken County	84/182	19.0%
Atomic Rd in Aiken County	92/182	18.4%
South Boundary Ave SE in Aiken County	117/182	16.5%
West Martintown Rd in Aiken County	127/182	15.6%
Beaufort St NE in Aiken County	141/182	14.3%
Wagener Rd in Aiken County	181/182	12.9%

Rock Hill Top Corridors



Interstates		
Corridor	**Rank**	**Score**
I-77 Fort Mill	2/20	61.7%
Major Arterials		
Corridor	**Rank**	**Score**
Celanese Rd in York County	23/95	33.4%
US 521 in Lancaster County	25/95	32.9%
SC 5/Heckle Blvd Int in York County	56/95	26.7%
Heckle Blvd in York County	66/95	25.3%
US 21 in York County	68/95	25.2%
SC 49 in York County	72/95	24.8%
US 160 in Lancaster County	81/95	24.4%
Cherry Rd in York County	83/95	24.3%
Minor Arterials		
Corridor	**Rank**	**Score**
Springfield Pkwy in York County	31/182	24.8%
Mt Gallant in York County	43/182	22.4%
Herlong Ave in York County	60/182	21.2%
Lesslie Highway in York County	63/182	21.0%
Dobys Bridge in York County	79/182	19.5%

Sumter Top Corridors



Major Arterials		
Corridor	**Rank**	**Score**
Broad Street in Sumter County	16/95	36.3%
US 378 in Sumter County W of 521	27/95	32.7%
US 378 in Sumter County E of 521	78/95	24.7%
Minor Arterials		
Corridor	**Rank**	**Score**
Loring Mill Rd in Sumter County	19/182	27.2%
Patriot Pkwy in Sumter County	24/182	26.1%
Miller Rd in Sumter County	42/182	22.4%
Alice Dr in Sumter County	129/182	15.4%
US 15 in Sumter County	169/182	13.3%

APPENDIX C

Action Plan Chronological Layout

The following tables provide the action plan in chronological format for the Programmatic and Deployment recommendations. Although recommendations are listed in order of logical deployment, it is not expected that a strict order be maintained. Every opportunity should be leveraged to achieve the goals and objectives of this plan.

Table A1 – Near-Term Action Plan Recommendations

ID	Title	Timeframe	Level of Resources
PC-1	Establish Statewide TSMO Council	NEAR	$
DCM-1	Traffic Signal Timing Upgrades	NEAR	$
DCM-2	Traffic Signal Upgrades	NEAR	$$
PR-1	Define Program Budget Needs	NEAR	$
PR-3	Develop Staffing Plan	NEAR	$
DTMC-2	Integrated TMC Concept of Operations	NEAR	$
DTMC-1	TMC Facility Upgrades	NEAR	$$$
PP-7	Establish TSMO Data Review Subcommittee	NEAR	$
DITS-1	Develop Statewide ITS Network Communication Strategic Plan	NEAR	$
PC-11	Prepare TSMO Informational Material	NEAR	$$
PP-5	Develop SCDOT TSMO Website	NEAR	$
PP-3	Encourage External Stakeholders to Integrate TSMO	NEAR	$
PC-4	Conduct Annual TSMO Briefing	NEAR	$$

ID	Title	Timeframe	Level of Resources
PC-9	Participate in Interagency Training Exercises	NEAR	$$
DCM-3	Automated Incident Detection Systems	NEAR	$
DCM-4	Dynamic/Variable Message Signs	NEAR	$$
DCM-6	Emergency Operations Plans	NEAR	$
DCM-7	Emergency Vehicle Preemption	NEAR	$$
DCM-10	Queue Warning Systems	NEAR	$
DCM-12	Real-Time Traveler Information	NEAR	$
DCM-13	Social Media	NEAR	$
DCM-15	Traveler Information Portals	NEAR	$
DCM-17	Vehicle Detection	NEAR	$$

Table A2 – Mid-Term Action Plan Recommendations

ID	Title	Timeframe	Level of Resources
DITS-2	Expand Interstate ITS Networks	MID	$$$
DITS-3	Expand Off-Interstate ITS Networks	MID	$$$
PC-3	FHWA Coordination	MID	$
PC-6	Facilitate TSMO Discussion at Transportation Industry Meetings	MID	$
PC-7	Formalize Interagency Agreements	MID	$
PC-10	Participate in After-Action Briefings	MID	$$
PC-8	Develop Incident and Emergency Management MOUs	MID	$
PP-1	Establish TSMO Standards and Guidelines	MID	$$
DTMC-3	Statewide ATMS Software Upgrade	MID	$$
PP-2	Modify Existing SCDOT Planning and Project Development Directives	MID	$$
PP-8	Develop Data Sharing Agreements	MID	$$
PP-9	Investigate Efficient Data Investment Strategies	MID	$$
DTMC-4	Common Data Platform	MID	$$
PP-10	Develop Performance Measures Dashboard	MID	$$$
DCM-11	Ramp Metering	MID	$$
DCM-14	Transit Signal Priority	MID	$$$
DCM-16	Truck Parking Systems	MID	$$$
PP-11	Develop Performance Measure Targets and Tools	MID	$$

Table A3 – Long-Term Action Plan Recommendations

ID	Title	Timeframe	Level of Resources
PR-2	Establish TSMO Program - Funding Resources	LONG	$$$
PR-4	Establish TSMO Program - Staffing Resources	LONG	$$$
PC-2	Establish Regional TSMO Task Forces	LONG	$
PP-6	Develop TSMO Informational Materials	LONG	$$
PP-4	Conduct TSMO Training	LONG	$$
PC-5	Conduct Annual Peer State TSMO Meetings	LONG	$$
PP-12	Manage TIM and TSM Performance	LONG	$$
DTMC-5	Planned and Unplanned Event Management	LONG	$$
PP-13	Leverage Data to Inform Operations and Investments	LONG	$$
DCM-5	Dynamic Speed Limits	LONG	$$
DCM-8	Integrated Corridor Management	LONG	$$$
DCM-9	In-Vehicle Services	LONG	$$