


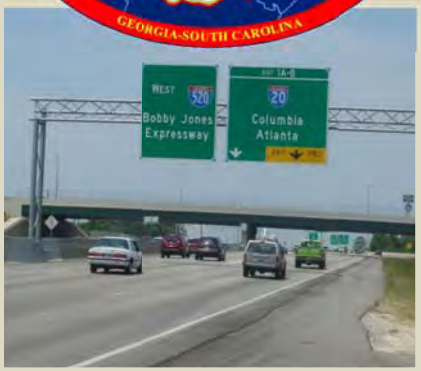


ATMS MASTER PLAN UPDATE
FINAL REPORT

Augusta Regional Transportation Study (ARTS)

December 2013

URS

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EXECUTIVE SUMMARY

The Augusta Regional Transportation Study (ARTS) has a number of transportation challenges and opportunities, including significant changes to the transportation system in recent years. These changes are a result of population growth and land-use changes throughout the ARTS region. There has also been a significant amount of technology change in the past 10 years. Recognizing these changes, the ARTS updated the Advanced Transportation Management System (ATMS) Master Plan in 2013, which was originally developed in 2002.

The ATMS Master Plan Update included the following tasks:

- Engage the ARTS stakeholders through a series of stakeholder meetings
- Inventory the existing ATMS assets
- Perform a needs assessment
- Define project goals and objectives
- Update the ITS architecture
- Develop ATMS project concepts
- Provide planning-level cost estimates
- Develop implementation plan and recommendations

BACKGROUND

The ARTS region has several successful intelligent transportation system (ITS) deployments on which to build, including these examples:

By the numbers … ITS in the ARTS Region

ATMS INFRASTRUCTURE[1]

EXISTING[2]		FUTURE[3]
2	Traffic Control Center (TCC) Facilities	4
107	Adaptive Controlled Traffic Signals	148
481	Total Traffic Signals	510
25	Emergency Vehicle Preemption Intersections	255
8	Dynamic Message Signs (DMS)	24
33	Surveillance Cameras	281
0	Transit "Next Bus" Signs	31
235	Fiber Optic Communications (miles)	356

[1] Includes freeway & arterial ATMS deployments

[2] Includes ATMS assets under construction or previously funded projects

[3] Includes build-out of all ATMS projects

- The temporary traffic management system set up by the City of Augusta each year for the Masters Tournament includes many technology components, which improves the level of service for the 50,000+ tournament guests.

- Several adaptive traffic signal systems have been installed throughout the region to address the dynamic nature of the traffic flow and resulting congestion, including Whiskey Road (SC 19) in Aiken County and Washington Road (SR 28) between Richmond and Columbia counties. Adaptive traffic signal systems are designed to detect and respond to actual traffic conditions, which results in minimizing the delay to motorists and optimizing the roadway capacity.

- Columbia County recently constructed over 200 miles of fiber-optic communications deployment, providing an opportunity to have remote access to ITS field devices throughout the county. These devices include traffic signals, dynamic message signs, emergency vehicle priority equipment, surveillance cameras, intersection flashers, and school flashers. Combined with the County's traffic management center, the operations staff is remotely monitoring and managing its transportation system and ITS assets, and the results have been an improved level of service for the transportation network. This model is a successful approach to maximizing the operational benefits, while minimizing the staff resources necessary to optimize the transportation system performance.

STAKEHOLDER NEEDS

The ARTS stakeholders were instrumental in guiding and shaping the Plan. An eight member Steering Committee worked with the consultant throughout the project, including monthly status meetings. Three stakeholder meetings were held to conduct the needs assessment, address ATMS software and communications opportunities, and review the ATMS project list that addresses the needs of the stakeholders.

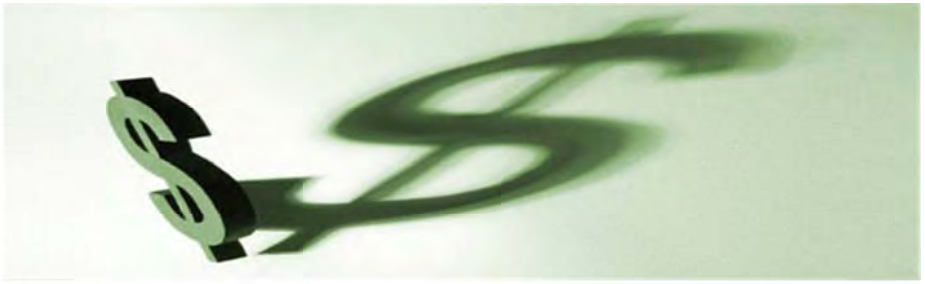
The development of ATMS projects focused on the following outcomes, which are consistent with the goals noted in the ARTS 2035 Long Range Transportation Plan:

- Integrate ITS with transportation planning and implementation
- Improve safety and first responder effectiveness
- Maximize existing traffic flow and transportation system capacity through strategies and technologies that mitigate congestion and improve travel flow and mobility
- Support event-specific transportation needs by providing overall traffic management capabilities and tools

ATMS FUNDING

To maximize the mobility benefits from the ATMS, a greater emphasis must be placed on ATMS operations and maintenance (O&M) within the ARTS region. For ITS to become a successful and mainstream element of the transportation system, the way that transportation O&M is funded must change. The funding source must be stable to maintain the quality of service. While funding for road and bridge improvements is relatively stable and consistent, many of the transportation funding sources used for construction projects preclude their use for O&M purposes. For this reason, O&M funding is often funded by the local agency, rather than by state or federal funding sources. Each agency must examine how to fund the increased focus on O&M to leverage the array of benefits that technology provides to the transportation system.

There are local, state, and federal funding sources available for deploying the ATMS projects, and each source has eligibility requirements to consider. Three ATMS projects within Richmond County are already funded with Transportation Investment Act (TIA) funds, and are scheduled to start deployment in 2015. Many local funding options are based on special purpose local option sales tax (SPLOST) funding, which tend to require several years to establish the special purpose tax and to start collecting the tax revenue, prior to deployment. Projects that are locally funded tend to be able to be deployed more quickly than federally funded projects, as a result of additional requirements that are attached to federally funded projects.



In general, adding ITS infrastructure within the limits of upcoming road and bridge projects is most likely a faster way to deploy portions of the ATMS projects, rather than pursue funding dedicated to an ATMS-exclusive project. Other road and bridge projects within Richmond and Columbia counties that are TIA funded should be examined to check for consistency with the ATMS Master Plan Update recommendations, and possibly include supporting elements (such as conduit for fiber communications) or ITS field devices.

IMPLEMENTATION PLAN

The table below lists the recommended projects in the ATMS implementation plan. Projects are grouped by their priority status. The horizon for the implementation plan is approximately 10 years.

ITS Project List and Priority

Project ID	ITS Project Name	Capital Cost Engineering & Construction[1]	Annual Cost Operations & Maintenance[2]
	Transportation Investment Act (TIA) Funded		
RC-1	Richmond County ITS Master Plan Implementation	$ 4.5 M	$ 350K
RC-2	Richmond County Emergency Preemption and Transit Vehicle Priority System	$ 1.5 M	$ 125K
	Short-Term (Year 0 to 3)		
RC-3	Augusta Fixed Route CAD/AVL System	$ 232K	$ 21K
RC-4	Augusta Arrival and Departure Passenger Info System	$ 440K	$ 40K
CC-1	Columbia County Emergency Preemption System Expansion	$ 150K	$ 15K
CC-2	Columbia County Video Surveillance System Deployment	$ 250K	$ 25K
CC-3	Columbia County DMS Deployment	$ 970K	$ 90K
AC-1	City of Aiken ATMS Expansion Phase 1	$ 2.1 M	$ 190K
AC-3	City of North Augusta ATMS Expansion Phase 1	$ 880K	$ 80K
SD-1	SCDOT Freeway Management System Expansion	$ 4.5 M	$ 350K
GD-1	GDOT Freeway DMS System Deployment	$ 1.1 M	$ 100K
ARTS-2	ARTS Travel-Time and Real-time Speed Data	$ 100 – 150K (study, RFP) $ 45K (pilot)	N/A
	Mid-Term (Year 4 to 6)		
CC-4	Columbia County Flashing Yellow Arrow Conversion	$ 435K	$ 82K
CC-5	Columbia County Portable Traffic Management Station	$ 193K	$ 5.5K
AC-5	Aiken County Emergency Preemption System Expansion	$ 780K $ 75K (eng) / $ 25K (eval, pilot)	$ 78K
AC-6	Aiken County Adaptive Traffic Signal Control Expansion	$ 725K	$ 66K
AC-7	Aiken County Travel Time System & Safety-Based Concepts	$ 84K	$ 13.5K
ARTS-1	ARTS Communications Study	$ 75 – 150K	N/A
ARTS-3	ARTS Advanced Warning to Avoid Railroad Delays	$ 80 – 150K (study, PE) $ 250K (pilot)	N/A

Project ID	ITS Project Name	Capital Cost Engineering & Construction[1]	Annual Cost Operations & Maintenance[2]
RC-5	Richmond County Flashing Yellow Arrow Conversion	$ 895K	$ 89K
RC-6	Richmond County School Flasher Network Upgrade	$ 730K	$ 67K
	Long-Term (Year 7+)		
RC-7	Richmond County ATMS Expansion	$ 3.3 M	$ 300K
AC-2	City of Aiken ATMS Expansion Phase 2	$ 1.26 M	$ 110K
AC-4	City of North Augusta ATMS Expansion Phase 2	$ 1.1 M	$ 100K
AC-8	Best Friend Auto Voice Annunciation System	$ 95K	$ 8.6K
CC-6	Columbia County Safety-Based Initiatives	$ 200K (study, PE) $ 265K (pilot – Concept 1 – 4)	N/A
CC-7	Columbia County Video Sharing System	$ 145K	$ 19.5K
SD-2	SCDOT Interstation Reference Markers	$ 150K	$ 4K
GD-2	GDOT Interstate Reference Markers	$ 150K	$ 4K
SD-3	SCDOT Freeway Motorist Assistance Expansion	$ 306K	$ 350K
GD-3	GDOT Freeway Fiber Optic Communications	$ 2.7 M	$ 230K

[1] Planning level estimates include survey, design, construction, and construction phase services associated with ITS deployments
[2] Planning level estimates include staffing, maintenance equipment, preventive maintenance, and break-fix maintenance

ARTS Projects

Three projects were identified as topics that require additional study prior to implementation. They are:

1. A **Communications Study** (ARTS-1) would focus on exploring inter-jurisdictional connections for the ATMS and address holes in wireless coverage. Primary stakeholders would be transportation staff, first responders, and law enforcement. This study would be particularly effective as all stakeholders continue to experience benefits from shared ITS and/or communications assets, which will likely create greater interest in sharing and combining ITS and/or communications assets across jurisdictional boundaries.

2. A **Travel Time and Real-Time Speed Data Study** (ARTS-2) would support region-wide mobility data collection, including real-time and archived data reporting. This data can be used for many applications and shared externally to improve traveler information, including the 511 systems. This study would be particularly effective in light of the FHWA's near-term focus on collecting transportation system performance

measures, and should also leverage the expanded communications system to be constructed within Richmond County within the next few years. A pilot study is recommended as an initial step.

3. An **Advanced Warning to Avoid Railroad Delays Study** (ARTS-3) would provide information to first responders and transit operators about the presence of trains within the region, and particularly near downtown Augusta. The roads to the medical centers in downtown Augusta are periodically blocked by train activity, resulting in longer delivery times for patients destined to the emergency room. A web-based warning system could be monitored by 911 Dispatch, transit dispatch, and other users to optimize routing of vehicles around railroad crossings blocked or impacted by trains. A pilot study is recommended as an initial step.

Richmond County Area Projects

Richmond County has two funded ATMS projects in the Transportation Improvement Act (TIA) list: a $4.0M Master Plan implementation (RC-1), and a $1.25M emergency vehicle preemption and transit signal priority system (RC-2). Construction for these projects begins in 2015, and includes approximately 26 miles of fiber-optic communications infrastructure, which doubles the amount of existing or previously funded fiber communications infrastructure. The result of these projects will be extensive remote surveillance capabilities for traffic management and the 911 Center, video sharing capability with other agencies and the public, an expanded transportation management (TMC) facility, improved emergency vehicle response times, improved transit route travel time reliability, additional adaptive traffic signal capability, and an expanded traffic signal system. The communications system will provide connectivity to the field devices, which provides significant benefits to the personnel that operate and maintain the system: traffic and field equipment surveillance, automated alarms when device failures occur, diagnostics for equipment health checks, and remote troubleshooting capabilities.

Other high priority projects for Richmond County include an automatic vehicle location (AVL) system for the Augusta Transit bus fleet (RC-3), and dynamic message signs for posting “next bus” times at over 30 bus stops and shelters that are located by agencies or institutions that generate significant transit ridership (RC-4). These improvements are beneficial to transit riders and enhance the utility

of the transit system, which carries approximately 750,000 riders each year.

Other ATMS projects include converting left-turn phases at traffic signals to flashing yellow arrow operation (RC-5), upgrading the school flasher system (RC-6), and a future phase of ATMS expansion (RC-7).

Columbia County Area Projects

Columbia County's high priority projects focus on completing their build-out of ITS devices on major arterials: emergency vehicle preemption (CC-1), surveillance cameras (CC-2), and dynamic message signs(CC-3). Since the fiber communications infrastructure has been constructed, the relatively low cost of adding the field devices represents a high value. Columbia County has already invested in a TMC facility and seeks to staff the TMC with dedicated operators to leverage the monitoring and management capabilities provided by the field devices, resulting in traffic control operational changes in response to incidents and construction, and timely and accurate traveler information dissemination.

Columbia County plans to implement 18 dynamic message signs on major arterials, and surveillance cameras at all traffic signals within the county. To support these signs (and the other ATMS devices), staffing the TMC with operators dedicated to monitoring and managing the ATMS system is a particularly important component for the future. Currently, Columbia County staffs the TMC with staff that has other assigned duties, and so the TMC is not staffed in a consistent or continuous manner during peak traffic periods. When the signs become active, the operational concept is to support the signs with timely and accurate traveler information on a consistent basis, necessitating that TMC operators are dedicated to monitoring and managing the ATMS.

Other ATMS projects include converting left-turn phases at traffic signals to flashing yellow arrow operation (CC-4), portable traffic management system (CC-5), safety-based applications (CC-6), and video-sharing system (CC-7).

Aiken County Area Projects

The state route arterial corridors in Aiken County are managed by the City of North Augusta and the City of Aiken, through an agreement with SCDOT. The high priority projects include an ATMS expansion surrounding each city (AC-1 and AC-3), and are primarily comprised of expanding the communications infrastructure and camera surveillance. The ATMS expansion projects will also tie the communications system to the facilities that are used to manage the traffic signal systems, which will provide additional operational and maintenance benefits as a result of remote monitoring and management capabilities.

Through the expansion of the communications infrastructure, the ATMS expansion projects will support the deployment of the medium priority projects: emergency vehicle preemption (AC-5), adaptive traffic signal control (AC-6), and travel time system & safety-based concepts (AC-7).

Low priority projects include additional ATMS expansion for both cities on arterial routes (AC-2 and AC-4), and a voice annunciation system for the Best Friend Express (AC-8).

Freeway Projects

The I-20 corridor is a key commercial truck, hurricane evacuation, and nuclear evacuation route, and connects Columbia, SC and Atlanta, GA. Monitoring and management of the freeway is particularly critical during large-scale evacuations. The I-520 loop serves as a bypass route and is particularly beneficial during times when traffic flow on I-20 is compromised by planned or unplanned traffic incidents.

The high priority projects include adding dynamic message signs for travelers approaching the Augusta metro area along I-20 in South Carolina and Georgia (SD-1 and GD-1). These improvements are intended to provide traveler information to advise motorists about traffic conditions and incidents, as well as provide routing information for special events, including the Masters Tournament.

For GDOT, low priority projects include mile markers to improve location identification on the freeway for incident management (GD-2), and a fiber communications system along the freeways to upgrade the planned cell-based communications system for surveillance cameras, which would improve reliability of the ATMS communications during a major incident (GD-3). For SCDOT, low priority projects include mile markers to improve location identification on the freeway for incident management (SD-2), and a motorist assist program (SD-3).

OPERATIONS AND MAINTENANCE

To maximize the mobility benefits from the ATMS, a greater emphasis must be placed on ATMS operations and maintenance (O&M) within the ARTS region. The growth of the ATMS within the ARTS region will require additional staffing, however the additional capabilities provided by the ATMS will also simplify and reduce task workloads, as compared to continuing to operate and maintain the transportation system with its existing system capability.

From an operations perspective, the benefits of a connected and intelligent transportation system will improve the capabilities of the operations staff. The tasks that respond to operational challenges will take fewer resources, since the area influenced by the problem can be remotely viewed and monitored while possible remedial measures are taken. A TMC facility is an effective workspace for operations staff, providing user-friendly tools for performing monitoring, ITS device health checks, diagnostics, and troubleshooting. Operations staff is often in the field or away from the office, and so the software tools necessary to monitor and manage the transportation system must be accessed via mobile apps and the web. The continued growth of automated functions and features within ATMS software will continue to evolve, however there will always be a need for operations staff to review the system performance and to make adjustments as necessary.

From a maintenance perspective, the Plan includes a 75% increase in the number of ITS field devices and a 25% increase in the miles of fiber communications infrastructure. The increase in the number of field devices, miles of communications infrastructure, IT networking

complexity, network security management, preventive maintenance, and break-fix maintenance will require additional staff and staff resources. However, the benefits of a connected and intelligent transportation system will also simplify and reduce staff workload, as compared to maintaining devices for which there is no remote connectivity.

SECTION 1.0 | INTRODUCTION

1.1 BACKGROUND AND STUDY AREA

The Augusta Regional Transportation Study (ARTS) is the federally-mandated regional Metropolitan Planning Organization (MPO) responsible for the coordinated transportation planning process in the region. The organization requires involvement by policy makers, technical staff, and citizens in order to address the various aspects of the transportation planning process.

The ARTS area includes the urbanized portions of Aiken County, South Carolina, and Columbia and Richmond Counties in Georgia. The area includes the Georgia cities of Augusta, Grovetown, Hephzibah, and Blythe; and South Carolina cities of Aiken, North Augusta, and Burnettown. The study area also includes the Fort Gordon Military Reservation located in Georgia's Columbia and Richmond Counties.

Historical population for the area's counties is shown in Table 1, which show particularly moderate to rapid growth in Columbia and Aiken Counties. Table 2 provides average daily traffic (ADT) volumes on selected roadways within the ARTS region. In addition, Figure 1 shows the overall boundaries of the ARTS MPO Study Area.

Table 1. Historical County Population (1990-2010), ARTS Region

County	1990	2000	2010
Aiken County, South Carolina	120,940	142,552	160,099
Columbia County, Georgia	66,031	89,288	124,053
Richmond County, Georgia	189,719	199,775	200,549

Source: 2010 US Census

Table 2. Selected Roadway Average Daily Traffic, ARTS Region

Road	1990	2000	2010
Richmond County			
I-20, west of SR 28 (Washington Rd)	44,700	48,800	59,300
SR 104 (Riverwatch Pkwy), S of I-20	16,600	22,500	20,500
Columbia County			
SR 232 (Columbia Rd), west of SR 28 (Washington Rd)	16,000	17,300	19,100
SR 388 (Lewiston Rd), south of SR 232 (Columbia Rd)	3,500	8,500	11,300

Source: GDOT STARS website

Richmond County has a total area of 328 square miles and is located along the Savannah River, which serves as the boundary between Augusta and Aiken County, South Carolina. The 2010 population was approximately 200,000, representing a growth of 1% from the 2000 census.

Columbia County has a total area of 308 sq. miles and is located along the Savannah River. The 2010 population was approximately 124,000, representing a rapid growth of 39% from the 2000 census.

Aiken County has a total area of 1080 sq. miles and is located east of Augusta-Richmond County, with the Savannah River running between the two counties. The 2010 population was approximately 161,000, representing a moderate growth of 12% from the 2000 census.

Based upon Augusta-Richmond County Planning Commission data, the 2035 (future year) population estimate in the ARTS area is approximately 551,000 people, which is a 14% increase from year 2010.

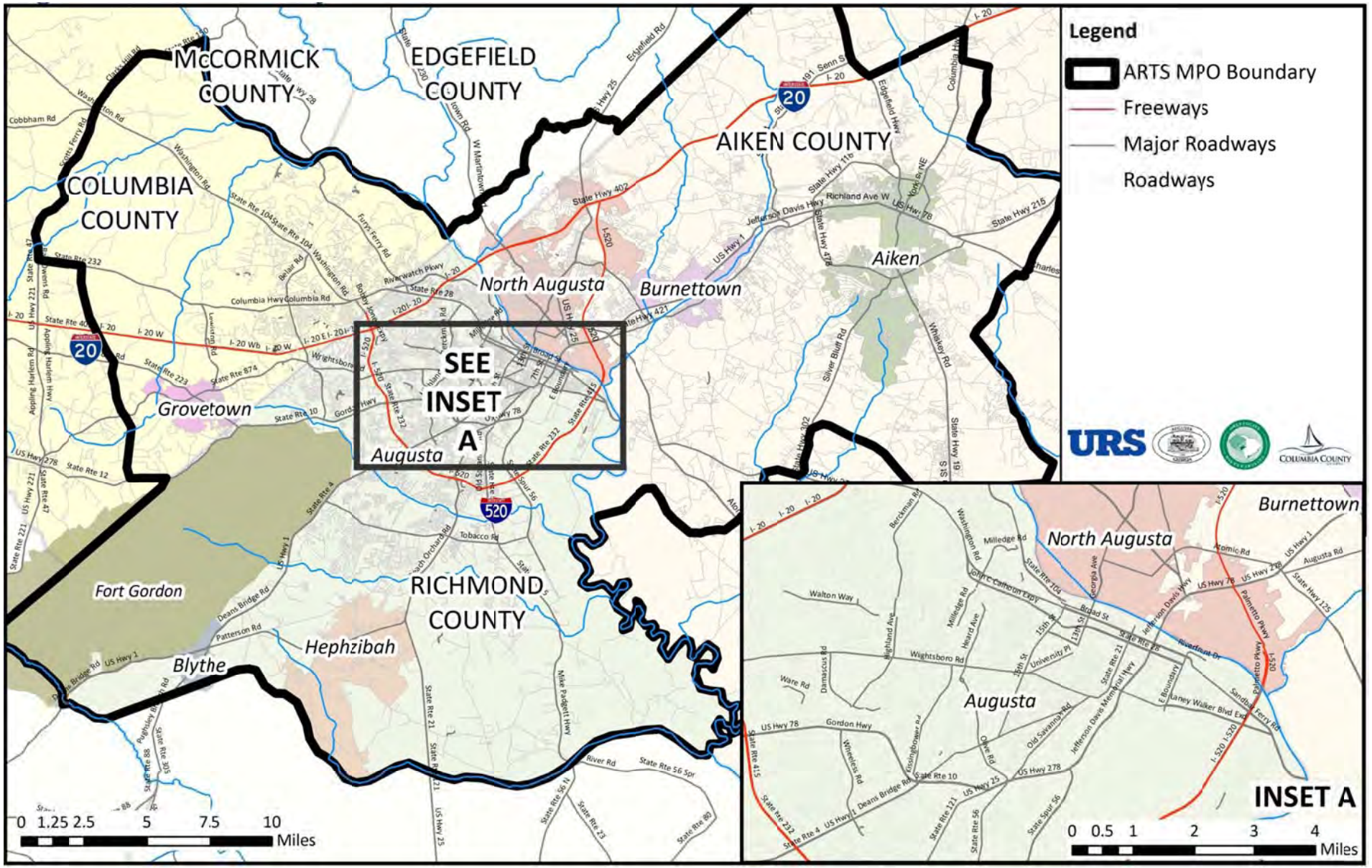


Figure 1. ARTS Study Area

Roadway Overview: Federal Highway Statistics indicates that the ARTS study area has 2,318 highway miles, including 1,550 miles in Georgia and 768 miles in South Carolina. The major roadways / routes include, but not limited to; I-20, I-520, US 1, US 25 BUS, US 78, US 278, SR 4, SR 28, SR 56, SR 104, SR 223, SC 121, SC 125, SC 126, SC 230, and SC 302. I-20 provides the most direct access to the region from Atlanta, Georgia, located northwest of the Augusta-Richmond metropolitan area, and from Columbia, South Carolina located northeast of the region. I-520 provides radial access to the City of Augusta from I-20 on the southwest side to US 1 northeast of Augusta. US 25 provides access to Savannah and US 78 to Charleston. US 1 connects Augusta to Macon and southeast Georgia, and connects Aiken to Columbia, South Carolina.

National Highway System (NHS) designated roads within the ARTS Study Area include; I-20, I-520, US 1, US 25, US 78, SR 56, SC 19 and SC 118. US 1/Deans Bridge Road and US 25/Peach Orchard Road in Georgia are classified as Non-interstate Strategic Highway Network (STRAHNET) routes and US 78/Gordon Highway is classified a Major STRAHNET Connector, since these routes provide access to the Fort Gordon Military Reservation. The NHS intermodal connectors are crucial roadways that provide freight linkages between intermodal transfer points or terminals and the public carriers or transportation routes which includes the following major facilities: public transit stations, airports, truck/rail terminals, inter-city bus stations, Amtrak stations, and multimodal passenger sites.

There are six (6) major corridors that cross jurisdictional lines between Richmond and Columbia Counties, including Bobby Jones Expressway, SR 223, Wrightsboro Road, Fury's Ferry Road, Washington Road, and Davis Road/Walton Way Extension/Jackson Road.

Major Roadway Bridges: The Savannah River runs northwest to southeast at the border of Georgia and South Carolina. There are six (6) major roadway bridges across the Savannah River: I-20, 5th Street (Jefferson Davis Memorial Bridge), US 1/US 278 (Gordon Highway in Georgia and Jefferson Davis Highway in South Carolina), US 25 BUS (13th Street in Georgia and Georgia Avenue in South Carolina), I-520 (Bobby Jones Expressway in Georgia and Palmetto Parkway in South Carolina), and GA/SC 28 Sand Bar Ferry Road.

Airports: *Augusta Regional Airport* at Bush Field, is a city-owned, public-use airport located six miles south of the central business district of Augusta. *Daniel Field* is located along Wrightsboro Road and Highland Avenue in the City of Augusta, and is a general aviation facility. Highway access to the airport from the east and west is via I-20 and I-520. *Aiken Municipal Airport* is located along US 1 near Exit 22 on I-20 and it serves corporate and general aviation needs in the area.

Truck Freight: The interstate highway system is responsible for moving the largest amount of the truck traffic. I-20 provides primary truck access to the Augusta region, while I-520 provides radial access to the City of Augusta from I-20 on the southwest side to US 1 northeast of Augusta.

Rail Freight: Freight rail transportation plays an important role in the overall transportation system in the ARTS area. Two Class I railroad companies provide freight service in the ARTS area. The Norfolk Southern Railroad has a mainline and spur tracks serving industrial

areas in Augusta, North Augusta and Aiken, which allows for efficient intermodal operations. The CSX Railroad has a mainline and spur tracks serving manufacturing facilities in Augusta and Columbia County, which allows for efficient intermodal operations. CSX Corporation has a mainline and spur tracks in the South Carolina portion of the ARTS area.

Public Transportation:

Augusta Public Transit (APT) currently operates nine (9) fixed routes within the service area. The system is primarily radial with seven routes terminating at the Transfer Facility at 1546 Broad Street, which also connects with Aiken's Best Friend Express. The remaining two routes, Barton Chapel and Lumpkin Road, terminate at a transfer point at K-Mart shopping center located southwest of downtown. APT also operates paratransit services for persons with disabilities, in compliance with the Americans with Disabilities Act of 1990.

In accordance with guidelines issued by the Federal Transit Administration (FTA), APT provides paratransit service within 3/4 mile of each fixed route during the same operating hours as the local service. Paratransit service is available only to certified eligible passengers. Currently, APT has 23 transit buses and seven (7) paratransit vehicles available for maximum service.

APT will begin constructing a new Operation and Maintenance Facility near the intersection of Mike Padgett Hwy (SR 56) and Lumpkin Road

Columbia County Transit is available to all residents of the county, offering curb to curb, demand-response service to all Columbia County destinations and also Richmond County, with the exception of the areas south of Gordon Highway.

Best Friend Express (BFE) offers three (3) fixed routes (blue, red, green) to serve the general public desiring transportation around the City of Aiken, the City of North Augusta, and the areas along the route between the two cities (along the Aiken-Augusta Highway), including Aiken Technical College as a transfer location. The BFE also crosses the state line to drop off and pick up passengers at the Augusta Public Transit transfer center so riders have an opportunity to use public transit in a wider service area. ADA Paratransit services complement BFE regular fixed routes for anyone traveling within ¾-mile of the BFE route. This service is called Dial-A-Ride (DAR).

Intercity bus service in the ARTS area is provided by Greyhound Lines, Inc. Intercity bus service is provided from Augusta to Atlanta five times a day and from Augusta to Columbia five times a day. Intercity bus service is provided from Aiken to Atlanta four times a day and from Aiken to Columbia five times a day. The Augusta intercity bus station (Greyhound Lines, Inc.) is located at 1128 Greene Street, and the Aiken intercity bus station is located at 153 Pendleton Street NW.

1.2 INTELLIGENT TRANSPORTATION SYSTEMS

An **Advanced Traffic Management System** (ATMS) field is a primary subfield within an Intelligent Transportation System (ITS). ATMS is a top-down management perspective that integrates technology, planning, operations/training and coordination to improve the flow of vehicle traffic, safety and mobility.

Technology: Technology is the backbone of transportation operations. It utilizes advanced technologies: computers, communications, electronics, and control systems to improve the efficiency and safety of the surface transportation system. Real-time surveillance systems monitor transportation facilities identifying unusual conditions that need immediate action, whether it is a bus running behind schedule or a crash on the interstate. Technology enables Transportation Management Centers (TMC) to impart accurate up-to-date travel information to the public, or to adjust traffic signal timings to handle a surge of traffic from a closed interstate or arterial. It enables first responders to overcome interoperability communication issues among themselves and with transportation personnel. It also increases transportation system efficiency, improves safety, reduces fuel consumption and environmental cost, and increases economic productivity.

Planning: When an incident temporarily closes an interstate or major arterial or disrupts traffic flow, it is already too late to plan a response. Detour routes, traffic control points, signing, and potential response resources should be identified in advance. Agency and personnel roles and responsibilities also have to be pre-defined.

Preparedness: This involves conducting training courses and/or table top exercises so that personnel can be fully prepared to respond to a major emergency or incident event. It also involves pre-deploying traffic management equipment so that portable Traffic Management System (PTMS) or accident investigation equipment for emergency responders will arrive in a timely manner, and not have to be transported across the ARTS Study Area. Emergency service patrols offer immediate on-scene resources to mitigate minor incidents and provide traffic support in larger ones.

Coordination: Operationally, the region as a whole is fragmented, with multiple transportation departments of transportation, highway service patrols, along with multiple local law enforcement and fire departments, emergency management agencies, and transit agencies. Institutional coordination, whether at the scene of an incident, between the various TMCs, or across jurisdictions or travel modes, is a major undertaking. Incident command structures must be established and maintained, and situational information disseminated. On-going coordination is required to make sure everything runs smoothly, and to correct problems that periodically occur.

The U.S. DOT Research and Innovative Technology Administration (RITA) maintains an on-line database (www.itsbenefits.its.dot.gov) of reported benefits of ITS programs around the nation. For example, deploying emergency service patrols on interstates has been demonstrated to reduce average duration of incidents by 33-60

percent, resulting in fewer secondary accidents and saving fuel. Improving traffic signal timings by synchronization allowing for optimal traffic progression has also been demonstrated to reduce travel times and total delays (congestion) by greater than 5 percent, translating into a 10 percent or more reduction in fuel consumption, as well as improving intersection safety. Using Automatic Vehicle Location (AVL) systems on buses have been shown to improve on-time bus performance by 12-23 percent, reducing passenger waits at bus stops.

ITS programs have unique funding and implementation requirements and challenges. While ITS projects are like other major transportation capital investments, in that they can be funded through the region's Transportation Improvement Program (TIP), they are unlike highway projects in that there are substantial maintenance and operations costs associated with them. Hardware, software, and communication devices have to be continually maintained and updated to remain consistent with the latest technology standards. Ultimately, operations and maintenance (O&M) costs can exceed the initial capital investment.

Many ITS initiatives are programmatic, for example, funding service contracts, vehicles and equipment, and training programs. In many instances, non-traditional transportation stakeholders like sheriff or fire departments will be the primary beneficiary of these programs. How to fund these types of programs (i.e., whether to use federal transportation monies, state/local funds, or even Department of Homeland Security funding) has been typically unclear at best. As transportation agencies evolve from a design-build culture to an operations culture, decisions on how to fund, operate, and maintain these types of programs need to be resolved.

1.3 EXISTING PLANNING DOCUMENTS

A number of key documents previously prepared for the ARTS study area will impact the planning, deployment, and operation of the region's ATMS/ITS. These documents were reviewed for information regarding existing conditions, stakeholder information, ITS technologies, strategies, goals, objectives, needs and regional transportation and mobility issues and concerns.

The documentation sources reviewed and/or referenced in the development of this ATMS Master Plan update includes:

1. Augusta Regional ATMS Master Plan, 2002
2. ARTS 2035 Long Range Transportation Plan (LRTP), 2010
3. ARTS Congestion Management Process (CMP), 2011
4. Augusta Regional Freight Study, 2009
5. Transportation Improvement Program (TIP) – FY 2012-2015
6. Unified Planning Work Program, 2013
7. Intersection Analysis, 2005
8. Augusta-Richmond County Comprehensive Plan, 2005
9. Columbia County Growth Management Plan, 2005
10. Columbia County 2025 LRTP
11. Aiken County Comprehensive Plan, 2004-2014
12. US 1/US 78 Corridor Study (Aiken County)
13. North Augusta Comprehensive Plan, 2005
14. Masters Tournament Traffic Operations Plan (City of Augusta)
15. Augusta Public Transit Development Plan (City of Augusta)

16. ITS Strategic Deployment Plan, GDOT
17. South Carolina Strategic Corridor System Plan, SCDOT

1.4 PROJECT SCOPE

The Augusta Regional Advanced Traffic Management Systems (ATMS) Master Plan (Plan) was first published and adopted in February 2002. The update to this Plan is intended to reflect changes in the ATMS/ITS program, technology, inventory of systems and infrastructure, ITS architecture, and current transportation, mobility and safety challenges and issues along existing and planned Traffic/ITS deployments within the ARTS study area.

The ARTS MPO moved forward to update the Plan so that the ATMS Master Plan better reflects and addresses current transportation issues and concerns in ARTS Study Area, meets current stakeholder needs, and conforms to the latest federal and regional requirements. The Plan accommodates and facilitates technology-related transportation improvements to increase efficiency of the existing surface transportation network by minimizing traffic congestion delays. By implementing the Plan, the utility of the existing transportation network will be optimized by minimizing and/or delaying the need for costly roadway widening projects and construction of new roadways. An improved transportation system also results in safety improvements and other quality of life benefits to the traveling public.

In its development, the ATMS Master Plan should be consistent with other previous planning documents and initiatives, including the ARTS 2035 LRTP and Congestion Management Process. Significant effort has been made to ensure consistency and compliance, and coordinate with the ARTS MPO and the key stakeholders.

The development of the updated ATMS Master Plan document has been subdivided into five sections and appendices. These sections are:

1. **Introduction** – this section includes overall background information, project description and scope, general description of ITS, and existing documentation reviewed.
2. **Existing System and Traffic Conditions** – this section includes a summary of existing traffic/ITS infrastructure and systems and roadway / traffic conditions within the Study Area.
3. **Needs Assessment** – this section includes a discussion of the stakeholder survey process, goals & objectives, and stakeholder needs and issues.
4. **Implementation Plan** – this section includes identification of potential ATMS/ITS projects, project prioritization and sequencing, operations and maintenance and deployment process including funding considerations.
5. **Appendices** – providing supporting information and data including ATMS Master Plan Exhibits, updated ITS Architecture information, and project cost estimate spreadsheets.

SECTION 2.0 | EXISTING SYSTEMS & TRAFFIC CONDITIONS SUMMARY

The first step in developing this Master Plan for the ARTS Study Area was to conduct an inventory of existing conditions on the freeways and major arterials. This inventory included available data on existing traffic control devices, locations of recurring congestion, and current plans for ITS projects. The existing communications infrastructure for traffic control was also inventoried.

2.1 EXISTING TRAFFIC SIGNAL / ITS DEVICES AND COMMUNICATIONS

Information was collected regarding existing traffic control signals, ATMS/ITS devices and communications infrastructure within the ARTS Study Area from each respective County and review of existing documentation. See the following tables and figures:

- Table 3 shows the number of existing, under construction, or previously funded traffic/ITS field devices for each County. Table 4 shows the existing Traffic/ITS Software currently being used.
- Figure 2 to Figure 4 show existing ITS and communications infrastructure.

Table 3. Existing Traffic/ITS Field Device Count & Communications

Field Device	Richmond Co. Area	Columbia Co. Area	Aiken Co. Area
Total Traffic Signals	271	65	145
Adaptive Traffic Signals	25	65	17
Detection – Video Image	51	28	28
Surveillance Cameras	12	8	0
EVP / TSP Equipped Intersections	0	15	10
Dynamic Message Signs	0	6	0
Transit "Next Bus" Signs	0	0	0
Beacons / School Flashers	90	71	0
Fiber Optic Comm (miles)	24[2]	200[1]	10[2]

Note 1: Columbia Co. Community Broadband – shared agency fiber optic network is already deployed
Note 2: Existing, under construction, or previously funded projects
Note 3: Includes arterial roadway ATMS assets only

Table 4. Existing Traffic/ITS Software

Field Device	Richmond	Columbia	Aiken
Traffic Signal Control	INSYNC, ACTRA	INSYNC	INSYNC, STREETWISE
Arterial Surveillance	N/A	GENETEC	N/A
Arterial DMS	N/A	INSYNC	N/A
Emergency Preemption	N/A	EMTRAC	TOMAR
Arterial Travel Time	N/A	INSYNC	INRIX[1]
Freeway Surveillance	NAV2	NAV2	PALGUIDE
Freeway DMS	NAV2	NAV2	PALGUIDE
Freeway Travel Time	INRIX[2]	INRIX[2]	INRIX[2]

Note 1: Travel-time / speed data through 511SC – selected City of Aiken major arterials
Note 2: Travel-time / speed data through 511GA and 511SC - interstates

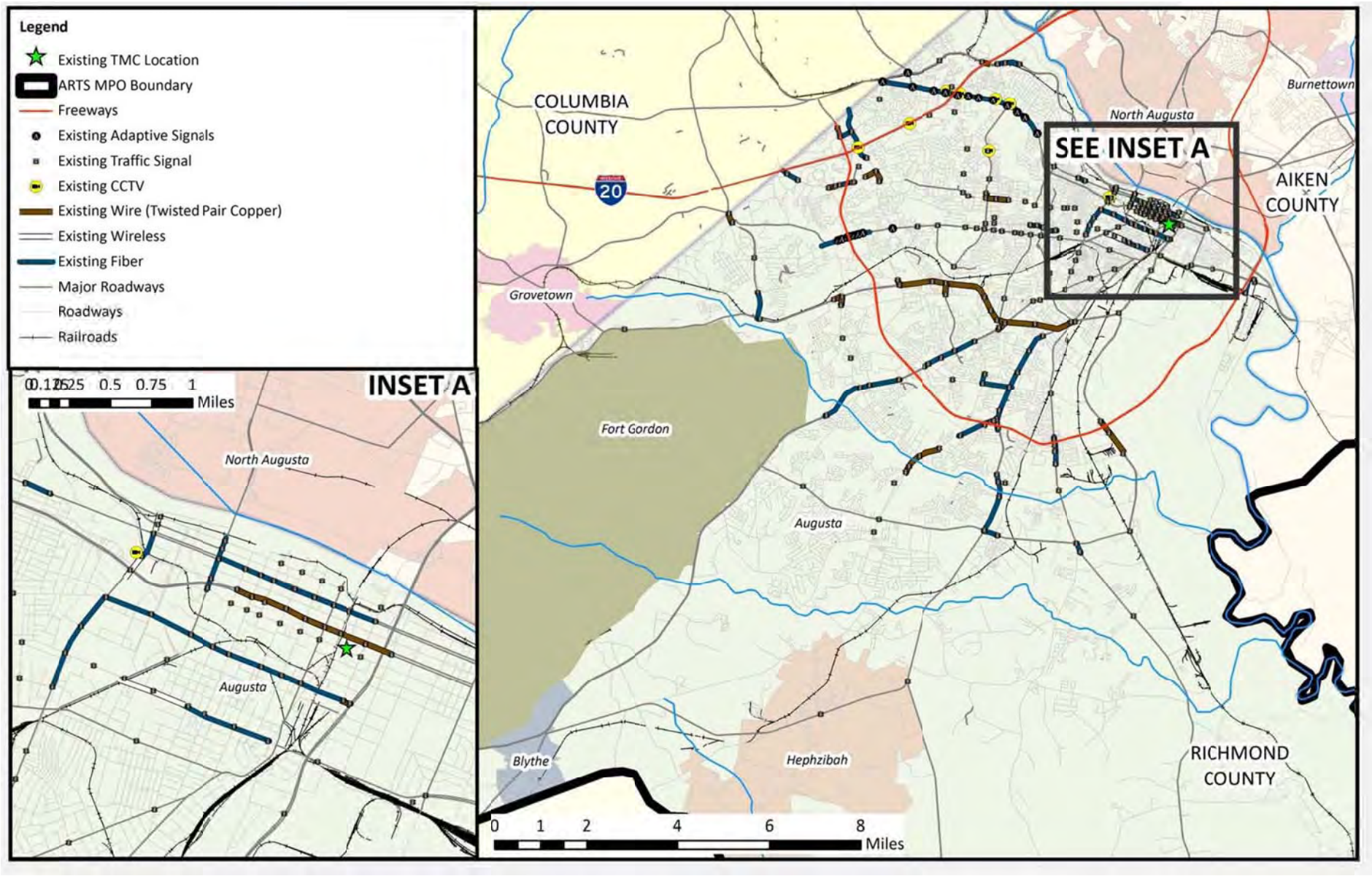


Figure 2. Richmond County Existing ATMS Infrastructure

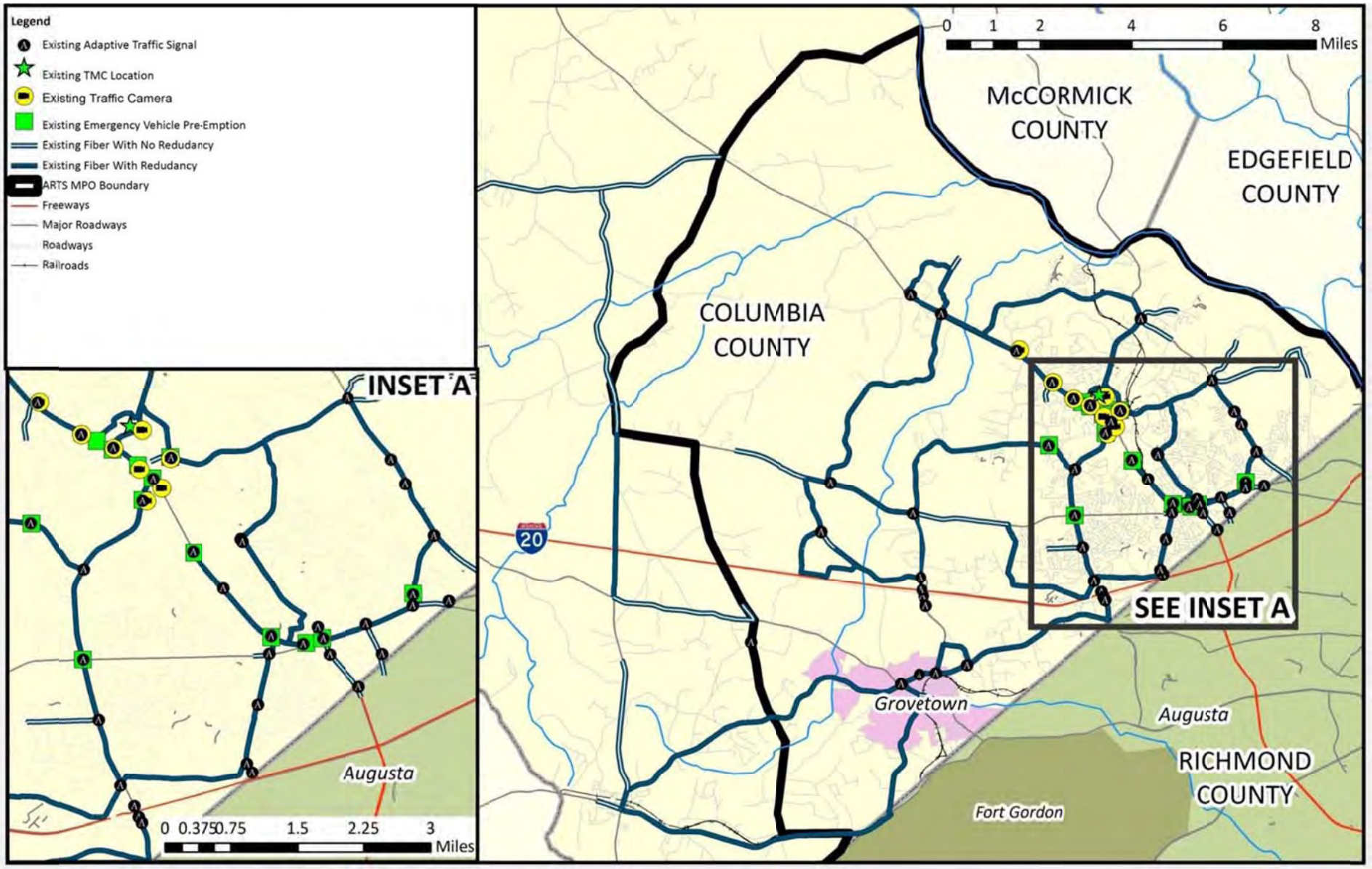


Figure 3. Columbia County Existing ATMS Infrastructure

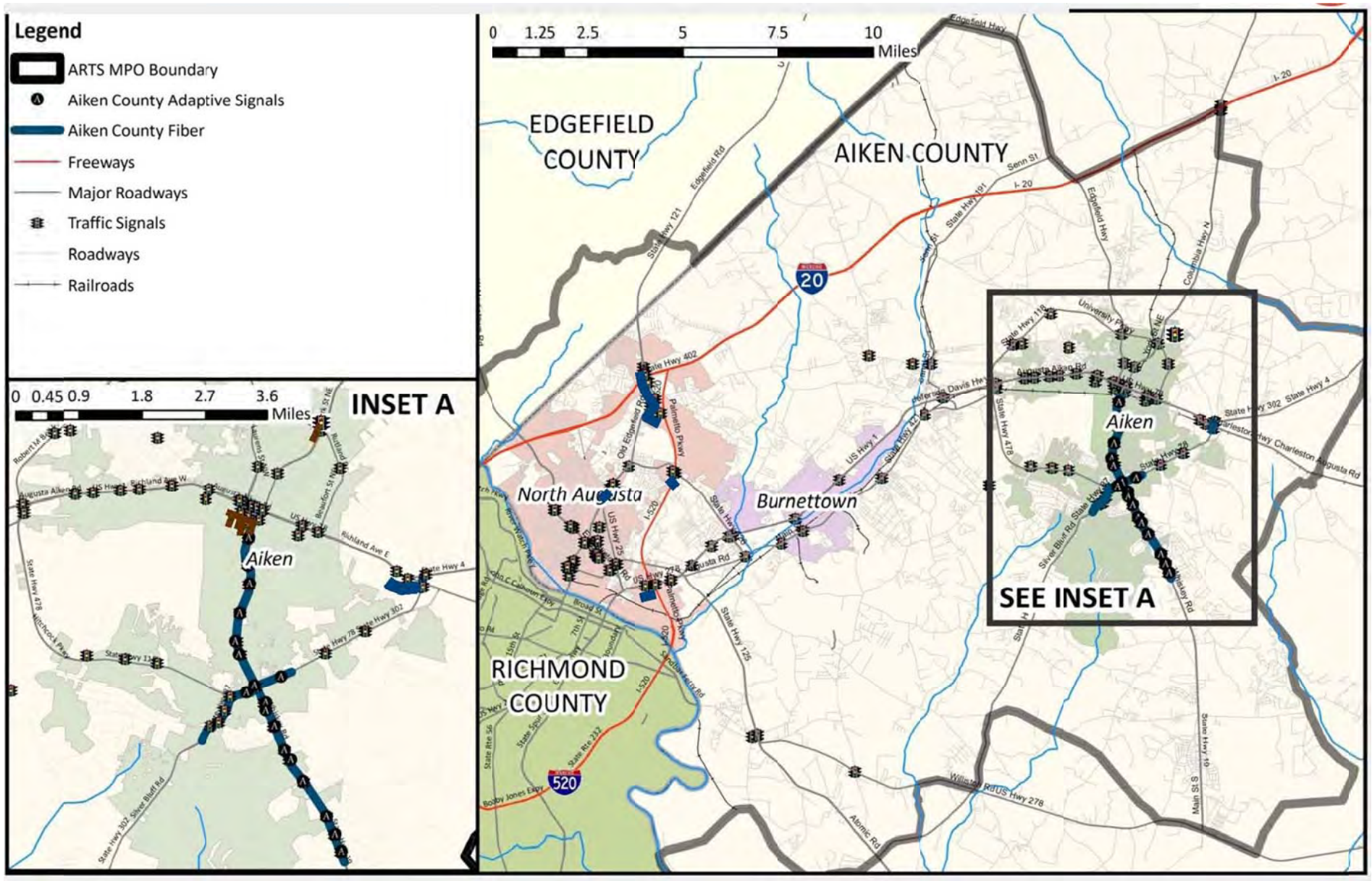


Figure 4. Aiken County Existing ATMS Infrastructure

2.2 LOCATIONS OF RECURRING CONGESTION

Based on the inventory of existing conditions and discussions with various stakeholders, it was determined that the following locations appear to exhibit a high level of recurring congestion as shown in Table 5.

Table 5. High Recurring Congestion Routes

County	Congested Corridors (no particular order)
Aiken	• Silver Bluff Rd (Whiskey Rd to Savannah Dr) • Dougherty Rd (Whiskey Rd to Silver Bluff Rd) • SC 118 (US 78 to Silver Bluff Rd) • Bettis Academy Rd (Ascagua Lake to Fields Cemetery) • Whiskey Rd (Richland Ave to Powderhouse Rd)
Columbia	• Baston Rd (Fury's Ferry Rd to Washington Rd) • Old Evans Rd (Belair Rd to Washington Rd) • Washington Rd (Hardy McManus Rd to Pleasant Home) • Flowing Wells Rd (Wheeler Rd to Washington Rd) • SR 223 (mid Grovetown to Ft. Gordon Gate)
Richmond	• 13th St / RA Dent Blvd (Reynolds St to Wrightsboro) • Wrightsboro Rd (Highland Ave to 15th St) • Wheeler Rd (Flowing Wells Rd to Walton Way Ext) • 15th St (Reynolds St to MLK Blvd) • Washington Rd (Pleasant Home to John Calhoun Exwy)

(Source: ARTS Congestion Management Process, 2011)

2.3 HIGH CRASH LOCATIONS

Based on the inventory of existing conditions and discussions with various stakeholders, it was determined that the following locations appear to exhibit a high level of crashes as shown in Table 6.

Table 6. High Crash Locations

(TOP 10 LOCATIONS, 2005 DATA)

County	Crash Location	No. of Crashes
Aiken	1. I-20 and Edgefield Road (US-25)	77
	2. Whiskey Road and Pine Log Road	46
	3. I-20 and Edgefield Highway (SC-19)	39
	4. Whiskey Road and Dougherty Road	36
	5. I-20 and Martintown Road	35
	6. Knox Ave and Martintown Road	30
	7. I-20 and Columbia Highway North	25
	8. Hitchcock Pkwy and Silver Bluff Road/Pine Log Road	24
	9. Jefferson Davis Highway and Atomic Road	23
	10. Richland Ave and Robert Bell Pkwy	21
Columbia	1. Washington Road and Bobby Jones Expy	70
	2. Washington Road and Belair Rd	39
	3. Belair Rd and Columbia Rd	37
	4. Washington Rd and Columbia Rd	35
	5. Washington Rd and Davis Rd	33
	6. Washington Rd and Ronald Reagan Dr	27
	7. Washington Rd and Baston Rd	26
	8. Columbia Rd and Flowing Wells Rd	25
	9. Washington Rd and Gibbs Rd	25
	10. Belair Rd and I-20 Westbound Off Ramp	24

Richmond	1. Deans Bridge Rd and Gordon Hwy	93
	2. Wrightsboro Rd and North Leg/Jackson Rd	70
	3. Gordon Hwy and Highland Ave/Wheeless Rd	64
	4. I-520 and Scott Nixon Memorial Blvd	62
	5. Peach Orchard Rd and Windsor Spring Rd	57
	6. Windsor Spring Rd and Tobacco Rd	57
	7. Wheeler Rd and R.C. Daniels Pkwy/Marks Church Rd	53
	8. Washington Rd and Boy Scout/Center West Pkwy	48
	9. Gordon Hwy and Milledgeville Rd East	47
	10. Peach Orchard Rd and Lumpkin Rd	47

(Source: ARTS Intersection Accident Analysis, 2005)

Based on the *Augusta Regional Freight Profile Report,* I-20, I-520, Gordon Highway, US 1, US 25, SC 19, and SC 302 are the most frequently used routes within the ARTS Study Area for commercial truck traffic / freight movement. In Richmond and Columbia County, Washington Road, Walton Way, Gordon Hwy, and Columbia Road have moderate to high truck percentages, resulting in higher crash rates at intersections involving commercial trucking vehicles. In Aiken County, I-20, Whiskey Road, Georgia Ave, Edgefield Road, York St, Rutland Dr. and Richland Ave also have moderate to high truck percentages, resulting in higher crash rates at intersections involving commercial trucking vehicles.

2.4 Existing incident management routesFigure 5 shows the existing I-20 incident management routes for providing alternative routes for situations involving I-20 roadway closures.

2.5 PROJECTS UNDER CONSTRUCTION OR TIA FUNDED

Based on the information obtained to date, Figure 6 through Figure 9 show the ITS and communications projects currently under construction or already funded for construction within the region.

2.6 SPECIAL EVENTS

The following special events occur on an annual basis, which draw from a large area and require traveler information.

- Masters (50,000+ guests during the week)
- Ironman event
- Running and other fitness events
- East Richland Horse Festival
- Arts in the Heart
- Bluegrass Festival
- Drag boat races on the Savannah River
- Diamond Lake sporting events
- Holiday parades
- Downtown-oriented event centers

2.7 EVACUATION EVENTS

The following evacuation scenarios influence the ARTS area:

- Hurricane evacuation for the east coast via the I-20 corridor
- Nuclear evacuation related to the Vogtle Electric Generating Plan (nuclear power), located near Waynesboro, GA

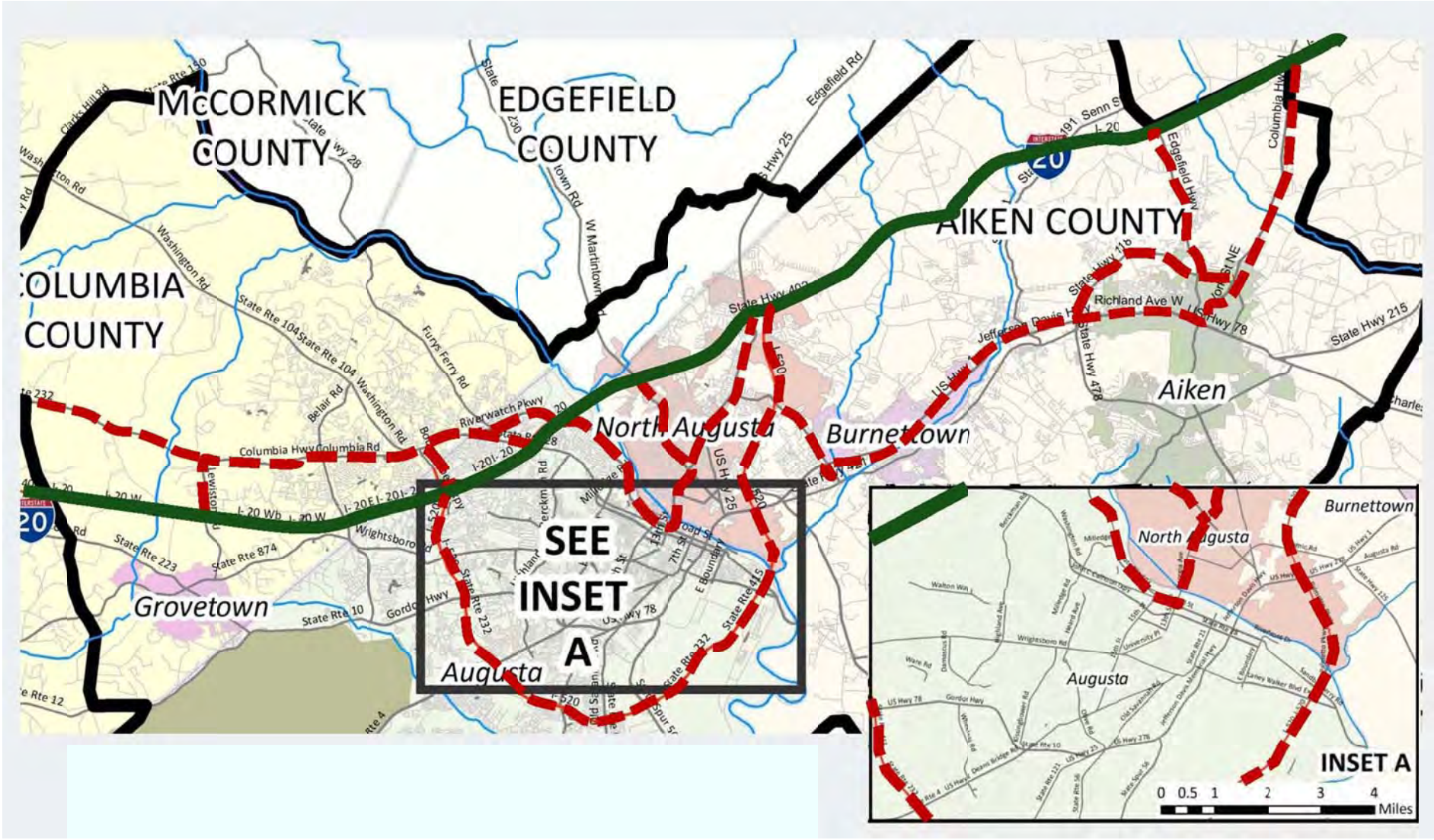


Figure 5. I-20 Incident Management Routes

Figure 6. Selected Improvements Under Construction or Funded, Richmond County Region

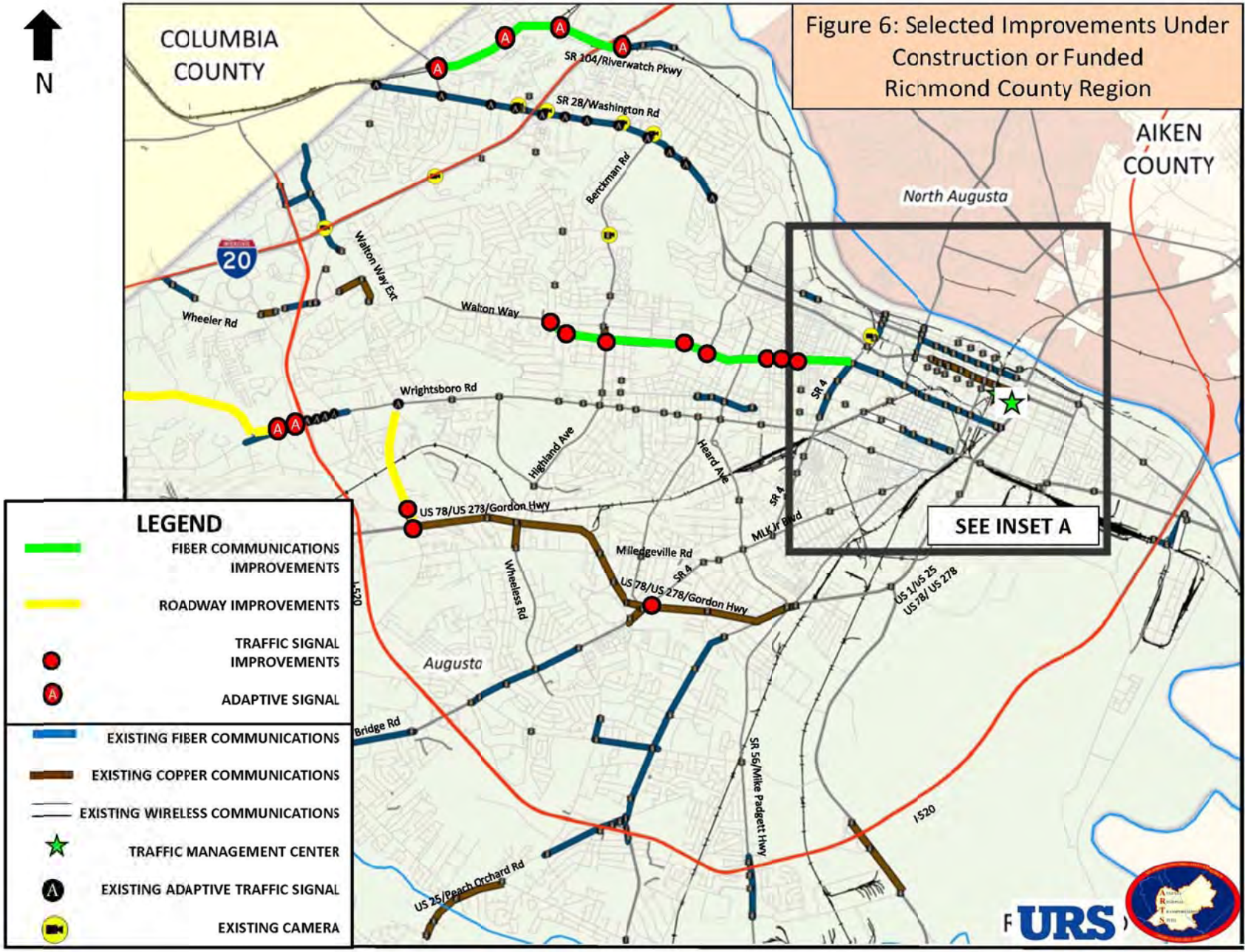


Figure 7. Selected Improvements Under Construction or Funded, Richmond County Region (inset)

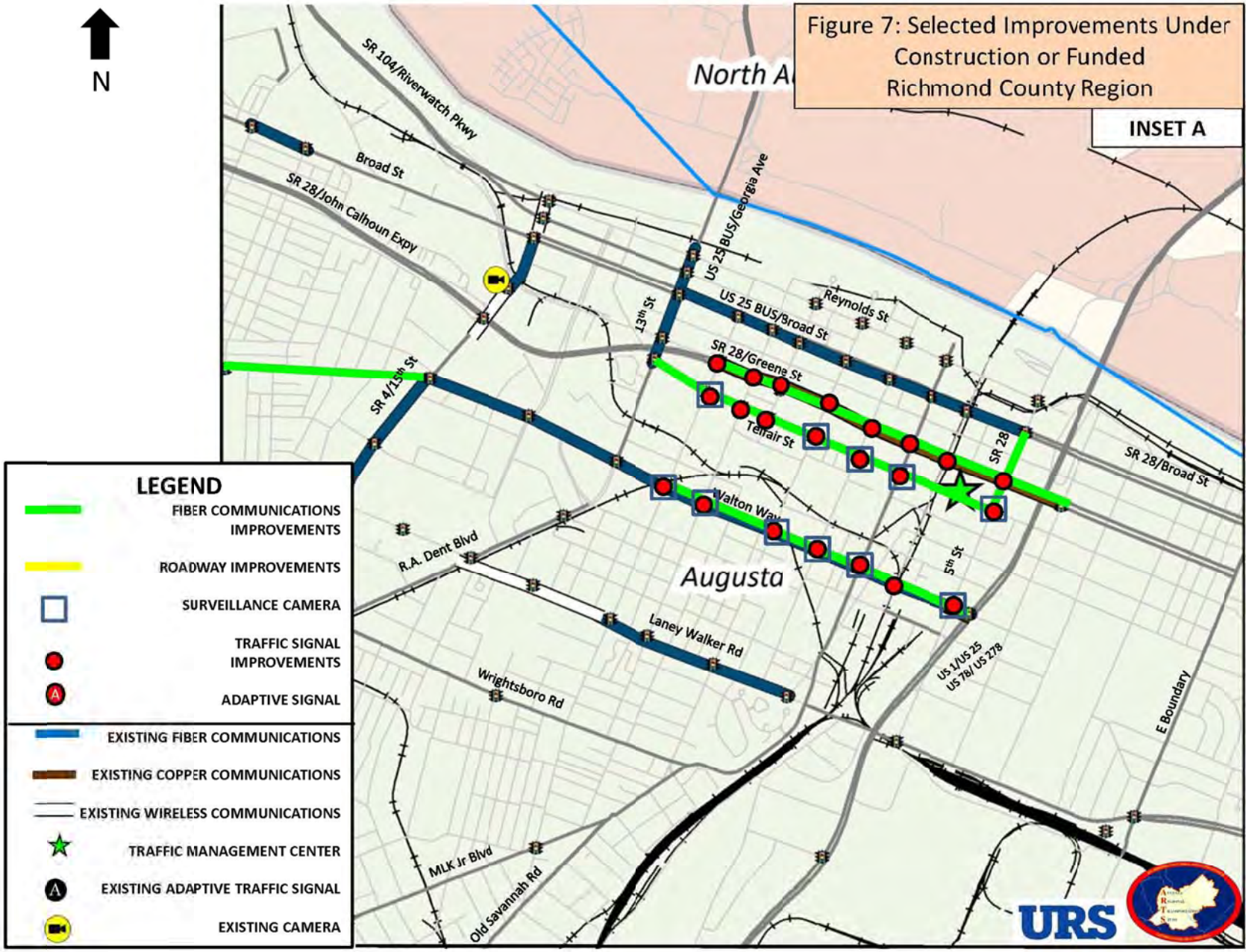


Figure 8. Selected Improvements Under Construction or Funded, Columbia County Region

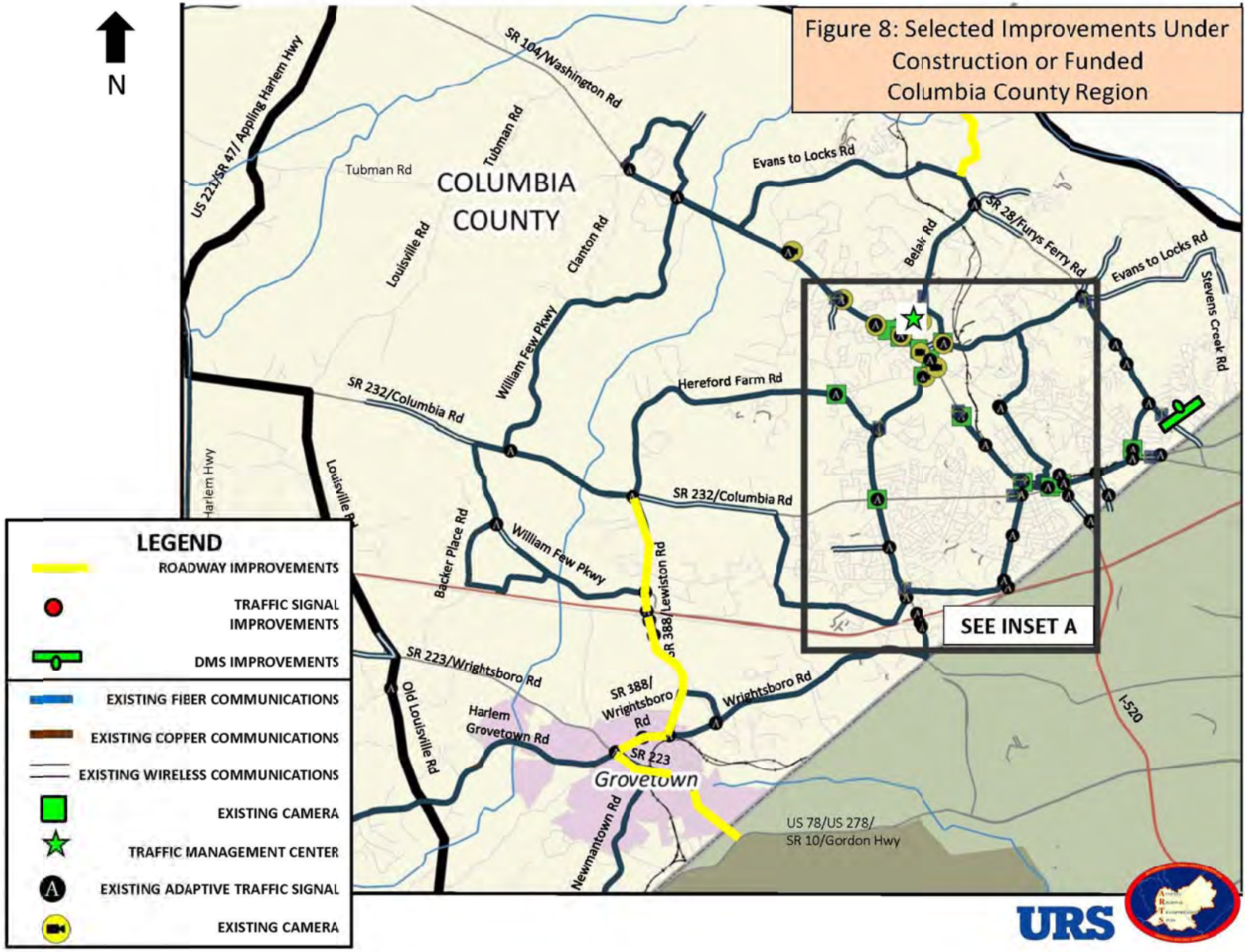
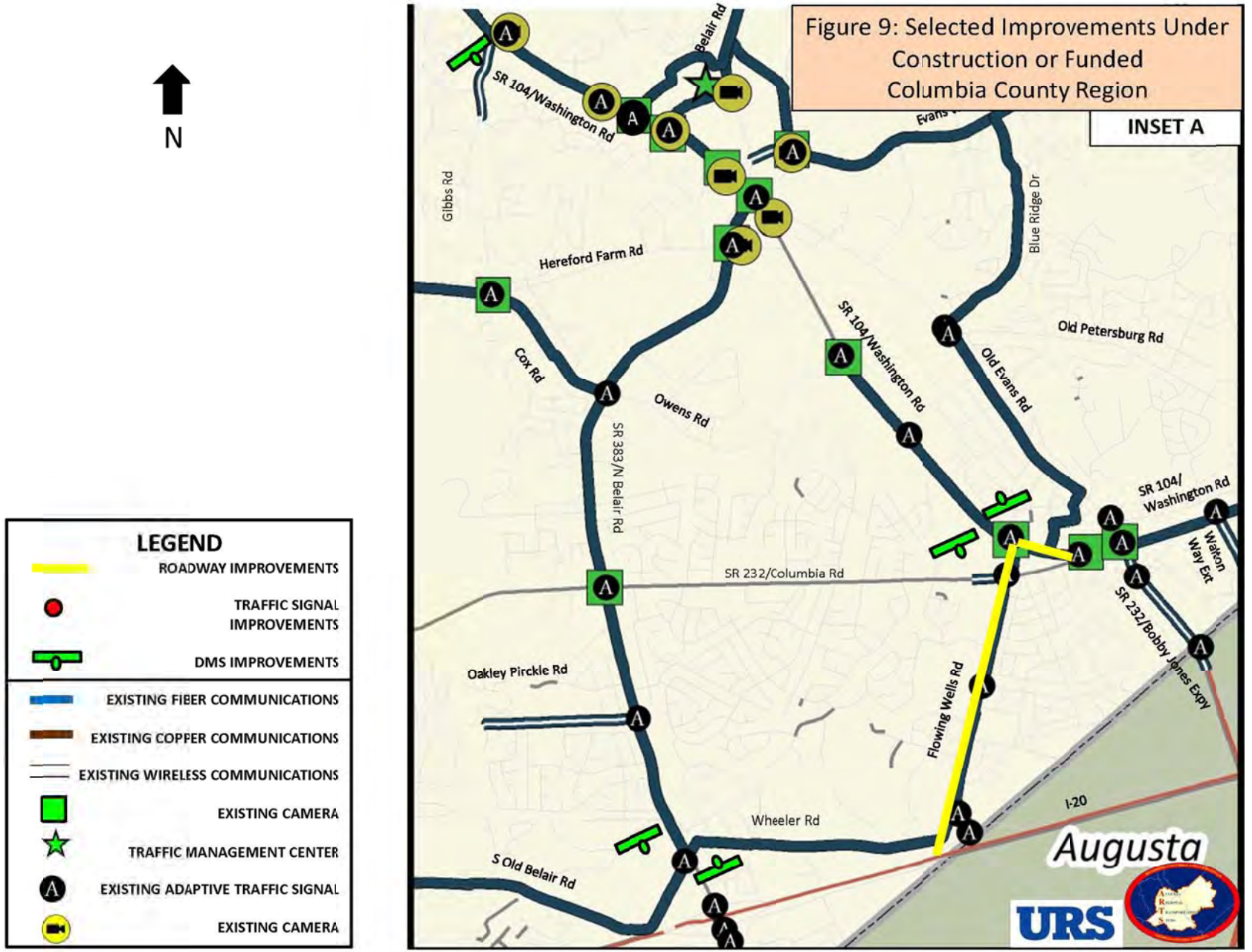


Figure 9. Selected Improvements Under Construction or Funded, Columbia County Region (inset)



SECTION 3.0 | NEEDS ASSESSMENT

3.1 STAKEHOLDER GROUP COMPOSITION

The ATMS Master Plan Update study team was guided by a targeted stakeholder group. This stakeholder group was developed to include those that either currently use, could utilize, or could benefit from ITS applications and comprised of several different types of agencies, including emergency management personnel, law enforcement representation, regional stakeholders, public agencies, and transit agencies. These included:

Emergency Management Stakeholders

- Aiken County EMA
- Aiken County Emergency Services (Fire and EMS)
- Augusta EMA
- Augusta Fire Department
- Columbia County EMA
- Columbia County Fire Department

Law Enforcement Stakeholders

- Aiken County Sherriff's Office
- Aiken Public Safety
- Augusta 911 Center
- Richmond County Sherriff's Department
- Columbia County Sherriff's Department
- Georgia State Patrol
- Grovetown Department of Public Safety
- Harlem Department of Public Safety
- South Carolina Highway Patrol

Regional Stakeholders

- Augusta Regional Airport
- Fort Gordon
- Plant Vogtle
- Savannah River Site

Public Agencies

- Aiken County
- Aiken County Planning & Development
- City of Augusta Information Technology
- City of Augusta Traffic Engineering Division
- City of Aiken Engineering and Utilities
- City of Aiken IT Department
- City of Burnettown
- City of Grovetown
- City of North Augusta Engineering and Public Works
- Columbia County Board of Commissioners
- Columbia County Engineering Department
- Columbia County Planning Department
- Columbia County IT Department
- GDOT
- GEMA Region 3
- SCDOT

Transit Agencies

- Augusta Public Transit (Richmond County)
- Best Friend Express (Aiken County)
- Columbia County Transit

Project Steering Committee

Individual stakeholder agencies with specific utilization of ITS applications were also included in a separate Steering Committee in order to guide the more specific and technically oriented components of the study. This group included representation from the following agencies:

- ARTS
- City of Augusta Traffic Engineering Division
- Augusta Public Transit
- Aiken County Traffic Engineering Division
- Columbia County Engineering Department
- City of Aiken Engineering and Utilities

3.2 STAKEHOLDER OPERATIONAL ROLES

High-level tasks/activities (aka responsibilities) that are, or should be, performed by stakeholders (aka roles) with respect to the operation of their ITS project/system. Detailed roles and responsibilities would be developed as each ITS project is developed and designed.

Traffic and Transportation Management Agencies and Centers

Regional traffic and transportation management agencies are responsible for monitoring and controlling the public transportation network. Transportation Management Centers (TMCs) and Traffic Control Centers (TCCs) are responsible for collecting transportation data, operating and controlling highway field devices, and (in the case of a TMC) disseminating traveler information. Additionally, TMCs frequently coordinate with emergency, law enforcement, and maintenance management agencies to quickly identify incidents and request/provide the necessary resources to clear incidents quickly and effectively.

The interstate system and its ITS components are controlled and maintained by GDOT and SCDOT. For the non-freeway system, the local agencies are responsible for the traffic signals, ITS, and communications infrastructure within their respective local jurisdictions. The local agencies that operate and maintain traffic signals on state routes and local streets are the City of Augusta, City of Aiken, City of North Augusta, and Columbia County. GDOT and SCDOT maintain jurisdictional control of the traffic signals on the state routes that are maintained by the local agencies.

Emergency Management Agencies/Centers

Emergency Management Agencies/Centers are generally responsible for protecting lives and property of residents within the region. They are responsible for responding to natural and man-made disasters, as well as implementing procedures to mitigate and recover from these

events. Disasters include all major incidents (e.g., weather, large fires, acts of terror, and serious HAZMAT spills).

Emergency Response Agencies

Emergency response agencies provide timely response and treatment of individuals involved in incidents as well as control at the scene of the incident so emergency personnel can provide treatment without public interference. These agencies are typically among the first to respond to incidents and emergencies affecting the regional highway network. Thus, emergency response personnel are usually the first to verify conditions in the field and report the information needed to initiate an appropriate response and clear roadways in a timely manner.

Highway Patrol

The Georgia State Patrol and South Carolina Highway Patrol are the region's highway patrol agencies and are responsible for traffic enforcement and crash investigations on all state highways in the region.

Law Enforcement Agencies

Sheriff Offices provide enforcement services for their respective counties, including the various transportation elements within the region. Sheriff Offices are primarily responsible for providing local emergency response services to the region as well as being an active participant in incident detection and monitoring.

Emergency Medical Services, Fire Rescue Departments

Generally speaking, Emergency Medical Services, Fire Rescue Departments provide on-site medical treatment to persons involved in crashes. Since time is of the essence whenever responding to injury crashes, these agencies must respond quickly. Any hesitation can be the difference between life and death. Therefore, these agencies must communicate frequently with traffic management agencies, and Sheriff Offices to initiate a timely and appropriate response. Information obtained by personnel at the crash scene and images obtained from cameras provide valuable information for determining the nature and extent of crashes, and other incidents.

Public Transportation Management / Transit Agencies

The transit agencies as mentioned in this Master Plan operate fixed routes, express, and paratransit services to residents within the region. Each transit agency is also responsible for alerting traffic and emergency response agencies of transit-related incidents so traffic management and emergency response can be implemented. They are also responsible for disseminating incident and major evacuation information, as well as basic transit information (fares, routes, schedules, etc.) to information service providers so the public can make/adjust their travel plans based on real-time information.

Public Works Departments

City Public Works Departments are responsible for maintaining city infrastructure and ITS/Traffic signal assets. These departments often have information that might benefit other agency operations. For

instance, real-time or scheduled construction information may be communicated to transit agencies, so that transit vehicles can be routed around areas impacted by construction activities. This information is also applicable for emergency response agencies for routing their vehicles.

3.3 STAKEHOLDER NEEDS ASSESSMENT

The study team and stakeholder groups met several times over the course of the study to discuss project status, survey ITS needs, and guide recommendations. Several meetings were conducted including:

Small Group Meetings: Small group meetings were held in advance of the first group stakeholder meeting in order to discuss overall needs and concerns as organized by geographic and/or discipline specific issues related to ITS.

Stakeholder Meeting # 1: This meeting was held in March 2013 for the purpose of introducing the study process to the stakeholders. Topics of discussion included existing ATMS assets, specific operational scenarios, discussion of ITS components, and an exercise in which stakeholders indicated geographic areas and locations where traffic issues occur and their relative concern for these areas.

At this meeting, participating stakeholders were asked to vote on their preferred or needed ITS applications utilizing high, medium, and low rankings. For traffic ITS applications, participants were asked to mark their top six applications. For transit ITS applications, participants were asked to mark their top three applications. The final and sorted rankings are shown in Table 7.

Stakeholder Meeting # 2: This meeting was held in June 2013 to discuss special topics related to ITS, including the possibility of a regional Traffic Management Center (TMC), ITS software requirements and opportunities, and communications systems throughout the region.

Stakeholder Meeting # 3: This meeting was held in October 2013 and reviewed the initial list of ATMS projects for stakeholder input, and also described the project programming, funding, and deployment considerations for ATMS projects.

Meeting minutes are provided in **Appendix A**.

Table 7. Stakeholder ITS Application Voting Results

ITS Application	High Rankings	Medium Rankings	Low Rankings
Traffic ITS Applications			
Compatible emergency radio communications	23	4	0
Traffic signal systems/timing optimization	22	7	2
Emergency vehicle pre-emption at traffic signals	22	7	1
CCTV image sharing with local agency and first responders	18	9	3
Dynamic Message Signs	10	14	4
ITS applications that support evacuations	10	11	6
Travel Time System	8	15	8
Regional Traffic Management Center (TMC)	8	12	9

ITS Application	High Rankings	Medium Rankings	Low Rankings
Apps and social media alerts for incidents and traffic congestion	8	11	9
Rural ITS applications (un-signalized intersection safety, geometric issues, etc.)	7	15	9
Red-light running	5	8	14
Environmental applications (fog, flooding, etc.)	4	14	9
Freeway patrols	3	12	12
Traffic map/travel time info major traffic generators kiosks	1	17	11
Transit ITS Applications			
On-board cameras	12	8	5
App for transit schedules	8	10	7
Kiosks or display message signs at bus shelters	7	6	10
Traffic signal priority at traffic signals	6	11	9
Bus route schedule adherence measuring capability	6	11	8
On-board transit voice annunciation	2	11	7

Stakeholder Input / Local Agency Needs

The project kick-off meeting included a voting exercise for stakeholders to mark areas of concern (also by low, medium, and high priorities) geographically on a map. Figure 10 to Figure 14 summarizes these geographic comments provided by the stakeholder group organized by stakeholder type.

Additionally, additional comments that were not geographic specific, encompassed a broader corridor area, or were emphasized specifically were also relayed by the stakeholder group and include the following:

1. Population growth throughout region
2. Savannah River Site traffic congestion on Whiskey Road/Atomic Road in Aiken County
3. Fort Gordon traffic congestion in Grovetown area
4. Recurring congestion in Columbia County, especially along Washington Road
5. The City of Augusta experiences frequent congestion on Washington Road
6. North Augusta – communication with and between signals
7. Overall radio and cell coverage issues (gaps) especially at Petticoat Junction

Other agency specific needs provided through a stakeholder voting process as part of the Project Kick-off meeting include the following (in no specific order):

ARTS:

1. Data/reporting for tracking mobility trends
2. TIA project definition
3. Inter-jurisdictional approach to traffic management and traveler information
4. ATMS sustainability

Richmond County:

1. Maximize throughout on corridors with growth
2. Fiber infrastructure planning, deployment
3. Emergency vehicle access in congested areas
4. Ambulance access/routing to downtown hospital
5. Ft. Gordon entrance congestion
6. Standards for ATMS infrastructure

Columbia County:

1. Maximize throughout on corridors with growth
2. Emergency vehicle access in congested areas
3. Access to ATMS from the Emergency Operations Center
4. TCC staffing
5. Standards for ATMS infrastructure

Aiken County:

1. Traffic signal coordination issues
2. Leverage alternate routes surrounding Aiken
3. Savannah River Site congestion relief
4. First responder communications system improvements between Aiken and SRS

South Carolina DOT:

1. First responder communication system issues

Georgia DOT:

1. I-20 traveler information
2. I-20 commerce mobility reliability

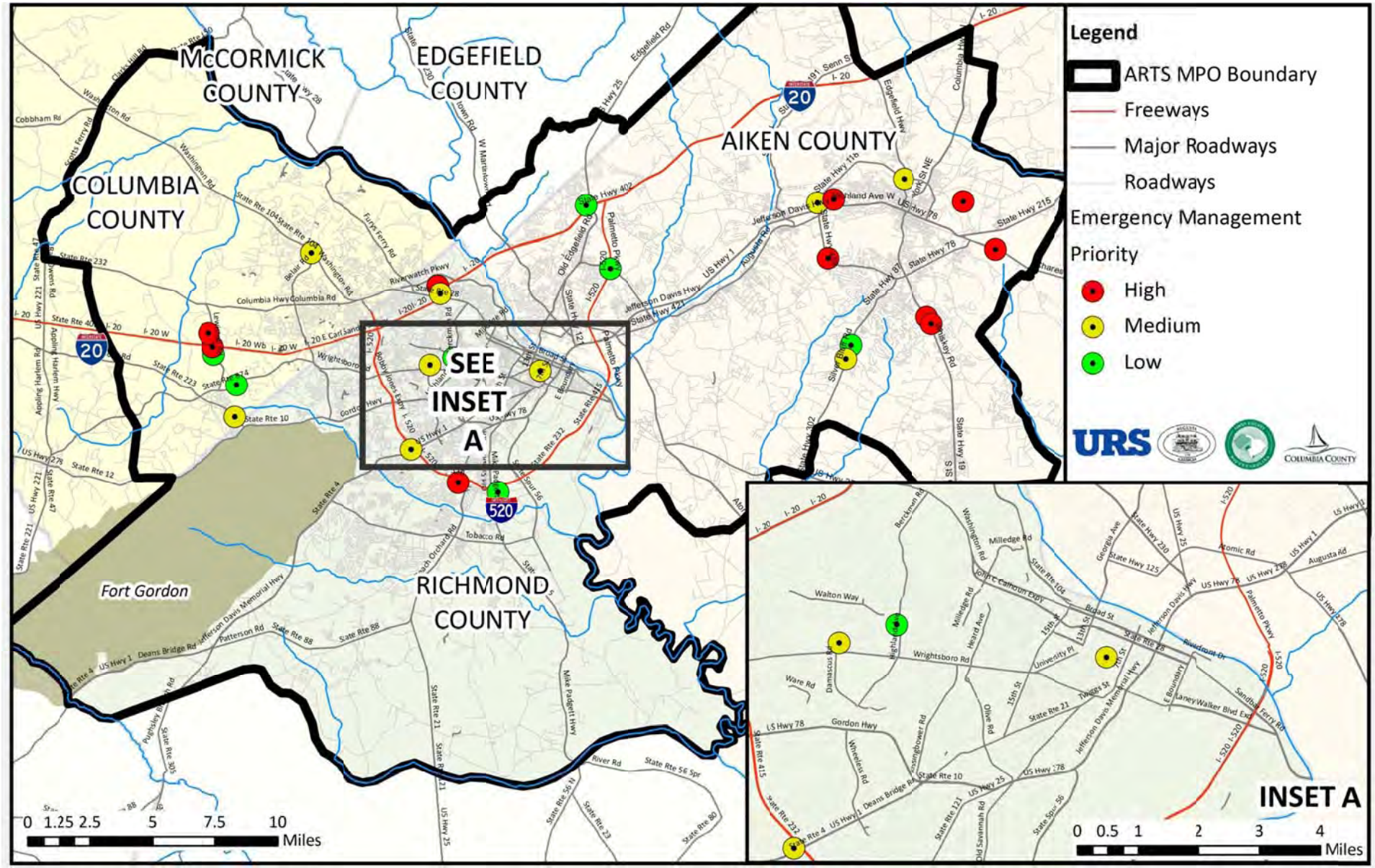


Figure 10. Emergency Management Stakeholder Comments

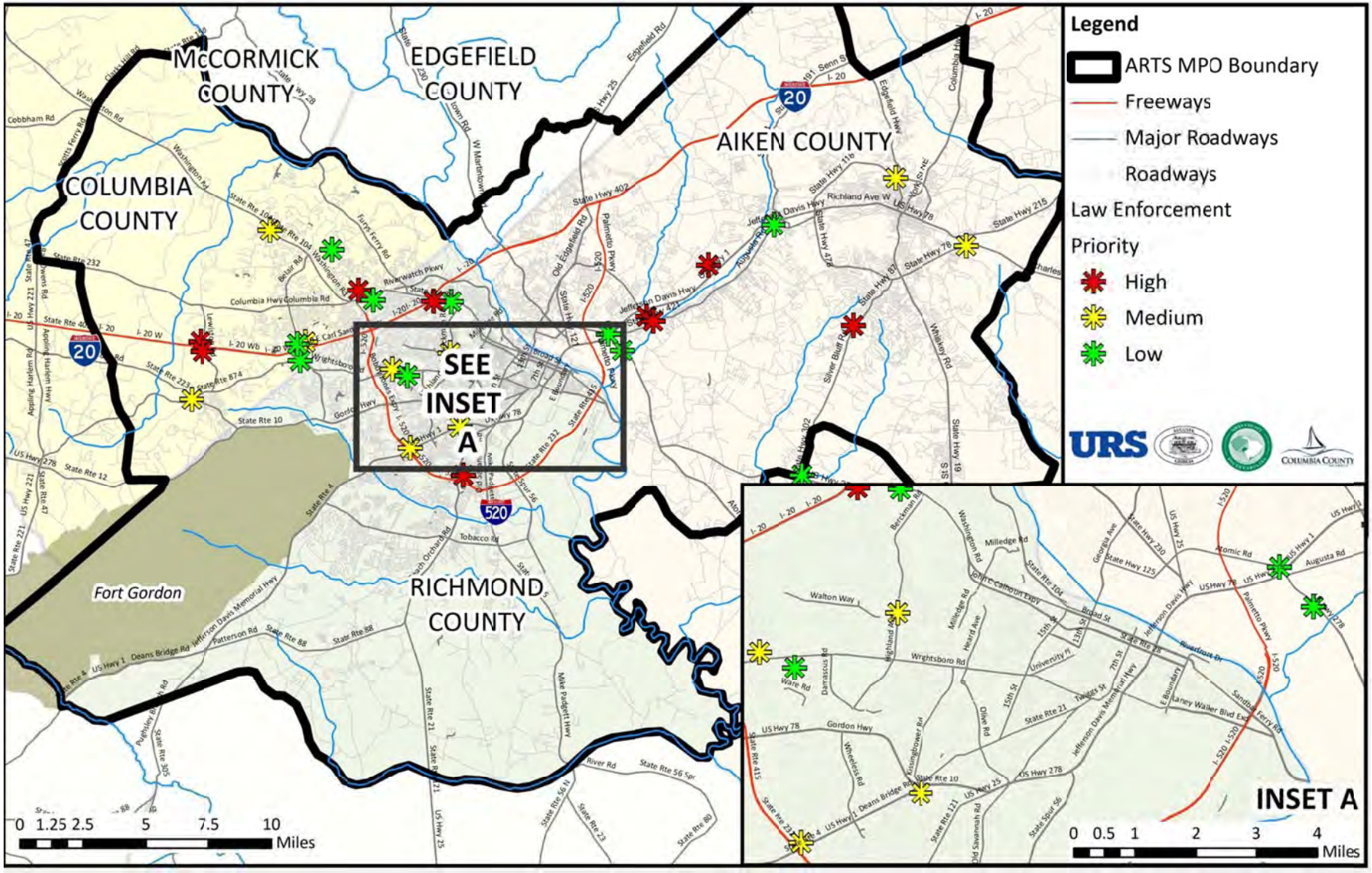


Figure 11. Law Enforcement Stakeholder Comments

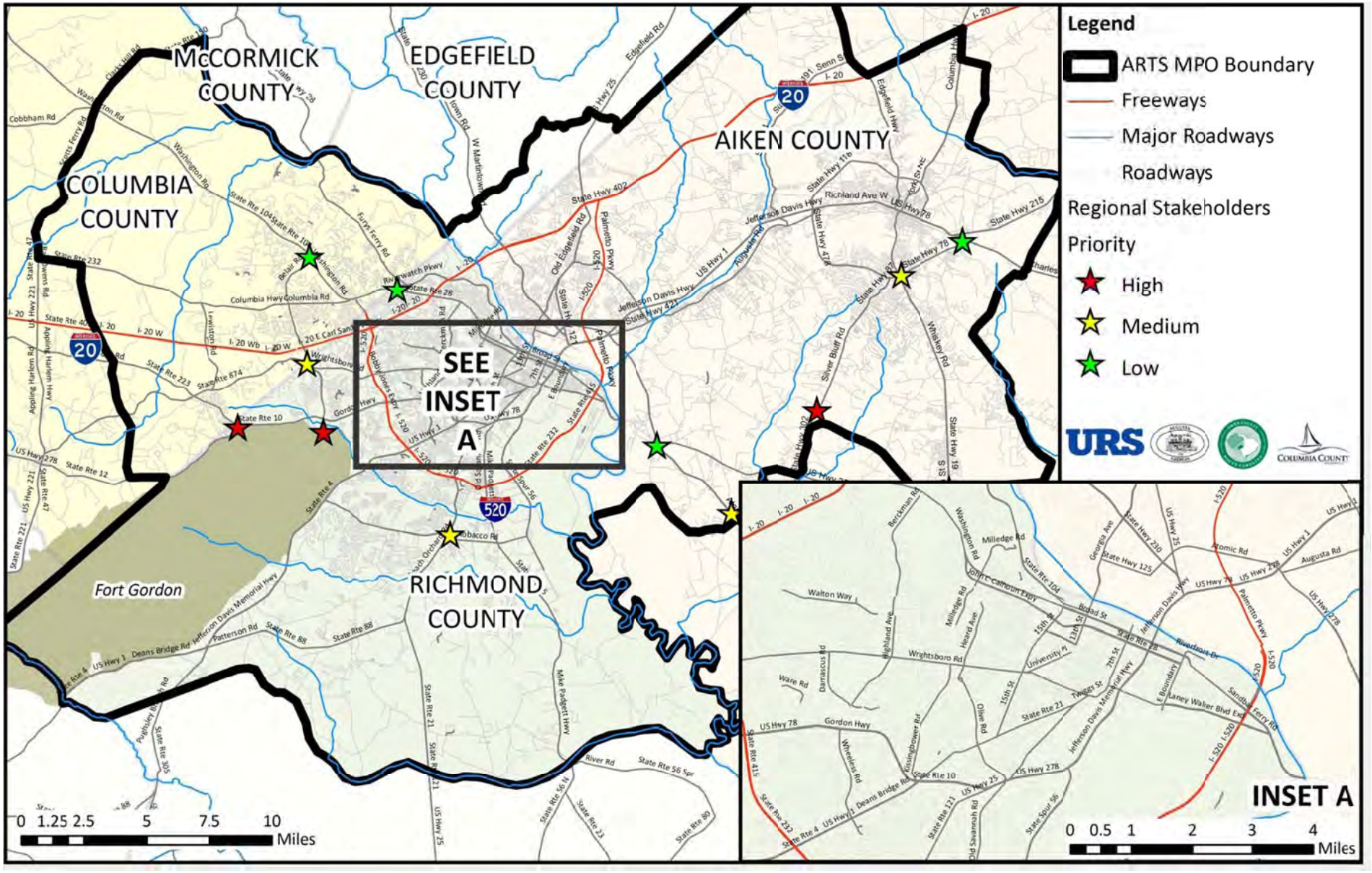


Figure 12. Regional Agency Stakeholder Comments

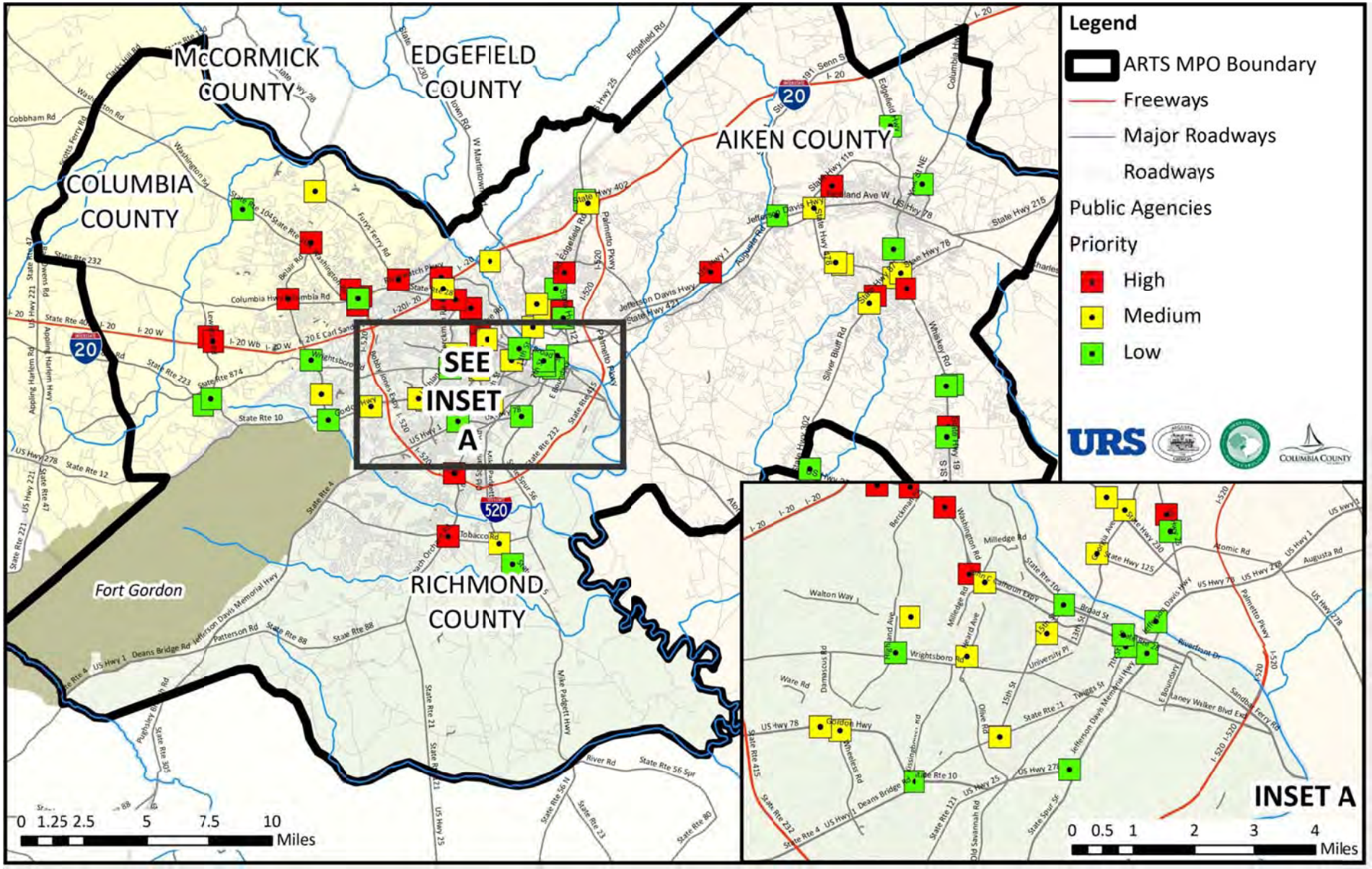


Figure 13. Public Agency Stakeholder Comments

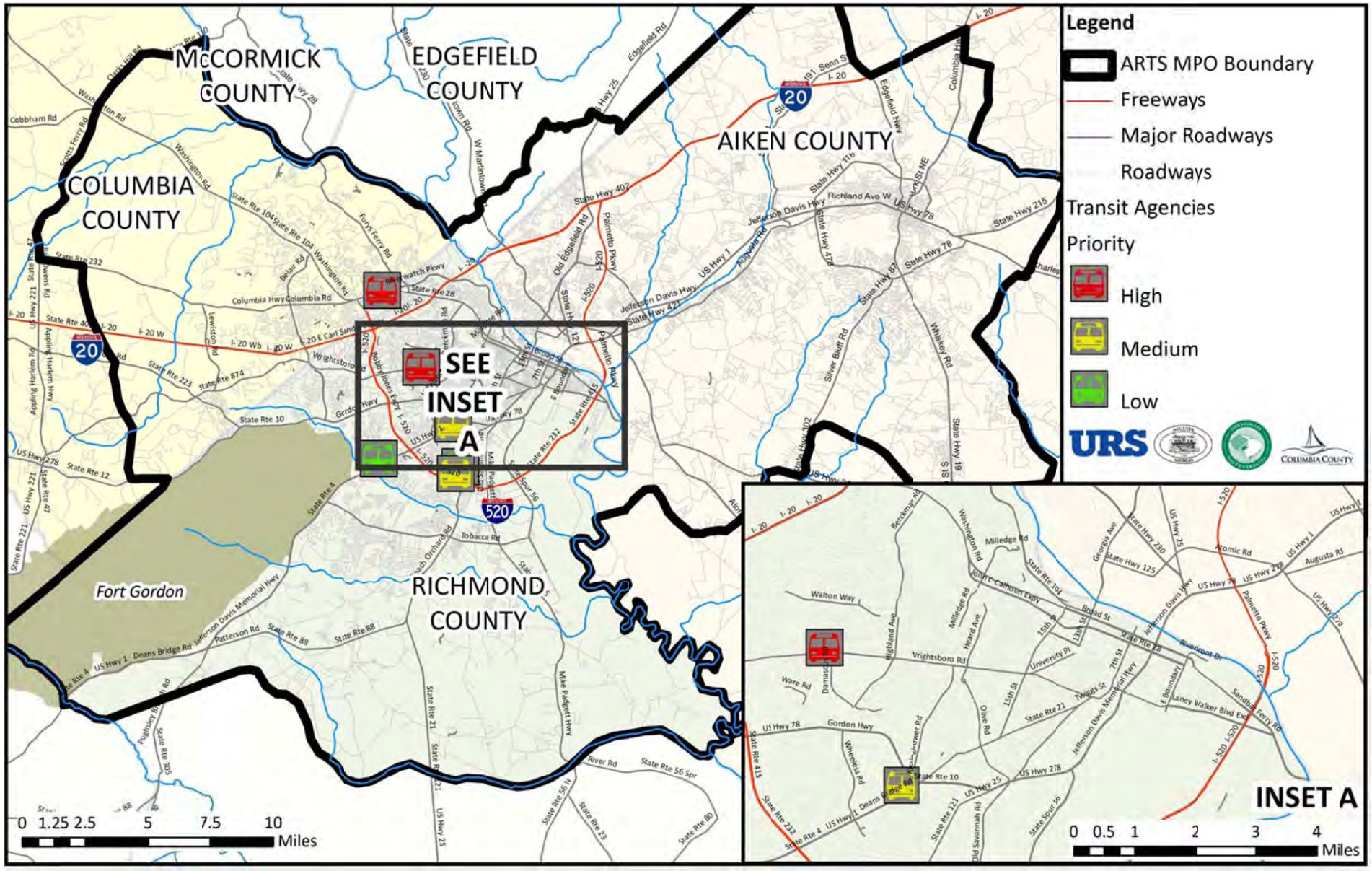


Figure 14. Transit Agency Stakeholder Comments

3.4 ATMS GOALS AND STRATEGIES

From the Stakeholder needs and existing documentation review, specific ATMS goals and strategies (objectives) were identified as documented in this section.

The MPO 2035 LRTP is a collective effort to address the development of a community-wide transportation system. The LRTP proposes a balanced transportation system, taking into account considerations such as personal mobility, growth management, regional economic development, neighborhood preservation, environmental concerns and citizen participation. The goals and objectives provided are consistent with the policies established by local agencies and jurisdictions.

The ATMS Master Plan goals and objectives (strategies) identified for this project took into account the stakeholder input and feedback from the various stakeholder and steering committee meetings as well as review of the ARTS 2035 LRTP and other existing transportation documentation listed in Section 1.3 of this Master Plan. The final list of goals and objectives are consistent with the ARTS 2035 LTRP and meet all stakeholder stated needs and requirements.

These ATMS Master Plan goals and strategies are also consistent with and support the seven national performance goals developed by FHWA as part of MAP-21, the legislated mechanism for the Federal-aid highway program. The seven national performance goals are as follows:

1. ***Safety*** – To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
2. ***Infrastructure Condition*** – To maintain the highway infrastructure asset system in a state of good repair.
3. ***Congestion Reduction*** – To achieve a significant reduction in congestion on the National Highway System.
4. ***System Reliability*** – To improve the efficiency of the surface transportation system.
5. ***Freight Movement and Economic Vitality*** – To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
6. ***Environmental Sustainability*** – To enhance the performance of the transportation system while protecting and enhancing the natural environment.
7. ***Reduced Project Delivery and Delays*** – To reduce project costs, promote jobs and the economy and expedite the movement of people and goods by accelerating project completion through eliminating delays.

The finalized goals and strategies (objectives) are shown in Table 8.

Table 8. ATMS Master Plan Goals and Strategies

ATMS Master Plan (Goals)[1]	**ATMS Master Plan (Strategies / Objectives)[2]**	ARTS 2035 LRTP (Goals & Objectives)[3]	MAP 21 National Performance Goals[4]
A. Transportation Efficiency and Quality			
G1 -- Enhance the quality of life, economic vitality by improving the efficiency and operations of the transportation system	1. Maximize existing traffic flow and transportation system capacity through strategies and technologies that mitigate congestion and improve travel flow and mobility	Goal 3, Objective 1 Goal 4, Objective 5 Goal 7, Objectives 2, 3 & 4	No. 2 - 7
	2. Support event-specific transportation needs by providing overall traffic management capabilities and tools		
	3. Provide and enhance (optimize) traffic signal coordination and corridor performance		
	4. Support and improve freeway/arterial incident management route diversion, emergency evacuation capabilities and operational coordination		
	5. Monitor and preserve ITS/Traffic signal equipment and infrastructure inventory		
B. Transportation Safety and Security			
G2 -- Increase the safety and security for all transportation modes	1. Improve safety and first responder effectiveness	Goal 6, Objectives 1 & 2 Goal 7, Objective 4	No. 1 & 4
	2. Reduce crash rates (primary and secondary) and improve safety at signalized intersections and other hot spots (urban and rural locations)		
	3. Provide real-time video sharing with emergency responders and others to facilitate incident and emergency response plans		
	4. Improve safety and reduce emergency vehicle response delays at at-grade highway-rail interface/crossings, etc.)		
	5. Provide improved response times and safety through emergency preemption systems with minimal traffic disruption		
C. Accessibility and Mobility			
G3 -- Promote accessibility and mobility of people and goods by providing comprehensive and reliable multi-modal traveler information and programs to people and businesses	1. Provide transit bus fleet management capabilities to provide improved operational efficiency, schedule adherence and provide capability to manage routes and scheduling information	Goal 3, Objectives 1, 2, & 3 Goal 7, Objectives 3 & 4	No. 3, 4 & 7
	2. Provide transit passenger information systems to affect travel choices through increased ridership		
	3. Provide reliable and accurate travel time and real-time speed data to support overall traffic management, traveler information, work zone and transportation planning applications		
	4. Provide improved bus transit arrival times		
	5. Provide en-route traveler information systems		

D. Integrated and Coordinated Operations			
G4 -- Provide and encourage interagency, inter-jurisdictional coordination, system integration and communications	1. Develop regional interagency communications plan to address needs and existing communications coverage gaps and compatibility issues	Goal 6, Objectives 1 & 2	No. 1 & 4
	2. Integrate ITS with transportation planning & implementation	Goal 7, Objectives 3 & 4	No. 1 & 4
	3. Expand and/or upgrade existing communication systems and networks for greater redundancy, reliability, connectivity and interoperability	Goal 6, Objectives 1 & 2	No. 1 & 4

Note 1: The ATMS Master Plan goals and objectives (strategies) identified for this project took into account the stakeholder input and feedback from the various stakeholder and steering committee meetings as well as review of the ARTS 2035 LRTP and other existing transportation documentation listed in Section 1.3 of this Master Plan. The final list of goals and objectives are consistent with the ARTS 2035 LTRP and meet all stakeholder stated needs and requirements.

Note 2: ATMS Objectives A-1, A-2, B-1 and D-2 were originally stated as Project Goals – but have been re-defined as Objectives to be consistent with the development of goals, objectives and functional requirements documented in this Master Plan.

Note 3: Reference the ARTS 2035 Long Range Transportation Plan (2010) for LRTP goals & objectives.

Note 4: Reference Section 3.3 for MAP-21 goals & objectives.

SECTION 4.0 | IMPLEMENTATION PLAN

4.1 FUNCTIONAL REQUIREMENTS

DEVELOPMENT FRAMEWORK

To best achieve the goals & strategies identified for this ATMS Master Plan while meeting the stakeholder needs, the **Transportation System Management and Operations (TSM&O) strategy** has been adopted as the framework for identifying and developing ATMS/ITS strategies and functional requirements. As congestion continues to increase disproportionately to funding resources, the current practice of roadway expansion is becoming obsolete or not possible. TSM&O is defined by the FHWA as:

> *"An integrated program to optimize the performance of existing multimodal infrastructure through implementation of systems, services, and projects to preserve capacity and improve the security, safety and reliability of our transportation system."*

In other words, TSM&O is a systematic and integrated project approach combining **ITS** measures, strategies and technologies with operational and institutional considerations to optimize the performance of the existing systems and infrastructure through implementation and operations of multi-modal, cross-jurisdictional systems, services, and projects. With fewer funds available to build our way out of congestion, improving our current roadways has become critical.

TSM&O emphasizes real-time active management and operation of the existing transportation system to improve mobility for all roadway users. To accomplish the goals and objectives established by the TSM&O program requires that all public and private agencies involved with transportation management and emergency/incident response to be partnered together as one cohesive entity to make operational and cost-effective deployment and investment decisions that impact the County/region as a whole.

Historically, ITS deployment has primarily focused on interstates however, another TSM&O objective is to focus on arterials/corridors and the use of real-time traveler information dissemination to influence travel patterns to cover multiple roadways, travel modes, and avoid traffic bottlenecks.

In addition to **TSM&O/ITS** strategies, another key congestion management strategy that will be critical to addressing ARTS transportation concerns and issues is **travel demand management (TDM)** as stated in the 2035 LRTP. TDM is not focused on facilities, but rather on programs or strategies designed to manage demand for vehicle travel to achieve system performance, environmental, and growth objectives. TDM strategies are designed to help reduce the demand for drive-alone travel on roadways by offering alternatives (i.e., carpools, vanpools, walking, etc.) to single-occupant vehicle driving, shift trips out of peak travel periods and eliminate the need for certain trips.

Although this ATMS Master Plan is primarily focused on TSM&O/ITS strategies and technologies, the strategies and technologies discussed and recommended in this ATMS Master Plan will support and promote the further development and expansion of TDM initiatives within the ARTS Study Area.

ATMS/ITS Functional Requirements

By working within a TSM&O development framework the following list of potential ATMS/ITS functional requirements capable of addressing key stakeholder needs and issues, goals and strategies (objectives), and local transportation mobility and safety issues were identified for possible inclusion as part of ITS project(s) and/or institutional and operational recommendations. The functional requirements are only high-level in nature, where detailed concepts and requirements would be determined as each ITS project is further developed and designed.

Once constructed, staffing to properly operate and maintain the ATMS/ITS infrastructure is an equally important consideration.

A. TRANSPORTATION EFFICIENCY AND QUALITY

Improved traffic management targets both recurring and non-recurring congestion. The primary objective is to move away from a static transportation system to a more dynamic and integrated transportation system. Examples include periodically re-timing traffic signals, installing more closed loop signal systems that can be centrally controlled to reflect current conditions, expanding and/or utilizing CCTV cameras, travel-time/vehicle detection, arterial DMSs, signal priority/preemption systems, and/or others devices along the arterials and state roads to facilitate management and response to traffic incidents and other events that impact the local and regional roadway network.

1. Provide and deploy CCTV surveillance cameras, freeway / arterial DMSs and/or other ITS devices and systems to provide traffic management and support incident/emergency management operations.
2. Provide system and/or infrastructure expansion to fill in missing system coverage gaps (i.e., at critical intersections, along critical roadway segments) along the interstates and arterials, as required.
3. Provide on-going traffic signal timing optimization program to provide and/or maintain optimal corridor performance through a program of regular/periodic traffic signal re-timing and traffic signal system upgrades/improvements as a result of changed traffic patterns and conditions along a corridor.
4. Provide and/or expand adaptive signal control system along selected corridors for optimal traffic flow performance.
5. Provide TCC/TMC expansion and/or upgrades (hardware, software, operational procedures) to support expanded and upgraded ATMS operations.
6. Provide remote access, monitoring and control capabilities for TMC/TCC applications for authorized users.
7. Provide and/or enhance special event management capabilities to facilitate traffic management capabilities; provide the capability to disseminate important event, and route information including parking (future) information and support evacuations or other major incident/emergency event. This would be managed from a local TCC/TMC with appropriate coordination with other agencies involved in the event.

8. Provide portable Traffic Management System (PTMS) for cases where permanent deployment of ITS devices is not available, feasible and/or cost effective.
9. Monitor and preserve ITS / Traffic signal equipment and infrastructure investments by upgrading Traffic signal cabinets and equipment to provide network monitoring capabilities to allow proactive maintenance activities.
10. Upgrade traffic signal cabinets with network monitoring capabilities including; IP conflict monitors, IP battery back-up, etc.
11. Provide an upgrade to communications to school flashers to allow for centralized control and monitoring of these flasher systems to enhance performance and flexibility to control flashers remotely.

B. TRANSPORTATION SAFETY AND SECURITY

A significant reason for traffic congestion in urban areas is due to traffic incidents ranging from flat tires to overturned tractor-trailers. These unforeseen events cause havoc, making commuters late, affecting truck deliveries, and ultimately making the region less competitive economically. Hazmat spills or crashes involving fatalities can turn what might have been a minor incident into a long-term road closure lasting hours. Primary incidents can cause secondary accidents, where drivers may slam into the rear of an unanticipated queue; the secondary crash can occasionally be worse than the original incident. More effective incident / emergency management will increase safety and survival rates for crash victims and emergency responders.

Incident management is a multi-step process involving incident detection and verification, emergency responder response, management of on-site emergency personnel, traffic management, clearance of vehicles and debris, and recovery to normal traffic flow. It involves diverse technical skills and an assortment of different organizational entities. Incident management programs have to be sensitive to all phases of incident management and the institutional relationships, many of which are outside the purview of the traditional transportation planning and funding processes.

1. Provide and/or expand emergency vehicle preemption (EVP) systems providing high priority activation to allow properly equipped emergency vehicles to pass through the signalized intersection unimpeded with existing traffic signals returning to normal operations in a timely manner. (Since EVP systems impact normal traffic signal operations, policy decisions by the agency having jurisdiction may need to precede their deployment.)
2. Provide a preemption system that is compatible / interoperable with existing systems and other agencies that use the roadway network to access emergency facilities / hospitals.
3. Provide and/or expand enhanced reference location signs which will permit travelers to accurately locate and communicate an incident location to 911 dispatchers providing for a quicker response time.
4. Provide the capability to share real-time surveillance video and situational traffic information with emergency responders prior to arriving at the scene so they are better prepared to handle the situation. This information should also assist

emergency responders to navigate around traffic congestion generated by the incident or emergency.

5. Provide flashing yellow arrow (FYA) conversion for existing signalized intersections that currently have left-turn phase with permissive left-turn movements, improving safety. Provide all upgrades to existing cabinets including 332 cabinet, Aux file, etc., as required.
6. Provide rural intersection warning system capabilities to provide active, real-time supplemental warning to drivers approaching an intersection and alert them to look for on-coming traffic. (Since the warning systems are still emerging, policy decisions by the agency having jurisdiction may need to precede their deployment.)
7. Provide a red light running compliance measurement tool at selected intersections to determine the level of red-light compliance and determine the need to implement measures to increase compliance and safety. (The measurement tool does not include an enforcement component.)
8. Provide traffic signal reflective back-plate upgrades to existing traffic signal indication to improve the visibility to reduce unintentional red-light running crashes.
9. Provide an advanced train warning system using advanced detectors from the rail crossing to provide estimated time of arrival and duration of trains at selected at-grade crossings so that emergency vehicle responders can avoid unnecessary delays en-route to area hospitals to protect and save lives.
10. Provide Interstate reference markers along I-20 and I-520 to provide motorists / travelers markers to use as an accurate reference point when they call into 911 or other to report an accident/incident along the interstate / highway.

C. ACCESSIBILITY AND MOBILITY

Provide travelers with increased multi-modal travel options and real-time travel-times and speed data, incident information, weather / roadway conditions, roadway construction activities, transit arrival and departure time information, travel mode options and locations, and other possible travel related information that gives them an opportunity to optimize their trips. With reliable and available information about travel conditions, available services and travel options, travelers can make intelligent decisions about alternative routes or travel modes, and make mid-trip corrective actions to avoid delays.

1. Provide CAD/AVL system for Augusta Public Transit to provide automatic tracking and location services of their fixed route fleet.
2. Provide transit passenger information system (i.e., arrival and departure times, bus stop announcements, etc.) using LED/LCD electronic dynamic message boards at selected bus stops and transfer stations.
3. Provide a voice annunciation system for the Best Friend transit fleet to provide patrons reliable bus arrival / stop information.
4. Conduct a study to investigate travel time technologies and develop a RFP to provide and/or expand real-time travel-time and speed data along major arterials. This should complement the existing travel time systems (GDOT 511 and SCDOT 511) and be capable of providing other information including traffic incidents, construction activities, transit and special events to allow for better choices, and reduced congestion.

5. Provide a travel time pilot project along Whiskey Road and/or other locations before committing to full scale deployment.
6. Provide transit signal priority (TSP) system providing low priority activation at selected intersections to provide better schedule adherence and increased ridership.
7. Provide a TSP system that uses the same equipment as the emergency preemption system deployment.
8. Provide and/or expand en-route traveler information systems to include DMS signs at selected critical decision points along I-20 to support incident management activities including route diversion and event-specific transportation needs.
9. Provide broadband web-site access to real-time video streams and other traveler information.

D. INTEGRATED AND COORDINATED OPERATIONS

Wide varieties of personnel and agencies are involved in managing an incident or other event, with each having their own set of priorities. Fire personnel tend to focus on rescuing people and/or dealing with Hazmat situations, police maintain traffic flow and obtain crash report information, tow truck operators may want to close lanes to upright a vehicle, and TMCs want traffic lanes open as soon as possible. Consequently, under intense pressure at crash sites, conflicts occasionally occur among emergency responders.

1. Develop a regional communications study to explore inter-jurisdictional connections and address performance coverage and compatibility/interoperability issues. Project should investigate communications needs, issues and problems to provide solutions and upgrades to the existing communications systems and networks to enhance agency and overall operational performance and increase system reliability and availability.
2. Expand and/or upgrade communications systems using fiber-based Ethernet network technology and systems to support traffic signal system, CCTV video surveillance system, and other ITS/Traffic network equipment and systems.
3. Deploy fiber optic infrastructure and associated network equipment for greater network flexibility, path redundancy, network reliability, availability and security.
4. Upgrade traffic signal cabinets for fiber-based Ethernet communications.

4.2 ATMS/ITS PROJECTS

ATMS/ITS Projects were identified by matching the ITS goals, strategies and functional/high-level requirements with potential ATMS/ITS and communications technologies addressing specific transportation, mobility and safety related issues within the ARTS Study Area. This process is illustrated in Figure 15.

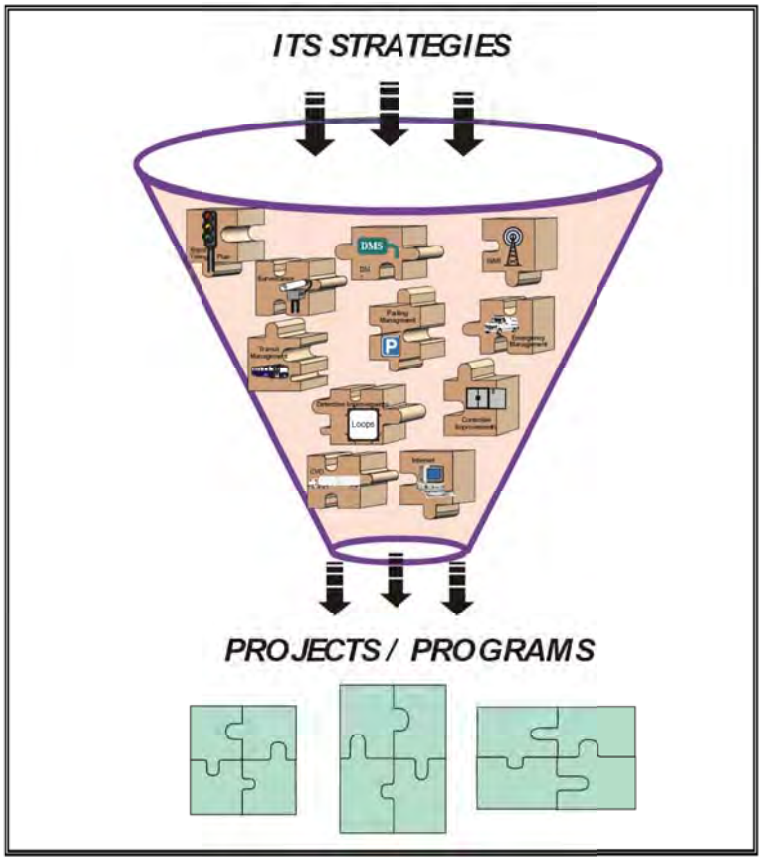


Figure 15. Combining Strategies into Projects

One or several strategies may be included or addressed in one ATMS / ITS project. Thirty-one (31) potential ATMS / ITS projects were identified as described below. The potential ATMS/ITS projects are divided into six (6) primary groups by jurisdiction or area, which are:

1. Region-wide (ARTS)
2. Richmond County (RC) area
3. Columbia County (CC) area
4. Aiken County (AC) area
5. South Carolina DOT (SD)
6. Georgia DOT (GD)

Project descriptions and locations, potential stakeholder involvement, project justification, project dependencies and estimated project costs are provided for each potential ITS project. Project descriptions are intentionally general to preserve a high level of flexibility in regard to the project scope to accommodate changes in technology prior to actual project design and deployment. For this reason, the costs are also general (i.e., rough order of magnitude), and include both capital outlay and operations and maintenance (if feasible or applicable). The costs are presented more as a means of envisioning a plausible deployment scenario, as opposed to providing a firm funding requirement.

Costs are based on similar projects and/or technology (device) bid costs from DOT and/or other agencies. See **Appendix E** *Project Cost Estimate Spreadsheet Index* and corresponding ATMS Master Plan Supplemental Data CD for cost estimate details and assumptions. They have been adjusted where possible and appropriate to reflect the specific project details and local contractor bids. Detailed project scopes, design requirements, and more specific cost estimates should be prepared during project design / concept development and scoping.

ARTS-1: ARTS COMMUNICATIONS STUDY

Project Description and Location(s):

Project would conduct a region-wide communication study to explore inter-jurisdictional connections and address holes in wireless coverage. Project would investigate communications needs, issues and problems to provide solutions and upgrades to the existing communications systems and networks to enhance agency and overall operational performance and increase system reliability and availability. The scope of this project could include a number of items as noted below, and the scope should be refined upon further review by the anticipated stakeholders:

1. Document existing inventory – field and center communications / network equipment and infrastructure (traffic/transportation agencies, emergency/incident response agencies, emergency operations centers/911 call centers, etc.). This will be used to perform a gap analysis depending on overall needs and issues to address.
2. Review operational response plans, protocols to support the development of a comprehensive list of communications needs and issues for evaluating the existing communication systems.
3. Develop a comprehensive communications plan and recommendations (including; fiber, WiFi/Internet, microwave wireless, telephony, etc.) to support existing and future operational procedures, needs and requirements for integrated response and traffic management for the region including; Petticoat Junction radio/wireless coverage issues, communications compatibility issues between emergency response agencies and transportation/traffic departments and others.
4. RF propagation & terrain analysis, frequency spectrum analysis (as required) and path analysis and wireless link design services would be provided to address wireless issues as required or needed.
5. Other design considerations would be investigated in regards to interoperability as required or needed including; shared systems, shared channels or Mutual-aid channels, incompatible radio equipment, patching and IP-based solution upgrades.

Agencies/Stakeholders Involved: ARTS (Lead), Richmond/Columbia/Aiken Counties, Cities, Emergency Management and Response Agencies, Fire and Law Enforcement Agencies, SCDOT, GDOT, State Patrol/Police, and Georgia Emergency Management Agency (GEMA) / Homeland Security (HS).

Project Justification / Potential Impacts (Benefits): Project would provide enhance regional and center-to-center communications within the ARTS region for law enforcement, first responders, and transportation personnel. It will address gaps and performance issues indicated by stakeholders.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 75,000 - 150,000 (study)

Estimated O&M Costs: N/A

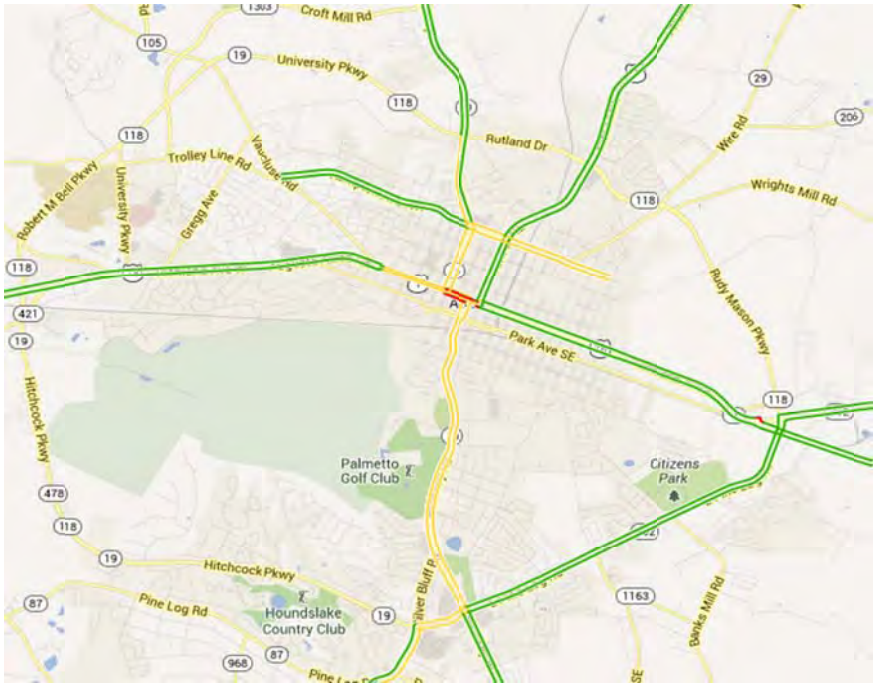
ITS Architecture Compatibility: N/A

Project Dependencies: Identification and participation of regional / area key stakeholders including transportation, emergency response and management, incident response and law enforcement agencies

ARTS-2: ARTS TRAVEL TIME AND REAL-TIME SPEED DATA

Project Description and Location(s):

Project would provide a study of best technology approaches for providing region-wide mobility data collection and real-time speed and travel time dissemination methods (i.e., DMS, web-sites, mobile devices with apps) that will best serve the overall needs of the ARTS region. Findings will be used to develop a RFP for advertisement to obtain the services of a real-time speed and travel-time data provider for the ARTS region. Currently, real-time speed data is available through the 511SC and 511GA web-sites along interstates and some major arterials within the ARTS region (see embedded graphic of City of Aiken) and would be expanded to include additional major roadways as determined during this project as well as providing data services and analysis tools. Data provided is envisioned to enable and support a wide variety of uses and applications, both existing and future. These include but are not limited to:



1. Advanced Traveler Information System (ATIS) – through use of web-sites (GDOT 511, SCDOT 511), web mapping services, mobile apps services, etc. provide pre-trip and en-route real-time travel-time information, congestion alerts, and advisory information on incidents, weather, special events, parking availability, and construction work zones.
2. Advanced Traffic Management System (ATMS) – provides real-time travel time and other traffic related information using DMS (both freeways and arterials) and using advanced traffic/incident management software tools to management and coordinate major events and incidents.
3. Work Zone Monitoring – support construction staging and planning operations.
4. Operations performance measures using historical data to monitor congestion levels, provide evaluation of mitigation measures, identification of bottlenecks and perform trend and origin & destination (O&D) analyses.
5. Trip planning using software applications with historical data to determine expected travel times by time-of-day or week and provide reliability measures advising potential travelers of buffer time.

A pilot demonstration could be included to demonstrate and test travel time services. This pilot demo would collect and report in real-time a distribution of travel times along the Whiskey Road, SC or other corridor. If included, this demo would replace Project AC-8 (Concept 1).

Agencies/Stakeholders Involved: ARTS (Lead), Counties, City of Augusta, City of North Augusta, City of Aiken, SRS, Grovetown, Augusta Public transit, GDOT, SCDOT, 511GA and 511SC providers

Project Justification / Potential Impacts (Benefits): Project would provide region-wide travel-time and real-time speed data that will support overall transportation management operations allowing for travel time to be disseminated throughout the region and provide valuable data to transportation agencies. This data will be of increasing importance as the FHWA begins to require performance metrics for arterials in future years.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 100,000 to $ 150,000 (study, RFP development) / $ 45,000 (F&I & data services & hosting, Bluetooth travel time system pilot demo)

Estimated O&M Costs: N/A

ITS Architecture Compatibility: N/A

Project Dependencies: None

ARTS-3: ARTS ADVANCED WARNING TO AVOID RAILROAD DELAYS (AWARD)

Project Description and Location(s):

Project would provide and perform preliminary engineering (PE) services to study the most effective and cost effective means to develop a system to provide sufficient advanced warning to emergency vehicles and law enforcement vehicles in route to at-grade crossings to avoid unnecessary delays and saving and protecting lives. Emergency first responders from Aiken County take two primary routes into Downtown Augusta to access area hospitals and get delayed at at-grade train crossings due to active train activity.

Project would investigate various alternatives (field and back-end hardware and software solutions), types and locations of advanced upstream enhanced train detection sensors, video surveillance, communications from the field to the back-end center(s), software processing of the real-time field data, and dissemination of estimated time of arrival and clearance of CSX and Norfolk trains at selected at-grade crossings. Project would also investigate application to Augusta-Richmond County emergency first responders as well as law enforcement agencies, and Augusta Public Transit bus services in the area.

Project would test the recommended concept before recommending full scale deployment. A pilot demonstration phase would be conducted from the Aiken County Emergency Operations Center (dispatch center) at the following at-grade rail crossings:

1. Walton Way near 12th Street
2. 13th Street between Fenwick St. and Telfair Street

Agencies/Stakeholders Involved: ARTS (Lead), Augusta-Richmond County, Aiken County Emergency Responders, County/City Emergency Responders, Augusta Public Transit, CSX and Norfolk Railroads.

Project Justification / Potential Impacts (Benefits): Project would provide critical notification and monitoring of active trains within the region allowing for emergency first responders in route to hospitals to divert and take alternative routes. This will save lives and improve overall system performance as well as provide transit, law enforcement and the public information on estimated time of arrival of trains at at-grade crossings.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 80,000 to $ 150,000 (study, preliminary engineering) / $ 250,000 (F&I, pilot demo)

O&M Costs: N/A

ITS Architecture Compatibility: ATMS13; EM02

Project Dependencies: Availability of broadband wireless internet services and/or other applicable communications services in the project locations.

RC-1: RICHMOND ATMS MASTER PLAN IMPLEMENTATION

Project Description and Location(s):

Project would provide Advanced Traffic Management System (ATMS) upgrades and expansion to provide enhanced and improved traffic signal and management operations, and surveillance capabilities as well as fill-in gaps in the existing communications coverage within Richmond County. Improvements and upgrades to be provided under this project would include the following, as illustrated on Figure 16 to Figure 18:

1. ATMS Expansion and Upgrades:
    a. *Fiber Optic Communications* – would include approximately 26 miles of new fiber optic infrastructure (i.e., primarily overhead/aerial) to expand the existing and/or planned fiber comm. to support improved traffic signal operations, support video surveillance and other. Fiber would be provided to provide a connection to Columbia County existing fiber to provide connectivity between County TMCs. To the extent possible, fiber would be installed overhead/aerial on existing utility poles (with new messenger or over-lashing to existing).
    b. *CCTV Video Surveillance System* – would include an estimated 82 new CCTV IP cameras (H.264) primarily mounted to traffic signal mast arm pole extensions to provide comprehensive video surveillance coverage at key / critical intersections with high accident rates and along high congestion corridors. Video Management Software would be provided, as required or needed, to monitor and control all cameras
    c. *Cabinet Communications Upgrades* – would include communications network upgrades to approximately 150 traffic signal cabinets to provide hardened Ethernet switches to provide IP network communications to/from the signalized intersection. Project will also include two (2) wireless nodes (for crossing bridge) will be provided, as required.
    d. *Traffic Signal Upgrades* – would include; a) replacement of older cabinets (at 11 locations) and b) expansion of the existing adaptive signal control system along key corridors/intersections (at 18 intersections).
2. **TMC Expansion and Upgrades** – would include system and space expansion of the Augusta-Richmond County TMC including; operator consoles and workstations, servers, office furniture, network equipment, video display monitors, equipment racks, software, network and AV cabling and remote access capabilities. Capabilities would also be provided at the County 911 Center including the 911 Dispatch Room and the Emergency Management Center room. See Figure 19 and Figure 20 for potential Traffic Engineering TMC / 911 Center room layout and concept.

- ***Remote access capabilities*** using web-based software platform with appropriate security measures would be provided. This would also provide the capability for equipping another facility (i.e., 911 Center) to functionally provide back-up capabilities to the system if the Augusta TMC goes off-line for any reason.
- ***Software access*** to NAV2 and other video-sharing websites would allow the TMC Operator to monitor and track incident /

emergency information during an event as well as monitor GDOT I-20 and I-520 surveillance cameras and DMSs. Roadway construction work zone locations and pertinent information would be able to be input by the Operator by putting an icon on a map with text description of the conditions. This project would look at the possibility of adding a software bridge (integration) of existing Emergency Management / Dispatch Center CAD information to allow dispatchers to input relevant incident information and data to NAV2 using their existing system software and interface.

- Traveler information about congestion, incidents and construction would be directly fed to the 511GA information system, which is accessible to the public via GDOT's website, mobile apps, and social media.

3. **Richmond County Video Sharing System (R-View)** – would include flexible, cost effective and secure video sharing capabilities throughout the County to transportation agencies, emergency responders, public agencies, media outlets, as well as the public. See Figure 21 for recommended video sharing system concept. The recommended video sharing system concept would include the following features and capabilities:

a. Capable of supporting the recommended CCTV camera video streams as well as the upgraded 12 video streams currently on Augustatraffic.com.

b. Video would be in a standard open format available at selectable bandwidths that could be accessed via personal computers, websites, intranets, internet, and through handheld / mobile devices (including; iPhone/iPad, Android Phone/Tablet, Blackberry). Provide support for all major browsers including; Firefox, Safari, IE, and Chrome. Note: GDOT may provide a video sharing solution as part of this project.

c. The secure video portal would be capable of being accessed by any designated partner agency, media outlet, law enforcement and emergency first responder, free of charge with proper login information from any intranet and/or internet connection.

d. The public and others would also have access to the video through an upgraded existing website (Augustatraffic.com) and/or a GDOT-sponsored video sharing website.

e. Depending on the cameras that a user is authorized to see, the video portal would be capable of being used as a map-based (Google map) view with several concurrent

cameras or as a list-based Video Wall of multiple concurrent cameras.

f. The solution would also include a feature that would track the current traffic incidents in Richmond County and automatically choose and display the closest cameras to the event.

g. Provide dedicated commercial-grade broadband Internet service at the TMC with both high bandwidth upstream and downstream performance – fiber-based Internet service is available in Augusta at a reasonable monthly cost.

Agencies/Stakeholders Involved: Augusta-Richmond County Traffic Engineering (Lead), Augusta IT, County 911 Center, Columbia County Engineering, and GDOT.

Project Justification / Potential Impacts (Benefits): Project would provide increased efficiency of overall traffic operations, increased safety to the traveling public, result in less delay and better travel times along major corridors, allow travelers to access corridor live video streams to make informed alternate route decisions, and improve emergency response readiness through access to live video en-route to incidents. It will also improve responsiveness for traffic and transportation maintenance personnel to field issues, and provide remote monitoring and troubleshooting capability for traffic control devices.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 500,000 (engineering) / $ 4,000,000 (F&I, construction)

O&M Costs: $ 350,000 (8 to 10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS01, ATMS03, ATMS08

Project Dependencies: The Richmond ITS Master Plan Implementation project is a high priority deployment item and is included in the ***TIA-funded (Band 1) initial ATMS deployment*** for early construction.

Figure 16. RC-1, Proposed Traffic Signal Upgrades

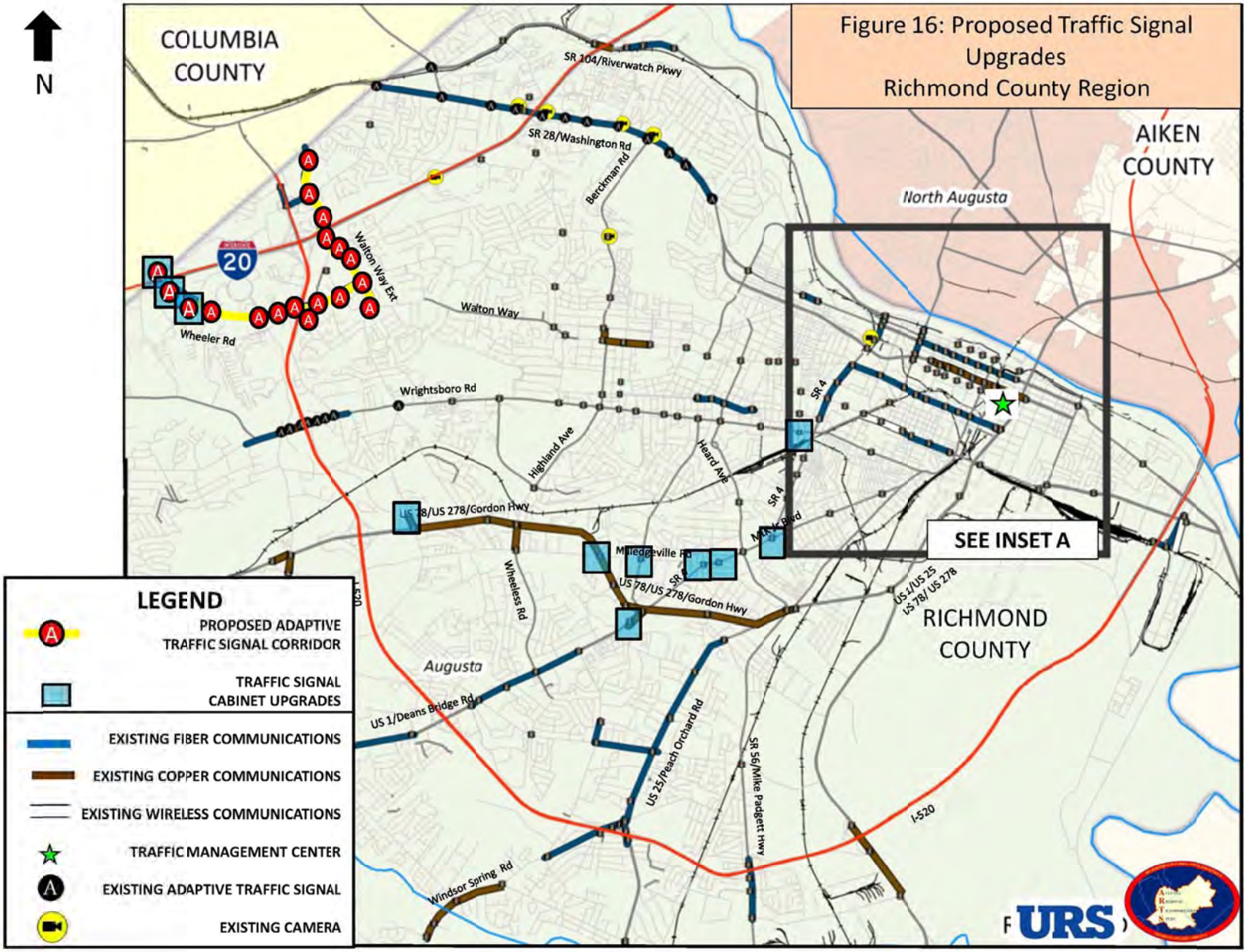


Figure 17. RC-1, Proposed Communications and CCTV

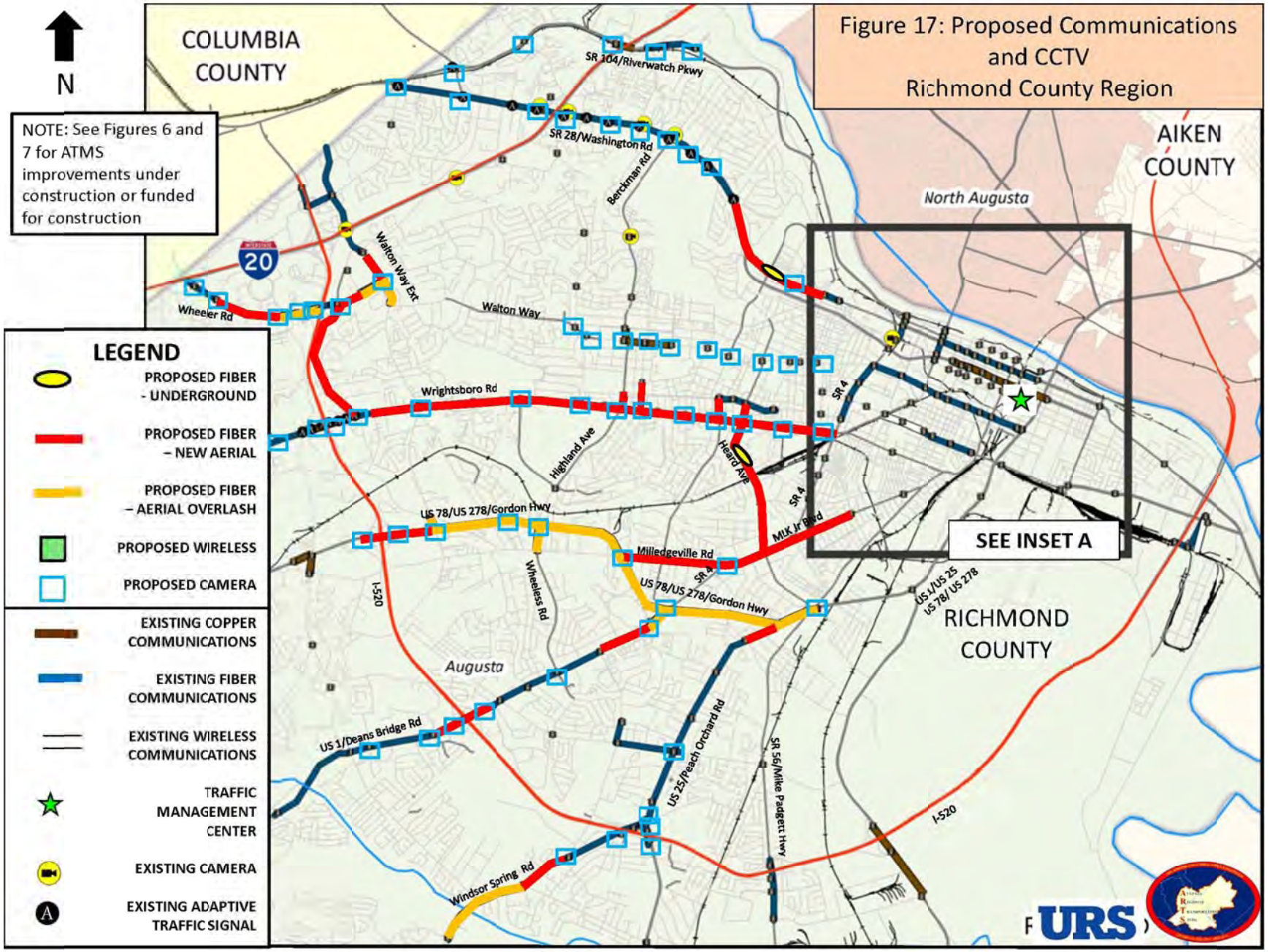


Figure 18. RC-1, Proposed Communications and CCTV (inset)

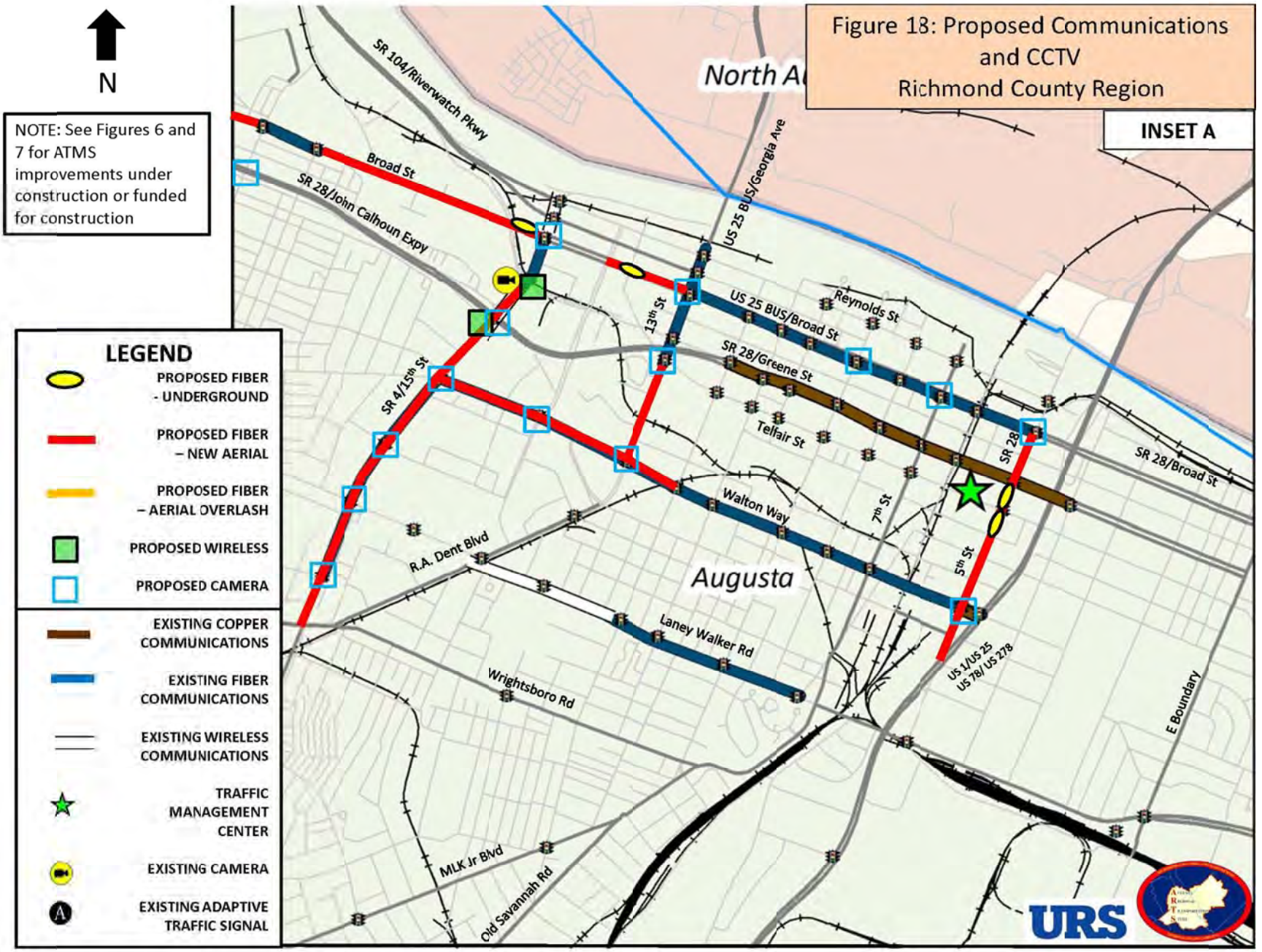
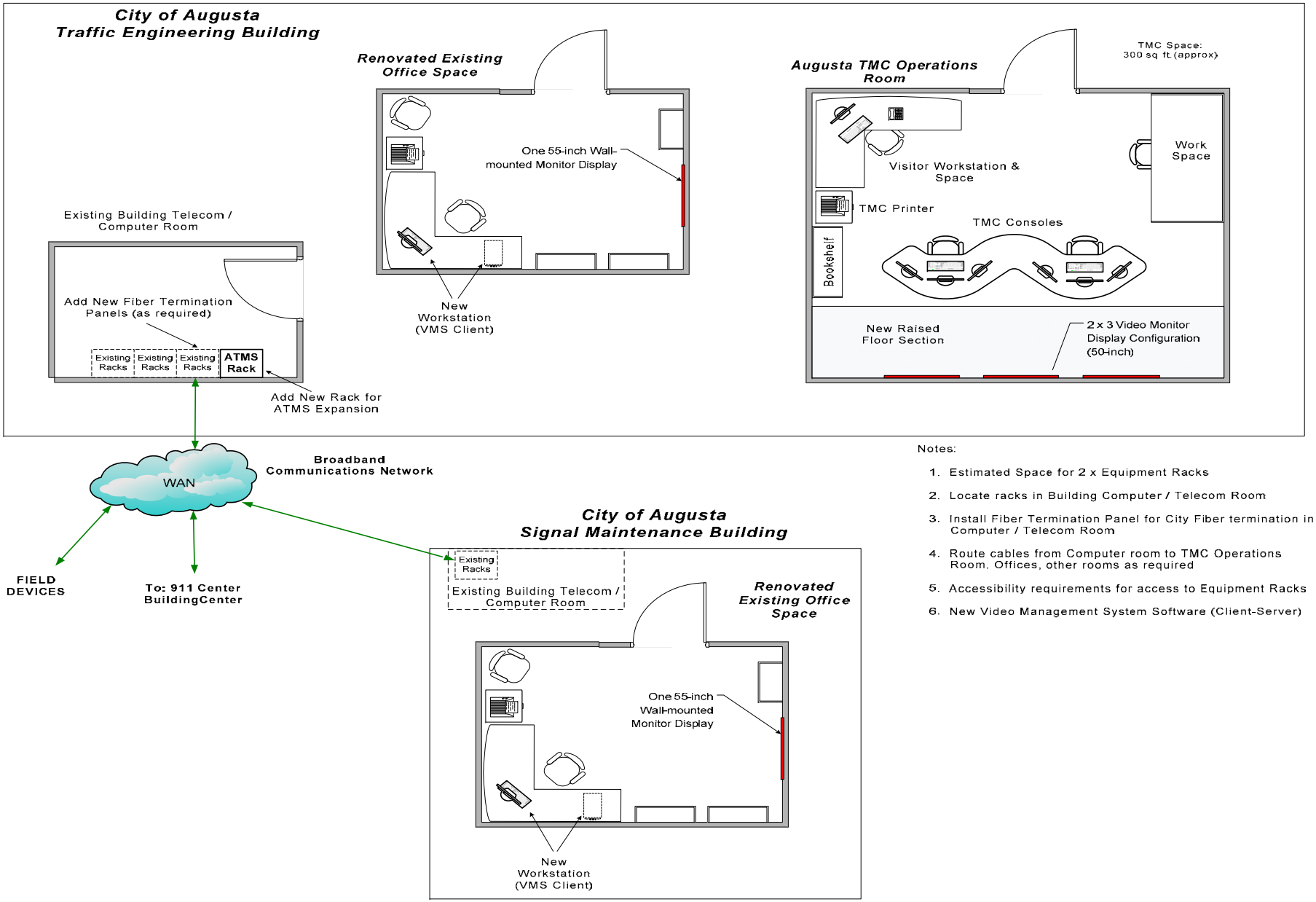


Figure 19: Augusta TMC Operations and Signal Maintenance Room Layouts *(Not to Scale)*



Notes:

1. Estimated Space for 2 x Equipment Racks
2. Locate racks in Building Computer / Telecom Room
3. Install Fiber Termination Panel for City Fiber termination in Computer / Telecom Room
4. Route cables from Computer room to TMC Operations Room. Offices, other rooms as required
5. Accessibility requirements for access to Equipment Racks
6. New Video Management System Software (Client-Server)

Figure 20: Augusta 911 Dispatch and EMC Room Layout *(Not to Scale)*

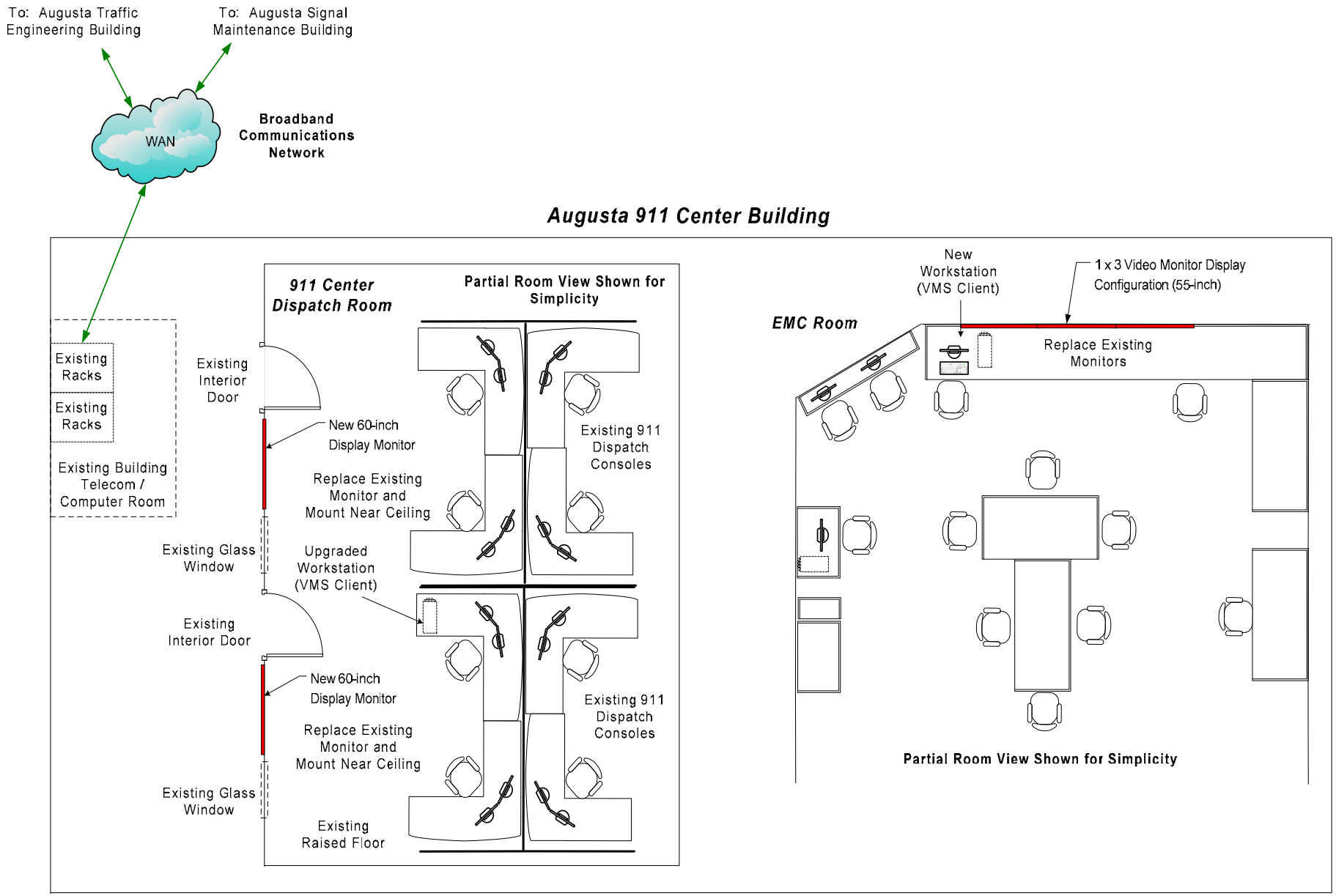
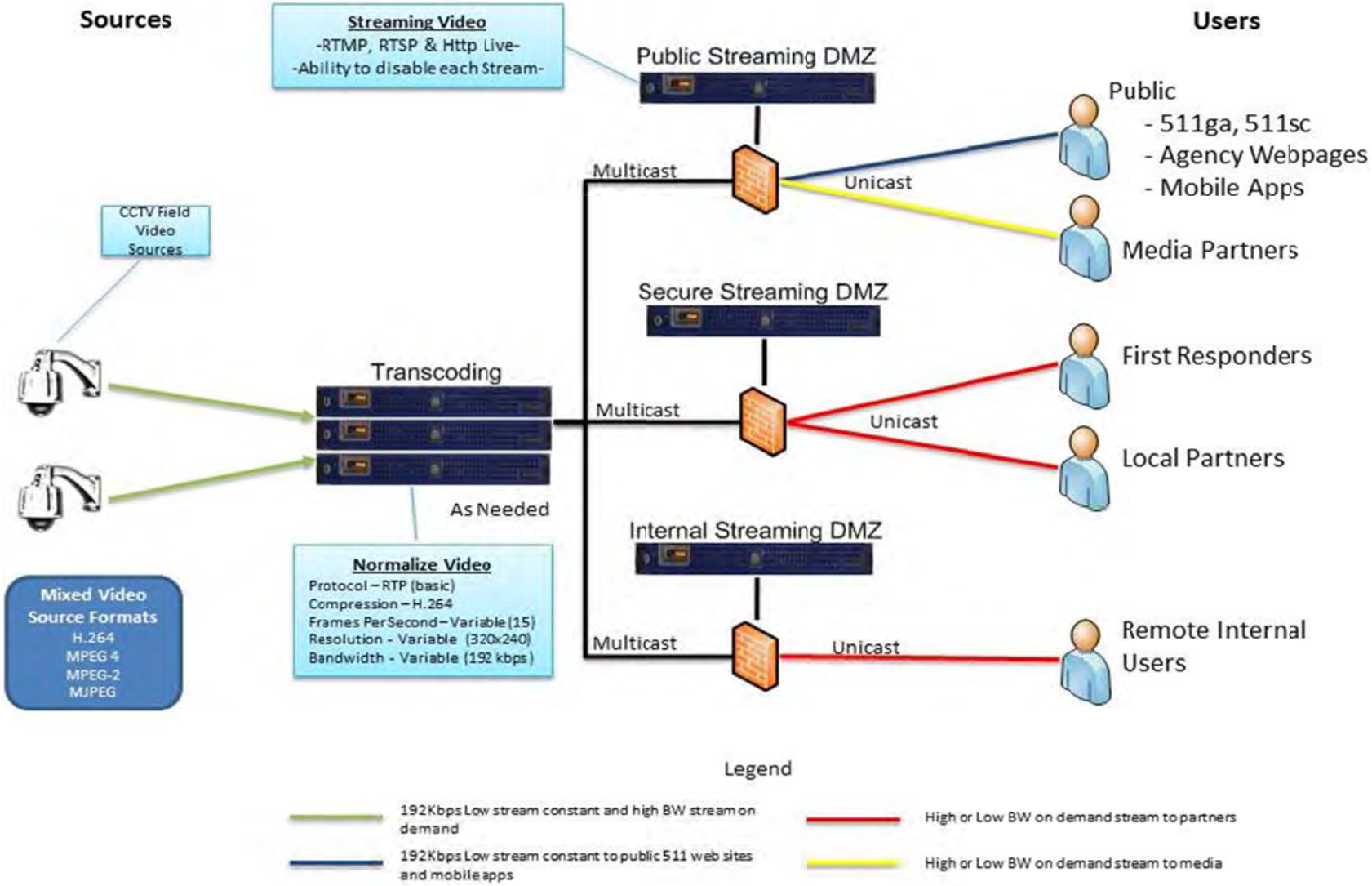


Figure 21: Video Sharing Concept



RC-2: RICHMOND COUNTY EMERGENCY PREEMPTION AND TRANSIT VEHICLE PRIORITY SYSTEM

Project Description and Location(s):

Project would provide Emergency Vehicle Preemption and Transit Signal Priority capabilities at selected intersections and on vehicles within the County. The system design would include the following features and capabilities. See Figure 22 and Figure 23.

1. System would support an estimated 120 intersections, 49 emergency first responder vehicles, and 23 Augusta Public Transit fixed route buses.
2. System would permit for multiple agencies to use of the same system (interoperable) – i.e., emergency responders, transit agency, law enforcement agencies and other counties.
3. System would provide three (3) types of activation – high priority (emergency preemption), low priority (transit signal priority) and probe vehicle (allow equipped vehicle to be used as a probe for travel time system without preempting system).
4. System would consist of a GPS-based system allowing for non-LOS (line of sight) operations with ranges up to 3000 ft. away from an intersection.
5. System would require a single intersection radio/GPS unit that would receive information from all directions and would also recognize activated turn-signal and relay priority call forward to the next appropriate intersection on route.
6. System would be able to be integrated into current traffic signal cabinets and utilized a dual system or multimode Phase Selector/ Priority Detector that interfaces with the existing signal controller.
7. Minimize traffic disruption / delays by providing protected left turns and adjustable activation based on estimated time of arrival (ETA) and/or distance.

Since these systems impact normal traffic signal operations, policy decisions by the agency having jurisdiction may need to precede their deployment.

Agencies/Stakeholders Involved: ARTS (Lead), Augusta-Richmond County (Lead), Aiken County Emergency Responders, County/City Emergency Responders and Law Enforcement Agencies, and Augusta Public Transit.

Project Justification / Potential Impacts (Benefits): System would reduce emergency response times, saving lives, increase safety for the emergency responders, and increase overall operational efficiency. It will also improve schedule adherence, reduce bus route running times and improve bus route travel time reliability.

Estimated Planning/Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 250,000 (engineering) / $ 1,250,000 (F&I, construction)

Estimated O&M Costs: $ 125,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: EM02; APTS09

Project Dependencies: The Richmond ITS Master Plan Implementation project is a high priority deployment item and is included in the ***TIA-funded (Band 1) initial ATMS deployment*** for early construction.

Figure 22. RC-2, Proposed Emergency Vehicle Preemption & Transit Priority System

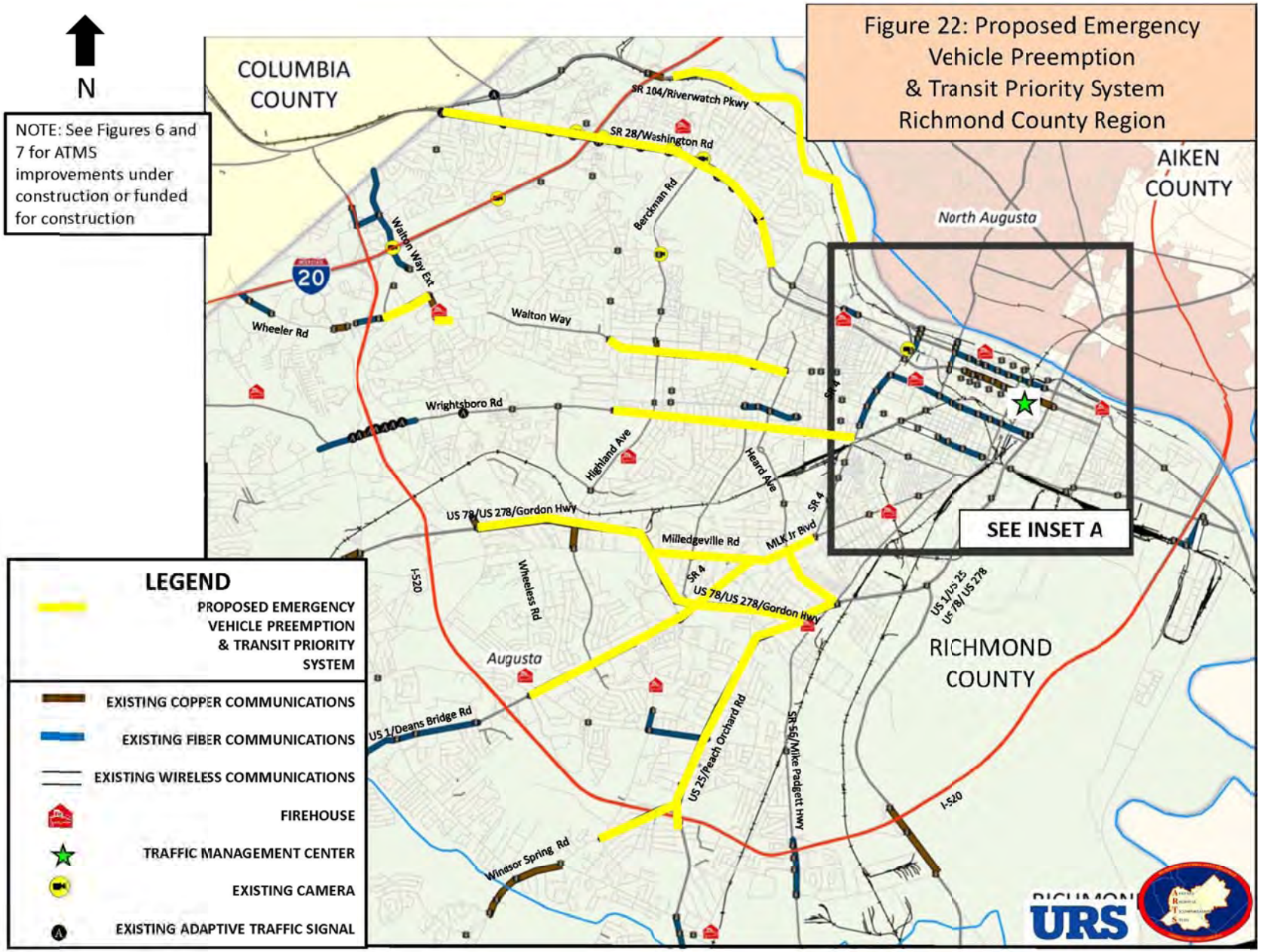
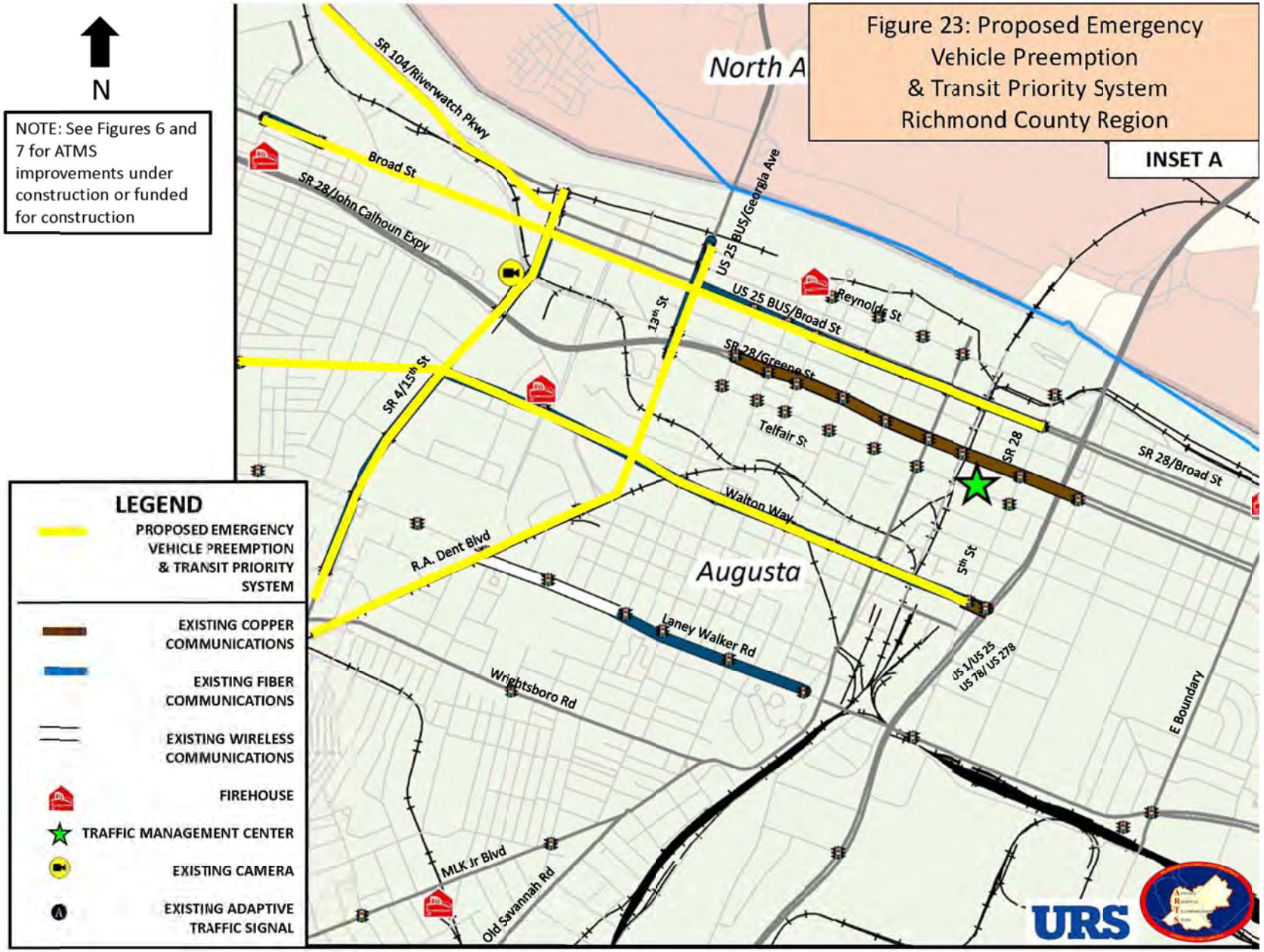


Figure 23. RC-2, Proposed Emergency Vehicle Preemption & Transit Priority System (inset)



RC-3: AUGUSTA FIXED ROUTE CAD/AVL SYSTEM

Project Description and Location(s):

Project would provide Augusta Public Transit a Fixed Route Computer Assisted Dispatch/Automatic Vehicle Location System (CAD/AVL) for their fixed route buses. The project would include the following features and capabilities:

1. System would provide CAD/AVL system capabilities for the existing fixed route fleet of 23 vehicles and support future expansion as needed.
2. System would provide real time schedule adherence and fixed-route service monitoring.
3. System would be fully integrated with the demand response system for the purposes of increasing ridership on fixed routes.
4. System would support and allow Augusta Public Transit to provide customers with precise information about when the next bus will come to a specific location (see Project RC-4 for details and concept).

Agencies/Stakeholders Involved: Augusta Public Transit (Lead) and Augusta-Richmond County Traffic Engineering.

Project Justification / Potential Impacts (Benefits): Project would provide capability to provide automatic tracking and location services for the transit fixed-route fleet allowing for better operational efficiency, increased performance, provide capability to manage routes and scheduling information. This project would also provide the necessary component s to support and permit Project RC-4.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 21,000 (engineering) / $ 211,000 (F&I, construction)

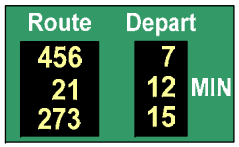
Estimated O&M Costs: $ 21,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: APTS01, APTS02

Project Dependencies: Deployment of this project is required to support Project RC-4. Coordinate with existing Transit Software being used for ADA paratransit / rural services.

RC-4: AUGUSTA ARRIVAL AND DEPARTURE PASSENGER INFORMATION SYSTEM

Project Description and Location(s):



Project would provide the capability of providing passenger information dissemination (including "Next Bus" arrival and departure times) to selected Bus Shelters/Stops. See Figure 24 for possible system design concept. The project would include the following features and capabilities:

1. Provide "Next Bus" signage at 31 locations including; 29 existing shelters/stops and two (2) transfer stations) within the County. See Figure 25 and Figure 26 for locations of recommended shelters/stops for deployment.
2. System design would provide real-time bus arrival and/or departure times (i.e., "Next Bus") for each Fixed Bus Route through the use of high-resolution LED and/or LCD electronic message boards mounted at a Shelter, Sign Post, and Transfer Station.
3. Signs would be either mounted on existing bus shelter or on a new sign post at a bus stop (that has no existing shelter facility). Power would be provided from near-by power services.
4. Each electronic message board would be tied into the Augusta Public Transit communications network and would be controlled from the Main Transfer Station facilities.
5. Calculation of estimated time of arrival and departures from each shelter for each bus route would be provided through add-on modules to existing Bus Dispatch and Management software (see RC-3 description for details).

Agencies/Stakeholders Involved: Augusta Public Transit (Lead) and Augusta-Richmond County Traffic Engineering.

Project Justification / Potential Impacts (Benefits): Project would provide valuable next bus arrival and departure times for transit patrons allowing them to use and plan their time for efficiently and effectively. Increase ridership and overall patron satisfaction of transit services, reliability and flexibility.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 40,000 (engineering) / $ 400,000 (F&I, construction)

Estimated O&M Costs: $ 40,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: APTS08

Project Dependencies: This project requires that an existing Augusta Public Transit fixed route CAD/AVL system be operational for their existing fixed route fleet (23 total buses). See Project RC-3 for details.

Figure 24: Augusta Public Transit Project Concept

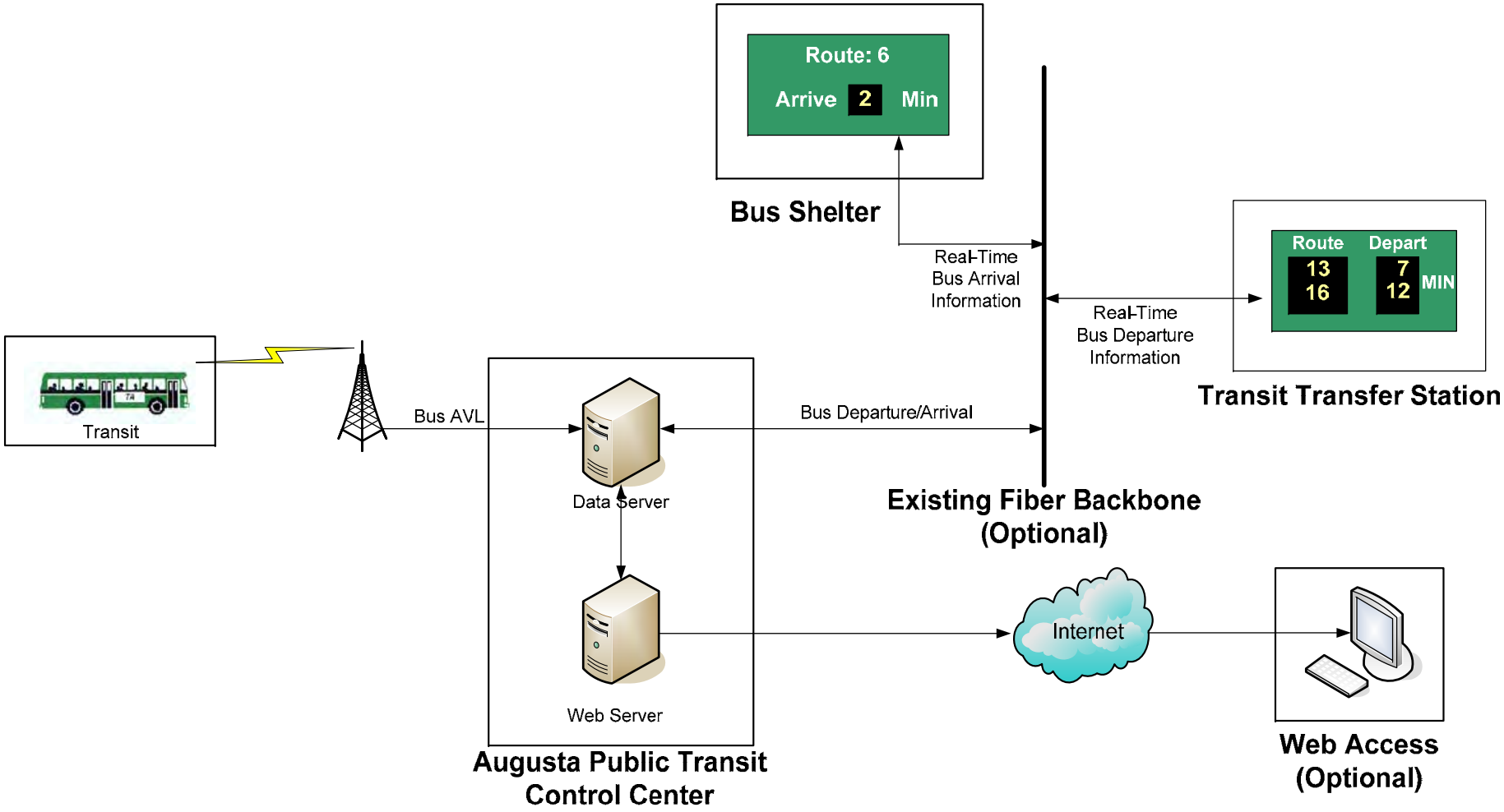


Figure 25. RC-4, Augusta Transit Next Bus Message Signs

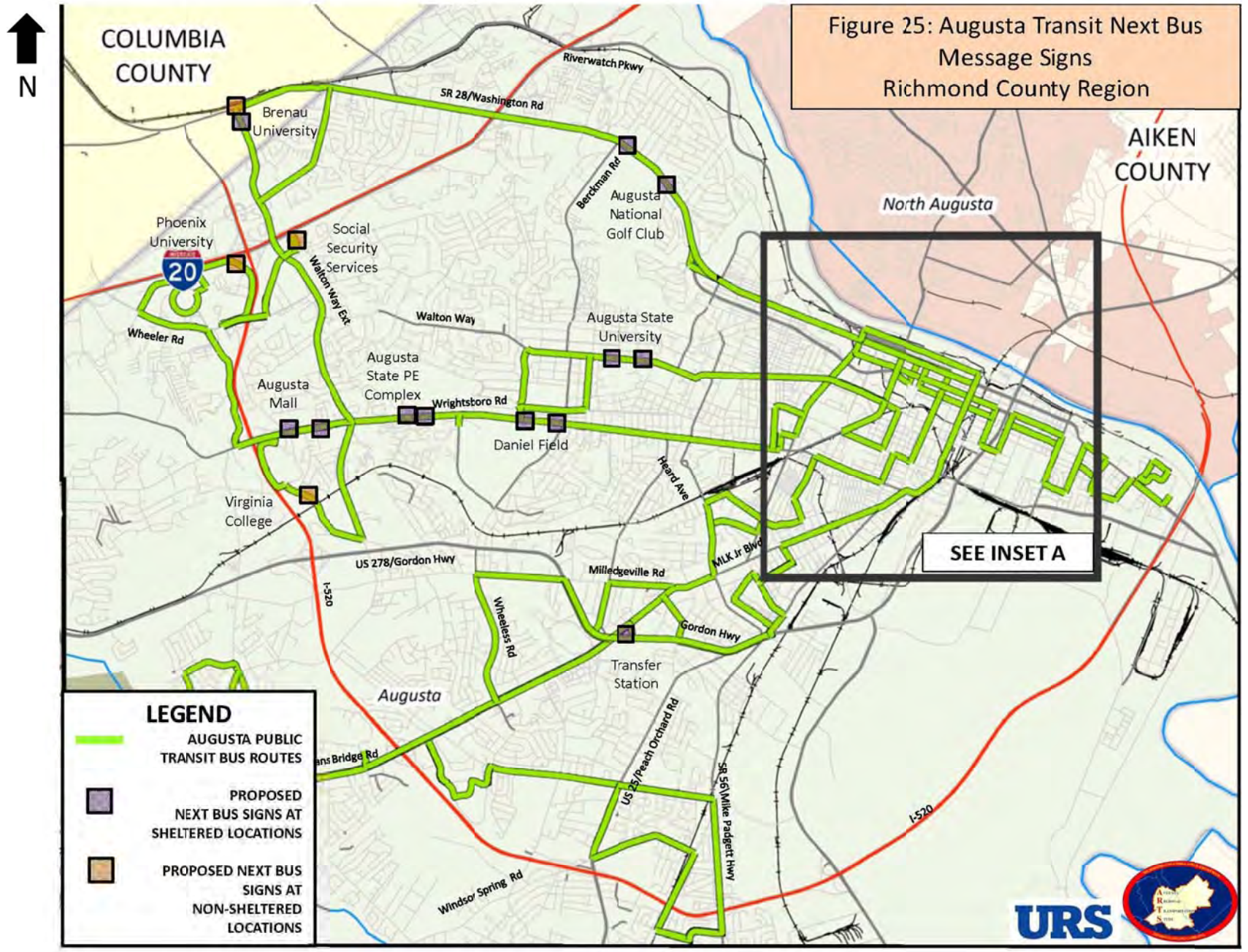
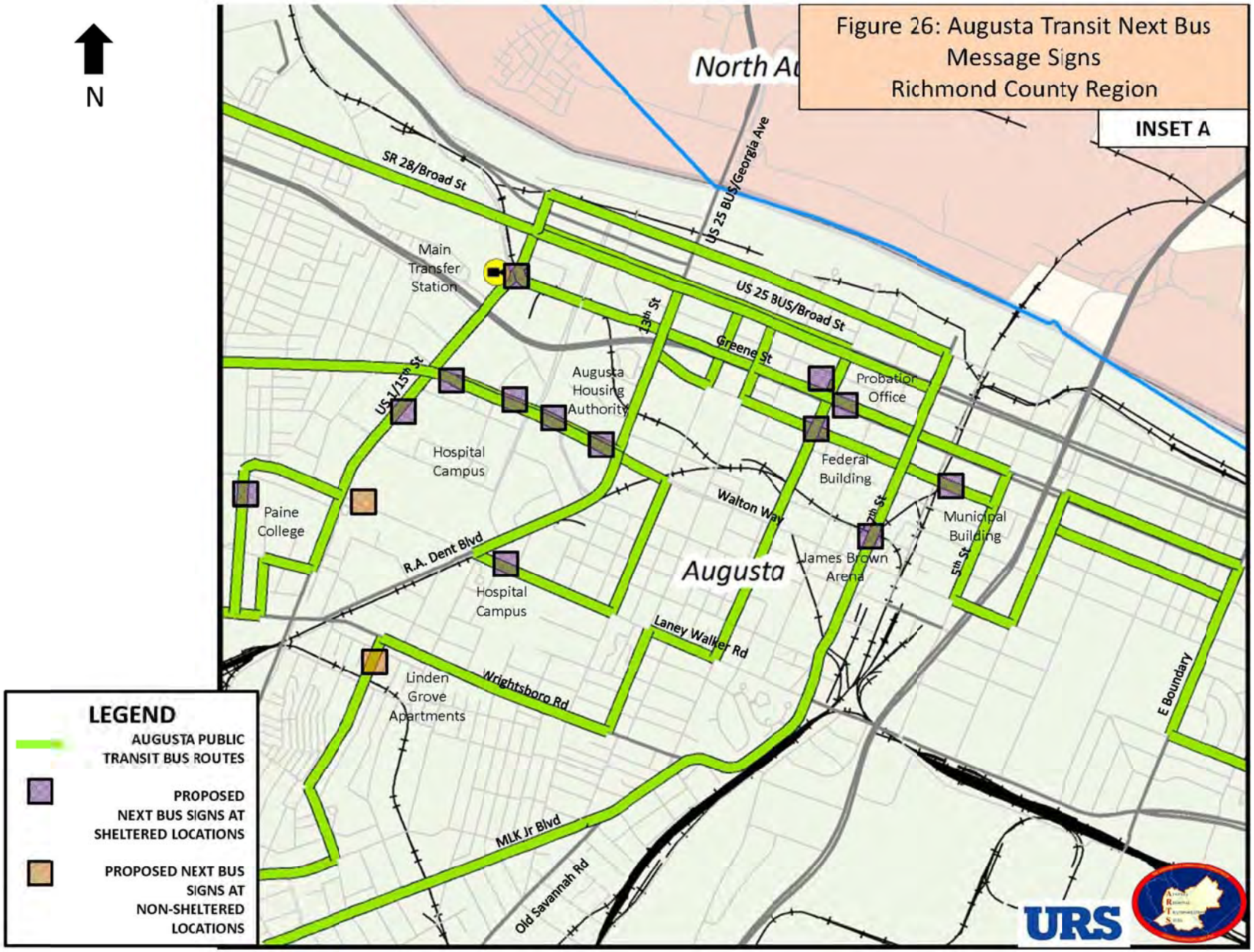


Figure 26. RC-4, Augusta Transit Next Bus Message Signs (inset)



RC-5: AUGUSTA-RICHMOND FLASHING YELLOW ARROW CONVERSION

Project Description and Location(s):

Project would upgrade existing intersections that already have left-turn phase with permissive left-turn movements to provide flashing yellow arrow signal-heads and capabilities. The project would provide the following features and capabilities:

1. System would upgrade (150 intersections, 240 approaches) that already have left-turn phase with permissive left-turn movements to flashing yellow arrows.
2. Survey existing cabinets and equipment and upgrade/add as required to support FYA operations including; utilize a 332 cabinet with Aux File, Type F or newer conflict monitor, additional conductor / wiring as required, etc.

Agencies/Stakeholders Involved: Augusta-Richmond County (Lead) Traffic Engineering and GDOT.

Project Justification / Potential Impacts (Benefits): Flashing yellow arrows have been shown to reduce intersection crashes (especially angle & opposing left collisions), move more traffic through an intersection, remove yellow trap condition, provide additional traffic management flexibility, and are more understandable to drivers and provide more opportunities for left turns.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 81,000 (engineering) / $ 814,000 (F&I, construction)

Estimated O&M Costs: Included in existing traffic signal maintenance costs

ITS Architecture Compatibility: ATMS03

Project Dependencies: Existing left-turn signalized intersections, existing cabinets and associated equipment will support FYA operations.

RC-6: AUGUSTA-RICHMOND SCHOOL FLASHER NETWORK UPGRADE

Project Description and Location(s):

Project would provide include 2-way communications upgrades to existing school flashers throughout the County. This will allow them to be connected to a wide area network for automatic control and management over a network and from a centralized location. The project would provide the following features and capabilities:

1. Support (initially) up to 90 school flasher locations
2. Determine and deploy a reliable communications network to communicate with each school flasher from a centralized location that may include: a) fiber optic connection and using Ethernet switches, 2) wireless Internet using 802.1b services, 3) cellular modems using SMS texting and/or 4) radio/wireless RS-232 connections
3. Centralized system (workstation/server with software) would provide the following capabilities: a) remote configuration and programming; b) support multiple day plans including; normal, early out, summer school day, etc.; c) support annual plans including; holidays, vacation days, etc.; d) override capability for inclement weather, special events, etc.

Agencies/Stakeholders Involved: Augusta-Richmond County (Lead) Traffic Engineering and GDOT.

Project Justification / Potential Impacts (Benefits): Project would provide enhance performance and flexibility to control school flashers remotely from a centralized location. Flasher schedules could be set to match the needs of the schools and provide better reliability of the flasher systems.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 60,000 (engineering) / $ 670,000 (F&I, construction)

Estimated O&M Costs: $ 67,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS26

Project Dependencies: Depends on RC-1 (fiber optic comm. and cabinet comm. upgrades) being operational or other network connection (i.e., wireless internet, area radio/wireless system) being available at the project locations.

RC-7: RICHMOND COUNTY ATMS EXPANSION

Project Description and Location(s):

Project would provide Advanced Traffic Management System (ATMS) upgrades and expansion within the County and City to provide enhanced and improved traffic operations, management and surveillance capabilities as well as fill-in gaps in the existing communications coverage within Richmond County. Locations would be determined during the design phase and would be designed to build on the completed and operational ATMS and fill-in gaps and provided necessary upgrades as required. Project would include the following:

1. Fiber Optic Communications -- continue to expand the fiber optic communications to pick up off-network signalized intersections.
2. Cabinet Upgrades – will include providing upgrades and integration of network monitoring capabilities including; IP conflict monitors, IP battery back-up, etc.
3. Traffic Signal Upgrades – will include replacement of older cabinets.
4. Signal Optimization – will include re-timing / optimization of selected corridors as required or needed.

Agencies/Stakeholders Involved: Augusta-Richmond County (Lead) Traffic Engineering, Augusta IT, and GDOT.

Project Justification / Potential Impacts (Benefits): Project would provide expansion of the existing ATMS (see TIA Project RC-1) which would provide increased efficiency of overall traffic operations, increased safety to the traveling public, result in less delay and better travel times along major corridors, allow travelers to access corridor live video streams to make informed alternate route decisions, and improve responsiveness for traffic and transportation maintenance personnel to field issues, and provide remote monitoring and troubleshooting capability for traffic control devices.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 300,000 (engineering) / $ 3,000,000 (F&I, construction)

Estimated O&M Costs: $ 300,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS03

Project Dependencies: Depends on Project RC-1 being fully operational.

CC-1: COLUMBIA COUNTY EMERGENCY PREEMPTION SYSTEM EXPANSION

Project Description and Location(s):

Project would provide and expand Emergency Preemption capabilities to include 35 additional intersections and would equip ambulances under an existing service contract (estimated 10 ambulance vehicles) with GPS-based equipment that is compatible with the existing / legacy preemption system. See Figure 27 and Figure 28 for locations of the additional intersections to provide emergency preemption capabilities.

Agencies/Stakeholders Involved: Columbia County Engineering (Lead), County Emergency Responders, Ambulance service contract vehicles.

Project Justification / Potential Impacts (Benefits): System expansion would reduce emergency response times, saving lives, increase safety for the emergency responders, and increase overall operational efficiency.

Estimated Planning/Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 150,000 (construction materials furnish only) – Note: County will be providing engineering and installation services for the emergency preemption expansion components.

Estimated O&M Costs: $ 15,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: EM02

Project Dependencies: Coordination with existing / legacy preemption system and signal cabinets.

Figure 27. CC-1, Proposed Emergency Vehicle Preemption System

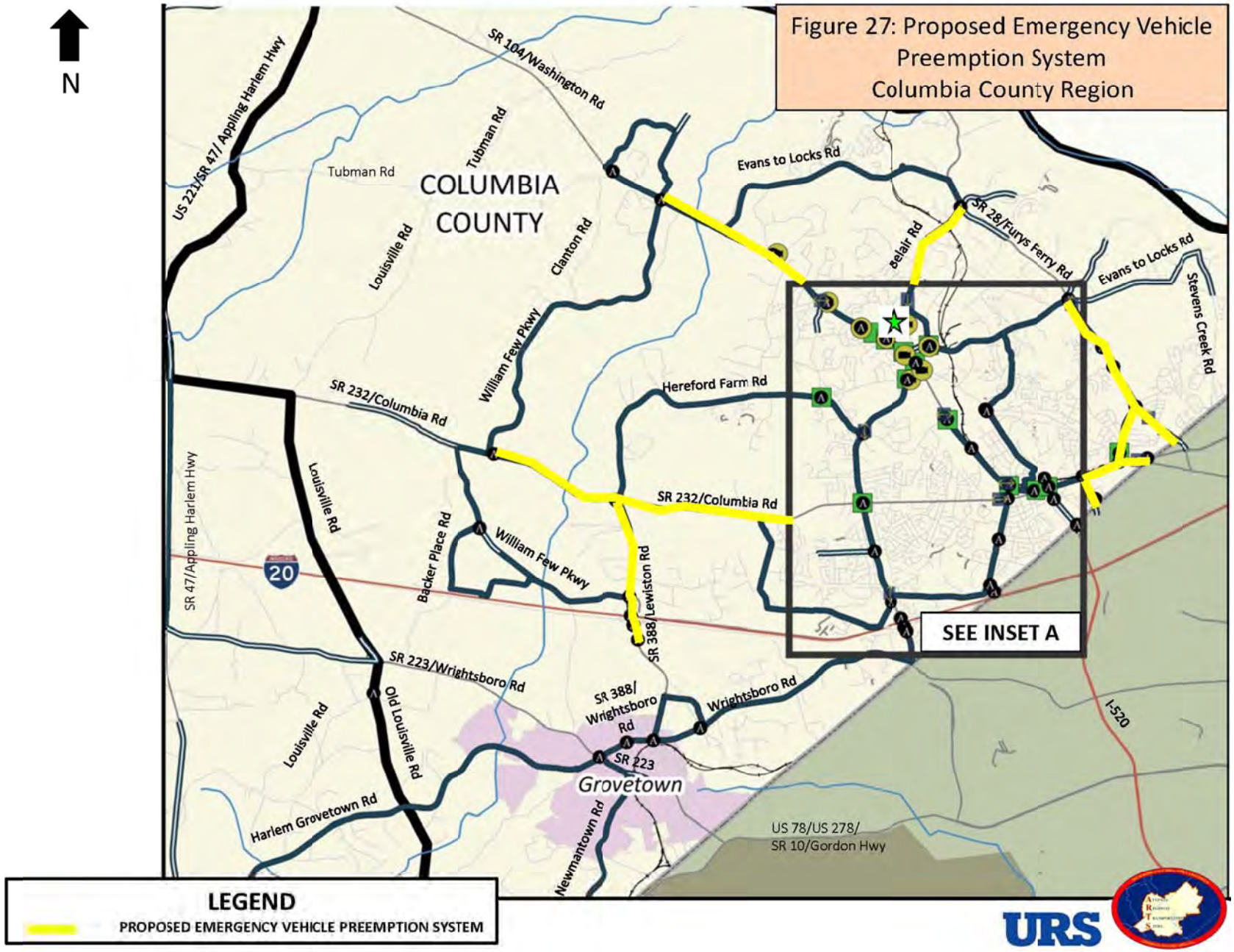
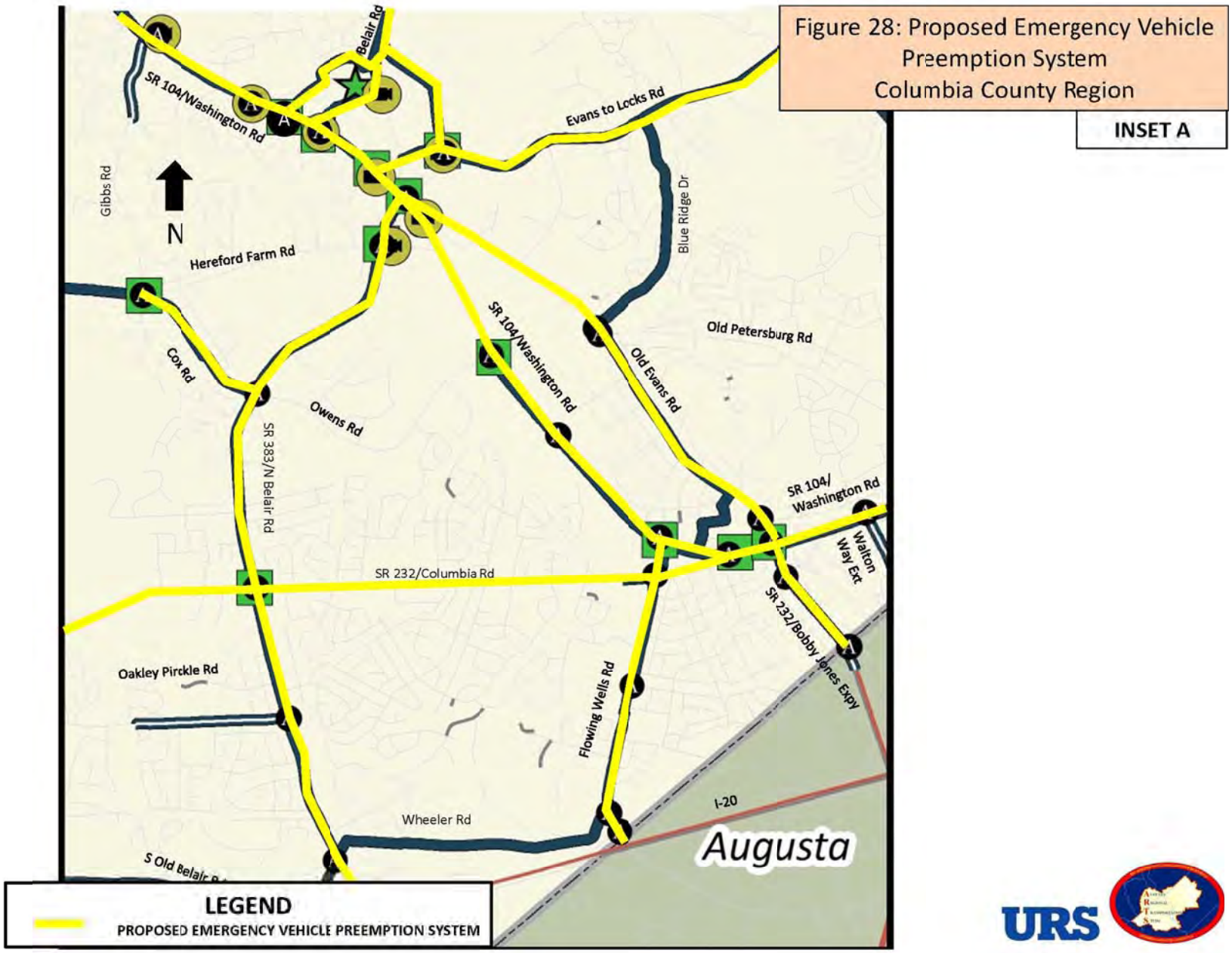


Figure 28. CC-1, Proposed Emergency Vehicle Preemption System (inset)



CC-2: COLUMBIA COUNTY SURVEILLANCE SYSTEM DEPLOYMENT

Project Description and Location(s):

Project would include the deployment of a total of 75 CCTV "Panomorphic" cameras and 55 CCTV PTZ cameras at selected locations/intersections within the County. These cameras will be tied into the existing fiber optic communications network within the County. These CCTV cameras will be integrated into the County's existing software for control and management of these cameras. See Figure 29 and Figure 30 for locations of recommended CCTV cameras within the County.

Agencies/Stakeholders Involved: Columbia County Engineering (Lead) and GDOT.

Project Justification / Potential Impacts (Benefits): Project would provide additional CCTV cameras to provide valuable and critical video surveillance at critical intersections and locations. This video will be used to help assess and determine potential incidents and facilitate the dispatch of necessary resources and coordination with appropriate emergency response agencies.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 250,000 (construction materials furnish only) – Note: County will be providing engineering and installation services for these cameras.

Estimated O&M Costs: $ 25,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS01

Project Dependencies: Existing fiber optic comm. and central Video Management Software (Genetec) and associated server(s) / hardware exists.

Figure 29. CC-2, Proposed CCTV

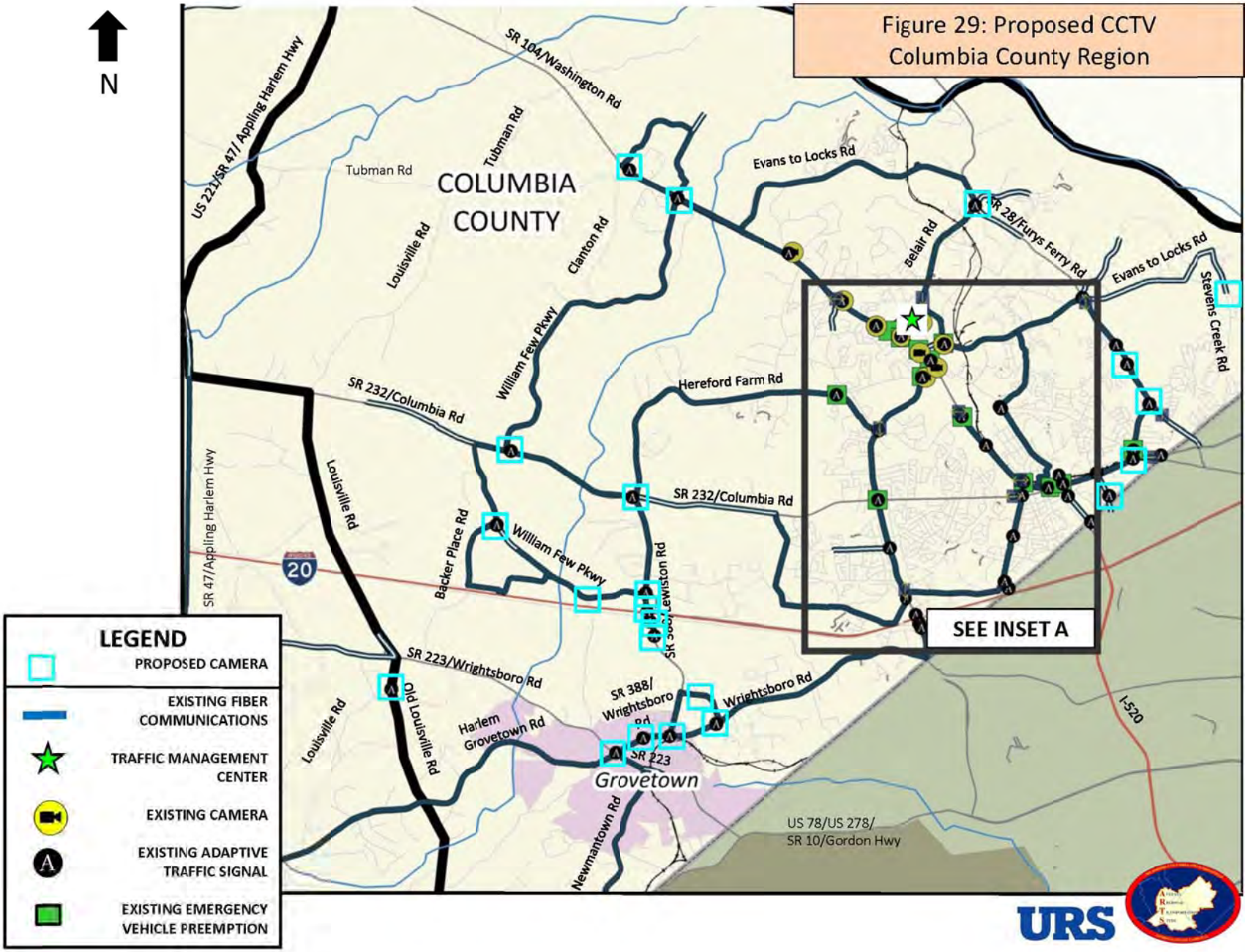
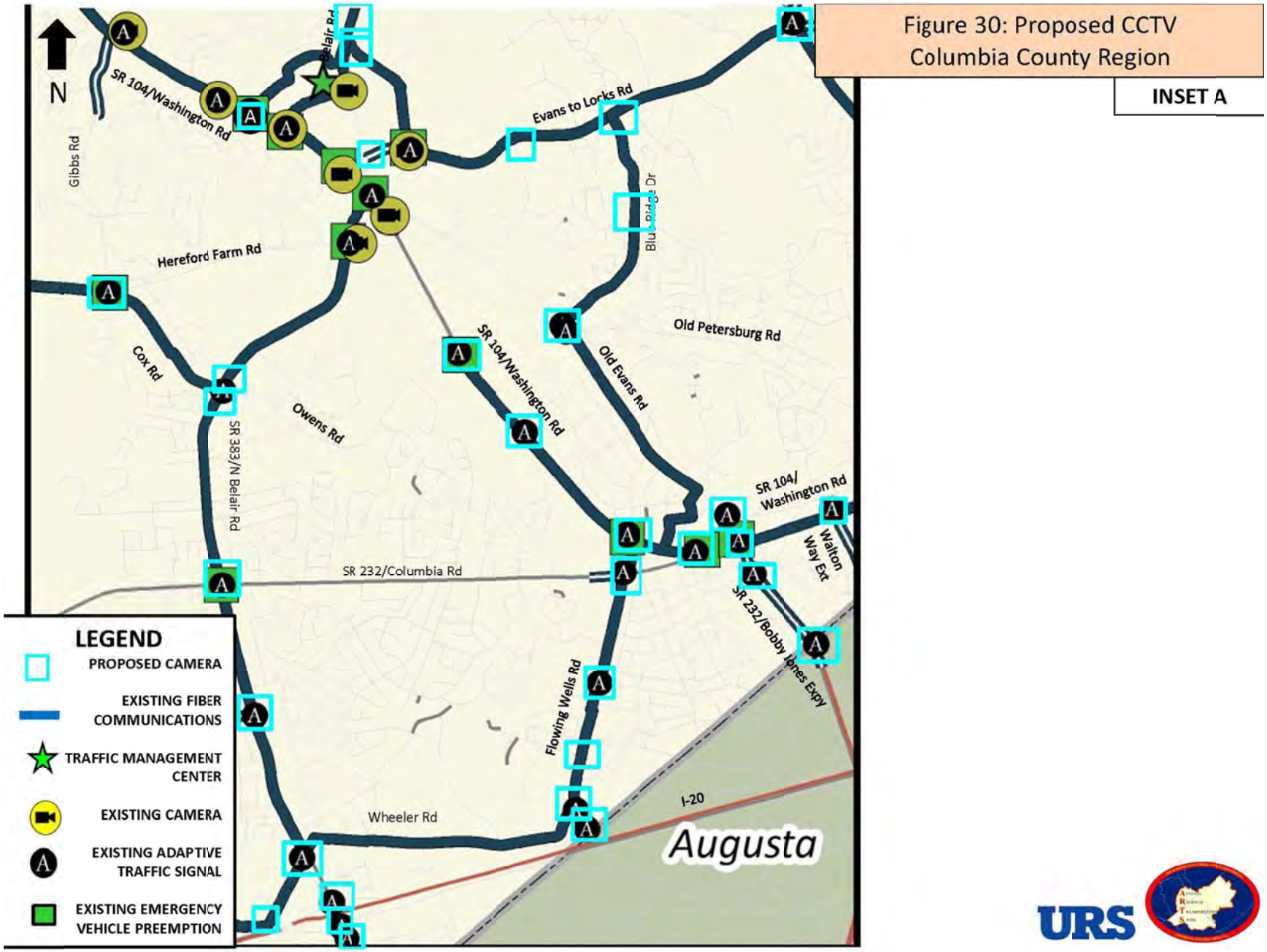


Figure 30. CC-2, Proposed CCTV (inset)



CC-3: COLUMBIA COUNTY DMS DEPLOYMENT

Project Description and Location(s):

Project would include the deployment of 12 DMSs within the County. These signs will be tied into the existing fiber optic communications network and integrated into the County's existing software for control and management of these signs. See Figure 31 for locations of recommended DMSs within the County.

Agencies/Stakeholders Involved: Columbia County Engineering (Lead) and GDOT.

Project Justification / Potential Impacts (Benefits): Project would provide additional DMS signs to provide critical / valuable information to the traveling public in regards to potential incidents, amber alerts, special events, emergency information, etc. as required depending on the scenario. This will facilitate the traveling public to make informed decisions on alternative routes, etc. as needed.

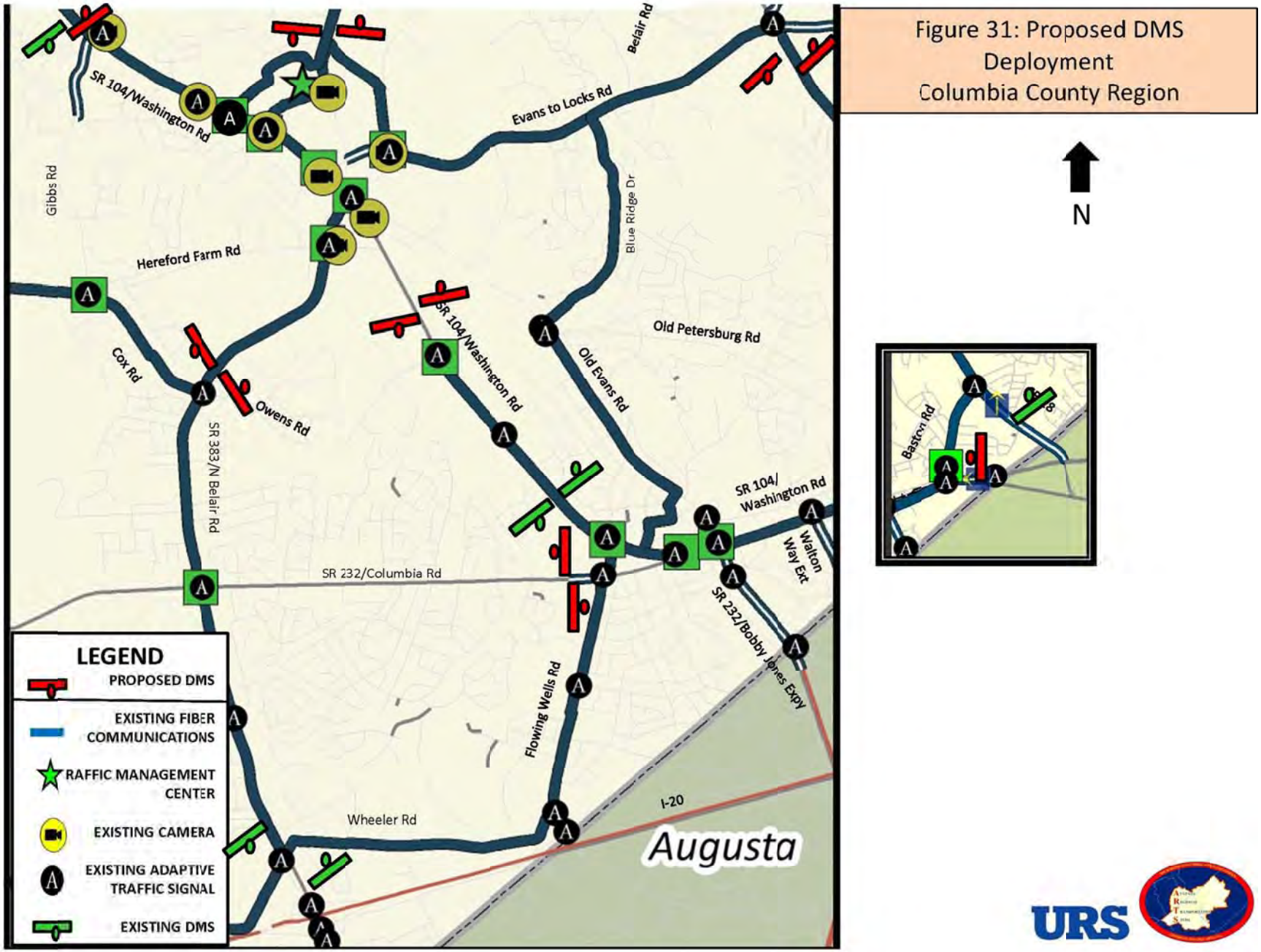
Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 70,000 (engineering) / $ 900,000 (F&I, construction)

Estimated O&M Costs: $ 90,000 (*annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS06

Project Dependencies: Existing fiber optic communications and central DMS software exists.

Figure 31. CC-3, Proposed DMS Deployment



CC-4: COLUMBIA COUNTY FLASHING YELLOW ARROW CONVERSION

Project Description and Location(s):

Project would upgrade existing intersections that already have left-turn phase with permissive left-turn movements to provide flashing yellow arrow signal-heads and capabilities. The project would provide the following features and capabilities:

1. System would upgrade (65 intersections, 250 approaches) that already have left-turn phase with permissive left-turn movements to flashing yellow arrows.
2. Provide would survey existing cabinets and equipment and upgrade/add as required to support FYA operations including; utilize a 332 cabinet with Aux File, Type F or newer monitor, additional conductor / wiring as required, etc.

Agencies/Stakeholders Involved: Columbia County (Lead) Traffic Engineering, City of Grovetown, and GDOT

Project Justification / Potential Impacts (Benefits): Flashing yellow arrows have been shown to reduce intersection crashes (especially angle & opposing left collisions), move more traffic through an intersection, remove yellow trap condition, provide additional traffic management flexibility, and are more understandable to drivers and provide more opportunities for left turns.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 40,000 (engineering) / $ 395,000 (F&I, construction)

Estimated O&M Costs: Included in existing traffic signal maintenance costs

ITS Architecture Compatibility: ATMS03

Project Dependencies: Existing left-turn signalized intersections, existing cabinets and associated equipment will support FYA operations.

CC-5: COLUMBIA COUNTY PORTABLE TRAFFIC MANAGEMENT STATIONS (PTMS)

Project Description and Location(s):

Project would provide and include Portable Traffic Management Stations (PTMS) that would provide traffic management capabilities within TIA project construction work zones as well as to facilitate traffic management during other events, etc. The recommended video sharing system concept would include the following features and capabilities:

1. Project would include (initially) two (2) Portable Traffic Management Stations (PTMS).
2. System would incorporate trailer mounted roadside speed and volume sensors to detect work zone congestion and CCTV surveillance.
3. System would include solar power and battery back-up capabilities.
4. System would provide communications to the Columbia County TMC computer system via radio, wireless/WiFi access points, IP-based cellular (4G services) or hard-wire cable (optical fiber, etc.) communication for processing.
5. The corresponding traffic / delay information would then be disseminated / provided to the traveling public via existing Columbia County portable or permanent changeable/variable message signs.
6. These portable systems can be stand-alone or integrated into the existing County ATMS/ITS and TMC. They also can be manual controlled, fully automated, or variations between.

Agencies/Stakeholders Involved: Columbia County Engineering (Lead) and Columbia IT

Project Justification / Potential Impacts (Benefits): Project would allow travelers to obtain corridor travel time delay and important traffic/roadway condition information, construction work zone information, and/or special event information in order to make informed decisions in regards to alternative routes and overall awareness of congestion ahead to avoid potential rear-end collisions.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 8,000 (engineering) / $ 185,000 (Furnish only and training, construction)

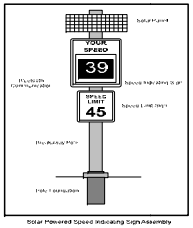
O&M Costs: $ 5,500 (3% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS06, ATMS08; MC08

Project Dependencies: Existing Broadband Internet services at the Columbia County TMC and broadband (4G, etc.) services throughout the County or close proximity of fiber network nodes for connectivity using wireless hops.

CC-6: COLUMBIA COUNTY SAFETY-BASED INITIATIVES

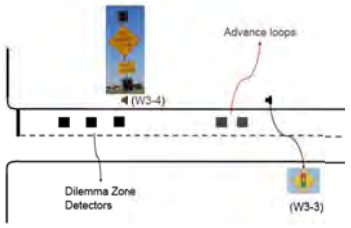
Project Description and Location(s):



Project would include various safety-based initiatives to improve overall safety of the traveling public. Before-after data would be collected to determine the effectiveness of various safety mitigation measures and concepts. Project would include the following:

1. ***Speed Warning / Indicator Sign System*** – This safety-based concept would include two (2) Speed Zone Warning (Indicator) Signs which would consist of a pole mounted speed sensing and indicating sign assembly that would provide drivers with their actual speed versus the posted speed by detecting their velocity with microwave (radar) speed detection. Project would demo to determine effectiveness of deployment. See Project AC-8 for additional details on this concept.

2. ***Red Light Running Compliance Measurement Tool*** – This safety-based concept would include equipment and software to provide at selected intersections to determine the level of red-light compliance. It will be able to provide triggered enforcement as required and provide the data and tools to investigate various mitigation measures to determine their effectiveness at a particular intersection. Intersections to implement will be investigated during this project (assume 2 intersections to study and demo) to determine effectiveness.



3. ***Rural Intersection Warning System*** – This safety-based concept would provide active, real-time supplemental warning to drivers approaching an intersection and alert them to look for oncoming traffic. The approach would be a low-cost, readily deployable system to reduce crashes and fatalities at low-volume, non-signalized rural intersections. Assume two (2) rural intersections for demo and observation of effectiveness.

4. ***Traffic Signal Reflective Back-plate Upgrades*** -- Back-plates are added to a traffic signal indication in order to improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background which is intended to reduce unintentional red-light running crashes. Assume three (3) intersections to apply and demo reflective back-plates to increase visibility and project will investigate / determine effectiveness.

Agencies/Stakeholders Involved: Columbia County Engineering (Lead), City of Grovetown, and GDOT.

Project Justification / Potential Impacts (Benefits): System concepts would improve safety and reduce congestion at critical intersections and along corridors.

Estimated Planning/Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 200,000 (study, engineering) / $ 30,000 (F&I, pilot demo – Concept 1); $ 50,000 (F&I, pilot demo – Concept 2); $ 180,000 (F&I, pilot demo – Concept 3); $ 5,000 (F&I, pilot demo – Concept 4)

Estimated O&M Costs: N/A

ITS Architecture Compatibility: ATMS19, ATMS24; AVSS05

Project Dependencies: None

CC-7: COLUMBIA COUNTY VIDEO SHARING SYSTEM (C-VIEW)

Project Description and Location(s):

Project would provide and include flexible, cost effective and secure video sharing system capabilities throughout the County to transportation agencies, emergency responders, public agencies, media outlets, as well as the public as required or needed. See Figure 32 for recommended video sharing system concept. The recommended video sharing system concept would include the following features and capabilities:

1. Capable of supporting the recommended new CCTV camera video streams within the County.
2. Video would be in a standard open format available at selectable bandwidths that could be accessed via personal computers, websites, intranets, internet, and through handheld / mobile devices (including; iPhone/iPad, Android Phone/Tablet, Blackberry). Provide support for all major browsers including; Firefox, Safari, IE, and Chrome. Note: GDOT may provide a video sharing solution as part of this project.
3. The secure video portal would be capable of being accessed by any designated partner agency, media outlet, law enforcement and emergency first responder, free of charge with proper login information from any intranet and/or internet connection.
4. The public and others would also have access to the video through a new or upgraded existing web-site or through mobile devices.

5. Depending on the cameras that a user is authorized to see, the video portal would be capable of being used as a map-based (Google map) view with several concurrent cameras or as a list-based Video Wall of multiple concurrent cameras.
6. The solution would also include a feature that would track the current traffic incidents in Columbia County and automatically choose and display the closest cameras to the event.
7. Provide dedicated commercial-grade broadband Internet service at the TMC with both high bandwidth upstream and downstream performance – fiber-based Internet service is available in the City of Evans at a reasonable monthly cost.

Agencies/Stakeholders Involved: Columbia County Engineering (Lead), Columbia IT, County/City Emergency Management and 1st Responders, County Sheriff and Fire, GDOT, 511GA, and Media outlets.

Project Justification / Potential Impacts (Benefits): Project would allow travelers to access corridor live video streams to make informed alternate route decisions, and improve emergency response readiness through access to live video en-route to incidents.

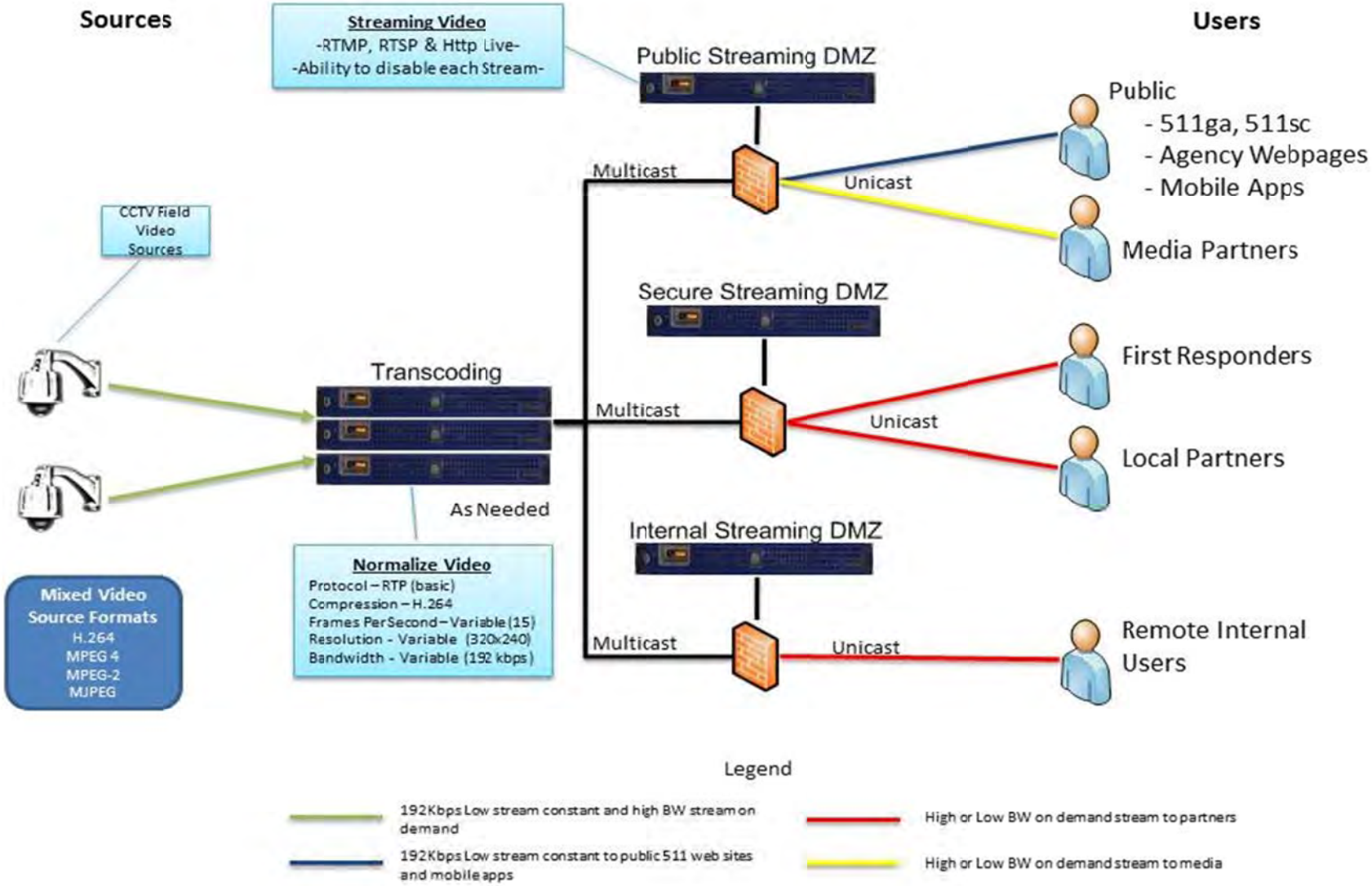
Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 15,000 (engineering) / $ 130,000 (F&I, construction)

O&M Costs: $ 19,500 (15% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS08

Project Dependencies: Project assumes that Project CC-2 (CCTV cameras installed and operational, broadband internet connection in place) is operational and assumes that video streams include H.264 + RSTP.

Figure 32: Video Sharing Concept



AC-1: CITY OF AIKEN ATMS EXPANSION PHASE 1

Project Description and Location(s):

Project would provide Phase 1 Advanced Traffic Management System (ATMS) upgrades and expansion to provide enhanced and improved traffic operations, management, communications and surveillance capabilities for the City of Aiken. The project would include the following features and capabilities, as illustrated in Figure 33:

1. Fiber Optic or Wireless Communications – will include approximately 15 miles of new communications to support improved traffic signal operations, support video surveillance and other.
2. CCTV Surveillance System – will include an estimated 8 new CCTV IP cameras to provide comprehensive video surveillance coverage at key / critical intersections with high accident rates and high congestion corridors. Video sharing with other agencies will be accomplished through an upgraded South Carolina 511 site (future provision by SCDOT).
3. Cabinet Communications Upgrades – will include communications network upgrades to approximately 23 cabinet / intersections to provide Ethernet IP-based communications to each cabinet / location.
4. TCC/TMC Upgrades – will include upgrades of the City of Aiken TCC/TMC to support improved operations including; operator console and workstation, server, network equipment, video display monitors, equipment rack, video management software, cabling and other.

Agencies/Stakeholders Involved: SCDOT (Lead) and City of Aiken Engineering.

Project Justification / Potential Impacts (Benefits): Project would provide increased efficiency of overall traffic operations, increased safety to the traveling public, result in less delay and better travel times along major corridors. It will also improve responsiveness for traffic and transportation maintenance personnel to field issues, and provide remote monitoring and troubleshooting capability for traffic control devices.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 190,000 (engineering) / $ 1,900,000 (F&I, construction)

Estimated O&M Costs: $ 190,000 (10% *annually, in 2013 dollars*). Arterial CCTV cameras would be maintained by SCDOT or the local agency that maintains the traffic signals.

ITS Architecture Compatibility: ATMS01

Project Dependencies: None

AC-2: CITY OF AIKEN ATMS EXPANSION PHASE 2

Project Description and Location(s):

Project would provide Phase 2 Advanced Traffic Management System (ATMS) upgrades and expansion to provide enhanced and improved traffic operations, management and surveillance capabilities as well as fill-in gaps in the communications coverage within the City of Aiken. Project would include the following, as illustrated in Figure 33:

1. Fiber Optic or Wireless Communications – will continue to expand the communications system to include approximately 8 additional miles.
2. CCTV Surveillance System – will include an estimated 15 new CCTV IP cameras to provide comprehensive video surveillance coverage at key / critical intersections with high accident rates and high congestion corridors. Video sharing with other agencies will be accomplished through an upgraded South Carolina 511 site (future provision by SCDOT).
5. Cabinet Communications Upgrades – will continue to upgrade cabinets to include approximately 6 additional cabinets / intersection to provide Ethernet IP-based communications to each cabinet / location.
3. Cabinet System Monitoring Upgrades – will include providing upgrades and integration of network monitoring capabilities including; IP conflict monitors, IP battery back-up, etc. to approximately 29 cabinets.
4. Traffic Signal Optimization – will include re-timing of selected intersections / corridors.

Agencies/Stakeholders Involved: SCDOT (Lead) and City of Aiken Engineering

Project Justification / Potential Impacts (Benefits): Project would provide increased efficiency of overall traffic operations, increased safety to the traveling public, result in less delay and better travel times along major corridors. It will also improve responsiveness for traffic and transportation maintenance personnel to field issues, and provide remote monitoring and troubleshooting capability for traffic control devices.

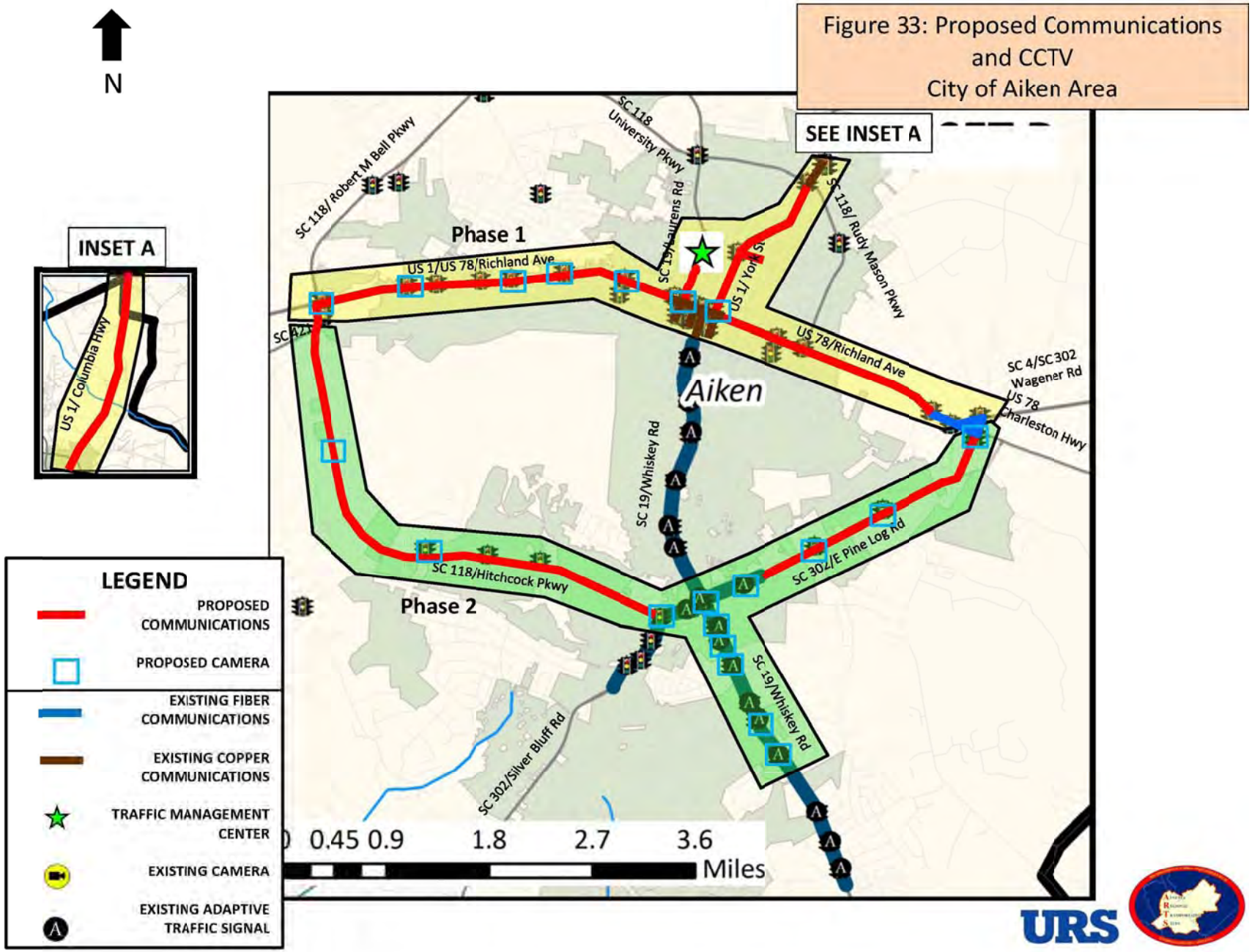
Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 115,000 (engineering) / $ 1,150,000 (F&I, construction)

Estimated O&M Costs: $ 110,000 (10% *annually, in 2013 dollars*). Arterial CCTV cameras would be maintained by SCDOT or the local agency that maintains the traffic signals.

ITS Architecture Compatibility: ATMS01

Project Dependencies: Depends on Project AC-1 being fully operational.

Figure 33. AC-1 & 2, Proposed Communications and CCTV (Aiken)



AC-3: CITY OF NORTH AUGUSTA ATMS EXPANSION PHASE 1

Project Description and Location(s):

Project would provide Phase 1 Advanced Traffic Management System (ATMS) upgrades and expansion to provide enhanced and improved traffic operations, management, communications and surveillance capabilities for the City of North Augusta. The project would include the following features and capabilities, as illustrated in Figure 34**:**

1. Fiber Optic or Wireless Communications – will include approximately 6 miles of communications infrastructure to support improved Traffic Signal operations, support video surveillance and other.
2. CCTV Surveillance System – will include an estimated 10 new CCTV IP cameras to provide comprehensive video surveillance coverage at key / critical intersections with high accident rates and high congestion corridors. Video sharing with other agencies will be accomplished through an upgraded South Carolina 511 site (future provision by SCDOT).
3. Cabinet Communications Upgrades – will include communications network upgrades to approximately 18 cabinet / intersections to provide Ethernet IP-based communications to each cabinet / location.
4. TCC/TMC Upgrades – will include upgrades of the City of North Augusta TCC/TMC to support improved operations including; operator console and workstation, server, network equipment, video display monitors, equipment rack, software, cabling and other.

Agencies/Stakeholders Involved: SCDOT (Lead) and City of North Augusta Engineering.

Project Justification / Potential Impacts (Benefits): Project would provide increased efficiency of overall traffic operations, increased safety to the traveling public, result in less delay and better travel times along major corridors. It will also improve responsiveness for traffic and transportation maintenance personnel to field issues, and provide remote monitoring and troubleshooting capability for traffic control devices.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 80,000 (engineering) / $ 800,000 (F&I, construction). Arterial CCTV cameras would be maintained by SCDOT or the local agency that maintains the traffic signals.

Estimated O&M Costs: $ 80,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS01, ATMS03

Project Dependencies: None

AC-4: CITY OF NORTH AUGUSTA ATMS EXPANSION PHASE 2

Project Description and Location(s):

Project would provide Phase 2 Advanced Traffic Management System (ATMS) upgrades and expansion to provide enhanced and improved traffic operations, management and surveillance capabilities as well as fill-in gaps in the communications coverage within the City of North Augusta. Project would include the following, as illustrated in Figure 34:

1. Fiber Optic or Wireless Communications – will continue to expand the communications system to include approximately 8 additional miles.
2. CCTV Surveillance System – will include an estimated 5 new CCTV IP cameras to provide comprehensive video surveillance coverage at key / critical intersections with high accident rates and high congestion corridors. Video sharing with other agencies will be accomplished through an upgraded South Carolina 511 site (future provision by SCDOT).
6. Cabinet Communications Upgrades – will continue to upgrade cabinets to include approximately 12 additional cabinets / intersection to provide Ethernet IP-based communications to each cabinet / location.
3. Cabinet System Monitoring Upgrades – will include providing upgrades and integration of network monitoring capabilities including; IP conflict monitors, IP battery back-up, etc. to approximately 30 cabinets.
4. Traffic Signal Optimization – will include re-timing of selected intersections / corridors.

Agencies/Stakeholders Involved: SCDOT (Lead) and City of North Augusta Engineering.

Project Justification / Potential Impacts (Benefits): Project would provide increased efficiency of overall traffic operations, increased safety to the traveling public, result in less delay and better travel times along major corridors. It will also improve responsiveness for traffic and transportation maintenance personnel to field issues, and provide remote monitoring and troubleshooting capability for traffic control devices.

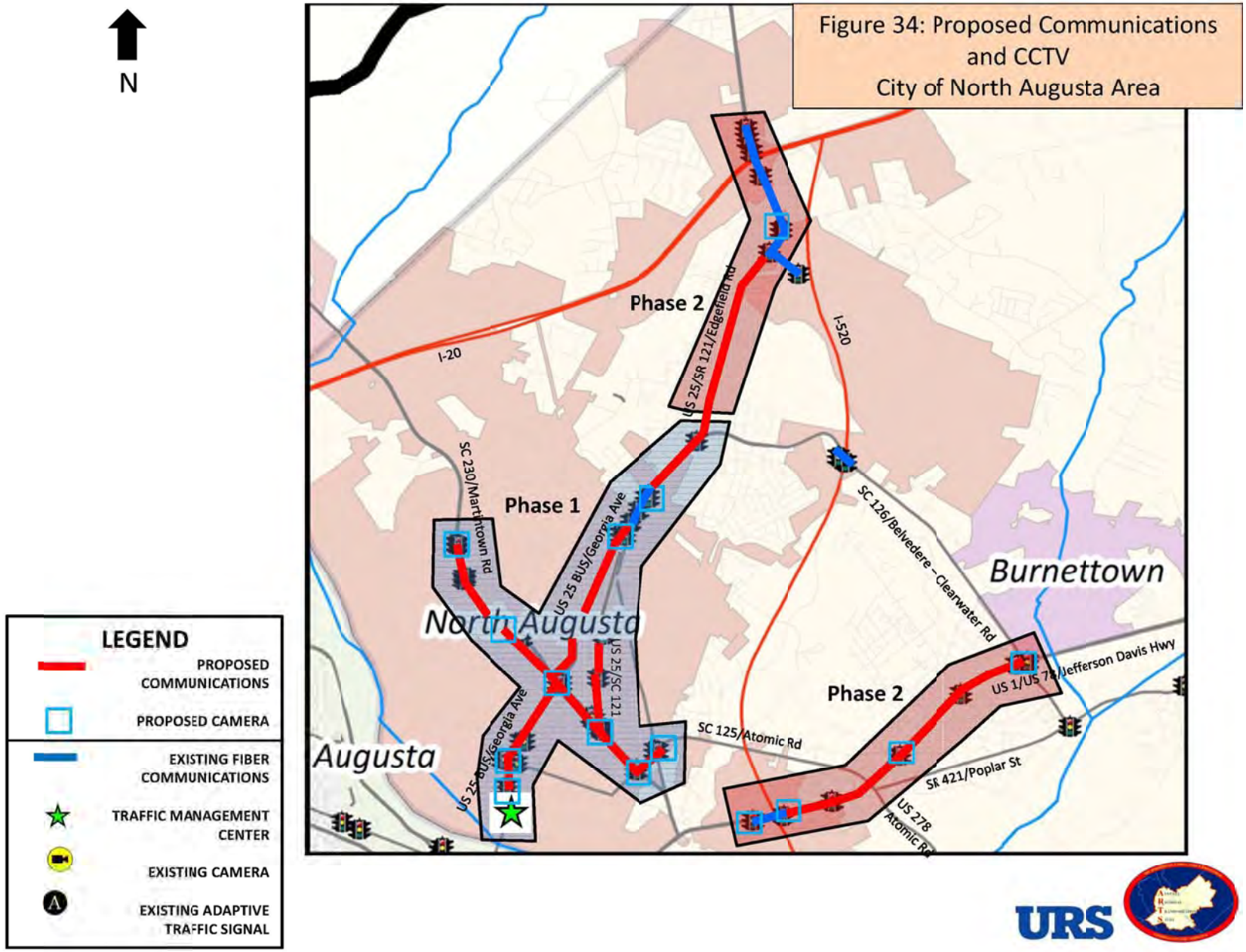
Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 100,000 (engineering) / $ 1,000,000 (F&I, construction)

Estimated O&M Costs: $ 100,000 (10% *annually, in 2013 dollars*). Arterial CCTV cameras would be maintained by SCDOT or the local agency that maintains the traffic signals.

ITS Architecture Compatibility: ATMS01, ATMS03

Project Dependencies: Depends on Project AC-3 being fully operational.

Figure 34. AC-3 & 4, Proposed Communications and CCTV (North Augusta)



AC-5: EMERGENCY PREEMPTION SYSTEM EXPANSION

Project Description and Location(s):

Project would provide and expand Emergency Preemption capabilities to include 77 additional intersections (within City of Aiken) and would equip existing emergency vehicles (estimated 20 vehicles) with preemption equipment. System would be an expansion of the existing / legacy system. See Figure 35 to Figure 37 for locations.

A pilot demonstration would be included (if needed or required)) to demonstrate and test potential impact on normal traffic signal operations (i.e., disruption to traffic flow) as a result of preemption system deployment. One intersection would be tested to demonstrate any adverse impact on normal operations and recovery time along with mitigation requirements and techniques before committing to full-scale deployment.

Since EVP systems impact normal traffic signal operations, policy decisions by the agency having jurisdiction may need to precede their deployment.

Agencies/Stakeholders Involved: SCDOT (Lead), City of North Augusta, City of Aiken, City of Burnettown, Aiken County, Aiken County Emergency Responders, County/City Emergency Responders, and Law Enforcement Agencies.

Project Justification / Potential Impacts (Benefits): System expansion would reduce emergency response times, saving lives, increase safety for the emergency responders, and increase overall operational efficiency.

Estimated Planning/Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 75,000 (engineering) / $ 25,000 (F&I, Evaluation, Pilot demo); $ 780,000 (F&I, construction)

Estimated O&M Costs: $ 78,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: EM02

Project Dependencies: Coordination with existing / legacy preemption system and signal cabinets.

Figure 35. AC-5, Proposed Emergency Vehicle Preemption System

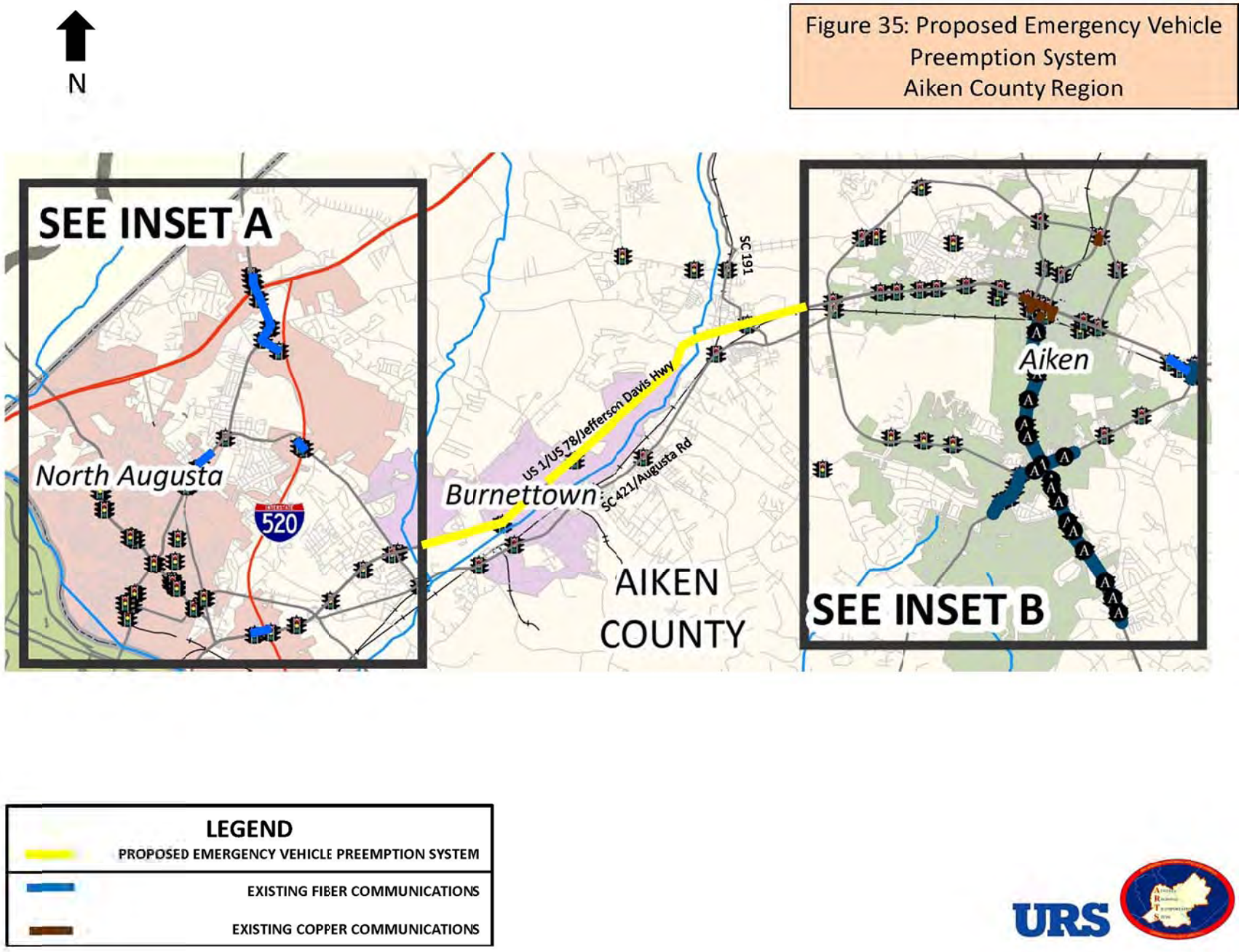


Figure 36. AC-5, Proposed Emergency Vehicle Preemption System (inset, North Augusta)

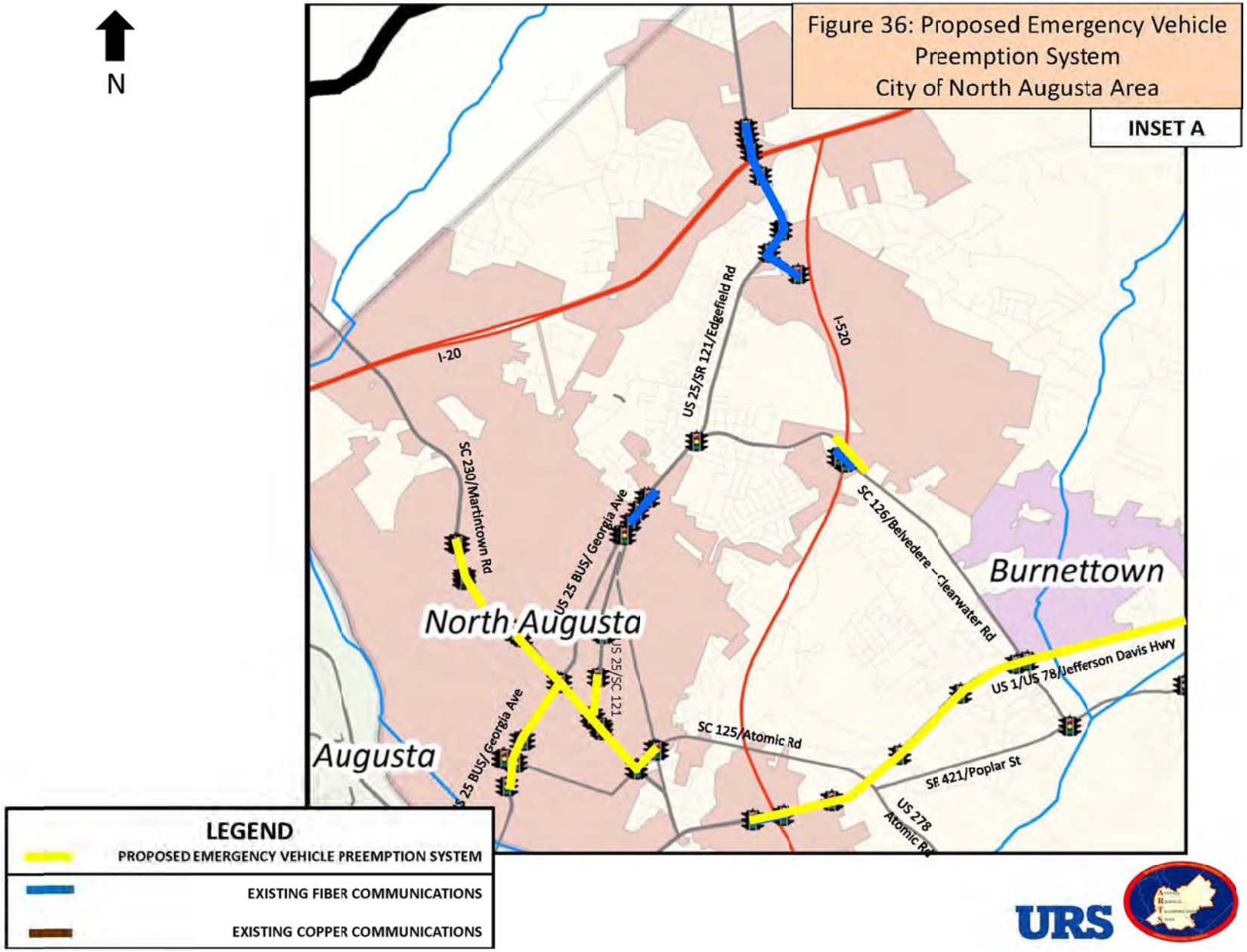
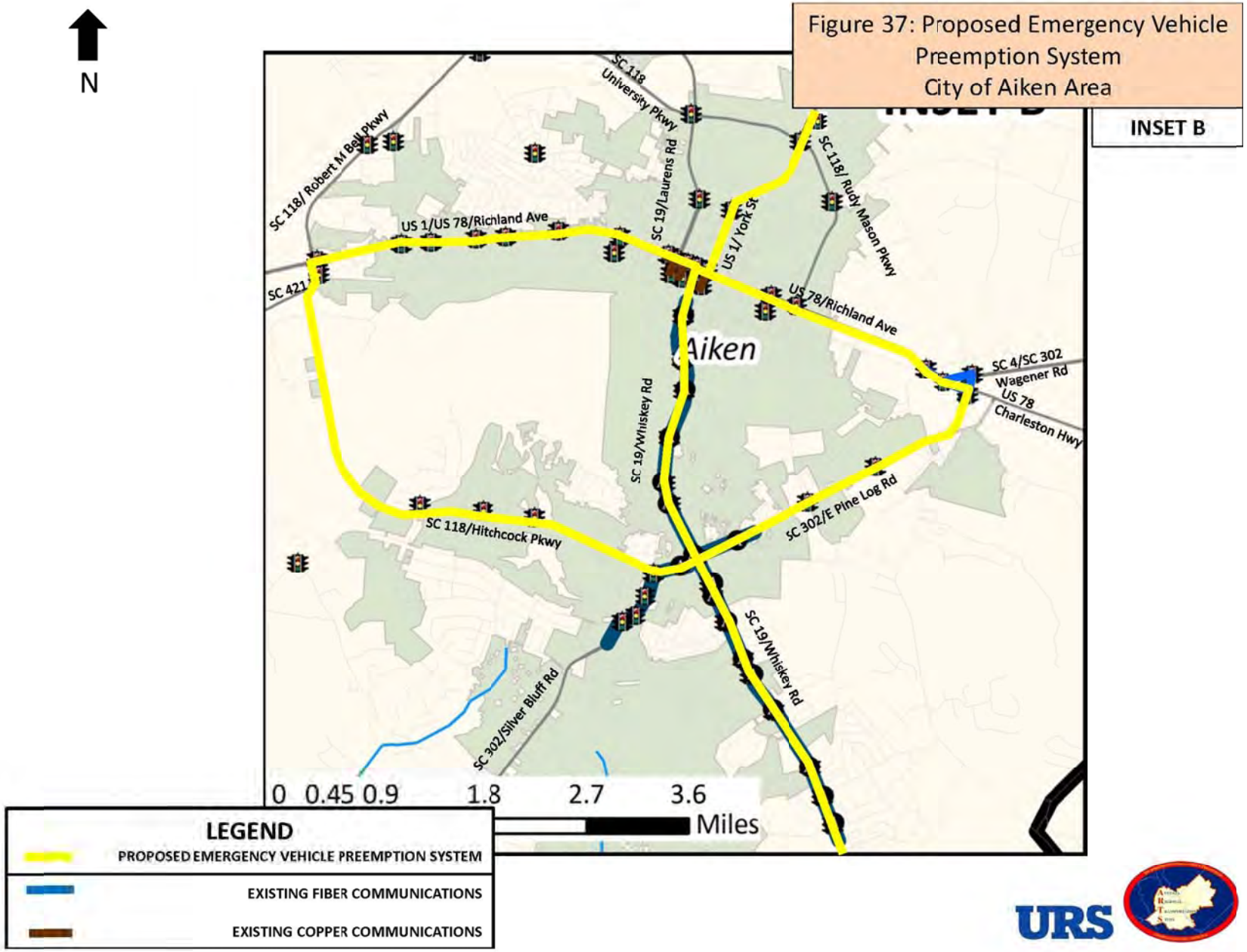


Figure 37. AC-5, Proposed Emergency Vehicle Preemption System (inset, Aiken)



AC-6: ADAPTIVE TRAFFIC SIGNAL CONTROL EXPANSION

Project Description and Location(s):

Project would provide Adaptive Signal Control expansion at selected intersections (include 23 intersections in City of Aiken). System would be an expansion to the existing / legacy system. See Figure 38 for recommended intersections or adaptive signal control expansion.

The traffic signals in North Augusta should be reviewed for potential adaptive traffic signal control operation, as traffic volumes grow and I-20 incident management needs are assessed.

Agencies/Stakeholders Involved: City of Aiken (Lead), City of North Augusta (Lead), and SCDOT

Project Justification / Potential Impacts (Benefits): Project would provide additional adaptive signal controlled intersections providing improve system operational performance and mitigating congestion / bottlenecks by moving more vehicles through the corridor / intersections.

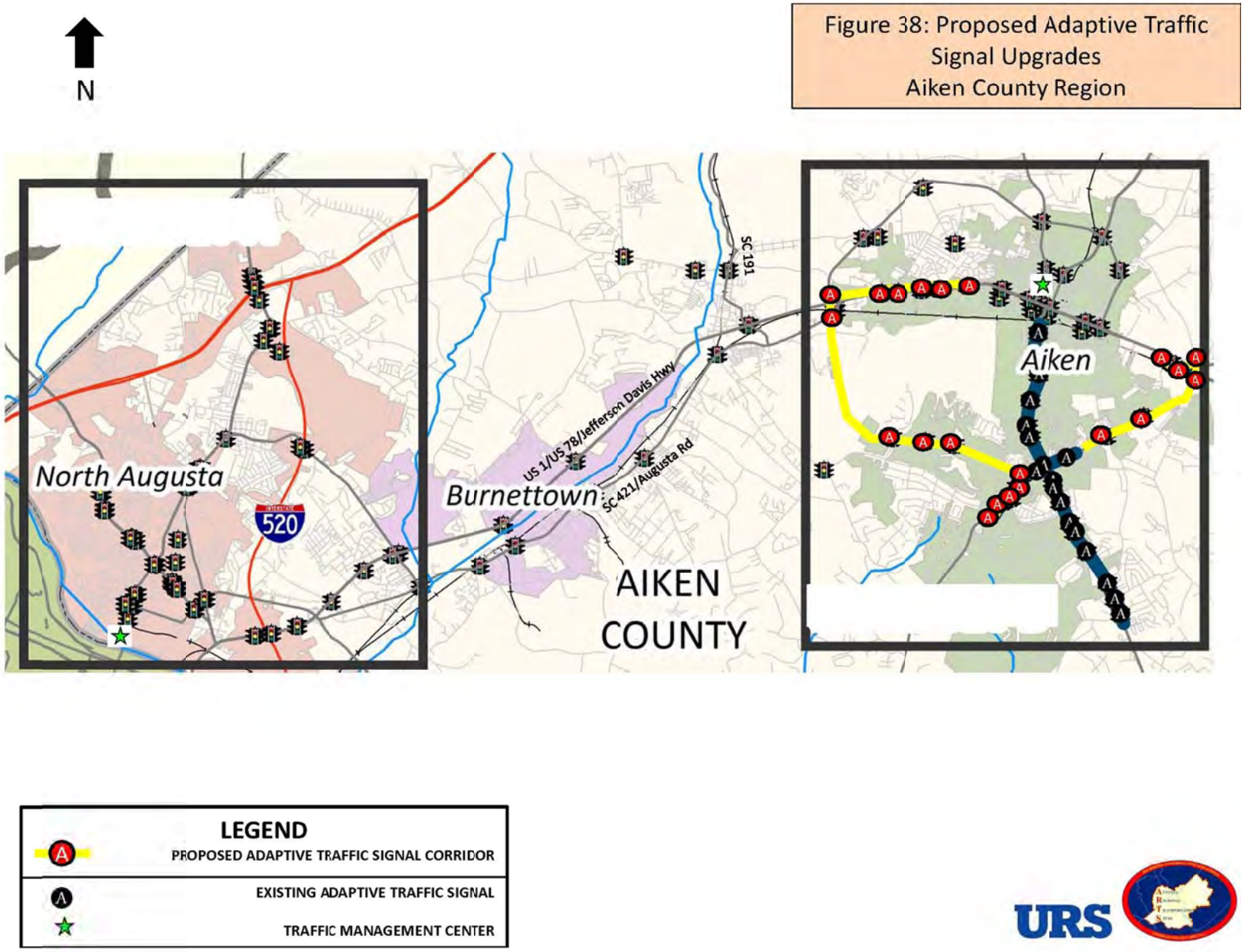
Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 65,000 (engineering) / $ 660,000 (F&I, construction)

Estimated O&M Costs: $ 66,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS03

Project Dependencies: Project adaptive control system is compatible with the existing adaptive control system including TMC software.

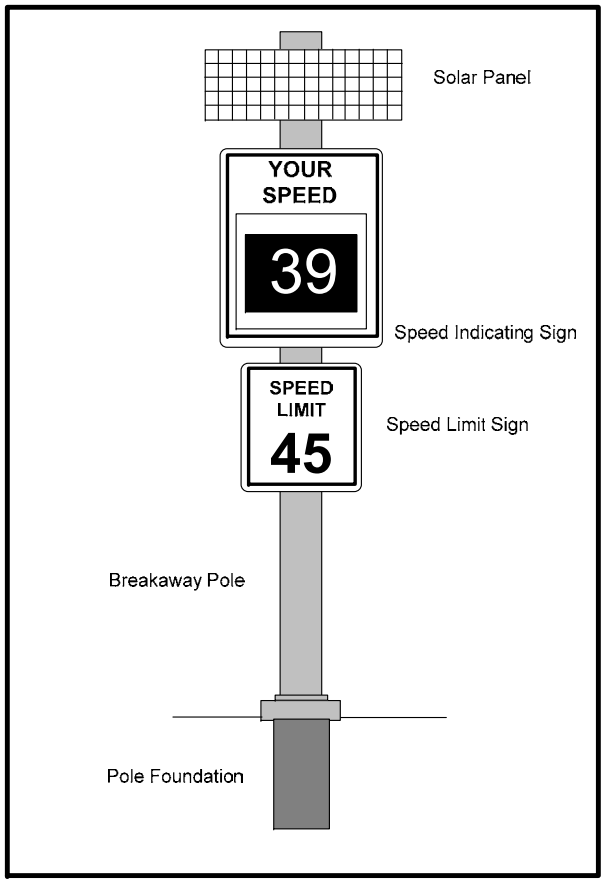
Figure 38. AC-6, Proposed Adaptive Traffic Signal Upgrades



AC-7: TRAVEL-TIME SYSTEM (TTS) AND SAFETY-BASED CONCEPTS – WHISKEY ROAD CORRIDOR

Project Description and Location(s):

Concept 1 - TTS: Project would collect and report in real-time a distribution of travel times along the Whiskey Road corridor (assume 7 sensor locations along Hwy 19 from Aiken to SRS area including vendor hosted Web portal / public interface and travel time services) within the project area. Travel times would be measured using a method of vehicle tracking that provides a reliable travel time measurement that includes a minimum of a 3% sample size of the total traffic volume. Identification of vehicles for travel time tracking would be performed without the need for any equipment or device to be attached to or in the vehicle. The intent of this TTS is to provide a system of hardware and software that collects field data and processes that data to deliver travel time information for display on mobile devices (iPhone/iPad, Android, Blackberry, etc.), and a public access website. Future display of travel time to arterial DMS signs will be investigated for future upgrade and expansion. Travel time data collection, processing and dissemination would be provided by and web hosted by the vendor for a nominal monthly fee. This will allow for the system to be tested for effectiveness and can be transitioned to an Aiken County self-hosted solution over time, as well as expanded to other corridors as required or desired. If desired, the TTS component could be included as a pilot demo as part of Project ARTS-2.



Solar Powered Speed Indicating Sign Assembly

Concept 2 – Speed Management: Project would also provide two (2) Speed Zone Warning (Indicator) Signs which would consist of a pole mounted speed sensing and indicating sign assembly that would provide drivers with their actual speed versus the posted speed by detecting their velocity with microwave (radar) speed detection. The sign would display the measured speed in miles per hour on an integrated bright amber LED display. Sign would consist of a solar powered sign assembly utilizing an integrated microwave speed detecting radar with a speed indicating LED sign for informing providing feedback to drivers of their actual speed versus the posted speed up to 1000 ft. in advance. The sign would have the capability of providing wireless RF communications and software for remote configuration and data collection.

This project would investigate, design and deploy these speed signs along Hwy 19 between Aiken and SRS and possibly other location (Silver Bluff, etc.).

Agencies/Stakeholders Involved: City of Aiken (Lead), SRS, and SCDOT.

Project Justification / Potential Impacts (Benefits): Project would provide valuable travel time information for travelers along the congested Whiskey Road corridor from the City of Aiken to the Savannah River Site (SRS). In addition, automated maximum speed-based signs will be used to reduce high-speed traffic along sections of this corridor and increase overall safety.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 7,600 (eng) / $ 76,000 (F&I, constr.)

Estimated O&M Costs: $ 13,500 (18% *annually, in 2013 dollars*) – Note: includes travel time data hosting services with web portal maintenance, GSM cellular services, and field troubleshooting and maintenance for TTI sensor and speed sign equipment

ITS Architecture Compatibility: ATIS01; ATMS02, ATMS06, ATMS19

Project Dependencies: WiFi/cell service along the corridor.

AC-8: BEST FRIEND EXPRESS AUTOMATED VOICE ANNUNCIATION SYSTEM (AVAS)

Project Description and Location(s):

Project would provide Automated Voice Annunciation System (AVAS) in the Best Friend vehicles (estimated 5 total with 3 active vehicles, 2 as backup) to provide automated bus stop announcements on Best Friend vehicles and electronic signs that display the upcoming stop. When vehicles are at stops, the AVAS would announce the route and destination of the vehicle to waiting customers. The existing GPS receiver automatically will determine adherence to the route and trigger the announcements as it approaches each stop by utilizing signals received from GPS satellites. This system would require no additional intervention from the operator beyond entering a route identifier.

Agencies/Stakeholders Involved: Lower Savannah Council of Governments (LSCOG) / Aiken County Public Transit (Lead), Aiken County Engineering, and SCDOT.

Project Justification / Potential Impacts (Benefits): Project would provide voice announcements for patrons on-board Best Friend routes and increase overall ridership and rider satisfaction.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 8,600 (engineering) / $ 86,000 (F&I, construction)

Estimated O&M Costs: $ 8,600 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: APTS08

Project Dependencies: Existing GPS / AVL system is operational.

SD-1: SCDOT FREEWAY MANAGEMENT SYSTEM EXPANSION

Project Description and Location(s):

Project would provide Freeway Management System upgrades and expansion along I-20 and I-520 to provide enhanced and improved traffic operations, management and surveillance capabilities along the interstates. See Figure 39 for locations of recommended DMSs, CCTVs and fiber optic communications along I-20 and I-520. Improvements and upgrades to be provided under this project include the following:

1. Fiber Optic Communications – will include 29.3 miles of new fiber optic infrastructure (i.e., primarily underground) to support improved freeway management operations, support video surveillance, dynamic message signs and other possible ITS devices.
2. CCTV Surveillance System – will include over nine (9) new CCTV IP cameras operated and maintained by SCDOT (Columbia) to provide comprehensive video surveillance coverage at key interstate interchanges along the interstate.
3. DMS System – will include two (2) DMS signs operated and maintained by SCDOT (Columbia) to provide critical traffic and roadway condition information to motorists along the interstates as well as support route diversion events onto regional arterial roadways within Aiken and Augusta-Richmond Counties. Locations of the DMSs will be finalized during design and include:
    a. DMS # 1 – Westbound (WB) I-20 in advance of the I-520 interchange, to support the function of I-520 as a bypass for incident management purposes
    b. DMS # 2 – Westbound (WB) I-20 in advance of the Martintown Rd interchange, directing traffic to North Augusta for incident management purposes and/or special event needs
4. Communications may include high bandwidth Internet / WiFi to connect with the SCDOT TMC in Columbia, as required or needed.

Agencies/Stakeholders Involved: SCDOT (Lead), Aiken County and GDOT

Project Justification / Potential Impacts (Benefits): Project would provide fiber optic communications, additional CCTV cameras, and DMS signs to improve freeway monitoring and provide critical / valuable information to the traveling public in regards to potential incidents, amber alerts, special events, emergency information, etc. as required depending on the scenario. This will facilitate the traveling public to make informed decisions on alternative routes, etc. as needed.

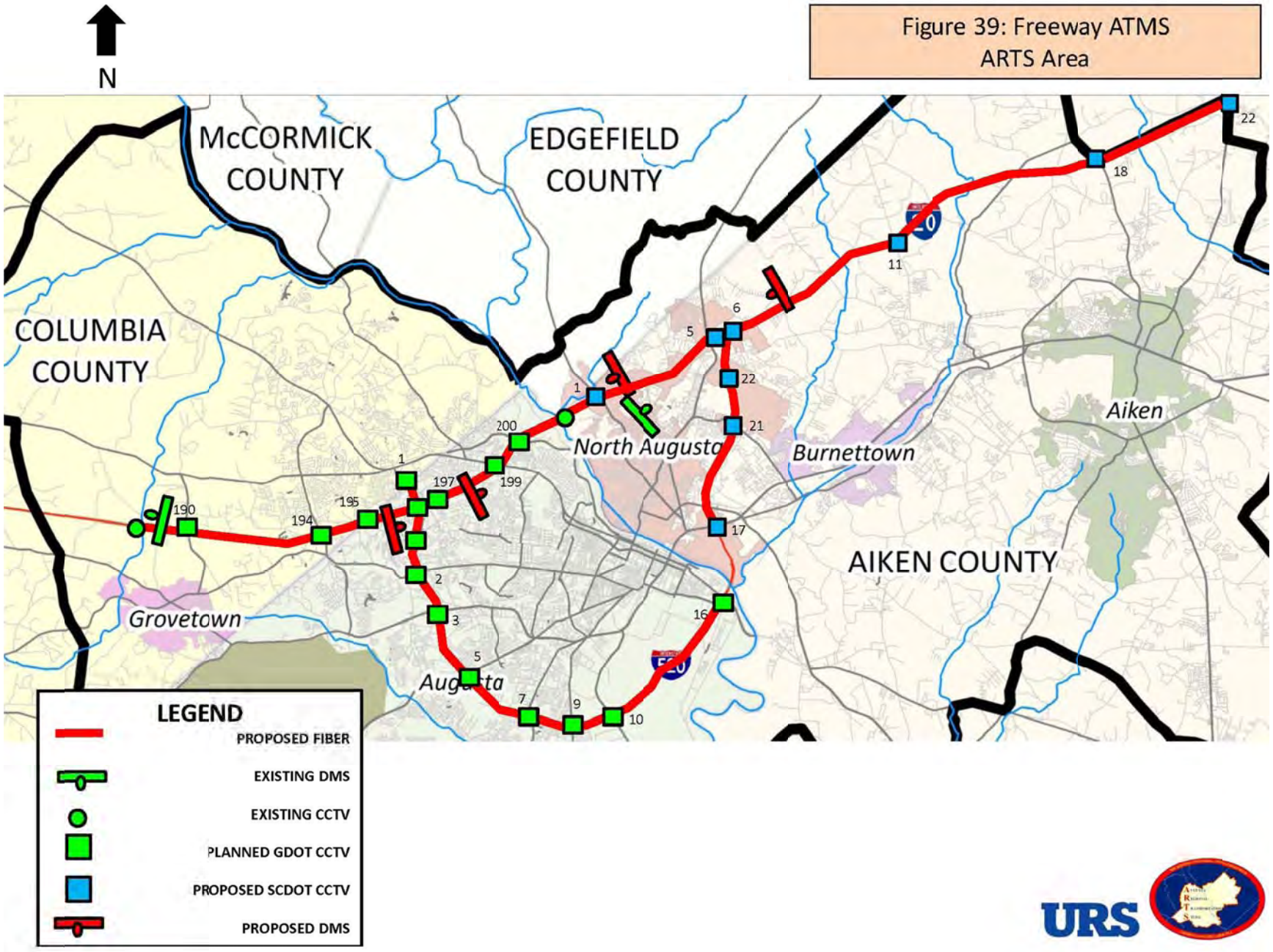
Estimated Engineering and Construction Capital Costs *(in 2013 dollars)*: $ 375,000 (engineering) / $ 4,100,000 (F&I, construction)

Estimated O&M Costs: $ 350,000 (8 to 10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS01, ATMS06

Project Dependencies: Communications to SCDOT TMC, and integration with Palguide software.

Figure 39. Freeway ATMS



SD-2: INTERSTATE REFERENCE MARKERS

Project Description and Location(s):

Project would provide Interstate Reference Markers along I-20 and I-520 to provide motorists / travelers markers to use as an accurate reference point when they call into 911 or other to report an accident/incident along the interstate / highway. This project would include the following:

1. Provide small reference markers (signs), (8-inches x 10-inches, typical) posted at the sides of the interstate and median facing the direction of travel indicating positions (mile marker) on the highway grid.
2. Assume 20 miles of coverage (initial deployment) within higher congested / accident rate segments along the interstate / highway system. Exact segment is TBD.
3. Markers would also show direction of travel and the shield of the particular interstate/highway with spacing approximately every 1/5-mile to 1/4-mile along the interstate.
4. Markers would be placed on 7 to 12-foot flanged steel posts and would be placed, where applicable, in line with reflective delineators or just behind guard rail. Markers within 50 feet of a delineator could take place of the delineator. Markers within 50 feet of existing sign or light posts maintained by DOT) should be affixed to these posts. Markers would also be affixed to bridges, retaining walls or similar features, as approved or required.

Agencies/Stakeholders Involved: SCDOT (Lead), State Police, Emergency Response Agencies, and GDOT.

Project Justification / Potential Impacts (Benefits): Project would provide reference markers along the interstates to provide motorist accurate reference points to use when calling in / reporting an accident or incident or if they broke down along the interstate. This will provide emergency responders and state police accurate information to respond to the accident/incident improving overall response times.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 20,000 (engineering) / $ 130,000 (F&I, construction)

Estimated O&M Costs: $ 4,000 (3% *annually, in 2013 dollars*)

ITS Architecture Compatibility: EM02

Project Dependencies: None

SD-3: SCDOT SHEP / MOTORIST ASSISTANCE EXPANSION

Project Description and Location(s):

Project would provide freeway service patrol (Road Ranger) expansion and upgrades. This would be an expansion of the existing State Highway Emergency Program (SHEP) capable of providing minor repair services to disabled vehicles, such as supplying gas or charging a battery and carry arrow boards, cones, and other warning devices for traffic control to assist in incident management.

Project would include 30 center-line miles along I-20 (22 miles) and I-520 (8 miles). Service times would be as follows: 7 am to 7 pm (M-F), 9 am to 7 pm (Sat) and 9 am to 5 pm (Sun); 24/7. Operations would be managed from SCDOT Columbia TMC.

Approximately three (3) active SHEP Trucks are anticipated during service hours.

Agencies/Stakeholders Involved: SCDOT (Lead).

Project Justification / Potential Impacts (Benefits): Project would provide a proven traffic management technique in mitigating minor incidents like disabled vehicles and providing on-scene incident assistance to emergency responders thereby reducing congestion / queuing and risk of secondary incidents.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 306,000 (capital, 3 vehicles)

Estimated O&M Costs: $ 350,000 (*annually, in 2013 dollars*)

ITS Architecture Compatibility: EM04

Project Dependencies: None

GD-1: GDOT FREEWAY DMS SYSTEM DEPLOYMENT

Project Description and Location(s):

Project would provide Freeway DMS System deployment along I-20 and I-520 to provide enhanced and improved traffic operations and management capabilities along the interstates. See Figure 39 on page 104 for locations of recommended DMSs along I-20 and I-520.

DMS System – would include two (2) DMS signs operated and maintained by GDOT (Atlanta) to provide critical traffic and roadway condition information to motorists along the interstates as well as support route diversion events onto regional arterial roadways within Columbia and Augusta-Richmond Counties. Full span structures (are assumed) would be provided and communications to the GDOT TMC would be provided through wireless Internet or cellular phone connections to each DMS, as required by GDOT. Locations of the DMSs will be finalized during design and include:

1. DMS # 1 – Eastbound (EB) I-20 in advance of the I-520 interchange, to support the function of I-520 as a bypass for incident management purposes
2. DMS # 2 – Eastbound (EB) I-20 in advance of the Washington Rd interchange, directing traffic to Augusta for incident management purposes and/or special event needs

Agencies/Stakeholders Involved: GDOT (Lead), Augusta-Richmond County, Columbia County, and SCDOT.

Project Justification / Potential Impacts (Benefits): Project would provide DMS signs to improve freeway monitoring and provide critical / valuable information to the traveling public in regards to potential incidents, amber alerts, special events, emergency information, etc. as required depending on the scenario. This will facilitate the traveling public to make informed decisions on alternative routes, etc. as needed.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 100,000 (engineering) / $ 1,000,000 (F&I, construction)

Estimated O&M Costs: $ 100,000 (10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS06

Project Dependencies: Communications to GDOT TMC, and integration with NAV2 software.

GD-2: INTERSTATE REFERENCE MARKERS

Project Description and Location(s):

Project would provide Interstate Reference Markers along I-20 and I-520 to provide motorists / travelers markers to use as an accurate reference point when they call into 911 or other to report an accident/incident along the interstate / highway. This project would include the following:

1. Provide small reference markers (signs), (8-inches x 10-inches, typical) posted at the sides of the interstate and median facing the direction of travel indicating positions (mile marker) on the highway grid.
2. Assume 20 miles of coverage (initial deployment) within higher congested / accident rate segments along the interstate / highway system. Exact segment is TBD.
3. Markers would also show direction of travel and the shield of the particular interstate/highway with spacing approximately every 1/5-mile to 1/4-mile along the interstate.
4. Markers would be placed on 7 to 12-foot flanged steel posts and would be placed, where applicable, in line with reflective delineators or just behind guard rail. Markers within 50 feet of a delineator could take place of the delineator. Markers within 50 feet of existing sign or light posts maintained by DOT) should be affixed to these posts. Markers would also be affixed to bridges, retaining walls or similar features, as approved or required.

Agencies/Stakeholders Involved: GDOT (Lead), State Police, Emergency Response Agencies, and SCDOT

Project Justification / Potential Impacts (Benefits): Project would valuable reference markers along the interstates to provide motorist accurate reference points to use when calling in / reporting an accident or incident or if they broke down along the interstate. This will provide accurate location information to emergency responders and state police to respond to the accident/incident improving overall response times.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 20,000 (engineering) / $ 130,000 (F&I, construction)

Estimated O&M Costs: $ 4,000 (3% *annually, in 2013 dollars*)

ITS Architecture Compatibility: EM02

Project Dependencies: None

GD-3: GDOT FREEWAY FIBER OPTIC COMMUNICATIONS

Project Description and Location(s):

Project would provide fiber optic communications to replace and/or upgrade existing cellular / Internet communications to ITS devices along I-20 and I-520. See Figure 39 on page 104 for recommended fiber optic communications route. Project would include 27.7 miles of new fiber optic infrastructure (i.e., primarily underground) to support improved freeway management operations, support video surveillance, dynamic message signs and other.

Agencies/Stakeholders Involved: GDOT (Lead)

Project Justification / Potential Impacts (Benefits): Project would provide fiber optic communications to improve reliability and availability of ITS operations along the freeway during emergency events including evacuations.

Estimated Engineering and Construction Capital Costs *(in 2013 dollars)***:** $ 230,000 (engineering) / $ 2,500,000 (F&I, construction)

Estimated O&M Costs: $ 230,000 (8 to 10% *annually, in 2013 dollars*)

ITS Architecture Compatibility: ATMS01

Project Dependencies: None

4.3 PROJECT PRIORITIZATION AND SEQUENCING

The candidate ATMS / ITS projects were ranked by the stakeholders in regards to priority. This priority translates into the anticipated implementation timeframe for each potential ATMS / ITS project.

ITS Project priority is presented as High, Medium, or Low general implementation timing as shown in Table 9.

Table 9. Project Priority and General Implementation Timing

Priority	Implementation Time Frame	Time Frame in Years
High	Short-term	0 – 3
Medium	Mid-term	4 – 6
Low	Long-term	7+

The general implementation timing (sequencing) of ATMS / ITS projects into these three implementation priority timeframes (i.e., short-, mid-, long-term) was determined by stakeholder input, however, final deployment scheduling will depend on the following implementation factors and/or considerations as required or needed:

1. **Project Prerequisites / Dependence on Other ITS Projects:** Project is dependent on other ITS and communications deployments (existing, programmed, planned) to provide full or partial operations and/or benefit (i.e., logical sequencing) – i.e., project depends on another project to be deployed first.
2. **Proximity to Planned/Programmed Roadway/ITS Project:** Project may be able to possibly leverage (through revision of an existing project scope) to expedite deployment of support infrastructure (i.e., conduit, etc.) – i.e., move up schedule and/or reduce ITS project implementation costs.
3. **Funding Opportunities/Availability:** Need to balance (spread-out) costs (construction/capital, O&M) over time (from year to year) – availability of funding will impact implementation timeframe and actual deployment. Depending on funding levels a proposed ITS project could be broken up into phases to allow deployment in stages dependent on level of funding.

Table 10 lists potential ATMS/ITS projects with their overall implementation time frame priority and sequencing. Table 11 shows proposed ITS projects and proximity to road and bridge projects that are funded by TIA.

Table 10. ITS Project Implementation Sequencing / Schedule

Project ID	ITS Project Name	Capital Cost Engineering & Construction[1]	Annual Cost Operations & Maintenance[2]
	TIA Funded		
RC-1	Richmond County ITS Master Plan Implementation	$ 4.5 M	$ 350K
RC-2	Richmond County Emergency Preemption and Transit Vehicle Priority System	$ 1.5 M	$ 125K
	Short-Term (Year 0 to 3)		
RC-3	Augusta Fixed Route CAD/AVL System	$ 232K	$ 21K
RC-4	Augusta Arrival and Departure Passenger Info System	$ 440K	$ 40K
CC-1	Columbia County Emergency Preemption System Expansion	$ 150K	$ 15K
CC-2	Columbia County Video Surveillance System Deployment	$ 250K	$ 25K
CC-3	Columbia County DMS Deployment	$ 970K	$ 90K
AC-1	City of Aiken ATMS Expansion Phase 1	$ 2.1 M	$ 190K
AC-3	City of North Augusta ATMS Expansion Phase 1	$ 880K	$ 80K
SD-1	SCDOT Freeway Management System Expansion	$ 4.5 M	$ 350K
GD-1	GDOT Freeway DMS System Deployment	$ 1.1 M	$ 100K
ARTS-2	ARTS Travel-Time and Real-time Speed Data	$ 100 – 150K (study, RFP) $ 45K (pilot)	N/A
	Mid-Term (Year 4 to 6)		
CC-4	Columbia County Flashing Yellow Arrow Conversion	$ 435K	N/A
CC-5	Columbia County Portable Traffic Management Station	$ 193K	$ 5.5K
AC-5	Aiken County Emergency Preemption System Expansion	$ 780K $ 75K (eng) / $ 25K (eval, pilot)	$ 78K
AC-6	Aiken County Adaptive Traffic Signal Control Expansion	$ 725K	$ 66K
AC-7	Aiken County Travel Time System & Safety-Based Concepts	$ 84K	$ 13.5K
ARTS-1	ARTS Communications Study	$ 75 – 150K	N/A
ARTS-3	ARTS Advanced Warning to Avoid Railroad Delays	$ 80 – 150K (study, PE) $ 250K (pilot)	N/A
RC-5	Richmond County Flashing Yellow Arrow Conversion	$ 895K	N/A

Project ID	ITS Project Name	Capital Cost Engineering & Construction[1]	Annual Cost Operations & Maintenance[2]
RC-6	Richmond County School Flasher Network Upgrade	$ 730K	$ 67K
	Long-Term (Year 7+)		
RC-7	Richmond County ATMS Expansion	$ 3.3 M	$ 300K
AC-2	City of Aiken ATMS Expansion Phase 2	$ 1.26 M	$ 110K
AC-4	City of North Augusta ATMS Expansion Phase 2	$ 1.1 M	$ 100K
AC-8	Best Friend Auto Voice Annunciation System	$ 95K	$ 8.6K
CC-6	Columbia County Safety-Based Initiatives	$ 200K (study, PE) $ 265K (pilot – Concept 1 – 4)	N/A
CC-7	Columbia County Video Sharing System	$ 145K	$ 19.5K
SD-2	SCDOT Interstation Reference Markers	$ 150K	$ 4K
GD-2	GDOT Interstate Reference Markers	$ 150K	$ 4K
SD-3	SCDOT Freeway Motorist Assistance Expansion	$ 306K	$ 350K
GD-3	GDOT Freeway Fiber Optic Communications.	$ 2.7 M	$ 230K

[1] Planning level estimates include survey, design, construction, and construction phase services associated with ITS deployments
[2] Planning level estimates include staffing, maintenance equipment, preventive maintenance, and break-fix maintenance

Table 11. TIA Project Proximity to ARTS ATMS Projects

PI No.	MPO TIP ID	CS#	County	Project Name	New Band	TOTAL TIA $	TOTAL Project $	Project Limits	Primary Work	Project Length (mi)	ARTS ATMS Projects That May Be Influenced
Band 1 Projects											
250470-	RC07-000017	CS-026	**Columbia**	**Old Petersburg Rd Improvements**	1	$20,000,000.00	$ 58,980,794.59	Baston Rd to Washington Rd	Widening	3.87	CC-1 and CC-2
0011414	RC07-001212	??	**Columbia**	**Robinson Ave/SR 223 Improvements**	1	$8,000,000.00	$ 8,000,000.00	SR 388 to SR 10	Intersection Improvement		CC-2
0008347	RC07-000032	CS-010	**Columbia**	**Wrightsboro Rd Improvements**	1	$3,000,000.00	$ 3,000,000.00	SR 388 to SR 223	Widening	0.83	RC-1, RC-2
250510-	RC07-000155	CS-204	**Richmond**	**Wrightsboro Rd Widening**	1	$ 2,000,000.00	$ 20,820,477.16	Jimmie Dyes Pkwy to I-520	Widening	2.4	RC-2, RC-2
0011394	RC07-000126	CS-257	**Richmond**	**Marks Church Rd Widening**	1	$ 7,849,390.00	$ 7,849,390.00	Wrightsboro Rd to Wheeler Rd	Turn Lane, C&G, Sidewalk, and Storm-Sewer System	1.38	RC-1
0011406	RC07-000144	CS-276	**Richmond**	**Walton Way Phase III Signals Bransford Rd**	1	$ 5,252,616.00	$ 5,252,616.00	Bransford Rd to Milledge Rd	Signals and Fiber Communications	0.55	RC-1 and RC-2
0011396	RC07-000129	CS-261	**Richmond**	**North Leg Rd Improvements**	1	$ 3,832,757.00	$ 3,832,757.00	Sibley Rd to Wrighstboro Rd	Intersection Improvement	0.07	
0011420	RC07-001219	CS-237	**Richmond**	**Druid Park Improvements**	1	$ 3,512,456.00	$ 3,512,456.00	Walton Way to Wrightsboro Rd	Resurface & Reconstruction	0.7	RC-1
0011699 (old 0011405)	RC07-000142	CS-210	**Richmond**	**Riverwatch Pky Corridor Improvements I20/SR 104**	1	$ 2,518,810.00	$ 2,518,810.00	I-20 to River Shoals Rd	Interchange Improvements	0.4	RC-1 and RC-2
0011407	RC07-000145	CS-277	**Richmond**	**Walton Way Phase III Signals Heard Ave**	1	$ 2,325,000.00	$ 2,325,000.00	Druid Park to Heard Avenue	Signals and Fiber Communications	0.63	RC-1 and RC-2
0011388	RC07-000116	CS-291	**Richmond**	**Gordon Hwy / Deans Bridge Rd Intersections**	1	$ 1,065,000.00	$ 1,065,000.00	Gordon Highway and Deans Bridge	Intersection Improvement	0.4	RC-1 and RC-2
0011402	RC07-000139	CS-288	**Richmond**	**Riverwatch Pky Adaptive Signal**	1	$ 682,087.00	$ 682,087.00	Furry's Ferry and River Shoals Pkwy	Adaptive Signals	2.63	RC-1, RC-2
0011403	RC07-000140	CS-267	**Richmond**	**Riverwatch Pky Fury's Ferry Rd Intersection**	1	$ 515,966.00	$ 515,966.00	Fury's Ferry Rd	Intersection Improvement	0.4	RC-1, RC-2
0011404	RC07-000141	CS-268	**Richmond**	**Riverwatch Pky / Stevens Creek Rd Intersection**	1	$ 430,739.00	$ 430,739.00	Riverwatch Pkwy and Stevens Creek Rd	Intersection Improvement	0.4	RC-1, RC-2

PI No.	MPO TIP ID	CS#	County	Project Name	New Band	TOTAL TIA $	TOTAL Project $	Project Limits	Primary Work	Project Length (mi)	ARTS ATMS Projects That May Be Influenced
Band 2 Projects											
0008346	RC07-000024	CS-009	**Columbia**	**SR 28 Widening**	2	$50,210,984.00	$ 50,210,984.00	SC line to CR 1236/Evans to Locks Rd	Widening	3.92	
0008350	RC07-000025	CS-013	**Columbia**	**SR 388 Widening**	2	$25,505,908.00	$ 25,505,908.00	I-20 to SR 232	Widening	1.59	CC-1 and CC-2
250600-	RC07-000019	CS-027	**Columbia**	**SR 1017 Improvements**	2	$20,000,000.00	$ 20,000,000.00	I-20 to SR 104	Widening	1.6	CC-1 and CC-2
220680-	RC07-000147	CS-207	**Richmond**	**SR 4 /15th St Widening**	2	$ 21,415,267.00	$ 28,029,260.19	Milledgeville rd to Government Rd	Widening	1.59	RC-1 and RC-2
0011413	RC07-001211	??	**Richmond**	**Berckmans Rd Widening**	2	$ 16,700,000.00	$ 16,700,000.00	Wheeler Rd to Washington Rd	Realignment	1.82	RC-1 and RC-2
0011419	RC07-001218	CS-253	**Richmond**	**James Brown Reconstruction**	2	$ 6,193,980.00	$ 6,193,980.00	Wrightsboro Rd to Riverwatch Pkwy	Resurface & Reconstruction	1.4	RC-1 and RC-2
0011408	RC07-000146	CS-209	**Richmond**	**SR 4 / 15th St Pedestrian Improvements**	2	$ 5,042,695.00	$ 5,042,695.00	Calhoun Expwy to Central Avenue	Bicycle/Ped. Improvements	1.55	RC-1 and RC-2
Band 3 Projects											
0008351	RC07-000031	CS-101	**Columbia**	**SR 388 Widening**	3	$26,198,019.00	$ 26,198,019.00	Wrightsboro Rd to I-20	Widening	2.95	
0011409	RC07-000148	CS-270	**Richmond**	**Telfair Street Improvements**	3	$ 19,233,219.00	$ 19,233,219.00	15th St to East Boundary ST	Sidewalks, C&G, and Storm-Sewer Reconstruction	2.19	RC-1 and RC-2
0011389	RC07-000117	CS-246	**Richmond**	**Greene St Improvements**	3	$ 9,880,736.00	$ 9,880,736.00	13th St to East Boundary St	Sidewalks, C&G, and Storm-Sewer Reconstruction	1.77	RC-1 and RC-2
0011421	RC07-001220	CS-215	**Richmond**	**6th St Resurfacing**	3	$ 6,843,938.00	$ 6,843,938.00	Laney Walker Blvd to Reynolds St	Resurface & Reconstruction	1.04	
0011415	RC07-001213	CS-213	**Richmond**	**5th St Improvements**	3	$ 5,118,150.00	$ 5,118,150.00	Laney Walker Blvd to Reynolds St	Sidewalks, C&G, and Storm-Sewer Reconstruction	0.98	RC-1
0011424	RC07-001223	CS-223	**Richmond**	**13th St Improvements**	3	$ 3,060,855.00	$ 3,060,855.00	RA Dent to Reynolds St	Resurface & Reconstruction	0.61	RC-1 and RC-2

4.4 OPERATIONS AND MAINTENANCE (O&M)

As with other transportation and infrastructure projects, ITS deployments require resources to facilitate operations and provide normal maintenance. An often overlooked or underestimated item in planning for technology-based projects is the cost to operate and maintain the system after it is installed. Deployment of technology is only as effective as it is maintained and operated properly to keep it functionally operating at initial performance levels.

Operations can consist of activities ranging from deployment of portable devices to operations and supervision of a TMC/TCC. These activities are often labor intensive, raising staffing issues that will need to be addressed during implementation. Maintenance of ITS infrastructure typically entails systems calibration, software and hardware updates, reestablishing lost communications, and repair of damaged equipment.

Costs associated with these tasks can be as varied as the operations themselves and the technologies in question. In some cases, operations and maintenance costs associated with ITS can be high in comparison with more traditional transportation infrastructure, however, when viewed in light of the benefit provided, they can actually represent on going savings in other areas.

Many DOTs have in-house IT, communications, and maintenance staff with the capability to maintain the new components installed as part of the ATMS/ITS; however, resources need to be allocated appropriately so that existing staff can accommodate the new systems in addition to their existing workload. If it is determined that the existing staff mix and technical skills represented is not adequate to handle the additional components installed, then a plan needs to be developed to acquire the necessary resources using equipment vendors and/or identify adequate budget for contract support and maintenance services. The following should be considered when planning for the operations and maintenance of ATMS/ITS:

- Identify funding and policies supporting ongoing operations and maintenance.
- Identify the aspects of the system needing operations or maintenance support.
- Identify the manuals (user, administrator, and maintenance), configuration records, and procedures that are to be used in operation and maintenance.
- Identify the personnel who will be responsible for operations and maintenance.
- Identify initial and ongoing personnel training procedures, special skills, tools, and other resources.
- Identify operations- and maintenance-related data to be collected and how it is to be processed and reported.
- Identify methods to be used to monitor the effectiveness of operations and maintenance.

The level of operations and maintenance support that is needed will vary based on the maintenance method selected and the size and/or complexity of the system. Compared to more traditional infrastructure improvement such as roadway projects, ITS improvements typically incur a greater proportion of their costs as continuing management, maintenance, and operations costs rather than up-front capital costs.

ITS equipment also typically has a shorter anticipated useful life than many traditional infrastructure improvements, and it must be replaced as it reaches obsolescence. Further complicating the

operations and maintenance of ITS is the sharing of ITS equipment and resources across different departments and possibly multiple agencies.

Each transportation agency (GDOT, SCDOT, counties, and cities) should assess its capabilities and current staffing to arrive at a maintenance and operations concept that fits its situation and size and complexity of their system. Complexity of the system may require specialty skill sets and/or require more frequent training to stay current with technology advancements. This assessment should be initiated during the project development process and finalized during system validation.

Currently, GDOT maintains ATMS/ITS infrastructure on the freeways via a statewide contract awarded to a contractor. GDOT typically operates freeway ATMS/ITS infrastructure via the GDOT TMC in Atlanta. ATMS/ITS infrastructure on arterials is normally maintained by the jurisdiction that requested and/or installed the field infrastructure. Currently, the City of North Augusta and the City of Aiken maintain the traffic signal infrastructure on state routes within and near these jurisdictions.

Currently, SCDOT maintains ATMS/ITS infrastructure on the freeways using state staff resources and a number of contractors. SCDOT typically operates freeway ATMS/ITS infrastructure via the SCDOT TMC in Columbia. ATMS/ITS infrastructure on arterials is normally maintained by the jurisdiction that requested and/or installed the field infrastructure. Currently, the City of Augusta and Columbia County maintain the traffic signal infrastructure on state routes within and near these jurisdictions.

Personnel resources needed for the operation of the system will depend on the design and level of automation included in the system versus requiring active participation by the agency maintenance personnel. Following are some examples of how other state and municipal transportation agencies have handled operations and maintenance responsibilities for their ITS:

- The Tennessee Department of Transportation (TDOT) uses contract maintenance for its systems, and has a separate contracted consultant to monitor the maintenance contractor. Existing DOT staff handles the management workload for the two contracts.
- The Mississippi Department of Transportation (MDOT) developed in-house maintenance staff capability, with some positions filled by contract labor and others by MDOT staff. This method required the purchase and maintenance of additional resources such as vehicles, test equipment, tools, safety gear, etc.
- Some municipalities have added the ITS maintenance duties to existing traffic signal maintenance groups. Typically, traffic signal maintenance shops have some of the equipment needed to support ITS operations and maintenance, such as bucket trucks and basic communications test equipment.

The ITS components that require routine and ongoing maintenance fall into one of three (3) categories: 1) central control, 2) field elements, and 3) communications. The FHWA maintains a database with the projected average life expectancy for many types of ITS devices, which can be referred to for more information.

4.5 TMC/TCC STAFFING RECOMMENDATIONS

The growth of the ATMS system will require greater focus on operations and maintenance staffing. The goal of operational staff and maintenance staff is to maximize the utility of the system in terms of functional capability and system operating performance.

As the ATMS infrastructure is installed, the new functionalities offered by the field devices and the software must be utilized to maximize the value of the ATMS investment. The key to maximizing the value is to have adequate operations and maintenance staff available to monitor and manage the transportation system. At the same time, the capabilities of the ATMS enhance the performance of staff through simplifying tasks and improving response times.

Staff that is dedicated to operations allows agencies to respond immediately to traffic conditions that may change rapidly on account of an incident or construction activity. Staff that focuses on updating information in a consistent and timely manner will benefit motorists, who will otherwise easily recognize information that is incorrect or out-of-date. Maintaining credibility with motorists is a key aspect of effective operations, and will ultimately be of high value to the motoring public.

Operations staff directly benefit from the ATMS by providing remote surveillance for the purpose of reviewing traffic conditions and observing traffic control device performance. The efficiency and effectiveness provided by remote surveillance will allow the existing operations staff to use their time more efficiently, and reduce response times for troubleshooting traffic issues. The combination of central software control and remote surveillance reduces the travel requirements for making operational changes in the field.

Maintenance staff directly benefit from the ATMS by improving their ability to remotely diagnose equipment issues. These improvements come in several forms: automated alerts and alarms when equipment failure occurs, communications system diagnostics to assess communications failures, and remote viewing of traffic control system equipment performance, such as vehicle detectors and conflict monitors. The efficiency and effectiveness provided by these diagnostic tools allow the existing maintenance staff to use their time more efficiently, and reduce response times for troubleshooting equipment issues.

Table 12 provides a summary of the growth of devices.

Table 12. Traffic/ITS and Communications Growth

Field Device	Richmond Co. Area		Columbia Co. Area		Aiken Co. Area	
	Exist	Future	Exist	Future	Exist	Future
Traffic Signals	271	280	65	75	145	155
Adaptive Signals	25	43	65	65	17	40
Surveillance Cameras	23	123	8	93	0	38
EVP / TSP Equipped Intersections	0	120	15	50	10	85
DMS	0	0	6	18	0	0
Transit "Next Bus" Signs	0	31	0	0	0	0
Beacons / School Flashers	90	90	71	71	0	0
FIELD DEVICE TOTALS	**384**	**644**	**165**	**307**	**155**	**278**
Fiber Optic Comm (miles)	25	51[2]	200[1]	200[1]	10	47[2]

Note 1: Columbia Co. Community Broadband – shared agency fiber optic network is already deployed

Note 2: 26 arterial miles are proposed (Richmond Co.) and 37 miles (Aiken Co.)

Note 3: GDOT and SCDOT assets within ARTS are not included in the table

From the ATMS/ITS projects recommended in this ATMS Master Plan, the number of traffic/ITS devices and subsystems will increase by over 75% and the miles of fiber communication will increase by over 25%. The large growth in numbers of field devices, associated fiber optic communications infrastructure and network equipment is a leading indicator for the need for additional specialized staffing and capabilities.

Recommended staffing is provided in **Tables C-1 to C-4** in **Appendix C**. Estimated TMC/TCC staffing costs are included in the overall O&M costs provided in the applicable project description sheets provided in Section 4.2.

4.6 STAKEHOLDER AGREEMENTS

Agreements may be required to realize some of the new ATMS/ITS projects and operations recommended in this ATMS Master Plan (i.e., video sharing, etc.).

Each connection between systems in the regional ITS architecture represents cooperation and a potential requirement for an agreement. There can be considerable variation between regions and among stakeholders regarding the types of agreements that are created to support ATMS/ITS deployment and operations.

With its focus on inter-jurisdictional coordination, a regional operational concept points directly to the types of agreements that may potentially be required between individual agencies and organizations. The following are some areas where formal or informal agreements may be needed as the integrated ATMS/ITS concepts and strategies identified in this Plan are implemented.

- *Inter-agency/Regional ATMS / Traffic System Control:* Joint sharing and potential control of traffic signals, detectors, CCTV cameras, and/or DMSs.
- Although information sharing is frequently implemented with little formality, agreements that detail the limits of authority, operational discretion, hours of operation and time of day/time of week where shared control would take effect, under what scenarios (i.e., major emergency/incident, etc.) would joint/shared control take place, and liability are required before "joint or shared control" could be implemented.
- *Coordination with Emergency / Incident Management:* Many of the ATMS/ITS devices put in place to monitor traffic conditions also provide information that is desirable to public safety and security agencies for Homeland Security and other law-enforcement activities.
- *Inter-agency/Regional Traffic Data and Video Sharing:* Video sharing is one of the recommended projects in this Plan.
- Once a decision is made and a solution is identified, agreements regarding the terms and conditions, types of data and information to be shared, how the information will be used, parameters for data format, quality and security, and access of the data and video will be needed.

There is typically considerable variation among stakeholders regarding the types of agreements that are created to support ITS deployment and integration.

Table 13 presents some common types of agreements.

Rather than a focus on technology in early cooperative agreements, the focus should be on the scope-of-service and specific agency responsibilities for various components of the service. Describe the high-level information that each agency needs to exchange in order to meet the goals and expectations of the other rather than defining how the delivery of that information will occur.

Table 13. Types of Agreements

Type of Agreement	Agreement Description
Handshake Agreement	• Early agreement between one or more partners • Not recommended for long term operations
Memorandum of Understanding	• Initial agreement used to provide minimal detail and usually demonstrating a general consensus • Used to expand a more detailed agreement like an Interagency Agreement which may be broad in scope but contains all of the standard contract clauses required by a specific agency • May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects though-out the region and the MOUs to specify the scope and differences between the projects
Interagency Agreement	• Between public agencies (e.g., transit authorities, cities, counties, etc.) for operations, services or funding • Documents responsibility, functions and liability, at a minimum
Intergovernmental Agreement	• Between governmental agencies (e.g., Agreements between universities and State DOT, MPOs and State DOT, etc.)
Operational Agreement	• Development of operations procedures that cross multiple jurisdictions • Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency • Identifies respective responsibilities for all activities associated with shared elements being operated and/or maintained
Funding Agreement	• Documents the funding arrangements for ITS projects *(and other projects)* • Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	• Standard contract and/or legal verbiage for a specific agency and serving as a master agreement by which all business is done. These agreements can be found in the legal department of many public agencies • Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (e.g., cities and counties) to have one *Master Agreement* that uses smaller agreements *(e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.*) to modify or expand the boundaries of the larger agreement to include more specific language

(Source: FHWA Regional ITS Architecture Guidance Document)

The process may begin with something as simple as a handshake agreement. But, once interconnections and integration of systems begin, agencies may want to have something more substantial in place. A documented agreement will aid agencies in planning their operational costs, understanding their respective roles and responsibilities, and build trust for future projects. Formal agreements are necessary where funding or financial arrangements are defined or participation in large regionally significant projects is required.

4.7 POTENTIAL FUNDING SOURCES

Funding is a critical aspect to ITS and traffic signal control improvements. Just as planning the ITS and advanced traffic systems has been a collaborative process, so is the development of financing strategies. Locally and across the U.S., major transportation projects often include a package of funding sources, including federal and state grants, locally generated funds to match those grants, and private-sector participation where possible.

This section provides potential funding sources that should be considered when further developing each of the ITS projects to eventual deployment.

A phased, incremental approach is recommended for the implementation of future ATMS/ITS elements. Each ATMS/ITS project consists of stand-alone subsystem(s) capable of delivering benefits, and each will be constructed under separate contracts over a period of time. Each subsystem would be integrated as appropriate with those implementations that have preceded it, evolving into the comprehensive system developed with the guidance of this, and successive, implementation plans.

The greatest risks of the phased implementation approach are associated with the integration of new systems with those that are already on-line and with the assignment of accountability of that function. When two subsystems cannot be integrated and one or both subsystems have to be modified, the costs may increase substantially. However, there are advantages. Since projects are spread out over time, the impacts to agency budgets are minimized. There is also the opportunity to select projects for which there is a high probability of success and that has highly visible benefits as early projects.

Table 14 provides a summary of potential federal, state and local sources that should be considered when identifying a funding source(s) for the ITS projects including:

Potential Local Funding Sources:

- GA – TIA discretionary (25% of TIA funds)
- GA – TIA-funded road and bridge projects
- GA – Special Purpose Local Option Sales Tax (SPLOST)
- SC – Local option sales tax (LOST)
- General funds (for 20% match on federally funded projects)

Potential State Funding Sources:

- GA – Statewide signal timing
- GA – Statewide signal design
- GA – Safety Program
- GA – Quick Response projects (under $200K construction)
- GA – Operational improvements
- SC (Federal) – Congestion Mitigation and Air Quality (CMAQ)
- SC (Federal) – Guide-shares

Table 14. Potential Funding Sources

Source Agency	Location	Funding Source	Eligible Project Types	Process Information	Contact
Local	GA	***TIA discretionary funds***	Transportation projects, at the discretion of the local agencies.	Controlled by local agency. 25% of TIA funds are distributed to the local agencies, and can be spent at the discretion of the local agency.	Local Agency
	GA	***TIA-funded road and bridge projects***	The opportunity to include ITS elements or supporting infrastructure (such as conduit) is limited to the project limits, the project description in the Concept Report, and the project funding.	The Concept Report is generally completed within 1 month of the NTP for the project.	Local Agency
	GA	***Special Purpose Local Option Sales Tax (SPLOST)***	A sales tax can be levied with the county for the specific purpose of transportation projects. The tax cannot support operations and maintenance.	The county levy portion is limited to 1%, and fractions are not allowed. The duration of the tax is 5 years, before a renewal vote is required.	Richmond County / Columbia County
	GA and SC	***General Funds***	Determined by local agency.	Controlled by local agency; typically used to match 20% of project cost, for which the remaining 80% is matched by another funding source.	Local Agency
	SC	***Local Option Sales Tax (LOST)***	A sales tax can be levied within the county for the specific purpose of transportation projects.	The county levy portion is limited to 2% above the SC State Sales Tax rate of 6%; the current levy in Aiken County is 7%. The sales tax is renewed on a 7 year cycle and must be passed by a public vote, and the most recent renewal started collecting tax in January 2013.	Aiken County
State	GA	***GDOT Statewide Signal Timing Contract***	Timing of state routes, and possibly local corridors that impact state routes or are impacted by state routes. Starting in 2014, signal timing-related repairs can be completed prior to implementing timings. Repairs would typically involve loop repairs, minor communications fixes, and pedestrian equipment. With limited funds available, repairs are focused on equipment that impacts signal timing efficiency.	Program is administered by Alan Davis, GDOT State Signal Engineer (aladavis@dot.ga.gov, 404.635.2832). Funding ranges from $500K to $1M annually.	GDOT District 2 Traffic Engineer, Kedrick Collins (kecollins@dot.ga.gov, 478-552-4619)
	GA	***GDOT Statewide Signal Design Contract***	Traffic signal upgrades along state routes, and they will often accept requests to upgrade off-system signals that are interconnected with signals on state routes. The work consists of full intersection upgrades including, but not limited to signal supports (span wire and mast arm), vehicle detection, signal cabinet,	Program is administered by Cynthia Burney (cburney@dot.ga.gov, 404. 631.1851). Available funding is $1M annually.	

Table 14. Potential Funding Sources

Source Agency	Location	Funding Source	Eligible Project Types	Process Information	Contact
			pedestrian facilities as per ADA requirements, LED signal heads, ITS devices, and communications.		
	GA	***GDOT Safety Program (LS30 LUMP)***	Intersection and corridor projects on state routes on local roads that indicate an overrepresentation of crashes. A benefit-to-cost ratio is calculated based on the crash reduction potential, based on crashes during the past 5 years.	Projects are reevaluated annually. Goals are to have 300% of the available funding program under design at all times, and deliver 150% of the program annually.	
	GA	***Operational Improvements Program (LS240 LUMP)***	Focus on projects that provide a significant improvement to traffic operations; project improvements are modeled to support scoring and ranking process.	Program is administered by Paul DeNard (pdenard@dot.ga.gov, 404.635.2843). Available funding is $10M annually, individual projects are intended to cost $1M or less; 10-20 projects per year	
	GA	***Quick Response***	Projects that reduce congestion and improve system reliability. Common projects include adding or lengthening a turn lane, traffic signal improvements, and equipment for maintaining traffic signal coordination.	Construction value must be less than $200K. Scheduled can be shortened for quick deployment. Project must be free of right-of-way or environmental issues.	
	SC	***Guide Shares***	Federal dollars controlled by the DOT. Used for new traffic signal installations and rebuilds statewide.	Currently a $7.5M program. District 7 has the latitude to defer or reprioritize projects.	SCDOT District 7
	SC	***Congestion Mitigation and Air Quality (CMAQ)***	Federal dollars controlled by the DOT. Focus on reducing traffic congestion and improving air quality, and can be used for intelligent transportation systems.	ARTS does not receive dedicated CMAQ funds, however SCDOT has a percentage of CMAQ funds that can be used for ITS.	SCDOT District 7
FHWA	SC and GA	***MAP-21 / National Highway Performance Program (NHPP)***	Provides support for the condition and performance of the National Highway System. Infrastructure-based intelligent transportation system capital investments are specifically mentioned as eligible projects.	States are responsible for selecting projects. Funds can be transferred to FTA for eligible projects. Available funding is $22B annually to all states. The typical federal funding share of a project is 80%.	
	SC and GA	***MAP-21/Surface Transportation Program (STP)***	Provides funding to preserve and improve the conditions and performance of surface transportation, including highway and transit.	States are apportioned STP funds. Funds can be transferred to FTS for eligible projects. Available funding is $10B annually to all states. The typical federal funding share of a project is 80%.	

Table 14. Potential Funding Sources

Source Agency	Location	Funding Source	Eligible Project Types	Process Information	Contact
FTA	GA and SC	***Urbanized Area Formula Program (5307)***	Planning, engineering design, and evaluation of transit project; capital investments in bus and bus-related activities including crime prevention and security equipment, communications, and computer hardware and software.	The funding is apportioned on the basis of legislative formulas. The federal share does not typically exceed 80% of the net project cost.	**FTA Contacts** GA – Christopher White SC - Dan Gray
	GA and SC	***Bus and Bus Facilities Grant (5309)***	New and replacement buses and facilities, including transportation centers, passenger amenities, accessory and miscellaneous equipment mobile radio units, fare boxes, computers, and shop and garage equipment.	The funding is apportioned on the basis of legislative formulas. The federal share does not typically exceed 80% of the net project cost.	
	GA and SC	***National Research & Technology Program (5312)***	Research, development, demonstration, deployment, and evaluation of technology of national significance to public transportation.		

Potential Federal (FHWA) Funding Sources:

- National Highway Performance Program (NHPP)
- Surface Transportation Program (STP)

Potential Federal (FHWA/FTA) Funding Sources:

- 5307 – Urbanized Area Formula Grants
- 5309 – Bus and Bus Facilities Grant
- 5312 – National Research & Technology Program

In addition to the sources listed in this section, others may exist that should be evaluated, such as; Private funding, Public-Private Partnerships (PPP), DHS (Interoperable Emergency Communications Grant Program), and State Homeland Security Programs.

On-going Operations and Maintenance Funding Considerations -- To ensure that the deployed ATMS/ITS projects will continue to operate as intended and meet the needs of travelers on a continual basis, the state/region must identify funding sources for day-to-day operations and maintenance of systems. Although most agencies would like to reduce O&M expenditures with the implementation of new systems, ITS and other technology-based systems often have significant ongoing costs.

The benefits of ATMS/ITS deployments are only achieved through efficient operation of the systems, which must be identified when justifying funding for the O&M costs. The first year of operation of the ITS will not be a good indicator for what annual O&M costs will be due to product warranties. Over time, the O&M costs will tend to increase as equipment ages and becomes outdated or obsolete, software needs constant updating with new devices drivers to be developed, and/or more devices are added to an existing system.

ATMS/ITS projects typically require or acquire equipment warranties ranging from 2 to 5 years depending on the item. This helps to mitigate some of the maintenance costs for the several years upon ITS deployment.

Purchasing extended warranties (if available) as part of the Bid proposal may be a way to help off-set some of the maintenance costs. Tracking equipment warranties and typical equipment life should be included as part of the agencies O&M planning process. It may be easier and cheaper to replace equipment before they get to a point of requiring more frequent maintenance / repairs to keep them working at a certain performance level.

In general, ITS equipment has a relatively short life span as compared to a highway or bridge. ITS equipment replacement should be expected on a regular interval, depending on the device. In addition, the costs associated with communications are an integral component to operating ATMS/ITS equipment. Funding for communications is required, whether leasing bandwidth from commercial communication providers or engaging service contracts to maintain agency-owned communications assets. Typically, local agencies cannot financially bear the full cost of operations and maintenance with their own resources. Therefore, agencies frequently seek federal funds if they are eligible. Agencies are obviously responsible for personnel and other intangible costs. On the other hand, big ticket items such as replacing DMS or major software upgrades are more problematic. In funding ITS with federal monies, there is an implied commitment to operate and maintain the system and equipment to maximize and sustain the investment.

Nationally, funding for O&M is a major concern with various transportation agencies as they express that O&M costs are becoming

a major constraint for considering expanding their ITS program. In some cases, the agency's entire ITS budget is used only for O&M purposes. Some possible considerations to mitigate this concern include:

- Consider using a portion of federal funding sources for traffic management O&M, such as CMAQ, NHS, and STP funds.
- Raise awareness of significance of ATMS/ITS O&M with senior management and elected officials who have an influence over funding allocations.
- Collaborate on projects with other agencies to provide greater leverage in pursuit of funding.
- Contract out maintenance (privatization of O&M) in an effort to (a) save maintenance dollars and utilize contracting dollars, which appear to be more abundant; and (b) perform necessary maintenance in the midst of hiring freezes and restrictions to adding positions.
- Procure spare parts as part of construction or maintenance contracts to avoid complications with procurement, compatibility, and funding after the system becomes operational.
- Identify ATMS/ITS O&M as a distinct budget category (which is vitally important), even if it competes for funds with other maintenance functions.
- Acknowledge ITS/traffic management O&M as an ongoing expense and provide a means of tracking costs.
- Purchase extended warranties (if available from manufacturer) and track equipment warranties and expected device life and potentially replace ITS equipment before emergency maintenance activities to keep the device or subsystem performing becomes excessive.

It is essential, from the inception of an ATMS/ITS program or project, to seek every opportunity to secure funding from a variety of sources. This commitment of funding can be from traditional sources, private enterprise, public/private partnerships, or other arrangements such as special congressional ITS earmarks.

It is also important to keep in mind that traffic management projects carry with them the obligation to operate and maintain the systems. Thus, it is critical to not only obtain capital outlay funding, but also to secure the commitment for covering on-going operating and maintenance costs.

4.8 PROCUREMENT OPTIONS

NCHRP Report 560: *Guide to Contracting ITS Projects* provides guidance on the selection of appropriate contracting options for the design and implementation of an ATMS/ITS project. Selecting the appropriate option depends on many variables, including the following:

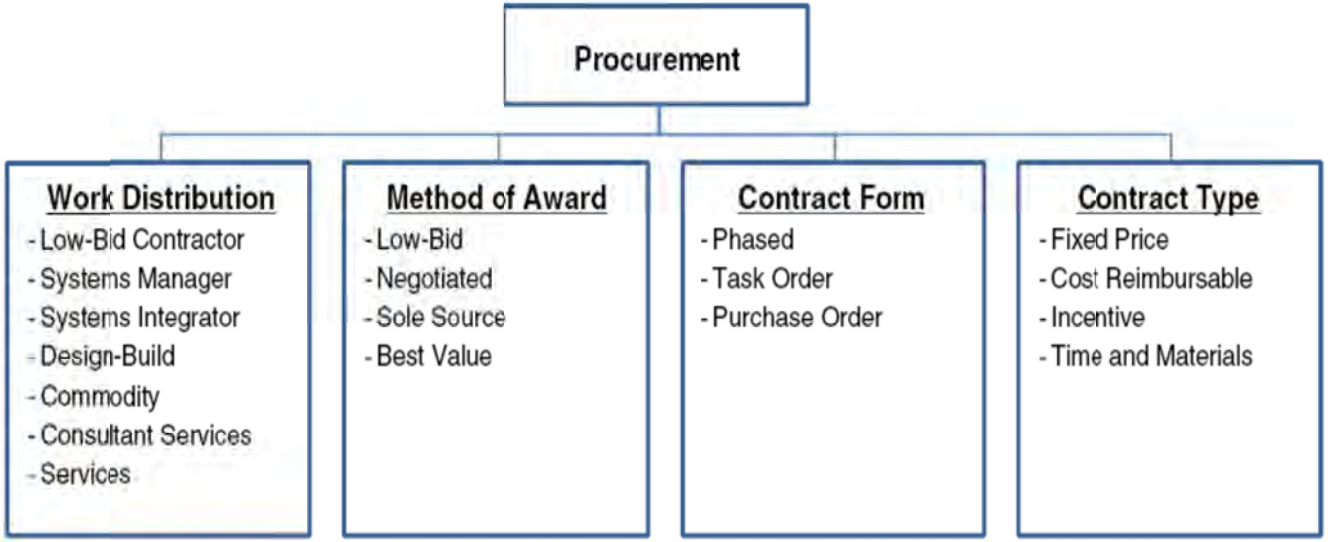
- Type and complexity of the required products, systems, and services
- Interdependence of project components and subsystems
- Inclusion of ITS components with roadway construction projects
- Use of varied and rapidly changing advanced technologies
- Need to pre-qualify consultants and/or contractors
- Constrained deployment schedule
- Magnitude of construction impacts on road users
- Risk management factors associated with capital investments

ATMS/ITS procurements often entail sophisticated combinations of hardware and software that are challenging to specify because they are tailored to the unique requirements of the procuring agency and use components embodying technology that may have advanced substantially in the time between the development of the project concept and the project implementation.

Because of these complexities and uncertainties, the low-bid contracting process that transportation agencies traditionally use to purchase capital improvements often is not the best approach for ITS procurements. If low bid is required due to the use of federal funds, consideration should be given to prequalifying the contractors prior to the low-bid process.

The complexity of a project can have a significant impact on the selection of a procurement strategy. ATMS/ITS projects can range in complexity from those that are relatively straightforward—as in adding field devices (e.g., CCTV, DMS, etc.) to an existing traffic management system—to those that are complex—such as the implementation of a new transportation management system, including custom software applications. The procurement strategy for these two undertakings would be significantly different. Additionally, operations and maintenance planning need to be considered in many ATMS/ITS projects prior to executing the final procurement plan. The four components of the procurement process—work distribution, method of award, form of the contract, and the contract type—are illustrated in Figure 40.

The ATMS/ITS procurement method can have substantial influence on the ultimate success of the ITS installation. The procurement method determines how responsibilities are distributed and decisions are made, the qualifications of the contractor, the systems engineering process, and the controls available to the contracting agency. The procurement method, ideally selected to suit the characteristics of the procuring agency as well as those of the project, has the potential to make or break a project.



(Source: NCHRP Report 560: Guide to Contracting ITS

Figure 40. Procurement Options

Decision on what type of procurement package to utilize ***will depend on the project characteristics, complexity of the project, as well as agency/department policies or preference***.

4.9 SYSTEM TESTING CONSIDERATIONS

TESTING PROGRAM

A testing program for ATMS/ITS consist of two primary phases: 1) verification of system and 2) validation of the system as described below:

Verification of System -- This section describes the system verification process, which is used to accept the system from the development/deployment team. This process may be performed by the DOT or municipalities or by a consultant hired to monitor and manage the installation under a Construction Engineering and Inspection contract. Having an engineering team experienced with ITS deployments and integration will free State/County/City DOT staff from this requirement and ensure the process is executed appropriately.

Verification ensures that the system meets its functional/technical requirements and matches the design and technical specifications. In this step, the system components are assembled into a working system to ensure that it fulfills all of its requirements.

Verification would typically be conducted over multiple sequential testing phases including; 1) bench level / factory level testing, 2) stand-alone testing, 3) system and subsystem acceptance testing and 4) burn-in test period to ensure that all requirements and any potential issues resulting from the design, installation or integration has been rectified and made fully operational. A detailed Test Plan with testing procedures would be developed and used to systematically test, verify and confirm that each project requirement has been met by the deployed ATMS/ITS project.

The challenge with ITS project deployment is that not all of the pieces are available at the same time; some will not fit together particularly well at first; and there will be pressure to change some of the pieces after they have already been assembled. The systems engineering approach provides a systematic process for integration and verification that addresses the challenges and complexity of assembling ITS.

Integration and verification are iterative processes in which the software and hardware components that make up the system are progressively combined into subsystems and verified against the requirements. This process continues until the entire system is integrated and verified against all of its requirements.

Validation of System -- This section describes the validation process, which ensures that the operational system meets the users' needs and its intended purpose. For example, in the validation step, the DOT/County/City may collect data for the purpose of a "before and after" study (if this is the case, data would also need to be collected prior to deployment).

Performance metrics will need to be identified and a Validation (Evaluation) Plan developed for each ITS project. The Validation Plan should define the metrics, how the data is to be collected (before and after), agency responsibilities and analysis of the data. In an ITS deployment, the validation process tends to be more complex than a typical roadway system. This is the natural result of having multiple agencies relying on the effective performance of any system.

In systems engineering a distinction is made between verification and validation. Verification confirms that a product meets its specified requirements. Validation confirms that the product or system fulfills

its intended use or purpose. The majority of system verification can be performed before the system is deployed. Validation really cannot be completed until the system is in its operational environment and is being used by the real users.

This is why the systems engineering approach seeks to validate the products / subsystems that lead up to the final operational system to maximize the chances of a successful system validation at the end of the project. Since validation activities are performed throughout the project development process, there should be few surprises during the final system validation.

ETHERNET SWITCH – Field Installation Test Form

Device Name: Make/Model: Serial #:

Testing Technician(s): Date:

FIELD INSTALLATION TEST PROCEDURE

Step #	Procedure	Results/Comments
1	Verify that the Ethernet Switch powers on.	
2	Verify that the Ethernet Switch is mounted securely to the rack, its power cord is neatly routed in the cabinet, and the switch is properly labeled.	
3	Verify all associated equipment is connected to the correct port on the Ethernet Switch and all patch and communication cords are neatly routed in the cabinet.	
4	Configure the laptop to be on the same IP subnet as the Ethernet Switch (see Configuration Data Sheet for port numbers).	
5	Connect the laptop to an open port on the Ethernet Switch with a standard RJ-45 to RJ-45 Cat5 Ethernet cable.	
6	Open a DOS command prompt window.	
7	Verify communication using the "Ping" command and the devices' IP addresses. a. Ping the Ethernet Switch. b. Ping the Hubs. c. Ping associated cabinet ancillary equipment and field devices (if applicable).	

Comprehensive Testing Program – To implement a testing program several levels of testing are necessary to verify the compliance of all of the detailed ATMS/ITS design requirements associated with ITS and communications project deployments. A "building block" approach to testing allows verification of compliance to Contract/Project requirements at the lowest level, building up to the next higher level, and finally full compliance with minimal re-testing of lower level requirements once the higher level testing is performed.

After components are tested and accepted at a lower level, they are combined and integrated with other items at the next higher level, where interface compatibility (and the added performance and operational functionality at that level) are verified. At the highest level, system integration and verification testing is conducted on the fully integrated system to verify compliance with those requirements that could not be tested at lower levels and to demonstrate the overall operational readiness of the system.

Testing starts with well-written requirements. From the testing perspective, the Project Specifications must be written with ***"testable" requirements containing clear and unambiguous pass/fail criteria*** (e.g., selection of a camera for PTZ control shall automatically select that camera input for display on the operator workstation monitor). Without testable requirements, it is difficult to ensure that the system performs according to its intended design and meets the expectations of the stakeholder. The requirements and verification testing process verifies that each requirement has been met; if it is not testable" there are no grounds for acceptance of the work.

Requirements should be written with simple, understandable, concise terms; be short and to the point. All technical terms and acronyms should be defined so there are no misunderstandings. For each (individual) requirement there should be one "shall" or "must" statement. If the requirements are complex, then they should be subdivided into a several individual statements to the greatest extent possible. The goal is that each requirement statement should be able to be clearly demonstrated and/or tested. A test case should be generated to verify each "shall."

Requirement statements should not mix dissimilar or unrelated requirements in the same statement. This will complicate requirements traceability and verification testing.

All requirements are also to be "***traceable" to previous stages*** (e.g., the System shall provide CCTV cameras with PTZ capabilities) in the design process (i.e., concept goals and objectives to functional / high-level requirements to detailed design requirements) to ensure that all stakeholder requirements and expectations are met once the system is deployed and operational.

It is important to be able to trace all of the requirements to an element of the detailed design and that all requirements are reflected in the final detailed design. See **Appendix D** *ATMS Master Plan Requirements Verification Matrix (RVM)* for an example developed for this ATMS Master Plan.

4.10 OTHER IMPLEMENTATION CONSIDERATIONS

Mainstreaming ITS Deployments

Mainstreaming ITS deployments is the key to initiating an ATMS / ITS Master Plan.

ATMS/ITS solutions to transportation issues should be treated similarly to other transportation solutions, incorporating them into the flow of planning and programming of projects. This means considering ITS projects alongside more traditional transportation solutions during the process of updating transportation programs both at the local level and at the state level.

The goal of mainstreaming is to ensure that ITS strategies and technologies are an integral component of the ARTS MPO planning and programming process and are incorporated into the ARTS LRTP and CMP.

Potential ITS Standards and Interfaces

ATMS/ITS standards define how ATMS/ITS systems, products and components are interconnected, exchange information, and interact within a transportation network. They are not design standards.

Using ITS standards provides the following benefits to the ARTS region:

1. Supports interoperability,
2. Supports 940 compliance,
3. Minimizes future integration costs,
4. Facilitates regional integration,
5. Supports incremental measurable development,
6. Prevents technological obstacles,
7. Minimizes operations and maintenance costs,
8. Prepares for emerging technologies,
9. Makes procurements easier, and
10. Makes testing easier.

This will ultimately allow transportation and other agencies to implement systems that cost effectively exchange pertinent data, video and accommodate equipment replacement, system upgrades, and system expansion. Standards also benefit the traveling public by providing products that will function consistently and reliably throughout the region. ITS standards contribute to a safer and more efficient transportation system and would facilitate regional compatibility and interoperability.

Making the best choices for standards to include in a project design depends on multiple factors, including throughput (how much data must be transmitted or received on the interface), network topology (how the ITS elements are connected together), and infrastructure (fiber optic lines, wireless, leased lines, etc.), among others. **Appendix B** lists ATMS/ITS standards and interfaces that are potentially applicable to the ITS projects recommended in this Plan. Standards provided in **Appendix B** may represent a superset of options, and in some cases, provide redundant capabilities. In addition, ITS standards may be a different maturity levels. Care should be taken to select the standards that best meet the needs of the region or project.

4.11 ITS ARCHITECTURE COMPLIANCE

All ATMS/ITS projects that intend to receive federal highway trust funds (whole or in part) are to be compliance with Part 940 of Title 23 of the Code of Federal Regulations (23 CFR Part 940) regarding systems engineering and ITS architectures. 23 CFR Part 940.11 (Project Implementation) addresses project level requirements for the planning and designing of ITS deployments. Part 940 stipulates that any project that moves into the design phase is required to follow a systems engineering process that is proportionate or appropriate with the project scope.

A project is defined as an ITS project or program that receives federal-aid. 23 CFR Part 940.11(c) states, "*The systems engineering approach shall include at a minimum*:

1. Identification of portions of the regional architecture being implemented,
2. Identification of participating agencies roles and responsibilities,
3. Requirements definition,
4. Analysis of alternate system configurations and technology to meet requirements,
5. Procurement options,
6. Identification of applicable standards and testing procedures,
7. Procedures and resources necessary for operations and management of the system."

Source: http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf

Prior to authorization of highway trust funds for construction or implementation of ATMS/ITS projects, compliance with Part 940.13 (Project Administration) must be demonstrated as stated above.

Table 15 provides a matrix to demonstrate compliance with Part 940 requirements in regards to ATMS/ITS Project Implementation.

Table 15. Part 940: Compliance Matrix

940 Compliance Project Implementation Requirement	ARTS ATMS Master Plan Reference
Update of ITS Architecture – identify portions of architecture to being implemented	This is provided in **Appendix B** *ITS Architecture Update* of this Plan
Identification of participating agencies roles and responsibilities	This is provided in **Section 3.2** *Stakeholder Operational Roles*
Requirements definition	This is provided in **Section 4.1** *Functional Requirements* and **Appendix D** *Requirements Verification Matrix*
Analysis of alternate system configurations and technology options to meet requirements	This is provided in **Section 4.0** *Implementation Plan* and **Section 4.2** *ATMS/ITS Projects*
Procurement options	This is provided in **Section 4.8** *Procurement Options*
Identification of standards and testing procedures	This is provided in **Section 4.10** *Other Implementation Considerations* and **Appendix B** *ITS Architecture Update*
Procedures and resources necessary for O&M of the system	This is provided in **Section 4.4** *O&M* and **Appendix C** *TMC/TCC Staffing*

4.12 DEPLOYMENT NEXT STEPS / RECOMMENDATIONS

The next steps provide recommendations to move forward the ATMS/ITS Projects identified in this ATMS Master Plan to deployment include the following:

1. Inform the FHWA that the ITS architecture has been updated for the ARTS region.
2. Add ATMS/ITS projects to the ARTS Long Range Transportation Plan (LRTP).
3. Include selected ATMS/ITS projects in the next Call for Projects for the next Transportation Improvement Program (TIP) – in February/March 2014. The TIP anticipated to be adopted at the June Policy Committee meeting.
4. Decide and establish procurement method that is optimal for type of deployment given the project type and scope – See Section 4.8 of this Plan.
5. Identify federal and state funding source(s), as applicable.
6. Identify local funding source (match), if necessary.
7. Utilize standardized ITS specifications and details to the extent possible (from GDOT, SCDOT, etc.) – make sure that Contractor understands the specifications and details when bidding the work. Clearly denote payment for integration work to ensure that the deployed system is operating as required and expected prior to making final project payment to Contractor.
8. Develop clear and "testable" project design requirements (see Section 4.9 *Systems Testing Considerations*) as each project moves into the Design phase to ensure the deployed system is what the County/City is anticipated and expecting – See example Requirements Verification Matrix developed for this ATMS Master Plan in **Appendix D.** This matrix provides traceability from the ATMS Master Plan goals, objectives to functional (high-level) requirements as provided in this Plan.
9. Identify, develop and execute any stakeholder agreements needed or required to support design, operations and/or maintenance of an ATMS/ITS project or program.
10. Recommend purchase of extended ATMS/ITS equipment warranties to offset / minimize in-house or maintenance contractor costs in the near-term.
11. Recommend consideration of performance-based maintenance contracts to increase device / equipment uptime performance levels.

12. Consider the System Manager role to supplement the typical CEI role.
13. Recommend that ATMS Master Plan be updated approximately every five (5) years to be an accurate reflection of stakeholder needs and account for changes in technology and programs.
14. Recommend that agency stakeholders (established during this project) continue to meet at least twice a year to discuss and coordinate ITS and communications implementations, identification and monitoring plan for performance metrics, potentials for increased cooperation, data and video sharing and ITS architecture updates.