Sumter County Advanced Traffic Management System (ATMS) Master Plan

SUMTER COUNTY
ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS)
MASTER PLAN

Prepared For

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LIST OF ACRONYMS

100Base-TX	100 Mbps Fast Ethernet
10GbE	10 Gigabit Ethernet
AC	Alternate Current
ADA	American with Disabilities Act
ADMS	Arterial Dynamic Message Sign
AGC	Automatic Gain Control
API	Application Programming Interface
ATC	Advanced Traffic Controller
ATCS	Adaptive Traffic Control System
ATM	Asynchronous Transfer Mode
ATMS	Advanced Traffic Management System
AVI	Automatic Vehicle Identification
AWG	American Wire Gauge
BIU	Bus Interface Unit
C2C	Center-to-Center
CALTRANS	California Department of Transportation
CCD	Charged Coupled Device
CMOS	Complementary Metal Oxide Semiconductor
COTS	Commercial Off-the-Shelf
CPU	Central Processing Unit
CCTV	Closed-Circuit Television
CFR	Code of Federal Regulations
DB	Decibel
DBm	Decibel with Respect to milliwatts
DC	Direct Current
DFD	Data Flow Diagrams
DMS	Dynamic Message Sign
DOW	Day-of-Week
DSP	Digital Signal Processing
DSRC	Dedicated Short Range Communications
DSSS	Direct Sequence Spread Spectrum
DTB	Dynamic Trail Blazer
EIA	Electronics Industry Alliance
EOC	Emergency Operations Center
ER	Entity Relationship
FHWA	Federal Highway Administration

FCC	Federal Communications Commission
FDOT	Florida Department of Transportation
FHSS	Frequency Hopping Spread Spectrum
FMCW	Frequency Modulated Continuous Wave
FMS	Freeway Management System
FOV	Field of View
FSK	Frequency Shift Keying
Gbps	Gigabits per Second
GE	Gigabit Ethernet
GHz	Gigahertz
GPS	Global Positioning System
GUI	Graphical User Interface
HAR	Highway Advisory Radio
HD	High Definition
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
ILD	Inductive Loop Detector
I/O	Input/Output
IP	Internet Protocol
IR	Infrared
ISM	Industrial, Scientific and Medical
ISO	International Organization for Standardization
ITS	Intelligent Transportation System
Kbps	Kilobits per Second
KHz	Kilohertz
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LTE	Long Term Evolution
Lx	Lux
MAC	Media Access Control
MAP-21	Moving Ahead Progress in the 21st Century
MB	Midblock
Mbps	Megabits per Second
MFES	Managed Field Ethernet Switch
MHz	Megahertz
MIB	Management Information Base
MJPEG	Motion Joint Photographic Experts Group
MMU	Malfunction Management Unit

MOA .... Memorandum of Agreement
MOV .... Metal Oxide Varistor
MPEG .... Moving Picture Experts Group
MUTCD .... Manual on Uniform Traffic Control Devices
MVDS .... Microwave Vehicle Detection System
NEMA .... National Electrical Manufacturers Association
NITSA .... National ITS Architecture
NSL .... Near Stop Line
NTCIP .... National Transportation Communications for ITS Protocol
O&M .... Operations and Maintenance
OSI .... Open Systems Interconnection
P/T .... Pan/Tilt
PoE .... Power-Over-Ethernet
POTS .... Plain Old Telephone Service
PPM .... Plans Preparation Manual
RFP .... Request for Proposals
RTMC .... Regional Traffic Management Center
RWIS .... Road Weather Information System
SAFETEA-LU .... Safe Accountable Flexible Efficient Transportation Equity Act – A Legacy for Users
S/N .... Signal to Noise
SAD .... Silicon Avalanche Diode
SD .... Standard Definition
SDK .... Software Development Kit
SHF .... Super High Frequency
SI .... International System of Units
SL .... Stop Line
SNMP .... Simple Network Management Protocol
SONET .... Synchronous Optical Network
SOP .... Standard Signal Operating Plan
SPD .... Surge Protection Device
SSR .... Spread Spectrum Radio
TCP .... Transmission Control Protocol
TMC .... Traffic Management Center
TMDD .... Traffic Management Data Dictionary
TSM&O .... Transportation System Management and Operations
TOD .... Time-of-Day
TVS .... Transient Voltage Suppressor

UDP .... User Datagram Protocol
UHF .... Ultra High Frequency
UPS .... Uninterruptible Power Supply
US .... Upstream
USDOT .... United States Department of Transportation
V2I .... Vehicle-to-Infrastructure
V2V .... Vehicle-to-Vehicle
VID .... Video Image Detector
VLAN .... Virtual Local Area Network
VME .... Versa Module Europa
WIMAX .... World Interoperability for Microwave Access
WISP .... Wireless Internet Service Provider
XML .... Extensible Markup Language

Sumter County Advanced Traffic Management System (ATMS) Master Plan

Executive Summary

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Sumter County is located in the west central portion of the Florida peninsula. Municipalities in the County include Bushnell, the County seat, and Wildwood. Sumter County is primarily rural, but in recent years has sustained a large increase in population primarily due to the expansion of The Villages, a retirement community in the County. The County's main freeway is I-75, which has four interchanges within the County. Florida's Turnpike intersects I-75 in Wildwood. Figure 1 shows the region and the jurisdictional boundaries of Sumter County.

Sumter County has an estimated 2013 population of 105,104, a 97 percent increase from that of 2000's population of 53,345. Because of this population growth and its corresponding increase in traffic, the County is actively pursuing the integration of their traffic signals into a fully integrated Advanced Traffic Management System (ATMS). To help achieve this goal, Sumter County, in cooperation with the Florida Department of Transportation (FDOT), had this Master Plan prepared for a proposed countywide ATMS. The ATMS Master Plan was prepared to guide deployment of ATMS and Intelligent Transportation System (ITS) components in Sumter County.

The Master Plan identifies locations for signal equipment upgrades and the deployment of components such as closed-circuit television (CCTV) cameras, arterial dynamic message signs (ADMSs), detection systems, and emergency pre-emption devices. The Master Plan includes an analysis of various systems and equipment that are currently available and makes recommendations on which elements should be included in the ATMS. These devices are intended to be integrated into and to work concurrent with the new ATMS. As part of the ATMS Master Plan development, a phased implementation plan was developed to upgrade Sumter County's existing infrastructure into a system that is highly effective and able to handle future transportation needs.

Regional coordination provides opportunities to expand the abilities of an ATMS. To expand the abilities of the Sumter County ATMS, the County should participate with the I-75 Florida's Regional Advanced Mobility Elements (FRAME) project, as well as other regional ATMS and ITS projects. Sumter County is and should continue to partner with FDOT District Five, the

Florida's Turnpike, and Lake Sumter MPO. By coordinating with these projects and entities, additional opportunities to implement ATMS infrastructure could be realized.

The goals for the Sumter County ATMS are to provide effective traffic management and improve public safety and security through the use of appropriate devices that provide the ability to monitor and control traffic flows, detect incidents, and inform drivers and the general public of roadway conditions.

RECOMMENDED ATMS ELEMENTS

Based on the analysis performed during the development of the Sumter County ATMS Master Plan, the following elements should be included in the ATMS.

Traffic Signal Controllers

The County should establish one brand of National Electrical Manufacturers Association (NEMA) TS2, Type 1 controller as the standard for installation in all traffic signal controller cabinets. While some central control software can communicate with and operate multiple brands of controllers, all of the different control software provide more features and function better if they are connected to controllers of the same brand. The traffic signal controller selected during the ATMS Phase I design will become the standard controller for Sumter County and implemented under Phases II and III. The standard NEMA TS2, Type 1 controller should have the following attributes:

- Ethernet ready
- Ability to revert to time-of-day (TOD) plan if communications is lost
- Ability to alert central control software when signal is in flash
- Meet Advanced Traffic Controller (ATC) Standard 5.2b
- Dedicated Short Range Communications (DSRC) compatible
- Capable of providing advance functionalities with the selected central control software

Detection/Travel Time Systems

Local intersection detection should be provided for each approach at each intersection. The most cost-effective and reliable solution for intersection detection is video image detectors (VIDs). Currently, the majority of the intersections in Sumter County have VIDs and there are several more that will have VIDs installed in upcoming construction projects. The VIDs may include multiple cameras per intersection or the single 360-degree field-of-view (FOV) system. The single-camera systems are generally less costly to install due to the reduction in the number of cameras necessary to provide detection at the intersection. Additionally, it would be reasonable to expect that the maintenance requirement for the single 360-degree FOV camera would be reduced over a multiple-camera VID system. Because of this, it is recommended to install the single 360-degree FOV camera at smaller intersections (i.e., intersections with one or two lanes per approach and minimal median width). For intersections that encounter adverse weather conditions, such as fog, a microwave vehicle detection system (MVDS) or infrared detectors should be considered due to their consistent operation despite adverse weather conditions. The VIDs should have the following attributes:

- High Definition (HD) capable camera
- Image stabilization
- Live streaming video over an Ethernet network

Currently, Sumter County has not deployed any advanced detection. The need to deploy advanced detection will depend on the type of traffic control system chosen for the County, particularly if adaptive or responsive control systems are implemented. For a typical advanced detection installation, microwave detectors provide the highest potential for reliability with the least installation cost. MVDSs are effective at evaluating and quantifying traffic patterns within signal control sections in Sumter County. The MVDSs should have the following capabilities:

- Compatible with SunGuide®
- Mean-time between failures of at least 10 years
- Capable of producing multiple data streams
- Capable of producing advance detection for multiple lanes and direction of travel
- Capable of providing count data, as well as speed, classification, occupancy, and volume

Many elements must be considered in the selection of a type of detector for collecting travel time data. The most cost-effective and reliable solution for detection is the use of Bluetooth readers at local intersections. Bluetooth readers should be considered on congested corridors where there is expected to be a greater density of Bluetooth devices in vehicles. The resulting travel time data from the Bluetooth readers can be used to provide travel time information to motorists using a website or dynamic message sign (DMS). Alarms can be set to notify a system operator that the travel times for a specific corridor have increased beyond a specified threshold. This could be useful for detecting incidents, allowing alternate timing plans to be implemented and minimizing the increase in delay due to the incident. The Bluetooth readers should have the following capabilities:

- Compatible with SunGuide®
- Compatible with various communications media (i.e., cellular, Ethernet, microwave)
- Able to provide security (i.e., masking or encryption) of learned Media Access Control (MAC) addresses

The recommended locations are limited to corridors at or near saturated conditions during peak hours that encounter higher than typical crash rates when compared to other corridors throughout Sumter County.

Traffic Control Options

To meet Sumter County's goals and objectives for traffic control, it is recommended that multiple timing plans be utilized, additional research into corridors for deployment of traffic responsive systems and adaptive traffic control systems (ATCSs) be performed, and coordination between control sections be utilized.

Having the ability to implement a special timing plan based on certain scenarios would be highly beneficial to the County. Because of this, it is recommended that the new central control software be capable of providing at least 32 individual timing patterns. This will allow the County to quickly react to an unexpected event or preplan for an expected event, which will reduce the expected delays for County motorists.

It is highly recommended that corridors with unpredictable volumes be researched further for implementation of traffic responsive operation or an ATCS. It has been determined there are several corridors throughout Sumter County where traffic responsive operation or an ATCS may prove useful due to traffic conditions that often change. The County has stated that the US

27/441 corridor and the CR 466 corridor are potential corridors for implementation of an ATCS. The implementation of an ATCS on the US 27/441 corridor should be coordinated with Marion County and Lake County to ensure optimal signal timing coordination. Additional corridors to be researched for ATCS implementation are the US 301 corridor in Wildwood, the US 301 corridor in Bushnell, and the CR 466A corridor.

It is recommended that coordination between control sections along known commuter routes experiencing predictable traffic patterns be utilized. This will decrease delay along the routes while improving the flow. The ability to coordinate between control sections should be included with the selected central control software.

Traffic Monitoring System

It is recommended that Sumter County procure dome HD CCTV cameras for traffic monitoring. The dome housing will provide additional protection from the elements while the HD version will ensure future compatibility and provide a clearer image to the end user. The CCTV cameras should have the following features:

- National Transportation Communications for ITS Protocol (NTCIP) compliant
- Image stabilization
- Low lux operation
- Pan, tilt, and zoom (PTZ) operation
- Ethernet ready
- Contain a heater or other defogging apparatus
- Capable of both black and white and color modes

It is recommended that CCTV cameras be placed at major intersections to monitor many of the major corridors within Sumter County. These locations are generally related to monitoring traffic flows, incident management, and signal maintenance. The exact placement of the equipment must be determined during the design phase.

Information Dissemination

To effectively manage traffic and divert motorists around incidents and areas of heavy congestion, an information dissemination system is needed, which should include ADMSs. Potential locations for ADMSs were evaluated based on a review of the County's roadway network. In general, the following locations in Sumter County would benefit from ADMSs:

- Locations approaching I-75 and Florida's Turnpike to inform motorists of conditions on I-75 and Florida's Turnpike, respectively.
- Locations on US 301 and SR 44 in advance of intersections with roads that provide access to I-75 and Florida's Turnpike.
- Locations on evacuation routes, where ADMSs would help direct motorists leaving evacuation areas and inform them of any unique traffic patterns (e.g., contra-flow lanes).

Other locations within the County may also benefit from ADMSs, but the above settings are considered to be the most critical for Sumter County with regard to information dissemination. The County will need to evaluate and prioritize the ADMS locations. This can be done during future design phases.

Central Control Software

Based on Sumter County's user needs and functional requirements of the central control software, a Commercial Off-the-Shelf (COTS) central control software is recommended. A COTS software would meet the desired functions and features while having a relatively low cost compared to the other types of central control software. The COTS central control software should have the following capabilities:

- NTCIP compatible
- Real-time monitoring of the ATMS
- Ability to interface with traffic responsive or traffic adaptive operations
- User-defined alerts
- Ability to integrate ITS technologies

Traffic Management Center

Because Sumter County does not currently have a Traffic Management Center (TMC), research into available space within the existing County Public Works Complex will be performed to find a suitable location that meets the physical and functional requirements. By locating the TMC within the existing building, requirements for facilities such as Heating, Ventilation, and Air Conditioning (HVAC) facilities, maintenance facilities, electrical and uninterruptable power supply (UPS) facilities, conference rooms, records storage, restrooms, kitchen/break room, parking facilities, and reception area would simply require modification, if any change is required.

The control room should be outfitted with an operator workstation consisting of a single standard office desk outfitted with a computer workstation with two standard Liquid Crystal Display (LCD) monitors. This will provide lower maintenance and operational costs than a light emitting diode (LED) flat panel wall or traditional cube type system. The recommended setup would provide the necessities for the County to operate the system on a part-time basis.

For the initial setup, the communications equipment will be housed at the The Villages Sumter County Service Center in Wildwood with the other server equipment maintained by the County's IT Consultant. This setup will be most efficient for the maintenance of the server equipment as the County IT Consultant is already located at this facility. Environment monitors should be used to monitor the room's temperature and humidity. The room should be enclosed and secured by an access-controlled door. This area could include space to pull and terminate fiber optic cable within the building as well.

The County TMC will provide space for staff working staggered hours to cover both peak periods of traffic. Both morning and evening peak traffic hours should be monitored to improve public safety and traffic congestion.

Communications

The Sumter County ATMS communications network will evolve as the ATMS is implemented. The initial focus of the communications network is to provide a network connection from the intersections along CR 466 and CR 466A to the Sumter County TMC through the use of existing fiber optic cable, proposed fiber optic cable, and Metro Ethernet connections at County facilities. With the further deployment of the ATMS, additional fiber optic cable will be installed, providing connections from the Sumter County TMC to additional intersections. The additional fiber optic cable will also connect to the FDOT-maintained fiber optic cable along I-75, eliminating the need to utilize the Metro Ethernet as a primary connection. The Metro Ethernet connections will remain active to provide route redundancy and to reach those areas that are not serviced by the fiber optic network. Cellular modems and wireless technology will be utilized to provide a connection to the isolated intersections where it is not cost-effective to create a connection using fiber optic cable. The ultimate communications network will consist of a mixture of proposed fiber optic cable, cellular modems, and/or wireless technology. In order to assist in the implementation of the network, the installation of conduit for fiber optic cable should be included in all future FDOT and County roadway projects. The FDOT Standard Specifications for Road and Bridge Construction Section 630 details the requirements for installing conduit.

Other Features

The County does not have the desire to implement emergency vehicle pre-emption. However, it is recommended the selected central control software be capable of identifying that intersections are off-line due to the existing railroad pre-emption in order to prevent the system from initiating a failed controller message and attempting to pick up the intersection. Today's controllers are equipped with local pre-emption and with the ability to send a message back to the monitoring system.

IMPLEMENTATION PLAN

The cost estimate of the entire Sumter County ATMS project is $11,832,552.23. Due to the significant costs associated with an ATMS, they are typically designed and constructed in phases. Currently, the ATMS project is projected to occur in three phases which may be adjusted or sub-divided based on changes in funding, technology or requirements. The contracting method for the construction of Phase I of the ATMS will be completed as a design/bid/build project. The contracting method for the construction of Phases II and III will be determined prior to the respective phase.

Phase I is anticipated to be in engineering design during the 2018 fiscal year with construction proceeding in the 2019 fiscal year. The Phase 1 engineering design estimate is $200,000 and the construction estimate is approximately $550,000. Phase I consist of a constructing a TMC control room in the Public Works Complex. ATMS control software and servers will be procured and installed at The Villages Sumter County Service Center. Additionally, this phase is projected to bring 13 prioritized intersections and one CCTV camera online. Communications will utilize a mix of existing and new infrastructure. Metro Ethernet connections and Sumter County leased lines will provide communications to some segments while others will be connected directly to The Villages Sumter County Service Center. A secure connection utilizing existing Sumter County communications will be created between the TMC at the Public Works Complex and The Villages Sumter County Service Center. Concurrent with Phase I, Phase II is anticipated to be in in engineering design.

Phase II is based on a cost estimate of $2,006,876.46 and is anticipated to be in construction during the 2020 fiscal year. Nineteen additional traffic signals along CR 48, SR 44 and US 27/411 will be upgraded and connected to the ATMS system. Additional infrastructure will be designed and constructed along CR 48 and SR 44 to provide a dedicated hardwired high speed connection between the TMC at the Public Works Complex and The Villages Sumter County Service Center utilizing FDOT shared fiber optic cable along I-75. Phase I Metro Ethernet and County leased connections will remain in place for redundancy. CCTV cameras and Bluetooth readers will be installed along corridors connected in both Phase I and Phase II.

Concurrent with Phase II construction, Phase III engineering design will be started. Phase III has an estimated engineering design cost of $900,000 and an estimated construction cost of $9,100,000. It is understood that Phase III has a very high cost estimate that probably exceeds what can be spent on the ATMS during one phase. For this reason, Phase III will be reevaluated at a later time and adjusted based on:

- Phase III ATMS infrastructure installed under other projects.
- Advances in the technologies of ATMS elements.
- Changes in available funding

Phase III will bring the remaining 20 intersections online. Bluetooth, CCTV camera coverage and motorist information systems are projected to be completed part of Phase III. Infrastructure installed during Phase III will additionally provide a critical redundant connection between the TMC at the Public Works Complex and The Villages Sumter County Service Center.

Sumter County Advanced Traffic Management System (ATMS) Master Plan

Master Plan

SECTION 1

INTRODUCTION

1. INTRODUCTION

Sumter County is located in the west central portion of the Florida peninsula. Municipalities in the County include Bushnell, the County seat, and Wildwood. Sumter County is primarily rural, but in recent years has sustained a large increase in population primarily due to the expansion of The Villages, a retirement community in the County. The County's main freeway is I-75, which has four interchanges within the County. Florida's Turnpike intersects I-75 in Wildwood. Figure 1 shows the region and the jurisdictional boundaries of Sumter County.

Sumter County has an estimated 2013 population of 105,104, a 97 percent increase from that of 2000's population of 53,345. Because of this population growth and its corresponding increase in traffic, the County is actively pursuing the integration of their traffic signals into a fully integrated Advanced Traffic Management System (ATMS). To help achieve this goal, Sumter County, in cooperation with the Florida Department of Transportation (FDOT), had this Master Plan prepared for a proposed countywide ATMS. The ATMS Master Plan was prepared to guide deployment of ATMS and Intelligent Transportation System (ITS) components in Sumter County.

The Master Plan identifies locations for signal equipment upgrades and the deployment of components such as closed-circuit television (CCTV) cameras, arterial dynamic message signs (ADMSs), detection systems, and emergency pre-emption devices. The Master Plan includes an analysis of various systems and equipment that are currently available and makes recommendations on which elements should be included in the ATMS. The analysis of the various systems and equipment are in Section 4 through Section 12 of the Master Plan, and the recommendations are in Section 13 of the Master Plan. These devices are intended to be integrated into and to work concurrent with the new ATMS. As part of the ATMS Master Plan development, a phased implementation plan was developed to upgrade Sumter County's existing infrastructure into a system that is highly effective and able to handle future transportation needs.

Regional coordination provides opportunities to expand the abilities of an ATMS. To expand the abilities of the Sumter County ATMS, the County should participate with the I-75 Florida's Regional Advanced Mobility Elements (FRAME) project, as well as other regional ATMS and

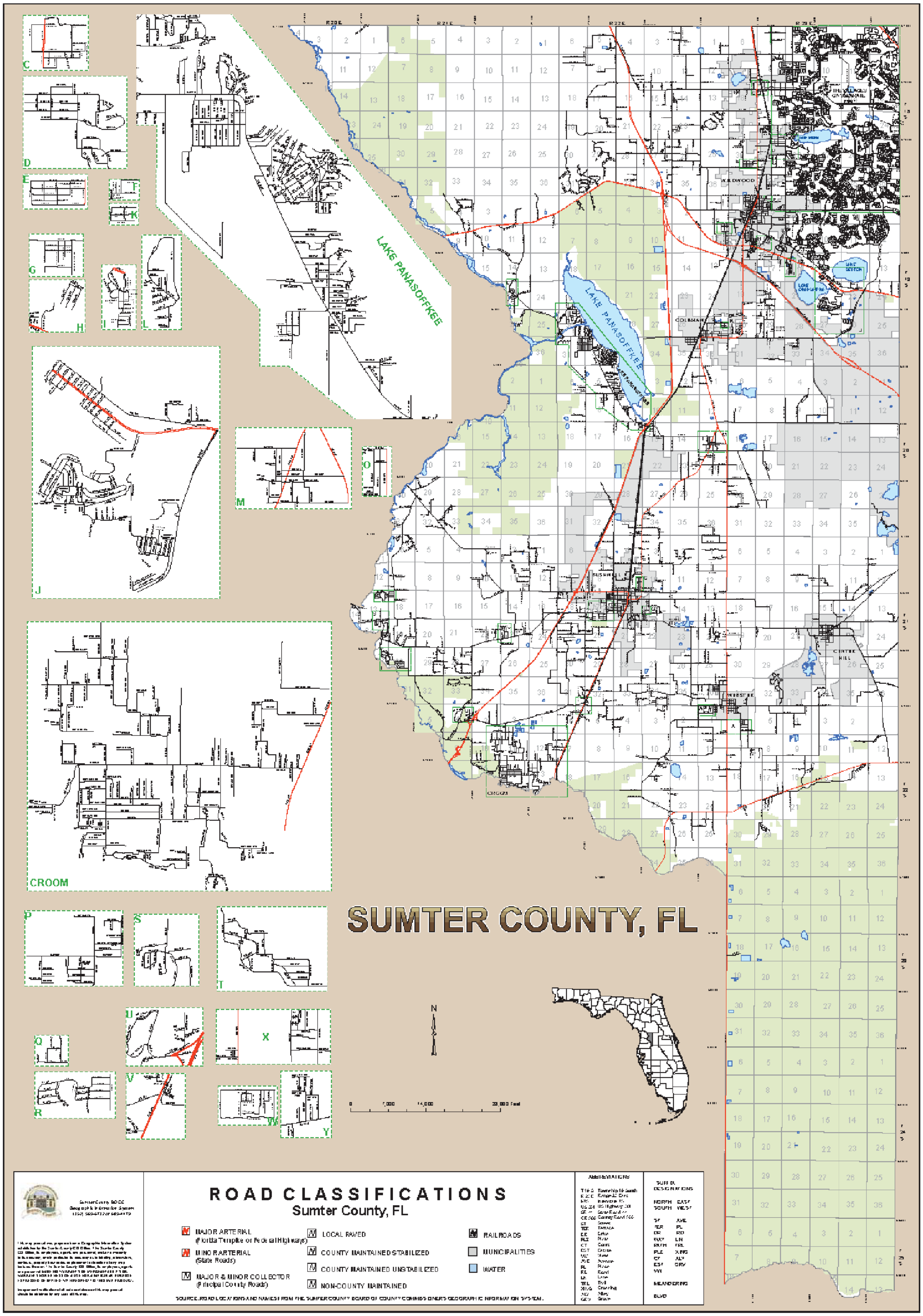
ITS projects. Sumter County is and should continue to partner with FDOT District Five, the Florida's Turnpike, and Lake Sumter MPO. By coordinating with these projects and entities, additional opportunities to implement ATMS infrastructure could be realized.

The goals for the Sumter County ATMS are to provide effective traffic management and improve public safety and security through the use of appropriate devices that provide the ability to monitor and control traffic flows, detect incidents, and inform drivers and the general public of roadway conditions.

Sumter County realizes the direct relation of public safety and security to the traffic operations and efficiency of the roadway network. It is recognized that the same technologies being used to enhance signal system performance can also provide public safety and security. These are all products of an ATMS.

The ATMS may include the following components:

- A distributed traffic signal system for traffic control
- Video monitoring cameras for monitoring roadway operations
- A detection system to be used for vehicle detection in control sections to improve operation efficiency
- Traffic control plan implementation for incident clearance
- An emergency pre-emption system for improved response time to incidents and emergencies
- Center-to-center (C2C) communications and interoperability between the County Traffic Management Center (TMC) and the FDOT's Regional Traffic Management Center (RTMC)



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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 1: PROJECT MAP	**Date**	03/23/17

Title: V:\0116002 - Sumter County ATMS Phase 2\Project Working Files\Documents\Task II - Master Plan Document\Figures\Master Plan Figures\Figure 1 - Project Map.dgn
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Date: 3/23/2017
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SECTION 2

TRAFFIC SIGNAL CONTROL SYSTEM

2. TRAFFIC SIGNAL CONTROL SYSTEM

The objectives for the Sumter County ATMS are to provide standardization of the intersection control equipment and to improve motorist operation and safety by installing devices to monitor and control traffic, detect incidents, and inform drivers of roadway conditions. The following individual goals are some of the integral aspects that quantify the system objectives.

TRAFFIC CONTROL

Enhancing the County's traffic control capabilities is the primary objective of the system. The expanded system should provide the flexibility to manually or automatically select timing plans in response to changing traffic conditions. Improved traffic flows that result from the enhanced system can provide motorists the benefits of reduced stops, delays, and queue lengths.

ITS CAPABILITIES

The ATMS will provide the TMC with ITS capabilities. The system will have the ability to monitor traffic through CCTV cameras and ultimately provide timely traffic congestion and routing information to motorists via DMSs and public media.

MAINTAINABILITY

Maintainability of the system is primarily tied to the requirements for maintenance of the equipment. ATMS enhancements are anticipated to create an increase in maintenance activities because of the increased amount of equipment. However, the relative amount of this increase can be reduced by the technical skills and the available hours of staff, and the preventative maintenance schedule established by the County for the enhanced system.

OPERATIONAL FLEXIBILITY

Operational flexibility is the relative ease of making software changes or updating operating features while maintaining overall system operation. System changes that demonstrate operational flexibility are measured through the capability to maintain overall operation with minimal impact to the traveling public while system changes occur.

RELIABILITY

The measure of the system's reliability is based on the overall frequency of equipment failures over time, and the failure's effect on the traveling public. System reliability is an essential characteristic of the system. The ITS devices that will enhance the system to an ATMS can provide greater reliability through the use of standardized equipment.

OPERATIONS ANALYSIS

The ATMS will provide the County with the capability to detect and identify road blockages so that better mitigation actions can be taken. Equipment failures can also be detected much more quickly. Having an ATMS will also allow the system to collect data that permits an evaluation of the system's effectiveness.

These representative individual goals are some of the integral aspects that are anticipated to support the County's overall objective of enhancing traffic signal system control and motorist safety through the ATMS.

COUNTY PRIORITIES

At a meeting of system stakeholders, each of the goals was discussed. The value of each was discussed. At the end of the discussion, a weighted vote was taken of the stakeholders to determine which of the goals were deemed most important. Each voter was given 100 points and told to spread those points among the six goals proportionate to the importance of each.

The operations staff vote had Traffic Control and ITS Capabilities goals as clearly the first and second most important goals, with all other goals well below in importance. The maintenance personnel had Reliability, Maintainability, and Operations as the most important goals. This difference in the importance of goals is not unusual as it reflects the job responsibility each group will have with the ATMS. With today's systems being so advanced and so flexible, this split will not have an impact on the selection of the system.

SECTION 3

EXISTING TRAFFIC SIGNAL HARDWARE INVENTORY

3. EXISTING TRAFFIC SIGNAL HARDWARE INVENTORY

The purpose of the inventory was to collect data regarding existing signal equipment and signal-related intersection hardware. Intersection design criteria utilized to evaluate the compliance of the signalized intersections are from the *Manual on Uniform Traffic Control Devices* (MUTCD), 2009 edition.

Currently, there are 49 existing signalized intersections in Sumter County, and they are listed in Table 1, as well as shown in Figure 2. The County contracts the maintenance of their signal equipment to Control Specialists, Inc. and VIBE got some of the inventory information from them.

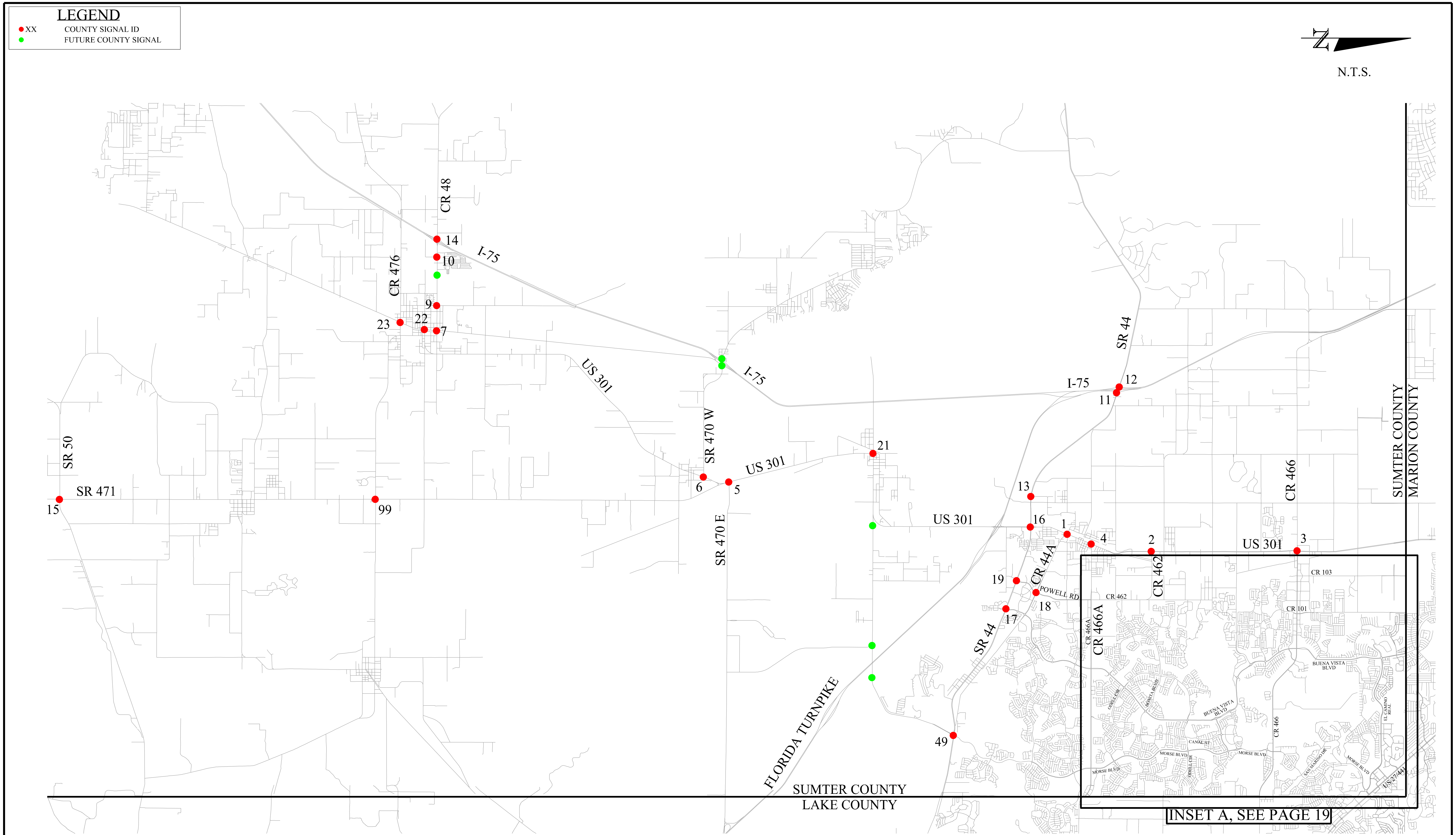
Table 1: Sumter County Signalized Intersections

County Signal ID	Major Street	Minor Street	Maintaining Agency
1	S Main Street (US 301)	Lynum Street/Huey Street (CR 44A)	Sumter County
2	US 301	CR 462 E	Sumter County
3	US 301	CR 466	Sumter County
4	US 301	CR 466 A	Sumter County
5	US 301	SR 470 E	Sumter County
6	US 301	SR 470 W	Sumter County
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)	Sumter County
8	US 27/441	NE 138th Lane (CR 109)	Sumter County
9	CR 48	N West Street (CR 311)	Sumter County
10	CR 48	Lowery Street	Sumter County
11	SR 44	I-75 NB Off-Ramp	Sumter County
12	SR 44	I-75 SB Off-Ramp	Sumter County
13	SR 44	Industrial Drive	Sumter County
14	CR 48	I-75 SB Off-Ramp	Sumter County
15	SR 50	SR 471	Sumter County
16	US 301	SR 44	Sumter County
17	SR 44	Buena Vista Boulevard/Heritage Boulevard	Sumter County
18	CR 44A	Powell Road	Sumter County
19	SR 44	Powell Road/Signature Road	Sumter County
20	CR 466A	Powell Road/CR 462 E	Sumter County
21	Commercial Street (US 301)	Warm Springs Avenue (US 301)	City of Coleman
22	Main Street (US 301)	W Noble Avenue (US 301)	City of Bushnell
23	US 301	Seminole Avenue (CR 48/CR 476)	City of Bushnell
24	No Signal	No Signal	

County Signal ID	Major Street	Minor Street	Maintaining Agency
25	No Signal	No Signal	
26	CR 466	CR 101/Belvedere Boulevard	Sumter County
27	CR 466	CR 103/Old School Road	Sumter County
28	Bailey Trail	Street Charles Place	Sumter County
29	Bonita Boulevard	Canal Street	Sumter County
30	El Camino Real	Buenos Aires Boulevard	Sumter County
31	CR 466	Southern Trace/Tall Trees Lane	Sumter County
32	CR 466	Morse Boulevard	Sumter County
33	CR 466	Tatonka Terrace	Sumter County
34	CR 466	Buena Vista Boulevard	Sumter County
35	CR 466A	Farner Place	Sumter County
36	CR 466A	Morse Boulevard	Sumter County
37	CR 466A	Sembler Way/Heald Way	Sumter County
38	CR 466A	Buena Vista Boulevard	Sumter County
39	Odell Circle	Canal Street (North)	Sumter County
40	Odell Circle	Canal Street (South)	Sumter County
41	CR 103	Wedgewood Lane	Sumter County
42	El Camino Real	Botello Avenue/Enrique Drive	Sumter County
43	Morse Boulevard	Rio Grande Avenue	Sumter County
44	Morse Boulevard	San Marino Drive	Sumter County
45	Buena Vista Boulevard	Southern Trace/Saddlebrook Lane	Sumter County
46	US 27/441	Bella Cruz Drive	Sumter County
47	US 27/441	NE 136th/Buenos Aires Boulevard	Sumter County
48	US 27/441	Morse Boulevard/W Boone Court	Sumter County
49	SR 44	CR 468/Morse Boulevard	Sumter County
98	CR 466A	Pinellas Place	Sumter County
99	SR 471	CR 48	Sumter County

At the time of the inventory, intersection 3 (US 301 and CR 466) and Intersection 4 (N. Main Street/US 301 and Cleveland Avenue (CR 466A)) were under construction, while the construction of intersection 49 (SR 44 and CR 468/Morse Boulevard) had not begun. These three intersections could not be inventoried.

This intersection inventory documents the on-street components of the signalized intersection and their MUTCD compliance. This section investigates the design elements, as well as the need for geometric and/or signal system modifications.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 2: SUMTER COUNTY INTERSECTION MAP (PAGE 1 OF 2)	**Date**	03/23/17
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LEGEND

- XX COUNTY SIGNAL ID
- FUTURE COUNTY SIGNAL

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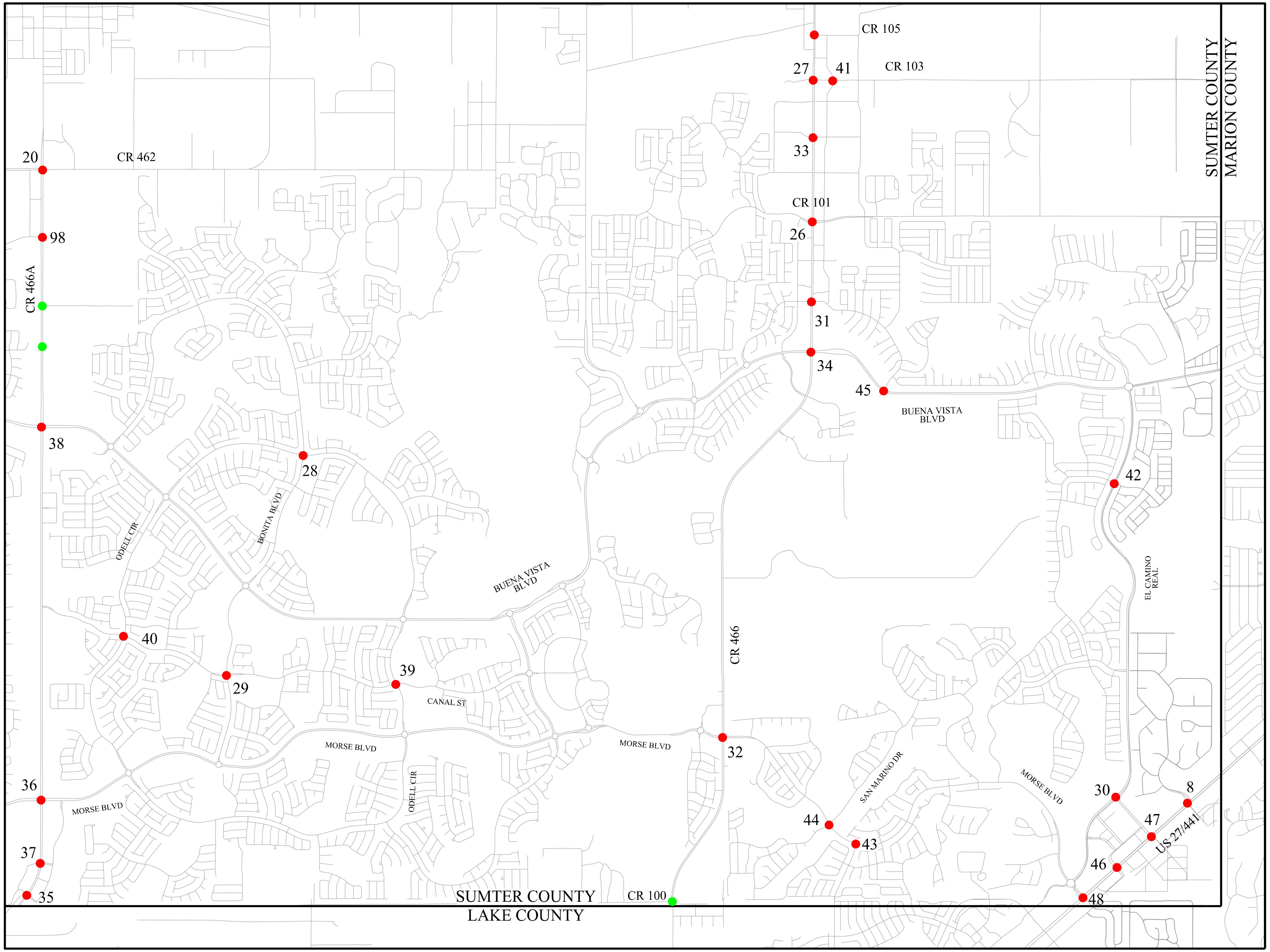

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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 2: SUMTER COUNTY INTERSECTION MAP (PAGE 2 OF 2)	**Date**	03/23/17
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Two signalized intersections were identified as privately owned and were excluded from the inventory and will not be connected to the County's ATMS. A signal listed on Colony Boulevard east of Morse Boulevard will be a privately owned future signal. These intersections are listed in Table 2.

Table 2: Privately Owned Signalized Intersections

Major Street	**Minor Street**
Lake Sumter Landing	Old Camp Road
Old Mill Run	Canal Street
Colony Boulevard	1000 Feet East of Morse Boulevard

For the purpose of planning signal interconnect, a list of future signalized intersections was compiled and can be found in Table 3. These locations can also be found in Figure 2.

Table 3: Sumter County Future Signalized Intersections

Major Street	**Minor Street**
US 301	CR 468
CR 48	Tractor Supply Company
CR 468	Florida's Turnpike SB Off-Ramp
CR 468	Florida's Turnpike NB Off-Ramp
CR 466	CR 100
CR 466A	NE 57th Drive
CR 466A	Trailwinds Village
SR 470 W	I-75 NB Off-Ramp
SR 470 W	I-75 SB Off-Ramp

METHODOLOGY

The information contained in this document was collected in the field during January 2014. This inventory information was used to document the equipment at each intersection, and to check intersection layouts, geometry, and standards compliance. Two photographs were taken of each roadway approach and five photographs were taken of the controller cabinet at each intersection. The inventory information was assembled in a database in order to perform various reviews on the condition of the intersection features.

A major portion of the intersection inventory consisted of inspecting and measuring the signal equipment at each intersection. Signal heads were checked for configuration, location, operation, and spacing. Measurements were taken of the vertical distance between the signal heads and pavement, the horizontal distance between the signal heads and the stopbars, and the distance between adjacent signal heads. Pedestrian facilities were reviewed, including sidewalks, pedestrian buttons, signs, displays, pedestrian ramps, and crosswalks.

The collected inventory information was subsequently entered into a database and from this database, a series of analyses were conducted. The analyses included summarizing the information on the inventoried signal locations and equipment, such as condition of signal cabinets and controllers, and presence of signal displays.

The Intersection Field Inventory Form is shown in Appendix A. The form contains entry fields to identify whether certain field conditions existed at the time of the inventory.

The analysis of the intersection inventory is included in Appendices B through J. The Appendices represent a consolidated summary of the data produced by the database analyses. The goal of this effort was to identify existing field infrastructure that will aid in meeting the future needs of an ATMS for Sumter County.

INTERSECTION INVENTORY

The field inventory efforts collected detailed information at 46 intersections. The field inventory included a detailed evaluation of the intersection layout and geometry, signing and pavement markings, signal features, and pedestrian features. As part of the field review, MUTCD compliance criteria were evaluated and intersection condition diagrams were prepared displaying key existing intersection features.

The amount of data gathered required the Intersection Field Inventory Form data to be summarized as separate Appendix items. These printed summaries are contained in Appendix B through Appendix J. The data summaries contained in the Appendices are compilations of the data and information from the completed Field Inventory Forms, with the Appendices generally categorized by each individual Intersection Field Inventory Form page. For example, data from each inventoried intersection for the Sidewalks page of the Intersection Inventory Form is summarized in Appendix I, titled Intersection Field Inventory Summary - Sidewalks.

MUTCD Compliance

The MUTCD provides national standards for all traffic control devices including, but not limited to, signs, signals, markings, and other devices that are utilized to regulate, warn, or guide traffic. The horizontal distances between signal heads and stopbars were verified for compliance. The MUTCD states that at least one signal head on each approach should be between 40 feet and 180 feet from the stopbar, or a supplemental signal head is required. The layouts of the markings were also noted during the field review. Stopbars and crosswalks were inspected for MUTCD compliance. Pedestrian features and associated hardware were noted as well. As part of this effort, the data collected indicate if street name signs are present.

Different aspects of MUTCD compliance criteria are contained on multiple pages of the Intersection Field Inventory Form package in order to have a comprehensive form that would be efficient to use when completing the inventories at the intersection site. As a result, MUTCD compliance data and information from the inventoried intersections are summarized in multiple Appendices. To illustrate, MUTCD compliance information relating to signal indications is contained on several different form pages. The signal head height information is contained on the Signal Head Height page and signal head arrangement and measured distance information is on the Signal Heads page of the form. Pedestrian heads and push buttons were inspected for their presence, as well as their working order. This information is on the Signal Compliance page.

Existing Signal Phasing

Current signal phasing was noted during the field review. Any special conditions or pre-emptions were recorded. This information will be used in the development of the system requirements. The Intersection Standard Signal Operating Plan (SOP) for each intersection is shown in Appendix B. The data in Appendix B is arranged by ascending County number, listing the SOP number at each of the intersections inventoried. The SOP number listed references the FDOT Standard block diagram illustrations. Information from the inventory on the compass orientation or direction of each signal phase is also contained in Appendix B.

Condition Diagrams

Condition diagrams were developed for each intersection using aerial photographs. The condition diagrams were reviewed for accuracy during the field review. Controller cabinet locations, geometry, and position and type of signal assembly were verified. These condition diagrams will be used in the development of the design documentation. Condition diagrams are provided in Appendix C. Intersection photographs for all signalized intersections were provided to the County in electronic format.

CONTROLLER CABINET INVENTORY

An inventory of the controller cabinets was performed. This inventory included documenting the cabinet manufacturer, location, installation date where available, size, and mounting style. This information is included in Appendix D. The majority of cabinets inventoried were Type V cabinets on concrete bases. There was one pole-mounted cabinet. In general, the cabinets appeared to be in good condition. The existence of communications conduits and spare conduits, including size and number, was documented based on a visual inspection of the bottom of the cabinet. There were two intersections that did not have communication conduit or any spare conduits. These intersections are listed in Table 4.

Table 4: Intersections without Communication or Spare Conduit

County ID	Major Street	Cross Street
21	Commercial Street (US 301)	Warm Springs Avenue (US 301)
34	CR 466	Buena Vista Boulevard

To make the intersections without spare conduits part of the ATMS, communications entries will be required. One of these cabinets is pole-mounted on a concrete strain pole, so it is recommended that a new base-mounted cabinet be installed at that location. For the existing ground-mounted cabinet, one option is to drill the existing pad to accommodate new conduit, but this is not recommended due to the difficulty of the installation and the potential downtime for the signal. An alternate solution is to install a new controller cabinet foundation very close to the previous one so that no rewiring is required.

A controller inventory was also completed at each intersection location. The information gathered included the manufacturer, model, installation date where available, and condition.

Conflict monitor information was also recorded. Communication type was also indicated on the form. Photographs were taken of the controller cabinet interiors and existing conduits inside the cabinets. The photographs were provided in electronic format.

The detectors were inventoried as well. The detector type, mount type, and number of channels were recorded for each detector within the cabinet. The phases being detected were also recorded for each detector. This information is included in Appendix E.

COMMUNICATIONS INFRASTRUCTURE AND EQUIPMENT

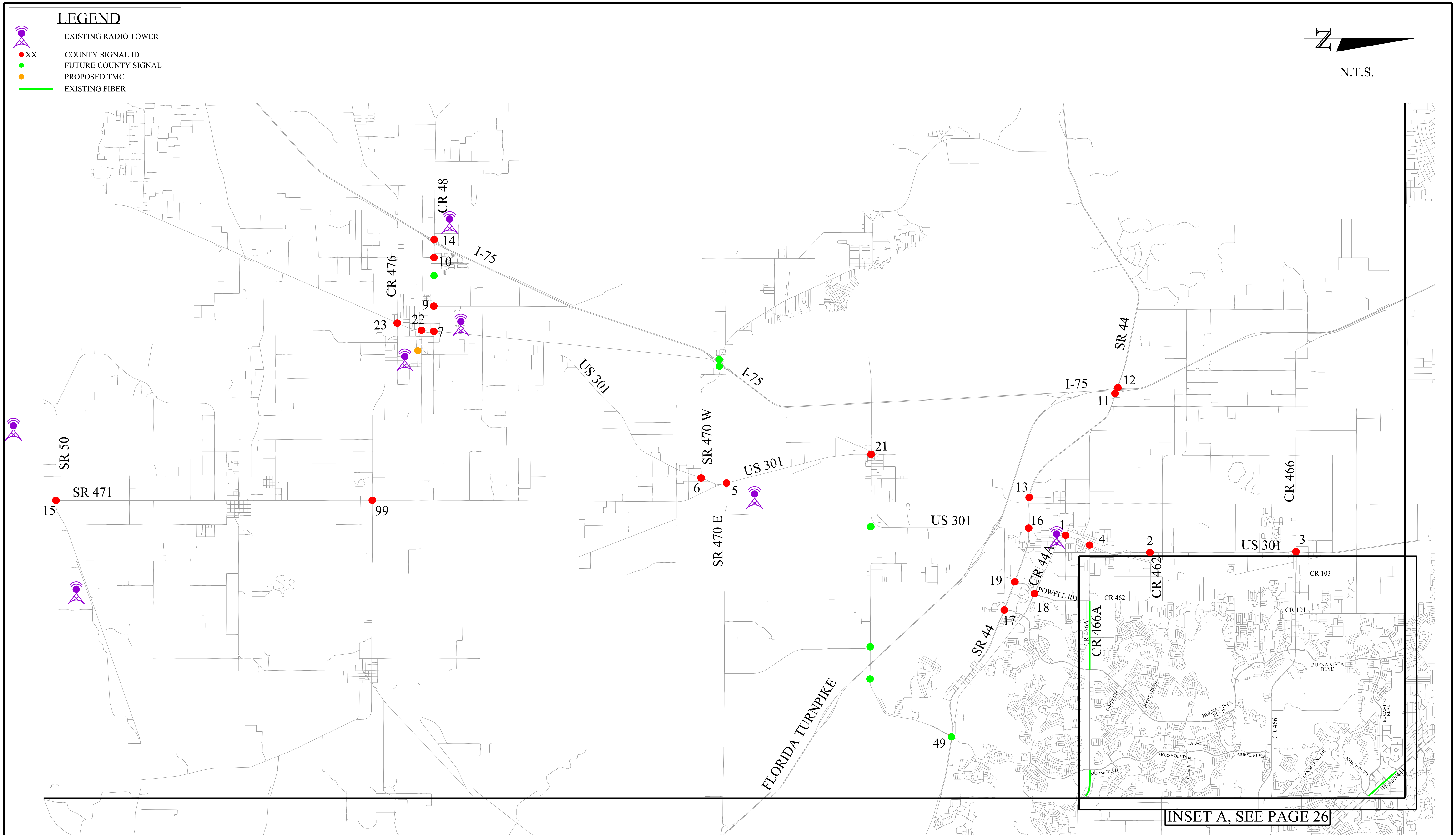
During early discussions on this project, it was stated that there is a limited amount of fiber optic cable present in the County. An evaluation of the existing communications infrastructure was conducted to help identify communications upgrades that will address Sumter County's needs.

There is currently no interconnect signal system in use in Sumter County. In recent years, the County has installed limited amounts of fiber optic communications cable between intersections and has installed some empty underground communications conduit as part of roadway construction projects.

Sumter County has leased several radio towers that are used for the radio system. The County has reinforced some of these towers as a result of a structural analysis recently performed and they should be adequate for additional equipment. A new tower has been constructed near East Seminole Avenue within close proximity of the proposed TMC. Figure 3 shows the existing communications infrastructure within Sumter County.

INTERSECTION ISSUES AND INADEQUACIES

The following paragraphs identify deficiencies that will need to be addressed for the intersections to be compliant with the applicable standards. Along with these deficiencies, proposed modifications to address deficiencies are presented. These modifications are based on a review of the layout, geometry, and existing conditions at each intersection.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 3: EXISTING SUMTER COUNTY COMMUNICATIONS INFRASTRUCTURE (PAGE 1 OF 2)	**Date**	03/23/17
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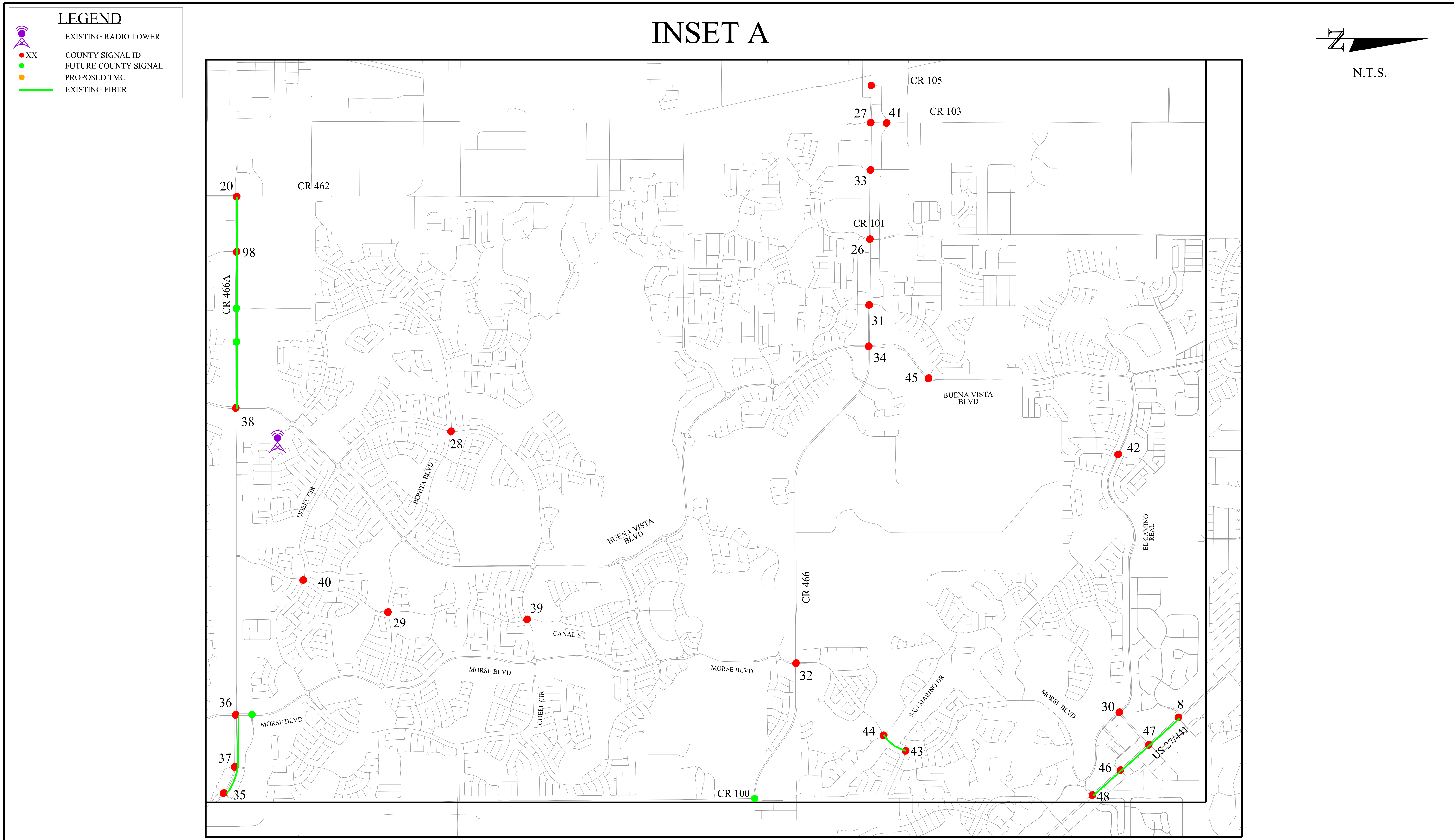
INSET A



Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 3: EXISTING SUMTER COUNTY COMMUNICATIONS INFRASTRUCTURE (PAGE 2 OF 2)

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Signal Head Deficiencies

The MUTCD requires signal heads to be at least eight feet apart. All of the intersections were found to comply with this requirement. Table 5 shows the intersection where the distance between the stopbar and the signal heads did not meet MUTCD distance requirements. The maintaining agency will need to evaluate this intersection and adjust the signals if possible. If the maintaining agency is not able to adjust the signals to meet the standards, the intersection will need to be modified. This could include adding a supplemental head or adjusting the stopbar.

Table 5: Intersection Not Meeting Stopbar Distance Requirements

County ID	Major Street	Cross Street	Approach
21	Commercial Street (US 301)	Warm Springs Avenue (US 301)	EB

All the signal heads and equipment in Sumter County were found to be black, as required. This information can be found in Appendix F.

Signal Head Height Deficiencies

The inventory included verifying that signal head heights meet minimum requirements. The MUTCD requires a minimum height of 15 feet from the bottom of the signal housing to the highway under the signal head. All of the County's intersections met the MUTCD minimum requirement. The intersections with signal heads that meet the MUTCD minimum requirement but not the FDOT minimum requirement of 17 feet 6 inches can be found in Table 6. Any signals that are scheduled to be rebuilt on the State Highway System, should be coordinated with District 5 Traffic Operations. There are instances where signal head height is intentionally designed to be below 17.5 feet to achieve adequate sight distance. This information is located in Appendix G.

Table 6: Intersections That Meet MUTCD Requirements But Not FDOT Requirements

County Signal ID	Major Street	Cross Street
1	S Main Street (US 301)	Lynum Street/Huey Street (CR 44A)
2	US 301	CR 462 E
6	US 301	SR 470 W
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)
8	US 27/441	NE 138th Lane (CR 109)

County Signal ID	Major Street	Cross Street
9	CR 48	N West Street (CR 311)
13	CR 44	Industrial Drive
14	CR 48	I-75 SB Off-Ramp
16	US 301	SR 44
18	CR 44A	Powell Road
20	CR 466A	Powell Road/CR 462 E
21	Commercial Street (US 301)	Warm Springs Avenue (US 301)
22	Main Street (US 301)	W Noble Avenue (US 301)
26	CR 466	CR 101/Belvedere Boulevard
27	CR 466	CR 103/Old School Road
30	El Camino Real	Buenos Aires Boulevard
33	CR 466	Tatonka Terrace
35	CR 466A	Farner Place
36	CR 466A	Morse Boulevard
37	CR 466A	Sembler Way/Heald Way
38	CR 466A	Buena Vista Boulevard
39	Odell Cir	Canal Street (North)
40	Odell Cir	Canal Street (South)
46	US 27/441	Bella Cruz Drive
47	US 27/441	NE 136th/Buenos Aires Boulevard
48	US 27/441	Morse Boulevard/W Boone Court
98	CR 466A	Pinellas Pl
99	SR 471	CR 48

Stopbar Deficiencies

The data collection effort included verifying that stopbars existed for each approach at each intersection. Table 7 shows the intersection where a stopbar is significantly faded, and all the data can be found in Appendix H.

Table 7: Intersection with Stopbar Deficiencies

County Signal ID	Major Street	Cross Street	Approach
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)	WB

It is recommended that the County correct the intersection with the stopbar deficiency as soon as possible.

Crosswalk Deficiencies

The data collection included the verification of crosswalks at each intersection, if practical. A crosswalk was deemed missing if curb ramps, landing pads, or pedestrian signals are present and a crosswalk is not. All crosswalk data is listed in Appendix I. Table 8 shows intersections where crosswalks are missing.

Table 8: Intersections Without Crosswalks

County Signal ID	Major Street	Cross Street	Approach
2	US 301	CR 462 E	SE/E-W, SW/E-W
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)	NE/N-S, SE/N-S

In some cases, the crosswalk was not installed because of signal timing, drainage, or another physical barrier. These locations are not noted as having missing crosswalks.

It is noted in Appendix I that County Signal ID 27 is missing a crosswalk. The County prefers not to install pedestrian features at this location and it is recommended that the pedestrian signal head assemblies be removed.

During the ATMS design phases, the pavement markings should be reviewed to determine if they are in acceptable condition and all current design requirements are satisfied.

Pedestrian Displays

At each intersection, field data was collected on the existence of pedestrian displays. Table 9 lists the intersection where a pedestrian display is missing on an approach where curb ramps or landings are present. This location should be evaluated by the County and, based on the evaluation, be addressed as soon as possible. All of the data that was collected can be found in Appendix J.

Table 9: Intersection with Pedestrian Display Missing

County Signal ID	Major Street	Cross Street	Corner/Direction
2	US 301	CR 462 E	SE/E-W, SW/E-W

Additional Pedestrian Features

At each intersection, field data was collected on the existence and condition of other pedestrian features. The intersection with missing pedestrian push buttons is listed in Table 10. This intersection is currently under design and the issue is being corrected.

Table 10: Intersection with Pedestrian Push Buttons Missing

County Signal ID	Major Street	Cross Street	Corner/Direction
2	US 301	CR 462 E	SE/E-W, SW/E-W

It is noted in Appendix J that County Signal ID 27 is missing pedestrian push buttons. The County prefers not to install pedestrian features at this location and it is recommended that the pedestrian signal head assemblies be removed.

Summary of Intersection Deficiencies

A thorough review of 46 intersections in Sumter County was performed in 2014. This review indicated that the majority of the intersections are MUTCD-compliant. MUTCD requirements for street name signs were met at almost all intersections. The deficiencies in pavement markings were noted in this document. All the inventoried intersections appear to have been constructed to meet MUTCD and other relevant design standards at the time of construction. Some deficiencies have been noted for the County to address as soon as possible, and all of the deficiencies will need to be upgraded as the intersections are improved.

The deficiencies noted during the 2014 review of the Sumter County intersections have since been corrected by the County. As the Sumter County ATMS is implemented, a detailed inventory of the intersections included in the respective ATMS phase will be performed to ensure the intersection meets the applicable requirements at the time of construction. The detailed inventory will be included under the initial task for the design of each ATMS phase.

SECTION 4

TRAFFIC SIGNAL CONTROLLERS

4. TRAFFIC SIGNAL CONTROLLERS

The traffic signal controller is the hardware device that ultimately determines system capability, expandability, and maintenance. A controller assembly, which is comprised of a number of components, operates each signalized intersection:

- The Controller Unit is typically a self-contained microprocessor-based device that serves as the "brain" for the controller assembly. The controller unit provides for the timing and sequencing of the traffic signals based on inputs from vehicular and pedestrian detectors, parameters programmed into the controller unit, and commands issued by a system master or central computer (if operating in a coordinated mode).
- Terminal Facilities include the means of interconnecting the controller unit to various other components in the controller assembly, as well as the field wiring of the intersection. Included within this category are the back panel, load switches (or switchpacks), harnesses, flasher, various load relays, and other electrical components.
- The Malfunction Management Unit (MMU) or Conflict Monitor provides an electrical check against the inadvertent display of unsafe combinations of indications on the signal heads, as well as other critical controller functions
- Detectors are used by the controller unit to identify the presence of vehicle or pedestrian demands. While pedestrian detectors are commonly push buttons, vehicle detectors include inductive loops, microwave units, and video detectors, and generally include an electronic amplifier or other sensing device within the controller assembly.
- Pre-emption devices alter the operation of the controller unit (timing and/or sequencing) in response to actuations by rail crossing signals, transit vehicles, and emergency vehicles.
- The Controller Cabinet provides a secure and weather-resistant enclosure for the controller assembly.

CONTROLLER PLATFORMS

The choice of the intersection controller platform automatically determines other hardware and software choices. These include the types of cabinet assembly, MMU, and the available candidate firmware, along with other ancillary devices.

Since the introduction of the NEMA actuated traffic controller standards in 1976 and the subsequent introduction of standards for the Type 170 controller system by the California Department of Transportation (CALTRANS) in 1979, signal maintaining agencies have had to choose between these two approaches to local traffic control.

In recent years, both platforms have evolved in terms of standards development. The NEMA standards, initially developed as TS-1, have evolved to the current TS-2 standards. Similarly, the Type 170 standards have evolved into the 2070 standards of today. Cut sheets from various controller manufacturers are provided in Appendix K. The following section summarizes these two distinct approaches to traffic control field devices.

NEMA TS-1 Platform

NEMA is one of the principal United States trade organizations for the electrical manufacturing industry. One of the functions of NEMA is the development of standards for electrical equipment. In 1976, NEMA developed and adopted a standard for traffic control equipment, designated as TS-1. Since 1976, the NEMA TS-1 standard has been enhanced and reissued five times.

One of the primary objectives for developing the TS-1 standard was to allow the interchangeability of control equipment within a control cabinet and to have uniform signal operation between different manufacturers. Prior to 1976, signal control equipment from different manufacturers was not interchangeable. Each manufacturer had different connectors for the controller unit, along with different input and output voltage levels. Many signal timing parameters had different meanings, depending on which manufacturer's controller was used.

The NEMA standards reflected input from traffic engineers, installers of traffic signal equipment, and other professionals in the field of traffic control. They described physical and functional requirements for fully-actuated traffic signal controller units and ancillary equipment. The controller unit functions described in the standards included two-phase through eight-phase, single-ring, and dual-ring operation. Input and output formats, environmental standards, and test procedures were also covered in the standards.

As technology progressed, other features that were not originally envisioned during the development of the standards were added to NEMA traffic controllers. These enhanced features, beyond the basic operation described in the NEMA standards, include internal coordination, systems interface, and pre-emption. As a consequence, the manufacturers added supplemental connectors to accommodate these additional functions. NEMA members could not agree on how best to accommodate these enhancements, so each manufacturer developed both hardware and software in a way that was most cost-effective for them.

This resulted in a general loss of the interchangeability of NEMA controllers, ultimately leading to the development of the NEMA TS-2 standard.

NEMA TS-2 Platform

In 1986, in an effort to address the interchangeability and interoperability issues being experienced with the TS-1 standards, NEMA began the development of a new enhanced controller standard, now designated as TS-2.

Several options were considered in the development of the new standard; each had advantages and disadvantages. After much debate and discussion, four candidate options were developed:

1. Standardize on the design of a fourth connector (D).
2. Utilize seldom-used pins on the A, B, and C connectors, and reassign them as needed for enhanced functions.
3. Proceed with an entirely new standard.
4. Proceed with a two-staged approach by adopting the first candidate and migrating to the third option over time.

Debate on the direction of the new standards lasted for over two years and the decision was reached to proceed with the third option – an entirely new standard. However, this generated user concerns about maintaining downward compatibility with existing TS-1 based hardware. A compromise was reached over the direction of this new TS-2 standard and two types of approaches were adopted: the TS-2 Type 1 approach and the TS-2 Type 2 approach.

TS-2 Type 1 Approach: New Direction

The NEMA TS-2 Type 1 approach defined a new direction in traffic control cabinet technology. The TS-2 Type 1 controller unit is not compatible with existing TS-1 units. Instead of relying on the 171 function-specific pins on the three connectors defined by TS-1, this new standard utilizes three high-speed data ports on the controller unit.

The first port is an Electronics Industry Alliance (EIA)-485, 15-wire connector utilizing a synchronous data link communications protocol. This allows for full duplex data exchange between the controller and the MMU, a detector rack, the back-panel assembly, and other ancillary devices. Interface with the ancillary devices and the controller is through a Bus Interface Unit (BIU).

The second port is an EIA-232C connector to allow the controller to interface to a printer and/or a personal computer. In addition, this port allows for the transfer of data between controllers.

The third port is a Frequency Shift Keying (FSK) 1200-baud serial port, to be used for system communications. This port is defined at the physical layer only; the structure of the data is not covered under this standard, but rather was the driving force behind the initial development of the NTCIP.

In addition to defining port structure, the NEMA TS-2 standard included other areas not covered under the previous standard. One such area was the definition of the enhanced operational features, including:

- Pre-timed Control
- Conditional Service
- Additional Detector Inputs
- Delay/Extension/Switching Detectors
- Dual Entry
- Alternate Phase Sequencing
- Start-up Flash
- Uniform Code Flash

- Exclusive Pedestrian Operation
- Coordination Parameters
- Pre-emption Parameters
- Time Base Operation
- Internal Diagnostics
- Detector Diagnostics

Also covered in the standard is a definition of the MMU. The MMU provides an expanded operation over standard TS-1 conflict monitors by not only checking signal displays at the signal field cable terminals but also cross checking for proper outputs from the controller. In addition, extended features available only in enhanced TS-1 conflict monitors are defined, including minimum clearance timing and multiple displays per channel.

TS-2 Type 2 Approach: A, B, and C Connectors

The TS-2 Type 2 approach has most of the same operational functions as the TS-2 Type 1, except the controller utilizes the standard A, B, and C MS-type connectors for data exchange with the cabinet back panel. This allows for the controller to be downward compatible with existing TS-1 assemblies. In order to accommodate expanded signal operations, 24 inputs and outputs previously defined by TS-1 have been reassigned, based on the programming of three mode inputs on MS connector A. This configuration allows for seven different controller configurations or modes.

Type 170 Platform

The states of California and New York jointly developed the Type 170 controller system specification in the mid-1970s, in response to the same controller interchangeability issues that prompted the development of the NEMA standards.

The Type 170 system is based on hardware standardization, and structures the controller assembly as a package consisting of a standardized memory module residing in a microprocessor unit housed within a standard cabinet enclosure. The controller unit uses a microcomputer that, with the addition of appropriate software, can be used in a variety of control applications. Thus, the controller unit can be tailored to the user's needs by incorporating an existing software program, by modifying an existing software program, or by developing a new program.

The software required for Type 170 traffic control operation resides on a standardized data module. This module is defined by the Type 170 specification and, therefore, is interchangeable between different manufacturers. This module and the internal modem are the only boards that are interchangeable between manufacturers; other circuit boards that make up a Type 170 controller are manufacturer-specific and will not work with other manufacturer's units.

At the same time the Type 170 controller was developed, a new cabinet standard was also developed. This new cabinet style uses a standard 19-inch rack mount form for the Type 170 controller and associated equipment. Standardized input and output racks were designed to operate in the cabinet, which has access from both sides instead of just the front. Over the years, the design has been modified to accommodate various jurisdictional needs, but they all maintain the standard 19-inch rack mount for the controller.

In the mid-1980s, the State of New York developed an enhanced version of the Type 170 controller, designated the Type 179 controller. This unit was used primarily in New York State, and included a number of features beyond the Type 170:

- A higher speed processor
- More user-friendly displays
- Larger memory capabilities
- Enhanced communications capability, making it better suited for system operations

Type 2070 Platform

The Type 2070 controller unit specification was developed by CALTRANS to provide distributed computing, control, and communications for field control devices used in an ITS environment. The Type 2070 platform is designed as a nonproprietary, configurable, open architecture platform that can be used for a wide variety of traffic management applications. It is intended to satisfy the high-end needs of ITS applications not possible with Type 170 controller units.

The heart of the Type 2070 controller is the Versa Module Europa (VME)-bus structure, a well-established computer industry standard. The VME-bus specification defines mechanical and electrical characteristics to allow manufacturer compatibility for the different function modules or cards. VME is a flexible open-ended bus system used in a variety of computing intensive tasks and is defined by the Institute of Electrical and Electronics Engineers (IEEE) 1014-1987 standard.

There are two different versions of Type 2070 controller units currently specified by CALTRANS, the Type 2070 and the Type 2070N (NEMA) controller. In addition, stripped down versions, such as the Type 2070L (Lite) and the 2070NL (NEMA/Lite), are also available from manufacturers. The FDOT has published a Model 2070 ATC Minimum Specification.

The Type 2070 controller unit was designed to support and be compatible with Type 170 controller units. This allows for both physical and plug interchangeability with the older series of controllers. However, unlike the earlier controller series, the 2070 provides multiprocessing and multitasking capability with each unit. Type 2070 controllers use the same type of standardized cabinets that were designed for the Type 170 units.

The Type 2070N controller unit consists of a 2070 controller with the addition of a NEMA interface module (which contains the A, B, and C MS-type connectors), a D connector, and two RS-232 communications ports. The Type 2070N controller unit is designed to be interchangeable and interoperable with NEMA standard traffic control cabinet assemblies. Newer devices also include an Ethernet port.

The Type 2070L controller unit uses the 2070 standard connectors, but deletes the VME bus interface. A 2070L includes all interfaces needed for the majority of traffic control signal applications, including an optional Ethernet connection.

The 2070 ATC specification defines the hardware requirements, the operating system for the controller, and an Application Programming Interface (API). The API allows software to be developed for the controller that can be added to the system as needed. This separates the hardware costs from the software costs and allows greater flexibility in designing, maintaining, and upgrading systems.

48-Volt Direct Current Traffic Signal Controller Cabinet

The latest development in traffic signal controller cabinets is the introduction of the 48-volt Direct Current (DC) traffic signal controller cabinet. Currently, the 48-volt DC traffic signal controller cabinet is only compatible with Type 2070 traffic signal controllers. The traffic signal controller cabinet is fed with 120 volts Alternate Current (AC) from the electrical service which is then converted to 48 volts DC by a current converter within the traffic signal cabinet. This allows the traffic signal controller cabinet to operate internally at 48 volts DC as opposed to the standard 120 volts AC.

The traffic signal heads connected to the traffic signal controller cabinet will also operate at 48 volts DC. Because DC experiences greater voltage losses than AC over the same distances, intersections requiring long lengths of cabling between the traffic signal controller cabinet and the traffic signal heads may experience voltage losses greater than the acceptable amount.

The 48 volts DC, when compared to the standard 120 volts AC, results in less power consumption equating to lower electrical bills and extended battery backup time when an uninterruptible power supply (UPS) is installed with the traffic signal controller cabinet. Another benefit to the 48-volt DC traffic signal controller cabinet is the technicians will be working with 48 volts DC as opposed to 120 volts AC, providing improved personnel safety.

A potential downside to the 48-volt DC traffic signal controller cabinet is the service outlets within the traffic signal controller cabinet will need to remain 120 volts AC, as the typical technician tools (laptops, drills, etc.) operate at this voltage. This potential downside can also apply to ITS devices such as CCTV cameras and Bluetooth devices, as they are typically configured for 120-volt AC operation.

At this time, the 48-volt DC traffic signal controller cabinet is in its infant state. So far, the 48-volt DC traffic signal controller cabinet has been installed across multiple agencies, including

Harris County, Texas which encompasses the greater Houston area. As the deployment of the 48-volt DC traffic signal controller cabinet continues, additional benefits and/or hindrances will be learned.

COSTS

Capital Costs

The costs to furnish and install a typical traffic controller assembly at an intersection typically range from $20,000 to $25,000, regardless of the type (TS-2 or 2070). This includes the costs for the cabinet, controller, MMU, and Input/Output (I/O) files.

Operations and Maintenance (O&M) Costs

The O&M costs should not exceed 5 to 10 percent of capital costs. Sumter County uses a maintenance contractor to maintain their signals and negotiates this contract on a biennial basis.

EMERGENCY VEHICLE PRE-EMPTION

Technologies

Pre-emption control is used to assist emergency and other designated vehicles in passing through signalized intersections by giving them a green signal indication as they approach. Another use of pre-emption is to prevent the length of queues from becoming excessive by introducing special timing plans.

There are several types of pre-emption available. One method pre-empts a signal at or near an emergency vehicle station by means of a switch inside the station. The signal changes to allow the emergency vehicle to exit, then resumes normal operation. The costs associated with this method of pre-emption are minimal.

Another method utilizes a radio or optical transmitter mounted on the emergency vehicle or other designated vehicle (bus) and receivers located at each intersection for each pre-empted direction of travel. The most recent technology includes Global Positioning System (GPS) tracking in the units. As the emergency vehicle approaches an intersection, a command is sent from the transmitter to the receiver that causes the signal to give a green indication to the emergency vehicle. After the emergency vehicle passes, normal operation resumes. Equipment costs are significant for this type of pre-emption equipment and are typically borne by the agency operating the emergency vehicles.

More advanced traffic control systems offer the ability to pre-empt in other ways. Pre-determined emergency vehicle routes can be called by a dispatcher. This method works best when large numbers of emergency vehicles are dispatched at the same time. Route pre-emption can also be utilized to accommodate inbound and outbound traffic flows for special events and special traffic patterns for emergencies, such as highway closures due to flooding, etc.

It is recommended that the selected Sumter County system be capable of incorporating pre-emption, but not necessarily as an integral part of the traffic system software because it is not a required function for conducting traffic signal control. It could be accomplished by means of another software/hardware package consisting of optical transmitters and receivers. The signal system should be designed to identify that the intersection is off-line by pre-emption in order to prevent the system from initiating a failed controller message and attempting to pick up the intersection. Today’s controllers are equipped with local pre-emption and with the ability to send a message back to the monitoring system.

Locations

Sumter County has railroad pre-emption installed at several intersections within the County, shown in Table 11.

Table 11: Existing Pre-emption Locations

ID	Main Street	Cross Street
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)
7	Main St (CR 48/CR 475)	Belt Ave (CR 48)
22	Main St (US 301)	W Noble Ave (US 301)

The County does not currently have any emergency vehicle pre-emption control. The existing controllers are equipped to handle emergency vehicle pre-emption if the County decides to add this feature in the future.

COSTS

Capital Costs

The costs associated with pre-emption are often borne by the emergency agency, typically the fire department. Per vehicle costs are in the $1,000 to $2,000 range.

O&M Costs

Operations costs for the system should be near zero. Maintenance costs should be less than five percent of capital cost and would consist of the occasional replacement of a defective unit at the controller cabinet

SECTION 5

DETECTION/TRAVEL TIME SYSTEMS

5. DETECTION/TRAVEL TIME SYSTEMS

An ATMS typically uses detection for three functions: local intersection detection for controller input; advanced detection for system information; and midblock detection for incident detection and travel time functions. These functions are fundamental methods to measure and improve the efficiency of traffic operations on arterials. To help achieve this objective, it is necessary to collect volume, speed, and travel time information to judge performance as well as provide to triggers for implementing alternative timing and travel plans. There are several detection technologies that Sumter County could deploy for these purposes. This section discusses the three forms of detection used in an ATMS, and the detection technologies used.

DETECTION/TRAVEL TIME SYSTEMS OVERVIEW

Traffic control deals with the movements of vehicles and pedestrians. For local intersection control, the detector unit (sensor electronics) responds by sending an actuation (output) to the controller unit, which in turn either extends the green for that vehicle or brings the green to it at the earliest opportunity. This action by the controller affects traffic movement, and new detector actuations may be produced. Detectors can also be used to acquire data for off-line analysis at some later date, for planning purposes, or for the evaluation of the effectiveness of control strategies being used.

All detectors operate on one of two basic principles. A vehicle or pedestrian may close the contacts of a pressure-sensitive switch by exerting a mechanical force or a vehicle's motion or presence causes a detectable change in an energy pattern. The inductive loop detector (ILD) is the most widely used detector and is an example of an energy pattern change detector.

The NEMA defines a detector as "a device for indicating the presence or passage of vehicles or pedestrians". A presence detector is intended to hold the actuation or "call" of a vehicle for as long as it remains in the detection area or zone. If an ILD is operated in the presence mode, a vehicle of known length that crosses the loop produces a call, the duration of which is used to calculate the vehicle's speed. The percent of time that the detector is calling, called the percent occupancy, is also computed. On the other hand, if the ILD is intended only to sense the arrival of a vehicle, it is called a passage detector. It is operated in the pulse mode to ignore the continued presence of a vehicle stopped within the detection zone. If so operated, no matter how long the vehicle remains in the loop, the call is only a "blip" or pulse lasting about one-tenth of a second. Passage detection is useful for keeping a count of vehicle volume.

Traffic detectors may be applied either singly or in multiple installations to measure presence, volume, occupancy, and speed. These surveillance measures can be used as control parameters at an individual signalized intersection or in a coordinated traffic signal system.

Vehicle arrivals tend to fluctuate at an individual intersection, so efficiency depends on responsiveness to demand that varies from minute to minute. An actuated green interval is elastic in length and can be tailored to actual arrivals. The green interval can vary from the minimum to the maximum settings on the controller on the basis of unit extensions generated by vehicles crossing the detectors.

An individual intersection can be signalized using one of the following four types of control:

- Pre-timed (no detectors)
- Semi-actuated (detectors on side-street approaches only)
- Basic full-actuated (detectors on all approaches)
- Volume-density type of full-actuated control

National Cooperative Highway Research Program (NCHRP) Project 3-27 developed comprehensive guidelines to help traffic engineers evaluate the costs and benefits of these control alternatives at individual intersections. The project found that the form of control that minimizes vehicle stops and delays at an intersection also minimizes fuel consumption and pollutant emission. Also, it was found that the differences in cost of acquisition, installation, operation, and maintenance were relatively minor among the control alternatives. Therefore, the form of control that minimizes stops and delay is the most cost-effective installation.

Typically, full-actuated control is the most cost-effective for most volume levels. Pre-timed control appears attractive when the intersection is operating close to capacity because, in theory at least, an actuated controller will repeatedly extend the green intervals to the maximum, thus performing no better than would a less expensive pre-timed model. In practice, actuated control retains its cost-effectiveness at high volume-to-capacity ratios because all phases usually do not peak at the same time and are not always fully utilized. It is incorrect to assume that an actuated signal ever operates on a fixed cycle length even under heavy conditions.

Semi-actuated control is the best choice only for side-street volumes that barely meet Warrant 2 of the MUTCD. If main-street volumes depart from the medium range, then full-actuated control again is preferable. The 24-hour range of approach volumes is best handled by using a full-actuated controller and detectors on all approaches. The need to rest the green on the heavily traveled main street is met by asserting a recall, or a call to the non-actuated mode, on that phase.

Travel time systems consist of multiple detectors strategically placed along a route. The type of detector used in travel time systems is able to provide a unique identification to the passing vehicle whether it is by using Bluetooth technology, SunPass transponder, or a license plate. When the vehicle passes the first detector along the route, the detector assigns the vehicle a unique identification. As the vehicle continues traveling along the route, additional detectors at known locations identify the vehicle and note the time of passing. The travel time system is able to provide the difference in time as the travel time for this link along the route.

The travel time for designated routes can be important pieces of information for Sumter County. By obtaining real-time travel time information, the County can identify incidents, judge performance of the traffic control system, and obtain performance measurement information to be reported to the FDOT and the Federal Highway Administration (FHWA). The travel time data may also be helpful in planning future projects or evaluating the effects of new projects.

INTERSECTION DETECTION

Currently, Sumter County uses a combination of ILDs and video image detectors (VIDs) for intersection detection. All new intersection detection will be VIDs. For many jurisdictions, the maintenance of ILDs has become a problem and Sumter County is no different.

Technologies

Many devices have been used to detect vehicles. Some, such as pressure detectors, are no longer popular. The following describes some of the devices that are in widespread use and should be considered for Sumter County.

ILDs

The ILD began to be used in the early 1960s. The loop consists of one or more turns of insulated wire (usually American Wire Gauge (AWG) 14, stranded) wound in a shallow, rectangular slot sawed in the roadway. At curbside, the two ends of the wire are carefully spliced to a factory-twisted and shielded lead-in cable that is led to an intersection cabinet housing the electronics unit. This unit drives energy through the loop at radio frequencies typically in the range of 20 to 200 kilohertz (KHz). The detector unit, lead-in wire, and loop wire comprise a tuned circuit of which the loop is the inductive element. A vehicle crossing the loop will absorb some of the radio frequency energy because of eddy currents created in the metal periphery (the chassis and the body, not the engine). The inductance is reduced, causing the resonant frequency to increase. At this point, various designs of ILD electronics process phase, frequency, amplitude, or impedance changes to actuate the detector's output relay.

Early ILD units used a fixed, crystal-controlled frequency close to 100 KHz. These units were discontinued because they could not track or compensate for drift in resonant frequency caused by environmental changes in moisture and temperature. Modern units are capable of tracking out such drift. The ILD electronics unit is fairly inexpensive, selling for approximately $750. Installation requires traffic disruption and pavement cuts. ILD detection is very flexible and can be highly dependable. The zone of detection varies widely, either passage or presence modes are selectable, and calls can be either delayed or extended. A few other advantages of the ILD include its capability to detect small vehicles, its capability to measure all traffic parameters, and the fact that it makes an excellent presence detector. The disadvantages of the ILD include the fact that cutting the pavement is involved for installation, as well as the closure of traffic lanes during installation and maintenance. The ILD is currently the most popular detector for individual intersections, signal systems, and freeway surveillance. Figure 4 shows a typical ILD installation detail.

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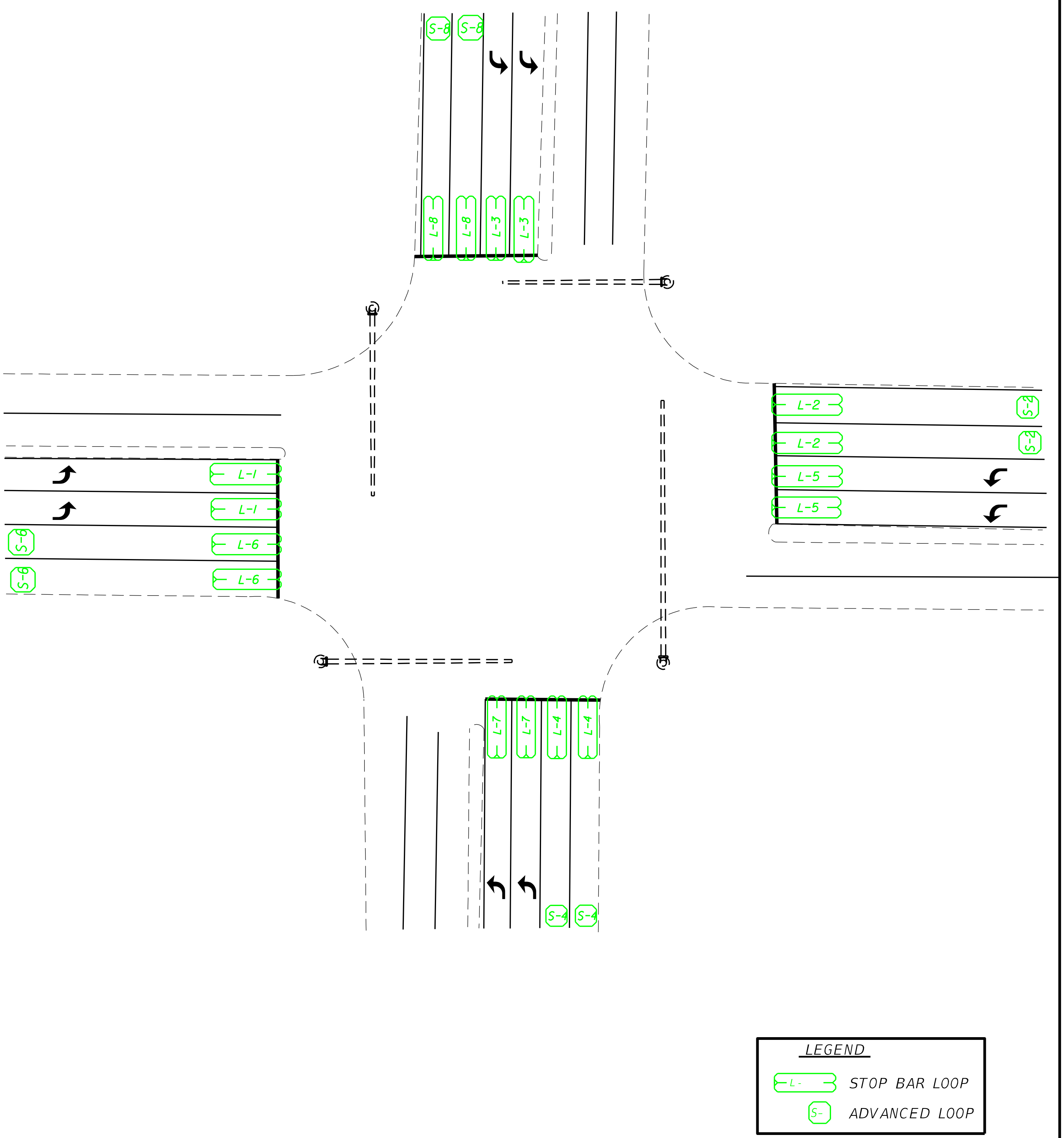

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Project Title	SUMTER COUNTY ATMS MASTER PLAN	Project No.	0116002
Drawing Title	FIGURE 4: TYPICAL ILD INSTALLATION DETAIL	Date	03/23/17

Infrared Detectors

In the mid-1950s, an optical detector was introduced that used infrared light. The narrow beams give the detector an especially precise field of influence, allowing use in specialized applications. For example, infrared detectors are used extensively in England for both pedestrian crosswalks and signal control. They were also used on the San Francisco-Oakland Bay Bridge, where they were side-mounted at 600-foot intervals on the upper deck of the bridge. The detectors established the presence of vehicles across all five lanes, thus providing an occupancy measurement. In recent years, a principle use has been to actuate "Following Too Closely" signs. In this application, police officers may cite motorists who allow their clear headway to fall to less than an acceptable time.

Disadvantages of infrared detectors include:

- Changes in light and weather cause a scattering of the infrared beam
- The lens system is sensitive to water and environmental constraints
- Concern exists about their reliability in high volume conditions

Infrared detectors now include both active and passive models. In the active system, detection zones are illuminated with low-power infrared light. The infrared light reflected from vehicles traveling through the zone of detection is focused by an optical system onto a sensor. A real-time signal processing technique analyzes the received signal and determines the presence of a vehicle. Environmental shifts are tracked automatically.

The passive system measures passage (motion) only. The unit contains a lens configuration that provides detection of moving vehicles within a three-degree zone of detection, which may be up to 300 feet from the unit.

The technology for infrared detectors has advanced to the point where bicycles and pedestrians can be detected based on body heat. This can be advantageous for the area around the Villages where golf carts are a frequent mode of transportation.

Microwave/Radar Detectors

The available MVDSs are a small unit mounted in either a side-fire or overhead mount. Microwave energy is beamed toward an area of roadway from an antenna and when a vehicle passes through the beam, the energy is reflected back to the sensing unit (antenna) at a different frequency. The detector senses the change in frequency, which denotes the passage of a vehicle. The capabilities of MVDS units include vehicle detection, occupancy, and data collection.

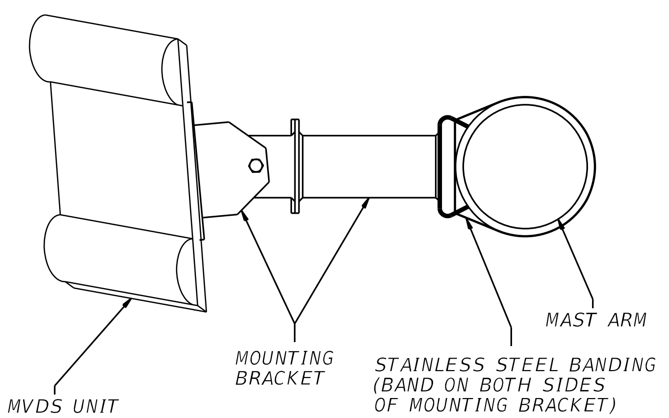
For the purpose of intersection detection, the MVDS unit uses multiple beams, as opposed to one, to detect passage as well as presence. This can be used for up to 10 lanes on a single approach. MVDSs do not disturb the pavement for installation, and it may not be necessary to close traffic lanes to install them. However, they require antenna alignment to operate properly. MVDSs can provide greater reliability than most intersection detection technologies as weather conditions and reduced visibility do not deteriorate the strength of the microwave beam.

MVDS units used for intersection detection have a more limited range compared to MVDS units used for advanced detection. Because of this, the MVDS unit should be mounted near the lanes to be detected. Also, occlusion due to trucks, median barriers, or traffic signal infrastructure can occur if the MVDS unit is not mounted high enough over the roadway. A typical intersection MVDS installation detail is shown in Figure 5. The figure also shows the multiple locations a MVDS unit could be installed dependent on the intersection configuration.

Video Detection

Cost reductions and technological advancements have led to the application of video imaging for traffic detection. In addition to loop emulation, video detection systems offer other capabilities that include wide-area detection, data collection, and automatic incident detection.

MVDS ATTACHMENT
N.T.S.



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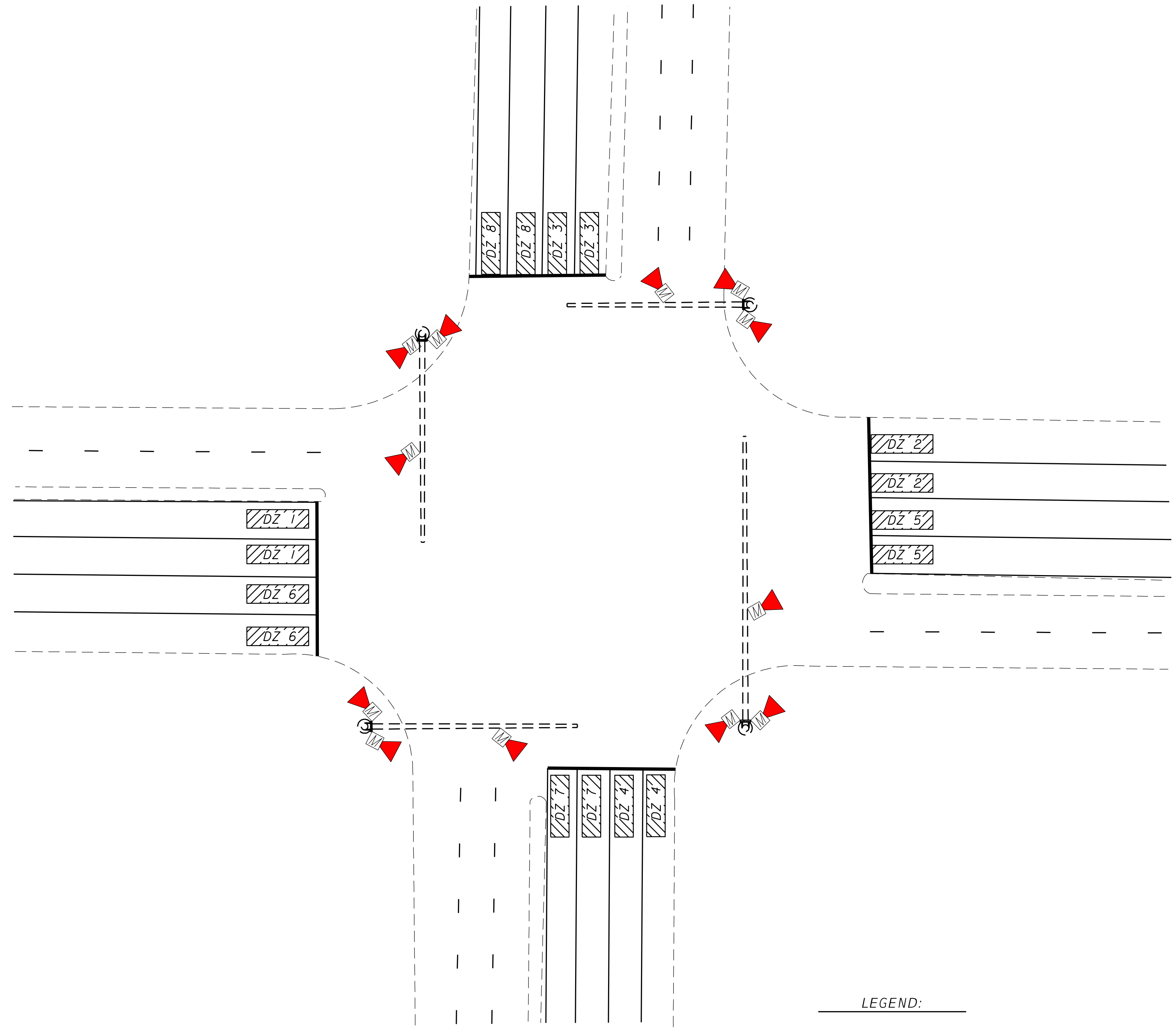

LEGEND:

M — MICROWAVE VEHICLE DETECTION SYSTEM (MVDS)

NOTE:
ONLY ONE DETECTOR IS REQUIRED PER APPROACH. MULTIPLE DETECTORS PER APPROACH ARE SHOWN TO REFLECT THE MULTIPLE LOCATIONS THE DETECTOR COULD BE INSTALLED DEPENDENT ON THE INTERSECTION'S CONFIGURATION. THE DETECTORS SHOWN ON THE CORNERS WOULD BE APPLICABLE TO STRAIN POLE CONFIGURATIONS AS WELL.

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The video detection system receives video input from small monochrome or color cameras mounted at an intersection. Upon receiving a real-time image of the traffic scene, the video processor stabilizes the image, adjusts the image for rapid lighting changes, effectively removes the background, and filters out artifacts and shadows. The resultant post-processed image consists of a blank background containing only identified objects which are tracked, including vehicles, motorcycles, bicycles, and pedestrians. By analyzing successive video frames in real-time, the system accurately tracks and gathers data about these objects, including direction of travel, location, speed, and length.

A disadvantage of VIDs is the potential of occlusion from other vehicles or objects. The probability of occlusion increases as the offset of the camera from the desired lanes of detection increases. To minimize the potential for occlusion, cameras are typically mounted above the roadway, often on existing poles, mast arms, bridges, or other structures.

Another disadvantage of VIDs is the potential for false calls due to movement of the camera. This can be due to the height and sway associated with the typical structures cameras are mounted to. To help minimize the false calls, the VID system must be capable of automatically re-aligning the incoming video image in real-time for comparison to previous images. This stabilization is conducted by electronically shifting the digitized video image to align with identified landmarks within the field-of-view (FOV).

Adverse weather conditions such as heavy rain, fog, or sun glare can impact the VID system's ability to detect vehicles.

Some manufacturers of VID systems provide intersection detection with a single 360-degree FOV camera, allowing for greater flexibility in the placement of the VID system at the intersection.

The system operator uses interactive graphics on a standard computer or laptop to configure the FOV and draw virtual detectors, either remotely or on-site. Virtual detectors are not physically placed upon the roadway, but overlaid on a video image of the traffic scene displayed on a computer screen. Placement, addition, and relocation of these virtual detection zones are easily accomplished in a short period of time. The information drawn on the computer screen is then transferred to the video processor in the field for tracking and detection.

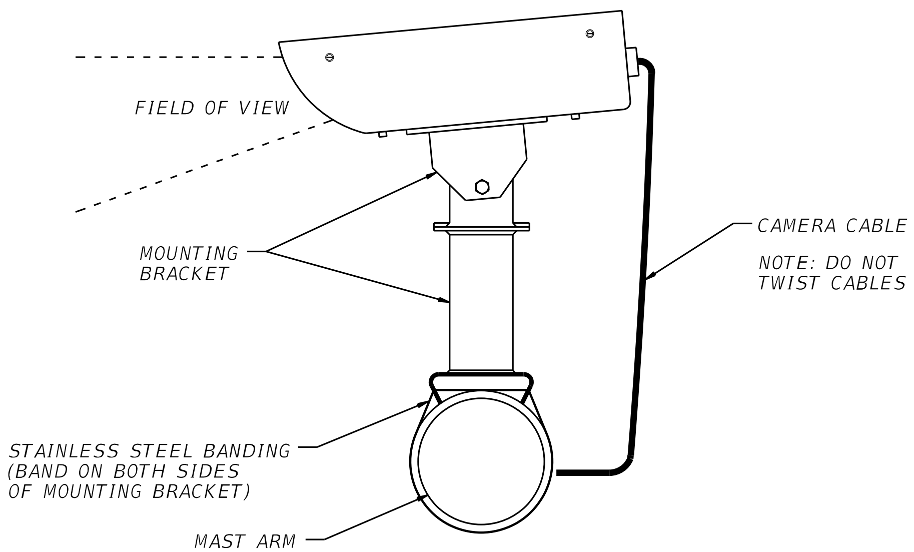
When a vehicle or object crosses a virtual detector, the system is capable of providing visual verification of the detector actuation on a computer at the TMC or on a notebook computer in the field. Video transmission is facilitated either through analog video means to a video monitor or video capture card, or by compressed digital video at a reduced frame rate. The compressed digital video may be transmitted via cellular telephone, standard hardwire telephone lines using a modem, or over a fiber optic cable network.

The system is capable of providing logic ground outputs for loop emulation and a simple interface to the traffic controller cabinet. In addition, these outputs can control warning signs and other devices for advanced traffic control. Wide-area detection, accomplished through a single eight-camera video processor, can replace up to 256 inductive loops without placing a single sensor in the roadway. This offers a significant advantage over ILDs.

Advanced communication of traffic information can be facilitated by RS-232 and RS-485 ports. Video processors can communicate directly to traffic controllers, providing valuable information regarding volume, speed, length, density, delay, headway, occupancy, and queue length. Providing this wealth of valuable information directly to adaptive control systems allows the more advanced traffic control systems to better handle the increasing needs of the motoring public. A typical VID installation detail is shown in Figure 6. Figure 7 illustrates a typical installation for a single camera, 360-degree VID system.

Wireless Magnetometer Detection

Wireless magnetometer detection systems consist of detectors, access points, and repeaters, and can be configured to provide intersection detection. The detectors and repeaters are wireless; therefore, no trenching, conduit, or saw cutting the pavement is needed for the installation of these devices. The access points have a single CAT5 cable that connects to a contact card within the traffic signal cabinet.



VIDS ATTACHMENT FOR MAST ARMS
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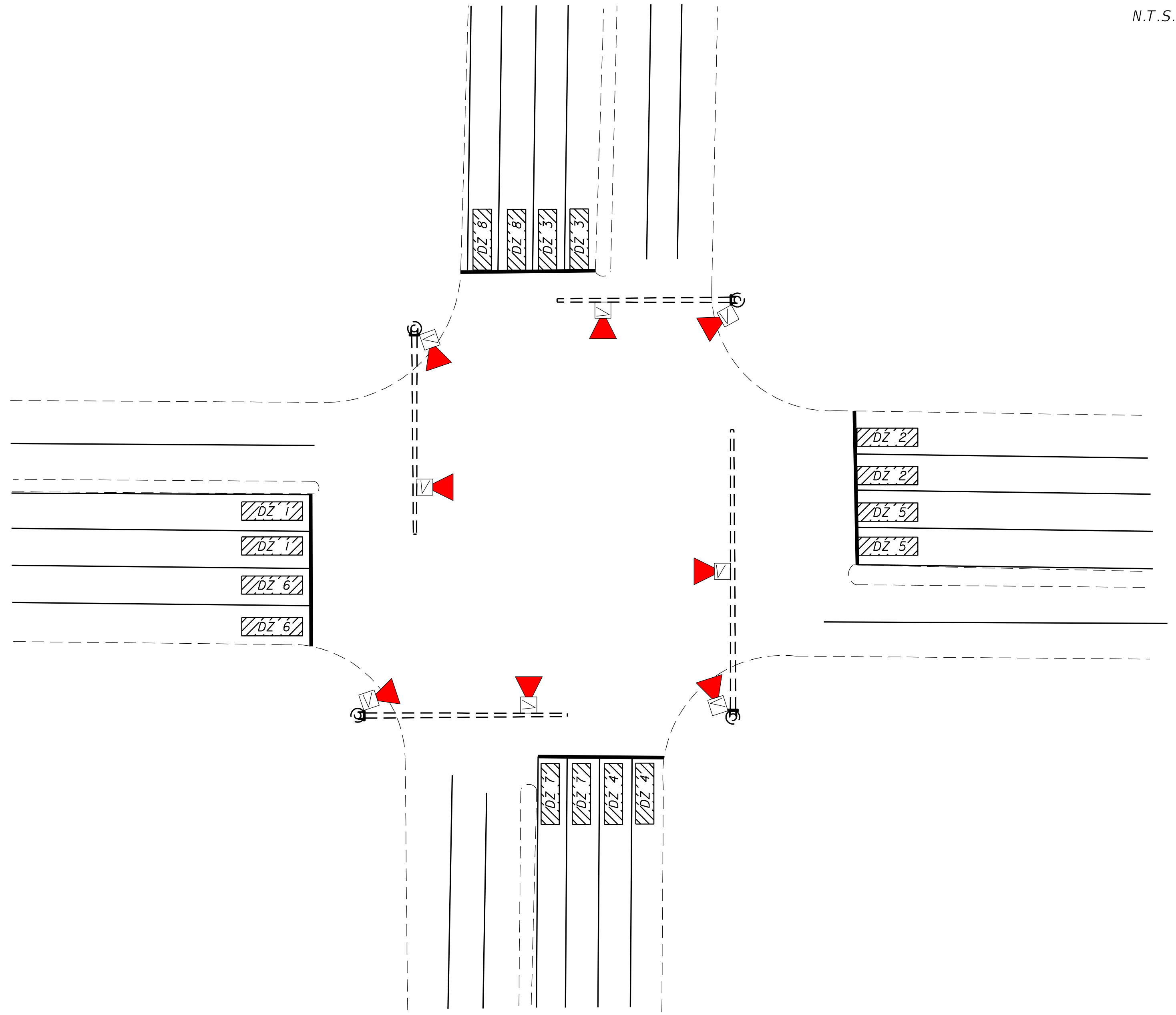

LEGEND:

VIDEO IMAGE DETECTOR SYSTEM (VIDS)

NOTE:
ONLY ONE DETECTOR IS REQUIRED PER APPROACH. MULTIPLE DETECTORS PER APPROACH ARE SHOWN TO REFLECT THE MULTIPLE LOCATIONS THE DETECTOR COULD BE INSTALLED DEPENDENT ON THE INTERSECTION'S CONFIGURATION. THE DETECTORS SHOWN ON THE CORNERS WOULD BE APPLICABLE TO STRAIN POLE CONFIGURATIONS.

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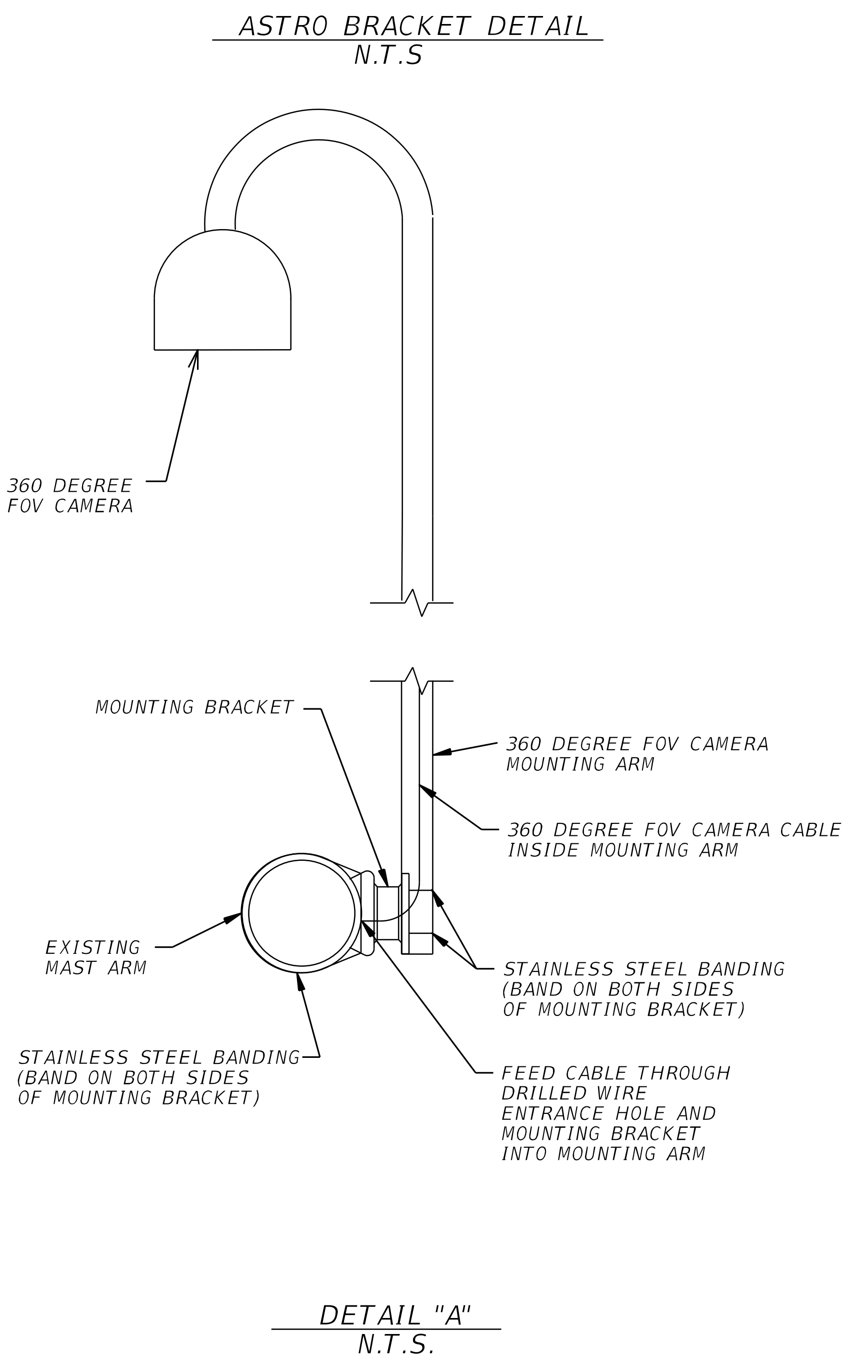
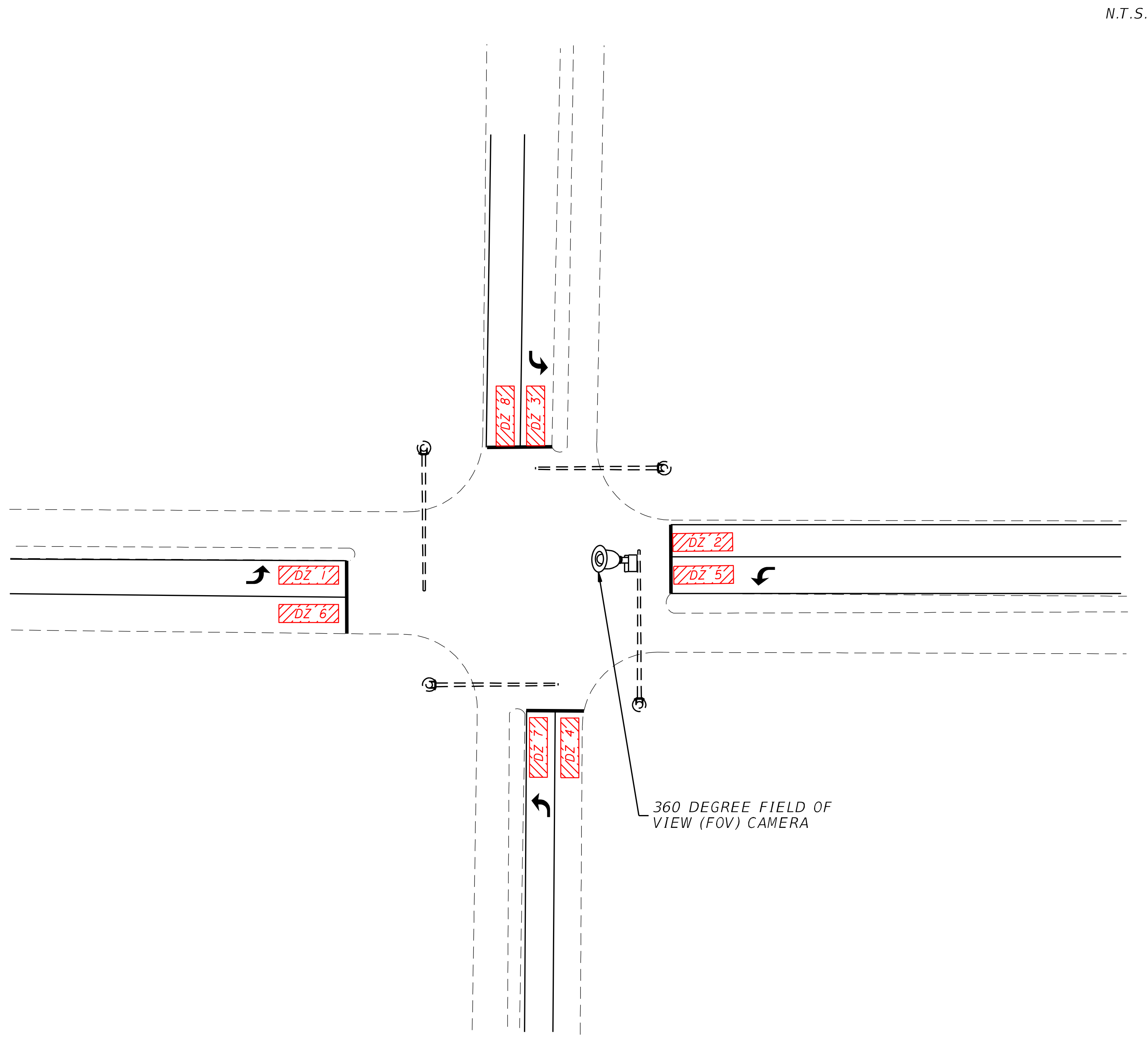
Drawing Title	FIGURE 6: TYPICAL VIDS INSTALLATION DETAIL	**Page**	52





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Title: V:\0116002 - Sumter County ATMS Phase 2\Project Working Files\Documents\Task II - Master Plan Document\Figures\Master Plan Figures\Figure 7 - Typical 360-Degree Vids Installation Detail.DGN
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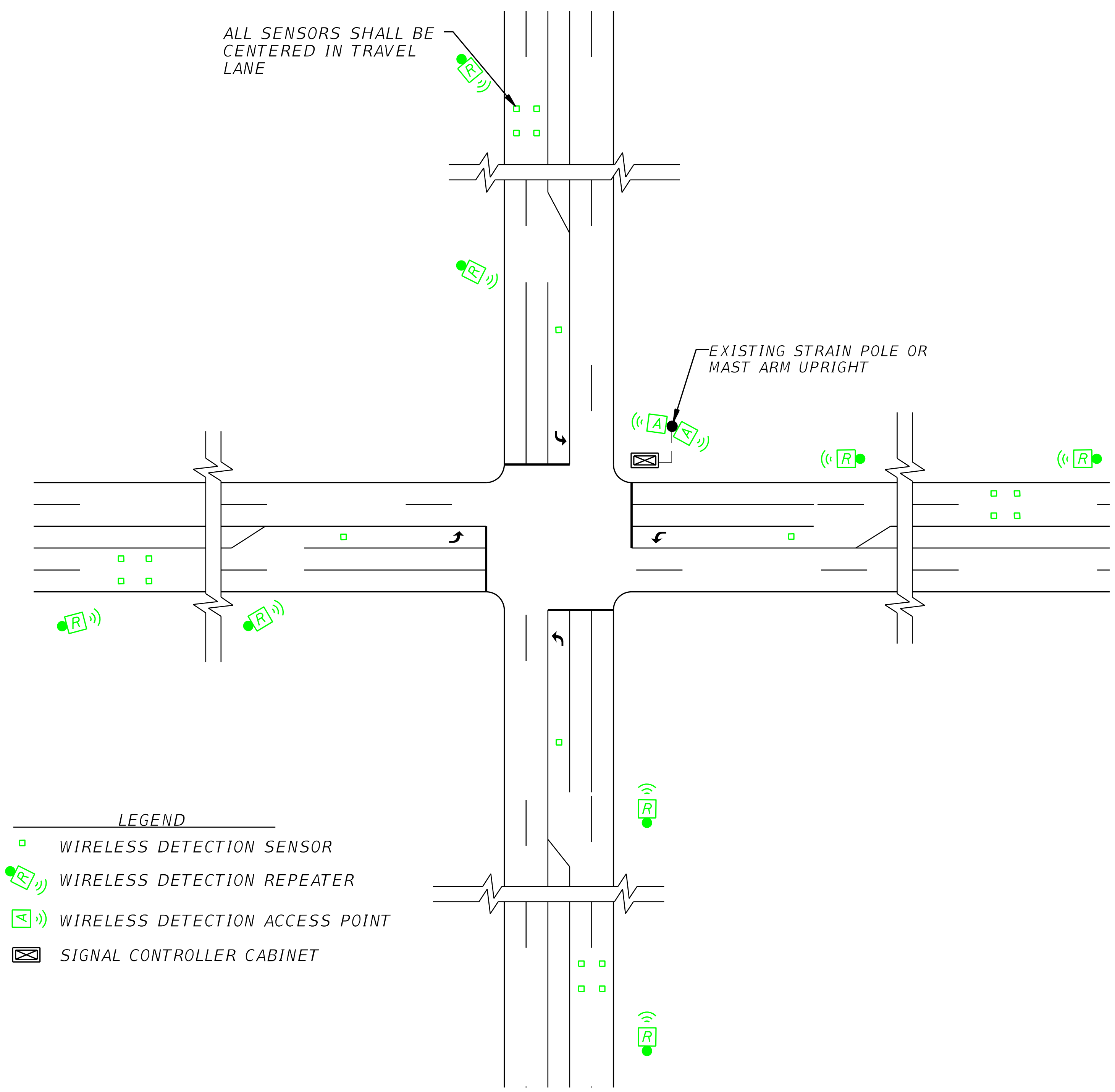
The detectors, sometimes referred to as pucks, are typically about five inches in diameter. The pucks are embedded in the roadway, in the center of the lanes to be detected. The pucks are wireless and communicate with the access point either directly or by way of a repeater.

The access points are typically located near the traffic signal cabinet due to the need to install a CAT5 cable from the access point to the traffic signal cabinet. The access point communicates to the contact closure card in the traffic signal cabinet via power-over-Ethernet (PoE).

The repeater is a wireless unit that communicates with the puck and relays the information to the access point. The repeater has a built-in battery which alleviates any need to install electrical wires to the unit.

The biggest advantage of the wireless magnetometer detection system is that it is a low-cost alternative to the other types of intersection detection. The need to saw cut for loops and install conduits for homerun cables is eliminated with the wireless magnetometer detection system. The time and cost of the maintenance of traffic during installation is lower for the wireless magnetometer detection system as the installation of the pucks is quicker than cutting loops and the repeaters are installed on the side of the road. The installation of the access points may require lane closures depending on the line of sight conditions at the intersection.

For the wireless magnetometer detection system to properly function, a single puck cannot malfunction. If a single puck malfunctions, false or missed calls can occur within the lanes containing the malfunctioning puck. Also, the wireless magnetometer detection system requires an unobstructed line of sight for the wireless communication to properly operate. Wireless magnetometer detection systems typically require a design specialist from the vendor to visit each site and provide support for the design of the detection for each intersection. Figure 8 shows a typical layout for the installation of a wireless magnetometer detection system.



TYPICAL ADVANCE WIRELESS DETECTION
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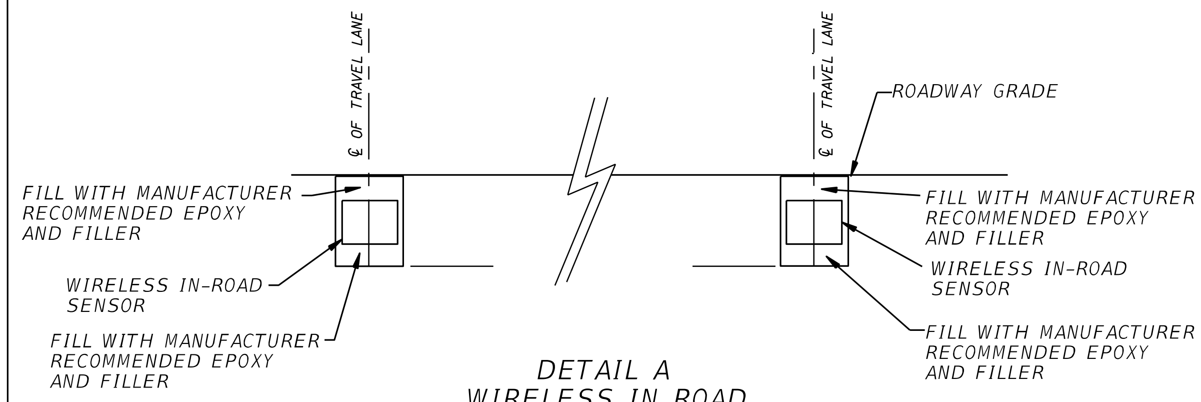
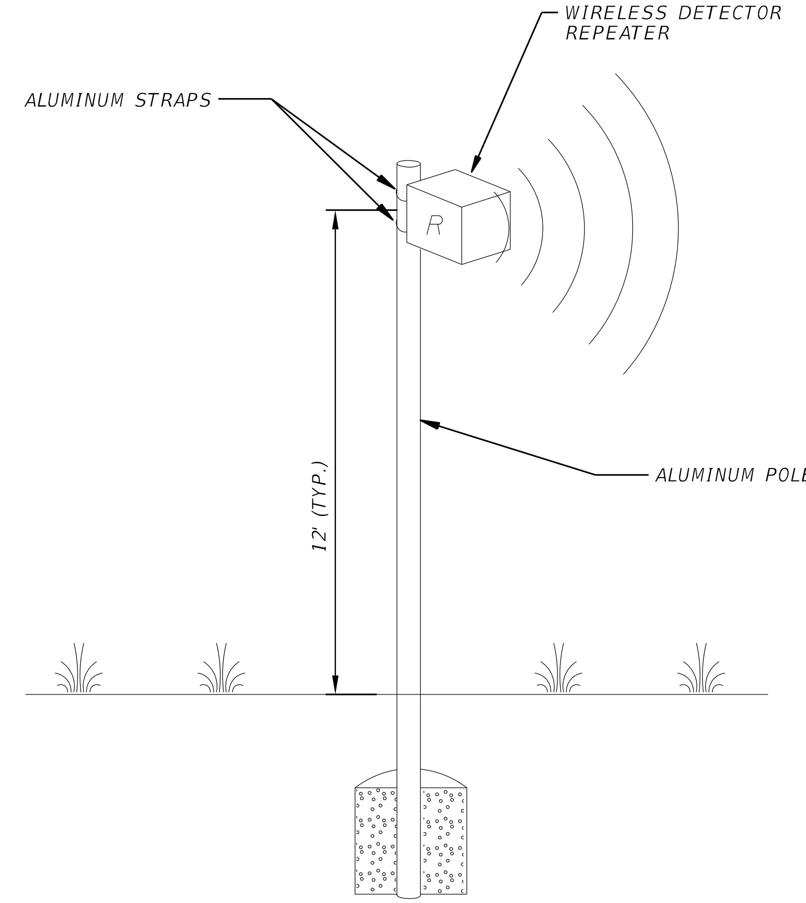


DETAIL A
WIRELESS IN ROAD
SENSOR DRILL/CORE DETAIL
N.T.S.



WIRELESS DETECTION REPEATER DETAIL
N.T.S.

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Drawing Title	FIGURE 8: TYPICAL WIRELESS MAGNETOMETER DETECTION INSTALLATION DETAIL	**Page**	55

Detector Selection for Intersection Control

Many elements must be considered in the selection of a type of detector for intersection control. Some of these are discussed below. More than one type of detector may need to be used for different applications with the Sumter County ATMS. A summary of the advantages and disadvantages for each technology used for intersection detection can be found in Table 12.

Table 12: Intersection Detection Technologies Summary

Technology	Advantages	Disadvantages
Inductive Loops	• High accuracy • Reliable • Not affected by adverse weather conditions (rain, fog, etc.)	• Involves cutting pavement for installation • Roadway resurfacing requires cutting of new loops • Lane closure required for installation and maintenance
Infrared Detectors	• Non-intrusive installation • Typically not affected by sharp contrast in sunlight to shade (under overpasses)	• Detector sensitivity may be affected by adverse weather conditions (rain, fog, etc.) • Concerns about reliability in high volume conditions • Doesn't have the ability to zoom
Microwave/ Radar Detectors	• Non-intrusive installation • Typically not affected by adverse weather conditions (rain, fog, etc.)	• When mounted in side-fire position, occlusion due to trucks and/or median barriers may occur
Video Detection	• Non-intrusive installation • Wide-area detection • Placement, addition, and relocation of detection zones are easily accomplished • Video can be streamed to TMC	• Detection performance may be affected by adverse weather conditions (rain, fog, etc.) • Accuracy of detection degrades as horizontal offset of camera increases • Accuracy of detection degrades due to camera movement
Wireless Magnetometers Detection	• Not affected by adverse weather conditions (rain, fog, etc.) • Less intrusive than loops	• Involves cutting pavement for installation • Lane closure required for installation and maintenance • Requires multiple detectors to create detection zone

Selection Based on Theory of Operation

Each type of detector is inherently unsuitable for certain applications because of inappropriate operating theory. For example, some ILD designs must be passed over for use in traffic signalization at intersections. An example is the design that terminates a continuous call from a queue moving over a long loop after only 15 minutes. ILD design differences are much more important in freeway surveillance and control, where the size of the field must be closely controlled and the times required for relay pick-up and drop-out need to be predictable.

Selection Based on Application

Application considerations further narrow the range of detectors in some instances. For example, the ILD is suitable in theory for large-area detection on an approach to a signalized intersection. The ILD is significantly less expensive than other detector types in most areas for this application. At an approach where it is not important to screen out false calls for the green (as with right-turn-on-red) and rudimentary traffic responsiveness is adequate, a small-area detector of any of the detector types would have an appropriate theory of operation, but a video or microwave detector might be chosen for its ruggedness and low cost over the years.

ILDs are becoming less common as the focus has switched to long-term maintainability, and the frequency of resurfacing projects has increased for many jurisdictions.

Selection Based on Ease of Installation

The easiest type of detection to install is difficult to determine. While video, infrared, and microwave detectors may not require closing lanes or cutting pavement, all these techniques require the installation of sophisticated electronic equipment either over or alongside the roadway.

Selection Based on Cost

Video detection claims to have lower life-cycle costs due to the longer life of their components. Contrasted to ILDs, where the loops may have to be replaced every five years or so, video detection claims a life of 10 years. Microwave, wireless magnetometer, and infrared make similar claims.

Costs

Capital Costs

A typical ILD installation at an intersection with four legs can cost approximately $6,800. A typical VID installation for a single approach at an intersection can cost approximately $4,500. A typical MVDS installation for a single approach at an intersection can cost approximately $8,000.

O&M Costs

Maintenance costs will vary depending on the type of detector chosen; ILDs will typically have a higher maintenance cost than the others due to the tendency for loops to deteriorate over time. Microwave and video detectors failures are relatively rare and should result in lower maintenance costs.

ADVANCED DETECTION

Since the volumes of movements at an intersection are usually not constant with time, often fluctuating from minute to minute, it is desirable to detect a movement by placing one or more detection devices along the vehicles' paths. This can be accomplished by installing advanced detection in conjunction with intersection detection.

Detectors used for advanced detection can also be used to acquire data for off-line analysis at some later date, for planning purposes or for evaluation of the effectiveness of control strategies being used. Information obtained from these detectors can be used to develop and refine signal time-of-day (TOD) plans, as well as traffic responsive or adaptive control plans. The precise detector locations for any selected adaptive corridors will need to be evaluated and adjusted based on the algorithms of the specific adaptive control system. Currently, Sumter County does not have any advanced detection deployed.

Technologies

Many devices have been used to detect vehicles. The following describes some of the devices that are in widespread use and should be considered for Sumter County.

Inductive Loop Detectors

As with intersection detection, ILDs can be used for advanced detection as well. Regardless of whether the ILDs are used for intersection detection or advanced detection, the same advantages and disadvantages apply.

Microwave/Radar Detectors

In addition to using MVDSs for detection for intersection control, they can be used to provide advanced detection. The MVDS provides vehicle detection, classification by length, speed, occupancy, data collection, and automatic incident detection, thus providing an additional means for understanding the traffic conditions throughout the County. This can also apply when using MVDSs for control section detection information.

MVDS installations can use wireless communications and solar power so that no conduit installation in the ground is required. This can be a very cost effective installation if the detector is a significant distance from the intersection.

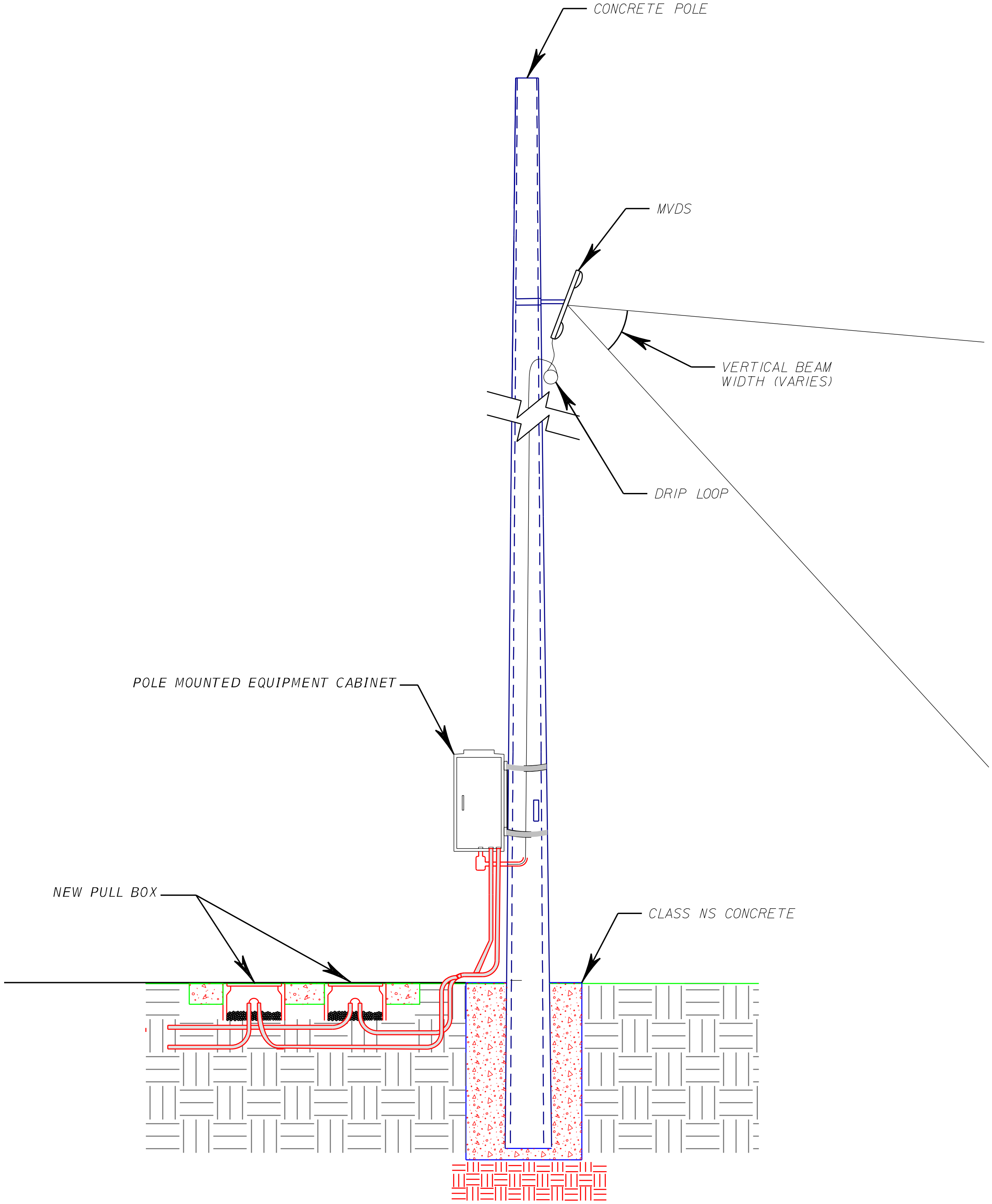
Just as with MVDS intersection detection, MVDSs for advanced detection do not disturb the pavement for installation, and it may not be necessary to close traffic lanes to install them.

A disadvantage is the limited flexibility of their installation requirements. A MVDS must be mounted at a specific height above the roadway which is correlated to the setback distance of the MVDS from the roadway. The farther the setback, the higher the MVDS will need to be mounted. This provides the MVDS with the proper angle for detecting the desired lanes. In constrained urban corridors, occlusion by trucks and/or median barriers can occur because the required mounting height of the MVDS isn't high enough due to the limited area for setback. Figure 9 shows a typical standalone MVDS installation detail.

Video Detection

Video detection can be used for advanced detection as well. The cameras used for advanced detection would be of the same type used with intersection detection, but instead of being aimed at the stop bar, the cameras would be aimed upstream. To accomplish this, the camera view to the point of detection must be clear of any obstructions such as trees, overhead signs, or other objects that may be located near or over the roadway. There are VID systems capable of providing both stop bar detection and advanced detection but these are usually associated with a traffic control systems such as INSYNC.

As with VID systems used for intersection detection, it is important that the VID system used for advanced detection be capable of automatically re-aligning the incoming video image in real-time for comparison to previous images. The effects of a swaying structure would be amplified when attempting to detect vehicles over 300 feet from the camera.



TYPICAL STANDALONE MVDS INSTALLATION DETAIL

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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 9: TYPICAL STANDALONE MVDS INSTALLATION DETAIL	**Date**	03/23/17

Title: V:\0116002 - Sumter County ATMS Phase 2\Project Working Files\Documents\Task II - Master Plan Document\Figures\Master Plan Figures\Figure 9 - Typical Mid-Block MVDS Installation Detail.DGN
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The VID system for advanced detection is configured the same way as for intersection detection, with a system operator using interactive graphics on a standard computer or laptop to configure the FOV and draw virtual detectors either remotely or on-site.

Wireless Magnetometer Detection

The wireless magnetometer detection systems can be configured to operate as a standalone advanced detection system or in conjunction with an intersection detection configuration. With either configuration, the system would consist of detectors, access points, and repeaters as stated previously. The installation process for the advanced detection configuration would be the same as the intersection detection configuration. For advanced detection, the detectors would be installed upstream of the intersection and use the repeaters as necessary to transmit the data from the detectors back to the access point.

Summary

Currently, Sumter County does not have any advanced detection deployed. The need to deploy advanced detection will depend on the type of traffic control system chosen for the County, particularly any adaptive or responsive control system. A summary of the advantages and disadvantages for each technology used for advanced detection can be found in Table 13. For a typical advanced detection installation, the microwave detectors provide the highest potential for reliability with the least installation cost.

Table 13: Advanced Detection Technologies Summary

Technology	Advantages	Disadvantages
Inductive Loops	• High accuracy • Reliable • Not affected by adverse weather conditions (rain, fog, etc.)	• Involves cutting pavement for installation • Roadway resurfacing requires cutting of new loops • Lane closure required for installation and maintenance
Microwave/ Radar Detectors	• Non-intrusive installation • Typically not affected by adverse weather conditions (rain, fog, etc.)	• When mounted in side-fire position, occlusion due to trucks and/or median barriers may occur

Technology	Advantages	Disadvantages
Video Detection	• Non-intrusive installation • Wide-area detection • Placement, addition, and relocation of detection zones are easily accomplished • Video can be streamed to TMC	• Detection performance may be affected by adverse weather conditions (rain, fog, etc.) • Accuracy of detection degrades as horizontal offset of camera increases • Accuracy of detection degrades due to camera movement
Wireless Magnetometers Detection	• Not affected by adverse weather conditions (rain, fog, etc.) • Less intrusive than loops	• Involves cutting pavement for installation • Lane closure required for installation and maintenance • Requires multiple detectors to create detection zone

Costs

Capital Costs

A typical ILD installation for advanced detection can cost approximately $2,000 per approach. A typical VID installation for advanced detection on a single approach of an intersection can cost approximately $4,500. A typical standalone MVDS installation with solar power can cost approximately $15,000, including a wireless link. A typical standalone MVDS installation with wired power costs approximately $20,000.

O&M Costs

Maintenance costs will vary depending on the type of detector chosen; ILDs will typically have a higher maintenance cost than the others due to the tendency for loops to deteriorate over time. Microwave and video detectors failures are relatively rare and should result in lower maintenance costs.

TRAVEL TIME SYSTEMS

In addition to using detection for intersection control, several jurisdictions are looking for detection to provide arterial travel time information. This information can be used for incident detection as well as measuring performance of the traffic control system. The measurement of performance is important because of the increasing FHWA requirements to provide reports for any system receiving Federal funding. To detect an incident, alarms are set to notify an operator that the travel times for a specific corridor have increased beyond a specified threshold. By detecting an incident, alternative timing plans can be implemented, resulting in the reduction of delay caused by the incident.

There are several technologies used for gathering travel time information, and they do this by identifying a specific vehicle at several locations along a corridor. For example, Lee County has implemented such a system on Colonial Boulevard using Automatic Vehicle Identification (AVI) devices. This system reads the toll transponders in vehicles and matches them at the different collection points to calculate a travel time.

Technologies

The following describes some of the devices that are in widespread use and should be considered for Sumter County.

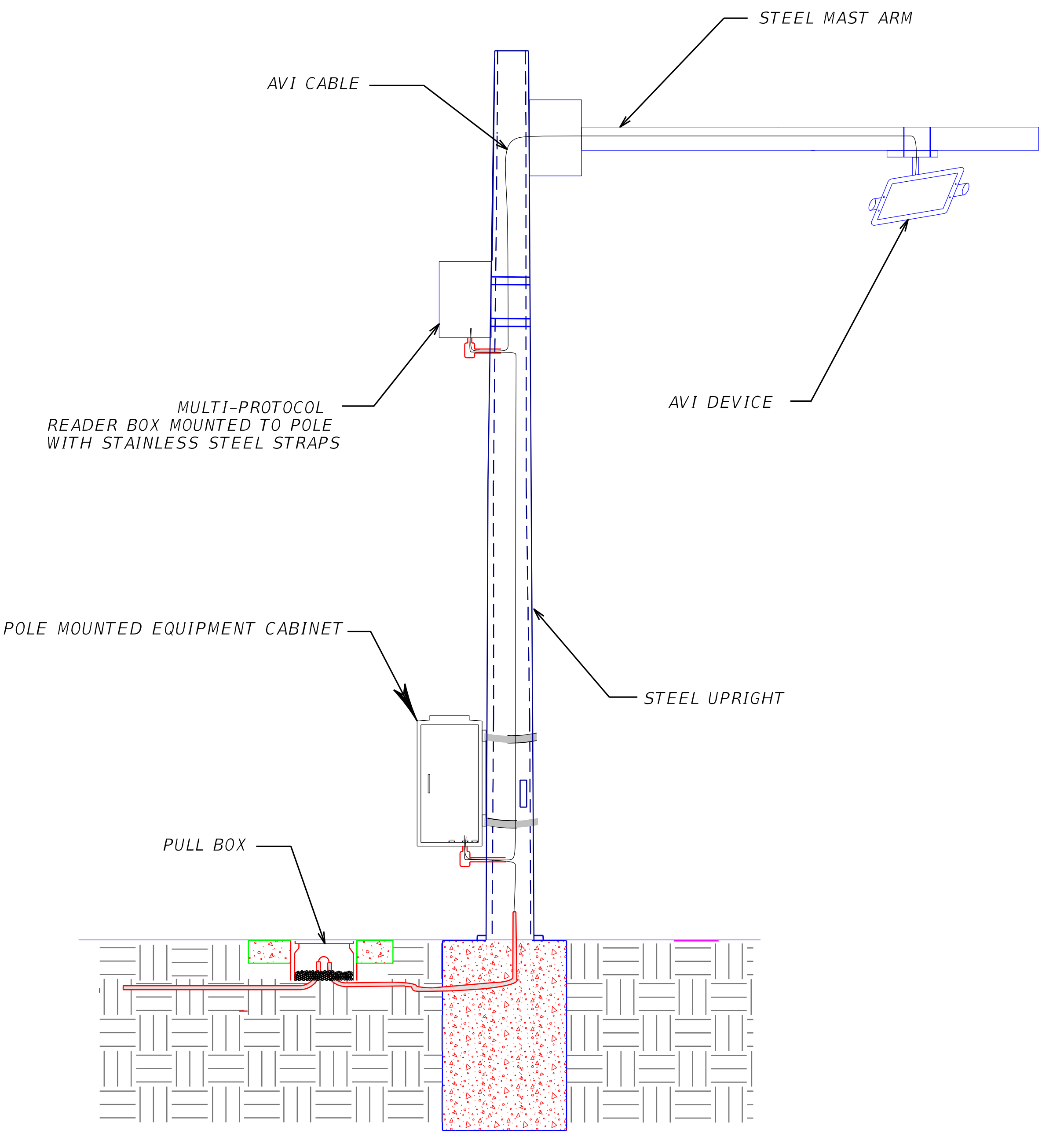
Automatic Vehicle Identification (AVI) Devices

The AVI devices operate using a radio frequency as outlined below:

- A roadside communication unit sends out a request from its antenna.
- When a vehicle equipped with an AVI device enters the antenna's coverage range, the transponder or tag responds to the roadside unit with the vehicle's identification.
- The information is retransmitted to a central control system for further processing and storage.

In order to calculate travel time using AVI, there needs to be roadside readers implemented at strategic locations along the corridor where travel times are to be identified. There would also need to be a significant number of vehicles that have AVI devices. This is possible in Lee County because toll transponders are used at bridge crossings. Advantages include their ability to provide the accurate determination of vehicle position as well as providing a calculated speed between two points and, hence, a travel time. The main disadvantages are the high cost of implementation and the limited range of the antenna.

AVI devices need to be deployed in each direction to accurately gather travel time information. AVI devices, while potentially useful in a side-fire configuration, lose accuracy unless they are placed over lanes. A typical site configuration for an AVI system is shown in Figure 10.



TYPICAL AVI INSTALLATION DETAIL
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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
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Title: V:\0116002 - Sumter County ATMS Phase 2\Project Working Files\Documents\Task II - Master Plan Document\Figures\Master Plan Figures\Figure 10 - Typical AVI Installation Detail.dgn
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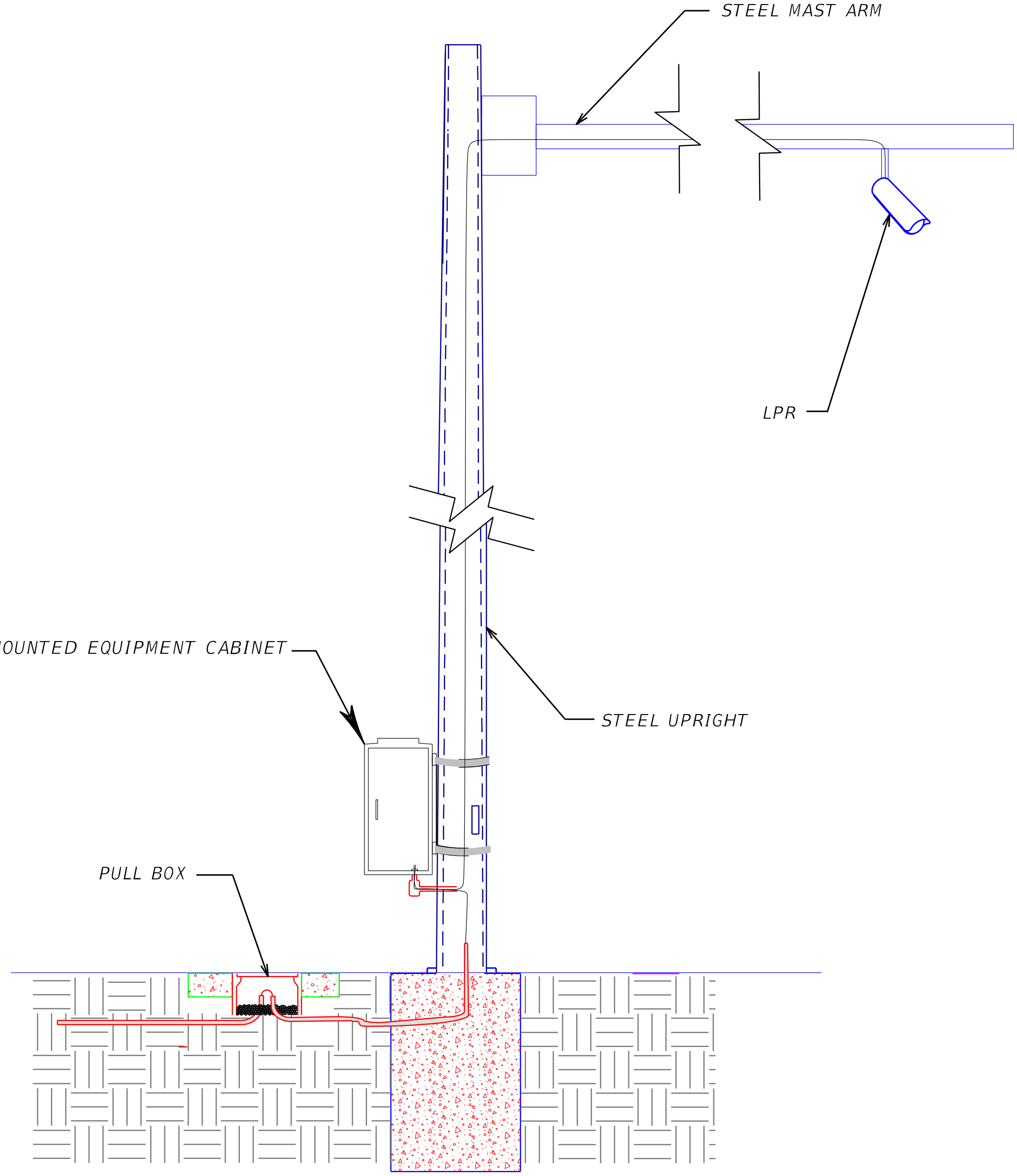
Date: 3/23/2017

License Plate Reader (LPR) System

LPR systems have been implemented on freeways throughout the State for quite some time now. The LPRs use high-quality video and computerized optical character recognition to read the license plate of a vehicle. The LPR system typically consists of a camera and a central processing unit (CPU) with a character recognition software. The camera is typically mounted over the roadway and oriented downstream to read the license plates on the rear of the vehicles. The CPU with the character recognition software is housed within the field cabinet at the LPR site. The data produced from the LPR system is collected and stored in the field cabinet, and the data consists of only partial portions of the license plates to alleviate any privacy concerns. Figure 11 shows the typical site configuration for a LPR system.

Just as with the AVI devices, in order to calculate travel time using LPRs, there needs to be roadside readers implemented at strategic locations along the corridor where travel times are to be determined. Advantages to the LPR system are similar to the AVI devices as they have the ability to provide the accurate determination of vehicle position as well as providing a calculated speed between two points and, hence, a travel time. The disadvantages of an LPR system include the high cost of implementation, and the accuracy of license plate recognition is affected by ambient conditions.



TYPICAL LPR INSTALLATION DETAIL
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Project Title	SUMTER COUNTY ATMS MASTER PLAN
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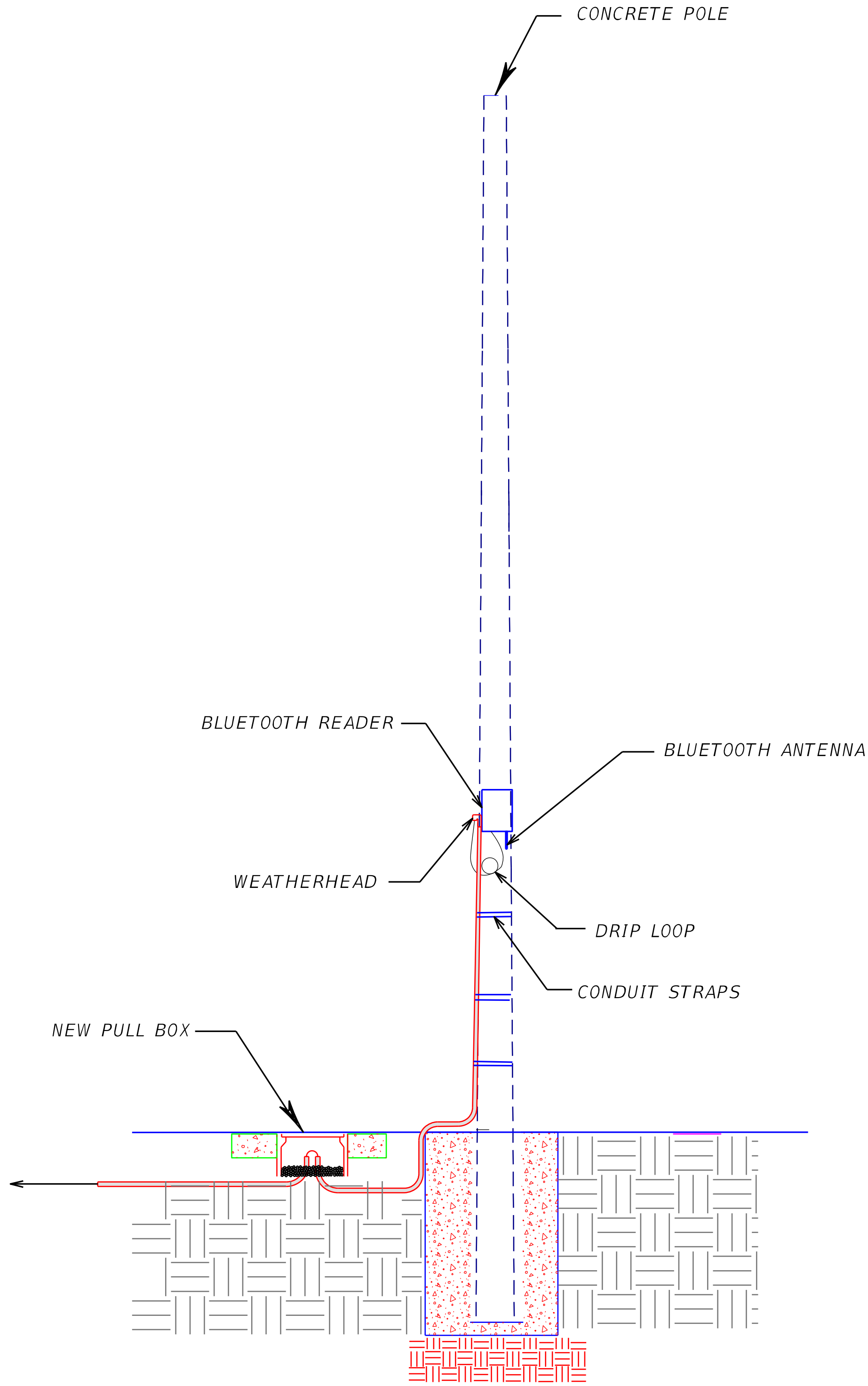
Drawing Title	FIGURE 11: TYPICAL LPR INSTALLATION DETAIL
Date	03/23/17

Bluetooth Readers

Bluetooth readers provide point-to-point travel time information reading vehicle transponders and matching them at the different collection points to calculate a travel time. Bluetooth devices, such as smartphones and many newer vehicles, have a unique MAC address which is transmitted short distances. In order to calculate travel time using Bluetooth, roadside Bluetooth readers are implemented at strategic locations along the corridor for which travel times are to be determined. The system works by having an initial Bluetooth reader pick up the MAC address and then a second Bluetooth reader farther along the corridor identify the same MAC address. This information is then processed to calculate the travel time. Bluetooth readers can communicate with their central software using either cellular or Ethernet configurations. The Bluetooth readers can be deployed anywhere along the corridor, but are often placed at existing signalized locations and connected to an Ethernet port on the Ethernet switch in the traffic signal cabinets for data transfer. Another option could be through independent cellular and solar powered locations, which are typically used for mid-block locations or remote intersections. The FDOT's Approved Products List (APL) currently has three types of Bluetooth readers/vendors; BlueTOAD, BlueMAC, and Iteris.

Since Bluetooth technology has become more widely deployed in recent years, the cost of implementation for field devices is relatively low for the amount of useful data they provide. A disadvantage is that the Bluetooth devices which are being read can be turned off by the owner, making them impossible to read. Another disadvantage is the range of the Bluetooth readers can be limited, leading to missed potential data points. These disadvantages contribute to the low sample size Bluetooth readers collect. Previously, Bluetooth readers were not able to detect Bluetooth devices which had active connections to other Bluetooth devices (i.e., cell phone connected to vehicle), but now they can. Because of this advancement in Bluetooth reader technology, the match percentage is now typically about 15 percent of total vehicles passing the Bluetooth reader. A typical site configuration for a Bluetooth reader is shown in Figure 12.



TYPICAL BLUETOOTH READER INSTALLATION DETAIL
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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 12: TYPICAL BLUETOOTH READER INSTALLATION DETAIL	**Date**	03/23/17

Summary

Many elements must be considered in the selection of a type of detector for collecting traffic condition information for travel times. A summary of the advantages and disadvantages for each technology used for travel time can be found in Table 14.

Table 14: Travel Time Technologies Summary

Technology	Advantages	Disadvantages
AVI Devices	• Provides accurate travel time	• Sample size dependent on the amount of detectable transponders (i.e., SunPass) traveling along corridor • Required to be mounted over travel lane due to limited range of antenna
LPRs	• Provides accurate travel time	• High cost • Required to be mounted over travel lane • Ambient conditions affect license plate recognition
Bluetooth Readers	• Low cost • Greater sample size compared to other types of travel time technologies • Doesn't need to be mounted over roadway • Easily relocated	• Bluetooth can only be detected if activated • Limited range of the antenna

Costs

Capital Costs

A typical AVI installation on an existing structure with an existing cabinet can cost approximately $25,000. A typical LPR installation on an existing structure with an existing cabinet can cost approximately $30,000. AVIs and LPRs are typically installed with DMSs or other sites with existing structures and cabinets to minimize cost, and should use available communications to relay information to the TMC. A typical Bluetooth reader installation at a signal cabinet can cost approximately $5,500, and should use available communications to relay information to the TMC. The installation of a Bluetooth reader is typically at a signal cabinet to minimize cost. Adding solar power for a stand-alone Bluetooth reader is estimated to cost approximately $1,000 in addition.

O&M Costs

Bluetooth reader failures are comparatively rare and should result in lower maintenance costs than an AVI or LPR. The O&M costs for Bluetooth readers can cost approximately $1,000 annually. This cost includes cellular data, data processing, and displaying of travel times to a website for viewing of real-time or historical data.

SECTION 6

TRAFFIC CONTROL OPTIONS

6. TRAFFIC CONTROL OPTIONS

This section identifies and examines several traffic control options that could be included in the Sumter County ATMS. These options can often enhance a system's operations, but are not essential to its operation. Each traffic control option can, however, have an impact upon the software, hardware, and operational requirements of the system.

TRAFFIC SIGNAL CONTROL OVERVIEW

The primary purpose of a traffic control system is to implement signal timing patterns. Each pattern is a set of cycle lengths, offsets, and splits that apply to every signal in a control section. A control section is a group of adjacent intersections that share common operational characteristics. Every signal must generally have the same cycle length as every other signal in the same control section in order to provide progression. In exceptional cases, a particular signal may have half or a third the control section cycle length. This operation is called double or triple cycling, respectively. Each signal operates at a particular offset, which is the time delay from the control section zero reference point to the beginning of that signal's main street green phase or interval. Each signal is assigned a set of splits, which represent the percentage of the control section cycle length that will be spent in each phase. Signals may have from two to eight phases, and each phase will have a split assignment. For actuated controllers, the actual time spent in a phase may be controlled by real-time vehicle demand, subject to a maximum time set by the phase split.

Cycle length is the parameter that has traditionally received the most attention in specifying signal systems. In general, it has been found that urban roadway capacity is limited by signalized intersection capacity, and that varying the cycle length with a given volume results in different levels of usable intersection capacity.

Signal timing patterns also need to consider offset and split as well as cycle length. Offsets are set according to the desired or demand flow of traffic. There are typically three basic classifications of offset determination: inbound toward an urbanized area, outbound away from an urbanized area, and balanced. Depending on the system's timing pattern capacity, there can be several plans associated within each of these designations. Split times are determined based upon the capacities and volumes of the intersection approaches.

One of the most important factors related to the successful implementation of a signal system is its ability to respond to fluctuations, recurring or non-recurring, in traffic volumes. Signal system timing patterns are typically initiated either on a TOD basis using a pre-determined schedule of pattern changes or on a traffic responsive basis using real-time data to monitor the fluctuations in traffic volumes. The timing changes can also be made manually by an operator observing the flow of traffic. In all cases, the signal timing patterns are developed from historical data. In Sumter County, the signal system should be designed for weekly and seasonal traffic volumes, and fluctuations within each of these.

Manual, TOD, and traffic responsive pattern implementation are all methods that attempt to achieve the objective of selecting the stored signal timing patterns that match the traffic patterns as they occur. All three of these forms of operation/pattern implementation are available with today's traffic control systems. TOD pattern selection is dependent on the ability to predict the required pattern and exactly when it should be implemented. To accommodate fluctuations in traffic, it is necessary to transition into peak period patterns ahead of the actual need. The inverse can often hold true for determining when to leave peak patterns. Traffic responsive operation, which often makes transitions smoother, requires that thresholds be developed for differing volume and occupancy conditions that in turn implement the appropriate pattern. Traffic responsive operation, however, requires sensors or detectors within each control section, along with communication links from the sensors to a central computer.

Adaptive Traffic Control Systems (ATCSs) provide for an even higher level of adaptability than does traffic responsive operation. Rather than selecting from a set of predetermined timing plans, ATCSs make frequent, small changes to timing plans while attempting to optimize traffic flows. These changes are based upon volume, occupancy, and speed data obtained from some sort of detectors. The biggest advantage of ATCSs is the ability to constantly upgrade timing patterns to meet the current needs of changing traffic conditions. The biggest disadvantage of this type of system is that it can require every movement of every intersection approach to be detectorized in some manner, such as inductive loop, microwave, or video detection. This results in additional detectors that must be regularly maintained.

Discussions with Sumter County were used to develop and evaluate potential system functional elements, which included:

- Traffic Signal Control Options
    - Multiple Timing Plans
    - Traffic Responsive Control
    - Traffic Adaptive Control
- Coordination Between Control Sections
- Pre-emption

Traffic Signal Control Options

Multiple Timing Plans

Alternative central control software that could be implemented offer varying capabilities related to the number of timing plans they are capable of implementing. However, all types of systems offer a significant number of timing plans.

The number of weekday and weekend plans used can account for the seasonal fluctuation in traffic. Special weekday and weekend holiday plans would also be beneficial to accommodate the increased traffic traveling to and from the Villages.

In addition, plans are necessary for special events, inclement weather, and incident management. The more timing patterns that are available for implementation, the more responsive a system can be in meeting fluctuating traffic patterns, especially a real-time control system. For the instances when I-75 or the Turnpike is closed and traffic is diverted to surface streets, Sumter County could implement special signal timing plans along a predetermined route to help mitigate the expected delays. The special timing plans would be implemented after notification of I-75 or the Turnpike being closed and verification with a CCTV camera.

Traffic Responsive Control

For traffic responsive operation, signal system timing is developed from historical data. Therefore, the effectiveness of the system operation is largely dependent upon past history and how well the timing patterns have been developed.

The use of traffic responsive control requires vehicle detection input from field devices to determine the required timing patterns. If traffic is predictable from one day to the next, it may not be necessary or cost-effective to develop traffic responsive operation to control the implementation of timing patterns.

Traffic responsive operation can be either signature matching or threshold timing pattern selection. Signature matching is a technique whereby measured data (volume plus occupancy) are compared to stored data to select the timing pattern associated with the closest match. Threshold selections consist of the selection of a cycle length, split, and offset based upon measured data greater than or less than threshold designations. In either case, traffic responsive control, like TOD control, is an attempt to select the stored signal timing pattern that best matches the traffic patterns.

There are different methods for implementing traffic responsive operation. One method is for traffic responsive to operate on a 24-hour basis. Another method is to allow traffic responsive operation to take effect only during certain parts of the day.

The beginning of a weekday AM peak period is predictable and somewhat constant. People are scheduled to arrive at work at a certain time every day. The beginning of the PM peak period is also predictable. Although there is more flexibility in schedule regarding when a person leaves work, there is a defined peak. The end of either peak period is not as predictable as the beginning. People may run errands on their way home from work, thus extending the duration of the peak period. Additionally, incidents can extend the duration of either of the peak periods.

As a result of these travel characteristics, the start of a peak period can be readily defined from historical data, and the conclusion of a peak period is not as predictable and thus cannot be readily defined from historical data. Therefore, knowing when to transition into a peak period timing pattern is easier to determine than is transitioning out of the pattern.

It has been observed from past experience that traffic responsive operation is well suited for use during off-peak time periods and as an aid in transitioning from peak period to off-peak period timing patterns. Traffic responsive operation for transitioning from an off-peak to a peak period signal timing pattern can prove to be disadvantageous. As traffic volumes increase from the off-peak to the peak period, it is critical to have the peak period signal timing pattern in effect so that the increasing volumes can be accommodated and no disruption occurs. The lack of coordination and disruption to traffic flow associated during the transitioning between timing patterns and periods, which can take several cycles, can prove to be non-recoverable when it occurs during a peak period.

Traffic responsive operation analyzes detector data for a user set period of time (i.e., 15 minutes) which are smoothed with respect to previously collected data to arrive at a threshold. Smoothing consists of weighting the new data collected against the data collected during the previous period. This helps to control sudden shifts or fluctuations by smoothing the information. As a result, traffic responsive operation selects and implements signal timing patterns for volumes that are somewhat historic. In the case of transitioning from off-peak to peak periods, traffic responsive operation is selecting a timing pattern based upon volumes that are less than what would actually be occurring when the pattern is implemented because the volumes are continuing to increase. During this scenario, traffic responsive operation is always playing catch-up and the timing pattern implemented may not accommodate the new volumes. The inability to accommodate the volumes initially may result in a non-recoverable situation for the entire peak period.

Traffic responsive operation utilized to transition from the peak period to the off-peak period and during off-peak to off-peak transitions can assist in matching the appropriate timing pattern with the traffic variations that can occur. If the peak period extends longer than normally anticipated, traffic responsive operation can continue implementing the peak period timing pattern while a TOD selection would have implemented the off-peak pattern. The same holds true if the peak volume period is shorter than normal. Then, traffic responsive operation would be able to implement the off-peak pattern sooner than would TOD selection. As a result, traffic responsive operation can respond quicker than pre-programmed TOD selection, resulting in a more efficient operation in the field.

The County operates most of their existing signals in a TOD/day-of-week (DOW) mode. It is recommended that the new system be designed not only to handle daily fluctuations in traffic volumes, but also weekly and seasonal fluctuations. Based on the seasonal and transient population impacts on the traffic flow characteristics, it is recommended that the selected system also have the capability of providing traffic responsive control.

The majority of today's central control software offer traffic responsive operation as a standard system feature. To make this feature work in Sumter County, however, will require improvements and additions to the current detection in the field. Traffic responsive operation may not be appropriate for implementation on a system-wide basis. For example, traffic within a certain corridor may be predictable from one day to the next, so it would not be beneficial to implement traffic responsive operation. However, along some major arterials within the County, such as the US 301 corridor in Wildwood, the US 301 corridor in Bushnell, and the CR 48 corridor in Bushnell, traffic is less predictable and they are candidates for traffic responsive operation. An assessment should be made on a control section basis regarding the implementation of traffic responsive operation.

Adaptive Traffic Control Systems

Some traffic control systems offer traffic adaptive control as an overlay to the central system. ATCSs on the market today can perform traffic control on an adaptive basis, and some can switch to TOD operations at certain times. As with traffic responsive operation, traffic adaptive control is generally not suitable (or cost-effective) for implementation on a system-wide basis. ATCSs provide the largest benefit in locations where traffic fluctuations do not follow predictable patterns. As described in FHWA's *Signal Timing Manual,* ATCS is most suitable for locations at which:

- Traffic conditions fluctuate randomly on a day-to-day basis

- Traffic conditions change rapidly due to new or changing developments in land use
- Incidents, crashes, or other events result in unexpected changes to traffic demand
- Other disruptive events, such as pre-emption, require a response

There have been several studies performed on adaptive control systems. One of the studies is the *NCHRP Synthesis 403 – Adaptive Traffic Control Systems: Domestic and Foreign State of Practice*. Much of the information presented here is summarized from that report.

The available ATCSs have various strengths and weaknesses. Some are known to operate best on arterial networks whereas others are known for their adaptive operations in grid networks. Each ATCS control methodology is unique to some extent, making it difficult to perform a direct comparison of the specific features of the ATCSs.

There are several functions that are common components of ATCSs, including:

- Detection – Each ATCS uses some form of system detection to determine the current traffic flow. The data developed allows the system to use its algorithms to adjust the traffic controllers.
- Type of action – An ATCS with upstream detectors can usually respond proactively to the demand, while stop line detector systems are more reactive. Some systems combine both approaches. Most systems use some form of real-time modeling to determine the best plans.
- Adjustment method – Each ATCS uses an optimization method based on heuristic techniques or some form of pattern matching.
- Timeframe for adjustment – Adjustment timeframes range from every few seconds to every 10 to 15 minutes. Studies can be found supporting both approaches.
- Levels of control – Many ATCSs use various levels of control, allowing the local controller some level of decision-making while supporting the overall system plan.
- Adjustments to signal timings – Most ATCSs adjust the three major elements of signal timing, which are splits, cycles, and offsets. Some do partial adjustment.

This list is not all-inclusive, but covers the most important items.

Table 15 compares some of the components found in ATCSs which have been marketed in the United States. The detection types are Stop Line (SL), Near Stop Line (NSL), Midblock (MB), and Upstream (US).

Table 15: Comparison Summary of Adaptive Technologies

	ACS Lite by Siemens	**INSYNC by Rhythm Engineering**	**OPAC by USDOT**	**RHODES by University of Arizona**	**SCATS by Roads and Traffic Authority**	**SCOOT by The Transport and Road Research Laboratory**
Detection	SL/MB /US	NSL	MB/SL	MB/SL	SL/NSL /MB	US/SL
Action	Proactive & Reactive	Proactive & Reactive	Proactive	Proactive	Reactive	Proactive & Reactive
Adjustment Time Frame	5-10 Minutes	Phase/Cycle	Phase/Cycle	1 Second	Cycle	Cycle

Coordination Between Control Sections

Signal systems are typically divided into groups of signals called control sections. Boundaries between control sections are determined by the distance between signalized intersections, variances in speed, volumes, cycle length requirements, physical barriers such as railroads and bridges, and differences in land use.

It is often desirable and consistent with travel patterns to link adjacent control sections to provide continuous flow along arterials (cross-town circulation) during peak periods, and then separate them during off-peak periods to allow for better interior circulation. Additionally, traffic flow patterns may warrant linking a particular intersection to different control sections by TOD. All modern central control software offer the ability to link control sections, although some may require additional hardware or software that is specified at the time of purchase. The linking of control sections is accomplished by utilizing a common cycle length and the TOD schedule to establish an offset relationship between the adjacent intersections operating in different control sections.

To perform coordination between control sections with a central traffic control system, the controller databases in two or more adjacent control sections are configured to select a mutually compatible pattern by TOD command. With this approach, however, the linking may not be completely coordinated. This may be due to the fact that the controllers are operating from different power sources. Because of this, the controllers' time reference can vary and the variance increases with time based upon when the last time clock synchronization occurred. This time variance is referred to as drifting.

Drifting between the local controller clocks can be controlled by synching the clocks on a regular basis. Central traffic control systems have the ability to synchronize all intersections to the same clock. It is recommended that the synchronization commands be transmitted when control section linking is scheduled, so that the section timing patterns are operating from the same zero reference point. Another option is to use GPS clocks for a master time reference at each intersection.

The US 27/441 corridor is a popular business and trucking corridor consisting of signals within neighboring Lake County and Marion County. Due to the location of the signals relative to each other, coordination of the signal timings is necessary to provide progression through the corridor. The unique challenge for accomplishing this is the signals will be included in three different control sections because the signals are located within three counties. As mentioned in the Coordination of Systems section, this would be accomplished by having the control sections constantly time synched with the central control software.

An alternative approach would be to transfer the operations of all the signals along the US 27/441 corridor to either Sumter County, Lake County, or Marion County. Transferring the operations of the signals would help alleviate the complications of coordinating a corridor across three counties.

PRE-EMPTION

Pre-emption control is used to assist emergency and other designated vehicles in passing through signalized intersections by giving them a green signal indication as they approach. The County does not currently have any emergency vehicle pre-emption control and does not anticipate adding emergency vehicle pre-emption in the future.

Sumter County has railroad pre-emption installed at several intersections within the County. Table 16 shows the intersections in the County where this exists.

Table 16: Existing Pre-emption Locations

ID	**Main Street**	**Cross Street**
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)
7	Main St (CR 48/CR 475)	Belt Ave (CR 48)
22	Main St (US 301)	W Noble Ave (US 301)

It is recommended that the selected Sumter County ATMS be capable of identifying that the intersection is off-line by pre-emption in order to prevent the system from initiating a failed controller message and attempting to pick up the intersection. Today's controllers are equipped with local pre-emption and with the ability to send a message back to the monitoring system.

SECTION 7

CONTROL SECTIONS

7. CONTROL SECTIONS

RECOMMENDED CONTROL SECTIONS

All existing and future signals were examined for possible placement into control sections for coordinated operation. These control sections will be areas of common timing plans when the ATMS is installed. Information used to develop these recommendations consisted of link distances and the existing and proposed roadway network. The recommendations were also based on the assumption that these signals would either now or at some point in the future be incorporated into the system. The control section boundaries can be found in Figure 13.

The following is a list of recommended control sections:

- The signals on Buena Vista Boulevard at Saddlebrook Lane/Southern Trace and CR 466, then extend west along CR 466 to include Southern Trace/Tall Trees Lane, CR 101, Tatonka Terrace, CR 103/Old School Road, CR 105, and US 301. The intersection of CR 103 and Wedgewood Lane should be included as well.
- The signals on Morse Boulevard at San Marino Drive and Rio Grande Avenue.
- The signals on US 27/441 at Morse Boulevard, Bella Cruz Drive, Buenos Aires Boulevard/NE 136th Avenue, and CR 109/NE 138th Avenue, and extend southwest on Buenos Aires Boulevard to include the signal on El Camino Real.
- The signals on CR 466A at Farner Place, Heald Way/Sembler Way, and Morse Boulevard.
- The signals on CR 466A at Buena Vista Boulevard, Pinellas Place, and CR 462/Powell Road. This control section should also include the future signals on CR 466A at the planned Trailwinds Village.
- The signals on US 301 at CR 466A, CR 44A, SR 44, and west on SR 44 to include Industrial Drive.
- The signals on SR 44 at Buena Vista Boulevard, Powell Road, and north on Powell Road to include the signal at CR 44A.
- The I-75 Northbound and I-75 Southbound off-ramp signals on SR 44.
- The two future Florida Turnpike on-ramp and off-ramp signals on CR 468.
- The signals on US 301 at SR 470 E and SR 470 W.
- The I-75 Northbound and I-75 Southbound off-ramp signals on CR 48.

- The signals on US 301 at CR 476, Noble Avenue, continue north on Main Street to include the signal at CR 48 and extend west on CR 48 to include the signals at N West Street, the future signal at Tractor Supply Company, Lowery Street, and the I-75 Southbound off-ramp signal.

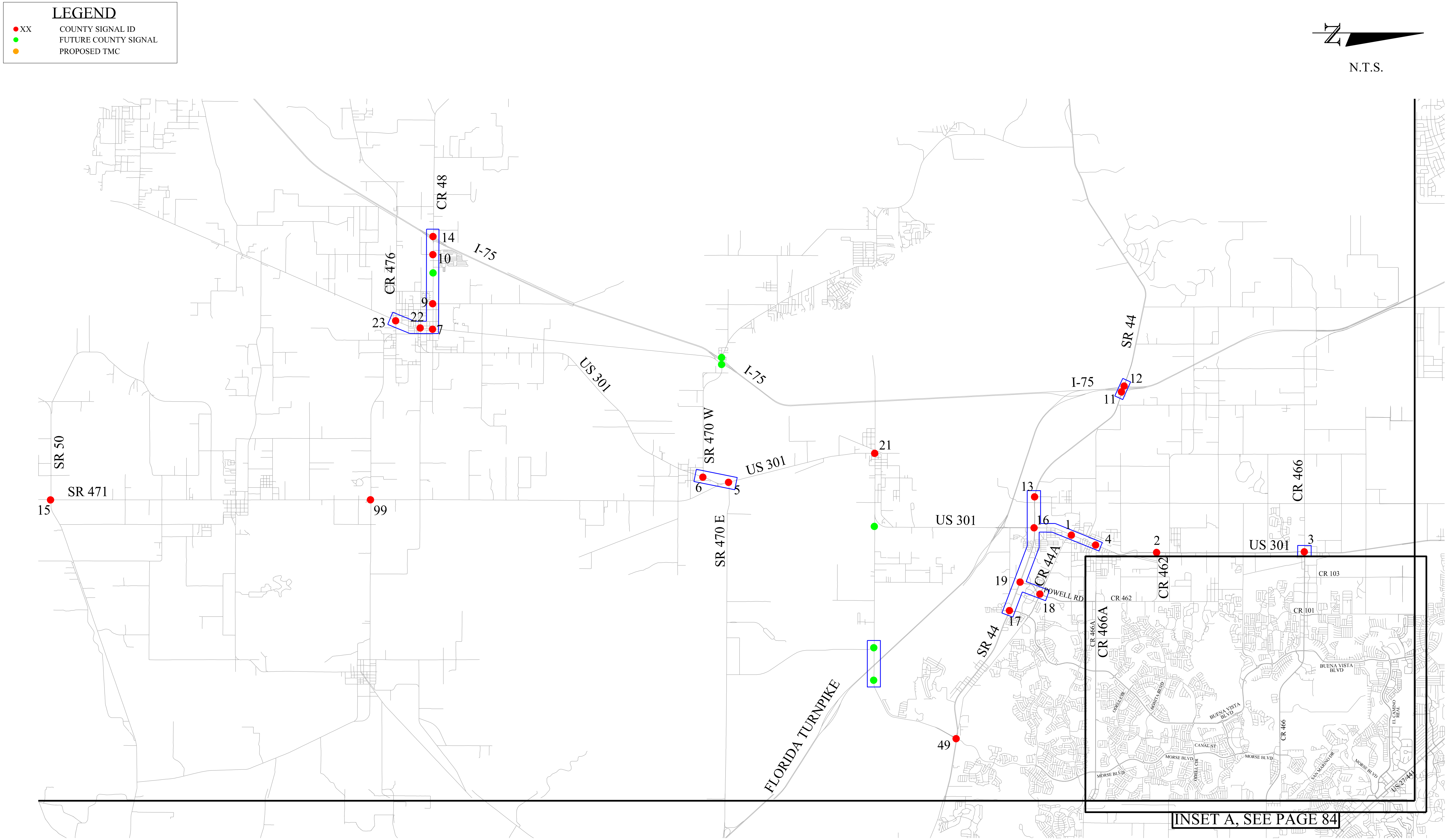
COORDINATION OF SYSTEMS

As the Sumter County ATMS is developed, coordination with neighboring traffic management systems and FDOT District Five is important for facilitating the flow of traffic. Research into the systems currently in operation by other agencies in the region was performed to determine the best method of system coordination. The other agencies in the region that were researched include Marion County, Lake County, FDOT District Five, and the Florida's Turnpike.

Marion County

Marion County has an ATMS with a TMC located in Ocala. The central control software currently in operation for Marion County's ATMS is TACTICS by Siemens. As of July 21, 2016, Marion County had a total of 49 intersections connected to the ATMS. Coordination with Marion County will be important along the US 27/441 corridor, where there are six intersections in close proximity. Four of these intersections are in Sumter County and two are in Marion County.

The recommended coordination of systems between Sumter County and Marion County is to coordinate signal timings along the US 27/441 corridor. This allows Sumter County the freedom of selecting the central control software they feel best satisfies their requirements while still providing benefits to the motorists along the corridor. Marion County plans to have the signals along the US 27/441 corridor connected to their ATMS by the end of 2017. Because the signals along the corridor will be connected to their maintainers' respective central control software, the coordination clocks will constantly be time synced to prevent time drifting.



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Drawing Title	FIGURE 13: PROPOSED CONTROL SECTION LAYOUT (PAGE 1 OF 2)

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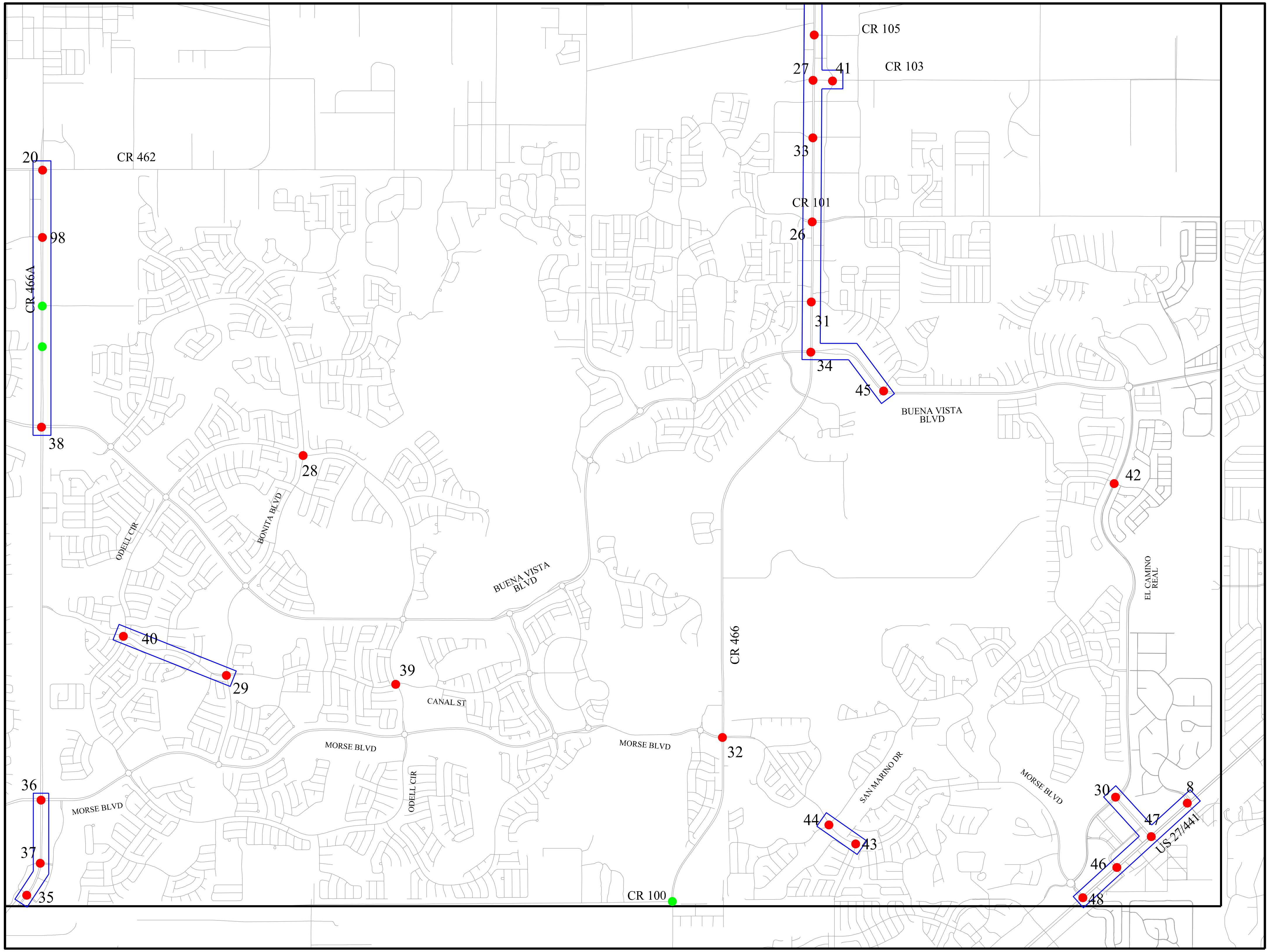
LEGEND

- XX — COUNTY SIGNAL ID
- FUTURE COUNTY SIGNAL
- PROPOSED TMC

INSET A

N.T.S.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 13: PROPOSED CONTROL SECTION LAYOUT (PAGE 2 OF 2)

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As a part of connecting the signals along the US 27/441 corridor, Marion County intends to implement ACS Lite along the US 27/441 corridor from SE 132nd Street Road to SE 178th Place. Because ACS Lite alters the offsets along the corridor, the coordination between the last signal running ACS Lite and the next signal could become out of sync. It is recommended that once ACS Lite is implemented, coordination along this section should be reassessed.

Lake County

Lake County recently procured a consultant to assist in the development of their Transportation System Management and Operations (TSM&O) Master Plan. It is anticipated that the Lake County TSM&O Master Plan will be completed by December 2017. Coordination with Lake County will be important along the US 27/441 corridor where there are ten intersections in close proximity. Four of these intersections are in Sumter County and six are in Lake County. Coordination will also be important along the CR 466A corridor where there are five intersections in close proximity. Three of these intersections are in Sumter County and two are in Lake County.

The recommended coordination of systems between Sumter County and Lake County is to coordinate signal timings along both the US 27/441 corridor and the CR 466A corridor. This allows both Sumter County and Lake County the freedom of selecting the central control software they feel best satisfies their requirements while still providing benefits to the motorists along these corridors. Because the signals along these corridors will be connected to their maintainers' respective central control software, the coordination clocks will constantly be time synced to prevent time drifting.

FDOT District Five

FDOT District Five has an established Freeway Management System (FMS) along its interstates, as well as on some arterials in advance of interchanges on the interstates. Currently, an expansion of the FDOT District Five FMS is under construction on I-75 throughout Sumter County. The expansion of the FMS along I-75 includes the installation of CCTV cameras, MVDSs, DMSs, and fiber optic cable for communications.

Coordination of the Sumter County ATMS and the FDOT District Five FMS is recommended to allow sharing of CCTV camera video at the I-75 interchanges within Sumter County. By sharing the CCTV camera footage, each agency will be able to expand its traffic monitoring capabilities, allowing the respective agency to better react to a given situation. Another recommended coordination of systems is the sharing of County maintained ADMSs in advance of the I-75 interchanges. By sharing the County maintained ADMSs, the motorists can be alerted of traffic conditions on I-75. Any sharing of system capabilities with the FDOT will require a Memorandum of Agreement (MOA).

Florida's Turnpike

The Florida's Turnpike has an established FMS along the Turnpike, as well as on some arterials in advance of interchanges on the Turnpike. The existing FMS along the Turnpike in Sumter County consists of CCTV cameras, MVDSs, DMSs, AVI readers for travel time, and fiber optic cable for communications.

Sumter County's ATMS and the Florida's Turnpike FMS should be coordinated to allow sharing of CCTV camera video at the Turnpike interchanges within Sumter County. By sharing CCTV camera video, each agency will be able to expand its traffic monitoring capabilities, allowing the respective agency to better react to a given situation. Messages on County maintained ADMSs in advance of the Turnpike interchanges should also be shared with the Turnpike so County motorists can be alerted of traffic conditions on the Turnpike.

SECTION 8

TRAFFIC MONITORING SYSTEM

8. TRAFFIC MONITORING SYSTEM

Video could play an important role in the operation of the Sumter County ATMS by providing the capability to monitor traffic, verify incidents, and verify operation of field components. CCTV cameras can provide the ability to see traffic situations from the computer monitor of the designated County employee(s) on a real-time basis, providing invaluable assistance in verifying the existence of traffic crashes and/or incidents. CCTV cameras can monitor traffic flows along a corridor, enabling the designated County employee(s) to select timing plans or adjust signal timings based upon the observed traffic flow patterns. An additional use of CCTV cameras, often overlooked, is the capability of verifying the operation of system components, such as traffic signals, without the time and expense of sending a technician out to the field to perform this function.

The typical viewing range for CCTV cameras is approximately one to two miles, depending on visibility, mounting height, image quality, zoom power, and obstructions. The video images from the CCTV camera can be viewed through several means, such as a system workstation, a video monitor, or a video wall display. Once displayed, the CCTV camera images can be manipulated through panning, tilting, and/or zooming to the desired location in order to verify traffic incidents or view the operation of system components such as traffic signals. Although some applications may call for "fixed" CCTV cameras, most CCTV cameras utilized for active traffic monitoring are Pan-Tilt-Zoom (PTZ) CCTV cameras. The PTZ feature of a CCTV camera allows the video image to be positioned and focused on the area of interest. The CCTV cameras may also be programmed to provide CCTV camera "tours", which contain automatic movement around preset positions.

At each CCTV camera site, the following is required: a CCTV camera mounting pole or other existing support structure, such as a traffic signal support; a camera/zoom lens in an appropriate housing; a communications system with a receiver to receive control data from the TMC and a transmitter to send video images from CCTV cameras; and a cabinet to house the communications and power supply components. In addition to those items, lightning and surge protection is typically provided to protect the sensitive electronics.

The security industry is the driving factor behind changes in CCTV camera technology. New technologies in CCTV cameras have reduced the size and amount of equipment required at an individual CCTV camera site. CCTV cameras are now of such size and weight (typically less than one foot in diameter for the dome and less than 15 pounds in weight) that they may be mounted on existing signal and lighting poles, and even on mast arms.

The newest CCTV cameras now include integrated video encoding into an Internet Protocol (IP) data stream, utilizing Moving Picture Experts Group (MPEG)-4, Motion Joint Photographic Experts Group (MJPEG), or H.264 formats. This feature reduces the amount of equipment needed in field cabinets, reducing costs, and allows for higher digital resolutions. The availability and use of high definition (HD) CCTV cameras with the ability to capture video in either 720p or 1080p resolutions are now widespread. This enhanced image quality can provide the public with a more detailed picture if the images are distributed to the public through a website or application.

TECHNOLOGIES

This section defines various characteristics of CCTV cameras that could be included in the Sumter County ATMS. The basis for the selection of the CCTV cameras will be a set of user and functional requirements.

Imagers

Earlier traffic monitoring CCTV cameras utilized analog cameras, which employ a solid-state chip rather than a tube to pick up the video image. The most common imaging chips used to be Charged Coupled Device (CCD) sensors and Complementary Metal Oxide Semiconductor (CMOS). In the past, CCD chips were preferred for their superior images with less noise and distortion. However, advancements in technology have produced CMOS chips that consume less power and process data at faster speeds with image quality matching the CCD chips. They have become the preferred choice among manufacturers for current product lines. The sizes of the imaging sensors, which started out at one inch, are getting smaller, allowing camera sizes to become smaller, faster, and less costly. The typical size is now a 1/4-to-1/3 inch.

Resolution

Resolution is the dimension of pixels produced by the camera. This value is expressed as number of pixels wide by number of pixels high. Some manufacturers express the resolution using only the height of pixels (1080p, 720p, etc.). Standard definition (SD) cameras have a resolution of 640 by 480, and HD cameras have a resolution of 1280 by 720 or 1920 by 1080. HD cameras have recently become mainstream and are in widespread use for traffic monitoring systems due to decreased cost and superior images and benefits.

Sensitivity

Sensitivity is the degree of response to light and is typically measured in Lux (lx). Lx is the International System of Units (SI) unit of illumination and equal to one lumen per square meter. Some technical data sheets list sensitivity as Maximum Sensitivity or Minimum Illumination. Direct comparisons are difficult between CCTV camera manufacturers as some manufacturers provide performance values based on an open shutter, with Automatic Gain Control (AGC) off or on, with Infrared (IR) Filter on or off, with different shutter speeds, etc. As a result, making a direct comparison of sensitivity among manufacturers may not be possible. The important thing to note is the more sensitivity under the given parameter, the better for low-light conditions.

Color/Black and White Technology

In the past, the use of color versus black and white cameras was an important consideration. Black and white cameras typically have better low-light performance than color cameras, making them better in locations where there is a lack of roadway lighting. In daytime conditions, color cameras perform as well as black and white cameras. Color cameras provide important information for traffic and incident monitoring, such as vehicle color, needed to describe and identify incidents. Color cameras are also easier to view and discern images, as the images are more natural than black and white. Today, dual-mode cameras are available from most vendors. These cameras operate in color during daylight hours and automatically switch to black and white during low-light conditions.

Thermal Imaging

In addition to black and white imaging for low light conditions, the FDOT now has thermal imaging CCTV cameras on the APL. Thermal imaging CCTV cameras make it possible to observe traffic clearly in total darkness and in bad weather. Thermal IR energy is more commonly known as heat. Because heat irradiated is not within the visible spectrum, special lenses can be used to focus on the IR waves emitted from objects. The focus IR light is scanned by IR detector elements that measure the different amounts of thermal IR light (heat) to create a temperature pattern called a thermogram. The thermogram is processed by the signal processing unit of the camera to produce a visible picture. The ability to see in darkness or in bad visibility conditions such as fog make these cameras ideal for low-lying areas on or near water, which are subject to dense fog, or for extremely remote areas where ambient light is nonexistent. Most thermal imaging cameras for traffic monitoring are hybrid cameras. These cameras work like a typical color CCTV camera in the day and are able to switch to thermal IR mode when conditions warrant.

Digital Signal Processor

Most advanced video cameras use Digital Signal Processing (DSP). Video has traditionally been processed as analog electrical signals. While analog processing is relatively inexpensive, it is not as efficient and cannot perform tasks such as noise removal, image stabilization, and digital zoom. The major benefit of DSP cameras is the minimization of analog circuitry, which may add noise to the video parameters with temperature. DSP cameras offer crisp lines, detail reproduction, and assure that functions are unaffected by time and temperature. DSP camera technology reduces discrete components, thus potentially improving reliability. The component reduction further facilitates smaller, lighter-weight cameras that consume less power.

Signal to Noise Ratio

The signal to noise (S/N) ratio is the ratio of the usable signal transmitted to the noise or undesired signal. This ratio should be as high as possible to minimize disturbance because it is a measure of the quality of transmission. The S/N ratio is usually expressed in decibels (dB). CCTV cameras for traffic applications generally operate at an S/N ratio greater than 50 dB.

Lens

The camera lens projects the view on the camera imager for reproduction as a video signal by the camera. The current market offers a variety of lenses with various features and characteristics. Each lens is manufactured for use in a particular application and environment. Glass lenses are more durable but are heavier and more costly than plastic. Basic information on parameters of importance is discussed below.

Focal Length

The focal length of a lens provides the distance from the lens to the imager. As the focal length increases, the image size also increases and magnification occurs. For arterial traffic monitoring, a zoom lens with a wide focal length range, typically around 4.0 to 135 millimeters (mm), is most commonly used. This type of lens provides a wide angle of view for observing multilane roadways as well as adequate zoom capability to zoom in on incidents. Common CCTV camera viewing distances with this type of lens are approximately one-half mile in each direction.

F-stop

The F-stop measures the amount of light that can reach the sensing device through the lens. The higher the F-stop, the less light transmitted through the lens. As a lens is zoomed, the F-stop value increases. For arterial traffic monitoring, video images may be required to be produced in low-light conditions and the lens should have a low F-stop such as about f/1.4.

Angle of View

This is a measure of the camera's FOV, measured in degrees. Angle of view is produced from a combination of the camera imager size, the lens format size, and the focal length range.

Focus

The lens is available in automatic and manual focus. Most modern cameras are automatic but allow for manual focus.

Iris Control

The lens is available in automatic and manual iris control. This controls the amount of light and brightness of the picture. Most modern cameras are automatic but allow for manual iris.

Zoom

A motorized zoom lens is available and should be specified. The camera and lens combinations reviewed have various optical zoom capabilities of 30X and have additional digital zoom capabilities beyond the optical zoom capabilities. Digital zoom degrades the quality of the image but can be useful in viewing distant images. Because 30X optical zoom is the typical used in ITS applications, electronic image stabilization is imperative to reduce image shake when zoomed in from a long distance.

Housings

The main purposes of a CCTV camera enclosure are to protect the camera from weather conditions, including moisture, dirt, and dust, as well as to reflect the heat and glare of the sun. Two types of CCTV camera housings are generally used in traffic applications, barrel and dome. Each has its advantages for particular applications. Barrel CCTV cameras can see up to approximately 40 degrees above horizontal. This may be useful in hilly areas where the road crest may be higher than the CCTV camera elevation. However, barrel CCTV cameras are generally slower to move because of the external positioners. Housings are typically constructed of aluminum, plastic, or steel. The housings are environmentally hardened, and most come with fans and heaters to better control the internal environment of the housing. Sunshields help keep the units cooler. Ambient temperature limits are usually specified, and several vendors' offerings are NEMA rated (-34 degrees F to +165 degrees F) and are on the FDOT's APL. Humidity tolerance levels are also typically given. Pressurized units can operate in 100 percent humidity without adverse effects.

Dome type CCTV cameras are characterized by very small and light camera/lens elements integrated with PTZ motors and data receiver/decoders to operate them. Dome CCTV cameras can be positioned to see up to horizontal and slightly above, but no more. The units are mounted within a self-contained housing. The lower half of the housing is a clear hemisphere, hence the name “dome” CCTV camera. For ITS use, several manufacturers now make units in housings that are sealed against the environment. Some housings are pressurized with dry nitrogen to prevent corrosion of the internal components. A sealed and pressurized housing is typically used for high mounted locations or locations subject to dust or dirt. This ensures the necessary reliability that is difficult to achieve when outside air is introduced into the camera environment. Pressure relief valves are typically used to reduce the chance of damage by over-pressurization. Low-pressure sensors are usually included as a feature to notify the maintainer that pressurization is beyond the low-pressure limits. The size of these CCTV cameras is approximately 10 inches in overall height and 9 inches in diameter. This size includes an integral sun shield to reduce internal temperatures. Dome CCTV camera assemblies may have clear or smoke colored lower sections to reduce heat. CCTV camera weights are approximately 8 to 12 pounds. A pole mount bracket adds about 5 pounds.

For the barrel type CCTV camera, the “barrel” part containing the camera is typically separate from the PTZ part. The actual camera elements of a barrel CCTV camera are similar to that of a dome CCTV camera, with comparable options for lenses, DSP, imagers, and analog or digital operations.

Pan/Tilt Capabilities

Pan/tilt (P/T) capabilities of dome CCTV cameras include 360 degree horizontal rotation (pan) and 0 to 90 degree downward rotation (tilt). Pan speeds may vary among the manufacturers. The selected P/T unit should provide a range of speeds that includes both high and low speed capabilities. In typical usage of the CCTV cameras, it is desired to have high P/T speed to quickly get to the location of interest, but they also want the low speed positioning capability to navigate about the scene, allowing the CCTV camera to be sensitive to slight movements. Many of the manufacturers offer presets as a standard feature within the capabilities of the control hardware/software. Preset accuracy values of one degree or better are desired. Models with precision stepper motors with direct or belt drives provide for quiet and accurate operation. Any drive unit using gears or chains is not recommended. Stepper motor drives do not experience drive gear slack and wear, which introduce less precise positioning. Preset and high position recall speeds are values of importance to CCTV camera specifiers and operating agencies.

Control Software

As previously noted, many manufacturers offer some degree of preset capability. Almost all manufacturers offer programmable privacy zone/blank-out capabilities to prevent viewing of certain fields of view. There are also labeling capabilities identifying preset title, CCTV camera identification, and other information. Tour capabilities are available, making it possible to have a continuous rolling tour of CCTV cameras within the system. Various alarm inputs are also available, depending on the configuration of the system and options ordered. All CCTV camera utilities should be able to be exercised from the central control system as well as at the field location. Most manufacturers offer a standard communications control protocol as well as optional protocols that may be implemented in multiple CCTV camera manufacturer systems.

Lightning and Surge Protection

CCTV cameras are very susceptible to damage from lightning-induced surges. It is important that new or existing poles be outfitted with air terminals and a high quality low impedance grounding system. An air terminal is a sharp pointed copper or copper-clad steel rod that projects above the top of the pole. Often mistakenly called “lightning rods,” their purpose is to provide a low impedance path to ground and thus reduce the chance of a lightning strike to nearby components within its “cone of protection” (Figure 14). The area of protection is described as a cone with an included angle of 45 degrees and the apex at the tip of the air terminal.

Surge protection devices (SPDs) should be of the highest quality. A common misconception is that metal oxide varistors (MOVs) are adequate surge protection and the larger the MOV, the better because the larger the MOV, the more energy it can dissipate. However, it can never dissipate all of the energy of a surge caused by a nearby lightning strike. Also, the larger the MOV, the longer it takes to react, thereby allowing damaging energy to pass to the protected electronics.

Most manufacturers recommend the implementation of a hybrid-type surge protection system. This uses smaller (faster) MOVs and high current gas discharge tubes in tandem. Silicon Avalanche Diodes (SADs), also called Transient Voltage Suppressors (TVSs), are used for extremely sensitive circuits as well. The idea is to use a robust device (the gas tube) to carry the burden of dissipating the bulk of the surge energy with a faster device to protect the circuit during the initial time that it takes for the gas tube to “fire” or activate. It is also very important to install surge protection where the camera signals enter the cabinet and at the CCTV camera itself. In the past, some vendors have stated that surge protection is not needed on IP cameras due to the nature of Ethernet signaling. The consensus among surge protection manufacturers and CCTV camera manufacturers is that SPDs are strongly recommended on both ends of CCTV camera cabling. Although many CCTV cameras may already include such surge protection inside the CCTV camera housing, the additional protection will complement the surge protection within the housing. Over time, SPDs may weaken due to repeated electrical surges. Redundancy as well as power from a pure sine wave device such as a UPS will best protect the sensitive electronics. Additionally, an SPD only performs as well as the grounding it is connected to. Ground connections should be short and clean with tight connections.

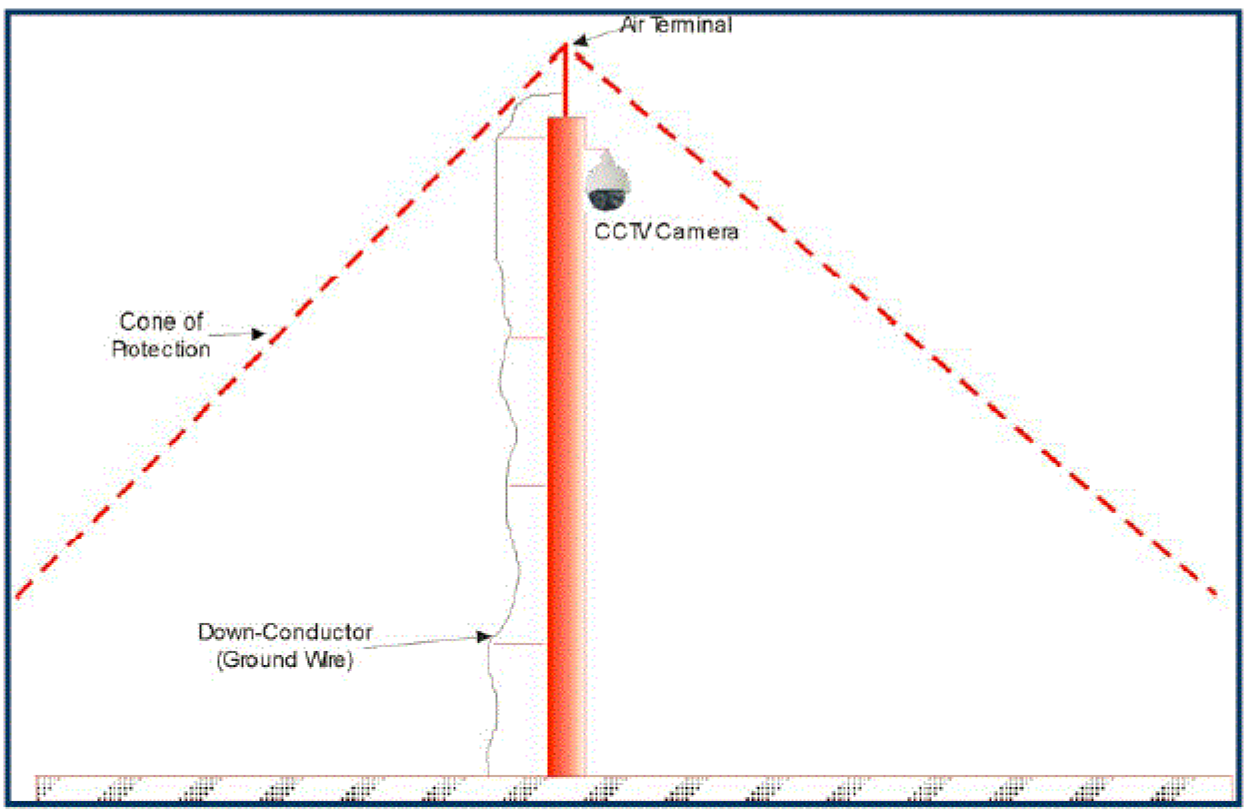


Figure 14: Theoretical Cone of Protection

Mounting

CCTV camera mounting heights vary with the local environment and intended use. In confined areas where the need is to view a signal queue, the height can be as low as the height of a mast arm, about 20 feet. However, at this low elevation, the local environment and occlusion from vehicles will limit the distance viewed. A good compromise is a height of about 30 to 40 feet.

Where access for maintenance is problematic due to mounting height or environmental factors, a lowering system that allows the CCTV camera assembly to be lowered on a cable or track for routine service or maintenance can be provided.

Evaluation

Table 17 presents a comparison between three manufacturer's specifications for HD dome CCTV cameras currently on the FDOT APL. While there are several similarities between products, each product has its unique properties. This makes the methodical comparison of CCTV camera characteristics very subjective. Additionally, customer service cannot be measured and compared from manufacturer data sheets.

TRAFFIC MONITORING COSTS

The costs to install CCTV cameras can vary based upon the type of installation. The greatest cost savings is realized by using existing structures for the CCTV camera installations.

Capital Costs

The cost for a CCTV camera is approximately $2500 to $3500, depending on manufacturer and feature set, not including mounting structure, installation, and surge protection.

O&M Costs

Maintenance costs for CCTV cameras tend to be higher than some other ITS elements due to their tendency to be struck by lightning, particularly in Florida. Good surge suppression and grounding helps mitigate this issue. Operations costs are also higher, as a person must view the CCTV camera images to be useful. Due to these factors, annual maintenance is expected to cost 10 to 15 percent of the capital cost.

Table 17: CCTV Camera Comparison

Feature or Characteristic	**Vicon Surveyor SN230W**	**Bosch VG5 ITS Series**	**GovComm GC-IMPO-FIZD**
Enclosure Type	Dome	Dome	Dome
Weight	12 lbs	6.8lbs	11lbs
S/N Ratio	>50db	>50db	>50db
Resolution	1920 x 1080	1920 x 1080	1920 x 1080
White Balance	Auto/Manual	Auto/Manual	Auto/Manual
Tilt Speed Manual	0.1˚ - 150˚/sec	0.1˚ - 300˚/sec	0.1˚ - 120˚/sec
Tilt Speed Presets	150˚/sec	300˚/sec	200˚/sec
Video Tilt View	-2 ˚ to 92˚	-18˚ to 90˚	-2˚ to 90˚
Pan Speed Manual	0.1˚ - 400˚/sec	0.1˚ - 400˚/sec	0.5˚ - 160˚/sec
Presets	79	256	256
Focus	Auto/Manual	Auto/Manual	Auto/Semi/Manual
Zoom Optical	30X	30X	30X
Zoom Digital	-	12X	16X
Shutter Speed	1 - 1/30,000	1 - 1/10,000	1 - 1/30,000
DSP	Yes	Yes	Yes
Day/Night Option	Yes	Yes	Yes
Sensitivity – mono mode	Color: 0.4 Lx; 1/30s	Color: 0.16 Lx; 1/30s	Color: 0.4 Lx; 1/30s
Resolutions	1080	1080	1080
Iris Control	Auto/manual	Auto/manual	Auto/manual
Lens Aperture (max)	f/1.4 – f/4.6	f/1.6 - f4.7	f/1.6 - f5
NTCIP	Yes	Yes	Yes
Sun Shield	Yes	Yes	Yes
Temperature Limits	-40˚ to 165˚F	-40˚ to 131˚F	-42˚ to 167˚F
Image Stabilization	Yes	Yes	Yes
Encoder Option	H.264/ MJPEG	H.264/MJPEG	H.264/MJPEG/MPEG4
Image Device	1/3 in. CMOS progressive scan	1/2.8 in. CMOS progressive scan	1/2.8 in. CMOS progressive scan
Angular Travel - 360˚ Continuous	Yes	Yes	Yes
Focal Length	4.4 - 132mm	4.3 – 129mm	4.4 – 129mm
Horizontal Angle of View	62.9˚ wide 2.2˚tele	59˚ wide 2.1˚tele	65.5˚ wide 2.11˚ tele
Tours	8	2 (256 scenes)	8
Privacy Zones	80	24	24
Alarms	4	7	7
Software	Included	Included	Included
Power Requirements	18-30 VAC	21-30 VAC	24-28 VAC

SECTION 9

INFORMATION DISSEMINATION

9. INFORMATION DISSEMINATION

Information dissemination is an important component of an ATMS. Motorists have developed an expectation to be informed about conditions around them, and providing information can help them make intelligent decisions about their routes. Information dissemination is also critical during times of emergency, such as hurricane evacuations. The common methods for information dissemination are by use of DMSs or via a website. DMSs are traffic control devices used for warning, regulating, and routing traffic, and are designed to provide motorists with real-time highway information. ADMSs serve this same purpose but are typically smaller and on arterial roadways. With the use of a website, travelers can access traffic-related information at any time.

ADMSs

The use of these devices has increased in recent years due to decreased prices and the availability of products that utilize various technologies. However, this trend has slowed down with the availability of this data on smart devices. Figure 15 shows an example of a typical ADMS mounted on a tri-cord structure.

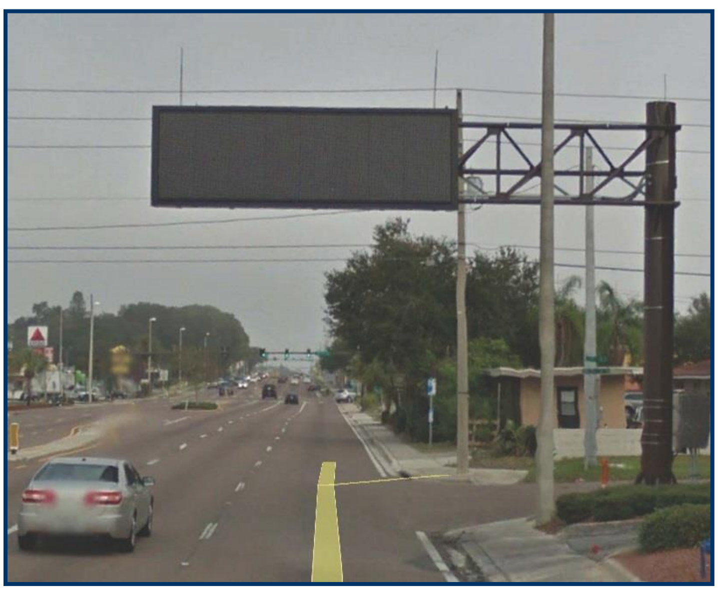


Figure 15: Typical ADMS

The objective of a DMS is to provide traffic information to allow the motorist time to avoid an incident, prepare for unavoidable conditions, or receive travel directions. The traffic flow and incident information collected by CCTV cameras and detectors can be quickly disseminated to the public through these signs. For all information displayed, the goal is to have a positive impact on the motorist's travel time. DMSs can also play a major role in the safety and security of motorists. DMSs can be used to:

- Inform motorists of varying traffic, roadway, and environmental conditions
- Provide specific information relative to the location and delays associated with incidents
- Advise motorists of detour routes because of construction or roadway closure
- Suggest alternate routes to avoid roadway congestion
- Reassure drivers on unfamiliar alternate routes
- Redirect diverted drivers back to freeways
- Provide travel times
- Display Amber/Silver/Law Enforcement Officer (LEO) alerts

The FDOT District Five is currently constructing DMSs on I-75 throughout their jurisdiction. These interstate DMSs will be controlled from the District Five RTMC. These DMSs will provide traffic information to motorists traveling the I-75 corridor and can be used to warn motorists of Interstate closures and possible diversion routes to avoid long-term delays associated with these closures.

Design criteria for DMSs are specified in Chapter 7 of the FDOT Plans Preparation Manual (PPM). Generally, DMSs should be placed approximately 1/4- to 1/2-mile before major intersection decision points to allow time for motorists to decide on appropriate action and change lanes if necessary. Signs should also be located on straight roadway sections, as legibility decreases at angles from the sign. In addition, CCTV cameras should be in place to observe the signs and verify that the intended message is being displayed correctly.

Size

The size of an ADMS depends on the messages to be placed, the size of the road, and the posted speed for the road. Per the January 2016 version of the PPM, the minimum lettering size for DMSs is governed by Section 2L.04 of the MUTCD. This section provides guidance for a minimum letter height of 18-inches on high-speed roadways (posted speed limit of 45 miles per hour (mph) or higher) and 12-inches on lower-speed roadways (posted speed limit less than 45 mph). This guidance represents a change from previous years, given that the PPM has traditionally allowed a minimum letter height of 15-inches for speeds of 45 to 50 mph.

Capital Cost

A typical ADMS using LED technology can cost between $30,000 and $50,000, depending on its size (not including support structure).

O&M Costs

Annual O&M costs can be expected to be in the range of 10 to 15 percent of the capital costs. Factors which are considered in this cost are the need for operators to put messages on the signs and the historically higher maintenance costs of these devices compared to some other ITS devices.

TRAFFIC WEBSITES

Traffic information can also be made available using websites. There are many types of traffic websites and website traffic content. Typically, larger agencies such as a state level government will provide traveler information on a statewide website. In 2000, the Federal Communications Commission (FCC) designated 511 as the nationwide telephone number for providing telephone traveler information. Since being implemented, 38 states have deployed various 511 programs. Florida currently operates its 511 system both as a phone service and a website, fl511.com. In 2014, the State of Florida signed an agreement to share its traffic data with Google and Waze, which had been acquired by Google in 2013. The arrangement allows both parties to share, mine, and disseminate collected data on their respective websites and applications. The FDOT utilizes the relevant Waze data on its fl511.com website and 511 app to supplement its information for Florida travelers.

Smaller agencies such as county and city level governments will typically partner with a content provider. Traffic content providers such as Total Traffic, SigAlert, and HERE.com offer software development kits (SDKs) to help develop and disseminate maps with traffic data for agencies who wish to display the information on privately branded websites. There is typically a recurring fee for these types of services. The benefit of using these services for a smaller municipality website is the ability to offer extended information to local travelers, such as camera feeds and DMS content typically not found on Bing, Yahoo, or Google. However, the cost for these services is passed on to the local tax payers. In many cases, smaller agencies will simply provide access to their data and images to companies such as Waze and local news media outlets for public dissemination. Most news outlets already have the staff, apps, and mechanisms in place to offer the content to their audiences. The images and data are usually marked or branded for recognition of the providing agency.

A sample website recently developed for the City of Seattle, Washington is shown in Figure 16. The City uses this site to help motorists plan for current traffic conditions before a trip.

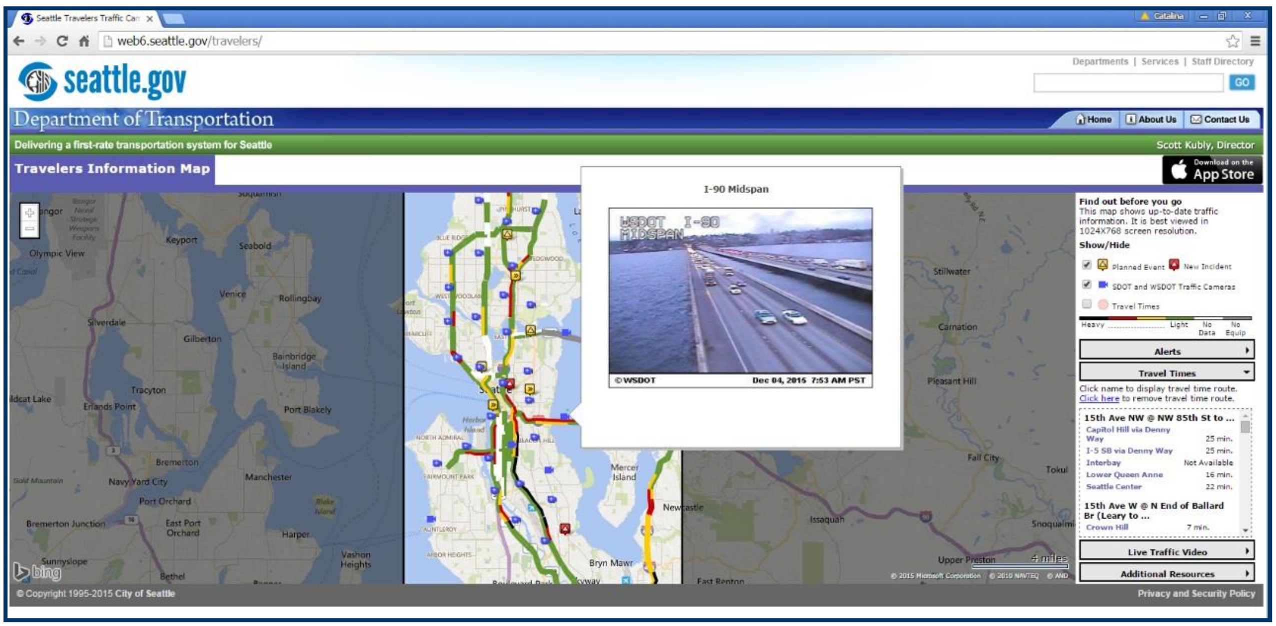


Figure 16: City of Seattle Traffic Website

Capital Costs

The costs of setting up a basic traffic information website can be quite low, and the site can be expanded over time as funding and resources allow. A basic site that can provide traffic information which is entered by an operator could be built for a few hundred to a few thousand dollars. Sites that integrate real-time information from the ATMS will be more costly, but will be of more benefit to the public.

O&M Costs

If the site is part of the existing County IT infrastructure, it could be operated at essentially no cost (or at least low cost) to the Public Works Division.

SECTION 10

CENTRAL CONTROL SOFTWARE

10. CENTRAL CONTROL SOFTWARE

An important part of an ATMS is the central control software. The central control software will allow Sumter County to monitor and control its traffic signals as well as improve its maintenance capabilities. The user needs and functional requirements for the central control software are described in this section.

USER NEEDS

National Transportation Communications ITS Protocol (NTCIP) Compatibility

The NTCIP has been developed to provide a communications standard that ensures interoperability and interchangeability of traffic control and ITS devices. The NTCIP allows a multi-vendor deployment of ITS technologies by providing a standard communications interface protocol for various ITS hardware and software products. The NTCIP allows for flexible future expansion without reliance on a specific brand of equipment. Currently, the County has Siemens/Eagle signal controllers installed in most of the traffic signal cabinets. The new central control software must support NTCIP compatibility in order to share data and support interoperable, multi-vendor equipment, and provide for interchangeable services throughout the region.

Real-time Monitoring

Real-time monitoring of system status is an essential element of an ATMS. Any central control software that the County purchases will be capable of allowing status monitoring of the entire system or any intersection in the system.

Ability to Provide Traffic Responsive and Traffic Adaptive Operation

Traffic responsive operation allows the signal operation to better respond to changing traffic conditions. Traffic adaptive systems adjust signal timing in real-time to respond to variations in traffic conditions. The County’s central control software should provide or be able to interface with systems that provide traffic responsive or traffic adaptive operation.

User-Defined Alerts

Because Sumter County does not intend on having a full-time operator to monitor the central control software, user-defined alerts will be essential. By having user-defined alerts, the operator can be on-call and respond to any alerts designated by the County.

Integration of ITS Technologies

The County has expressed a desire to implement cost-effective ITS technologies such as CCTV cameras to assist in monitoring traffic congestion, to implement special timing plans, and to expedite response times to incidents. At a minimum, the central software must be NTCIP compliant and support ITS technologies, namely CCTV cameras, detection devices, and DMSs.

FUNCTIONAL REQUIREMENTS

The central control software will primarily control traffic signals within the County. Although most signals will be connected through the central control software and coordinated utilizing TOD timing plans, several intersections will continue to be isolated and operated based on local control.

The traffic signal system monitoring should be in real-time with an extensive graphical user interface (GUI), graphical and textual system displays, detector status (count, speed, occupancy), and malfunction indications. The central control software should be able to provide communications failure logs and present graphical real-time system status. Inventory information for each intersection, such as signal head type, controller, intersection graphics signs, and maintenance records, should be available by clicking on the intersection icon shown on a system map display.

Consistent with the FDOT District Five's ITS Architecture, the State and County will share traffic information for regional traffic control. The goal is to have the County participate in a regional traffic control partnership with FDOT District Five. Due to liability and operational concerns, the County should not relinquish control of their signals to any other jurisdiction under most circumstances.

Sumter County should also enter into an agreement with Lake and Marion counties for the coordination of the signals along US 27/441. Each jurisdiction should operate and maintain their own signals but agree to share data and information so that the signal operation is coordinated through the corridor.

Based on the above, the central system requirements are summarized in Table 18 for the proposed central control software for the ATMS.

Table 18: Central System Requirements

Requirement	Functions Provided
Traffic Management	• Traffic operations • Recurrent congestion management • Non-recurrent congestion management • Special event management • Seasonal traffic management • Emergency/disaster management
Modes of Operation	• Operator control of coordination modes • TOD control of coordination modes • Support traffic responsive as an option • Support adaptive as an option
Data Requirements	• Second-by-second data for intersection operations including phase indications, timing plans, and intersection status • Volume, occupancy, speed data by user-specified parameters • Historical detector and signal timing data for developing timing plans off-line • Maintenance information, including operational alarms and diagnostic alarms
Information Exchange	• Volumes • Speeds • Occupancy • Timing plans • Phase indications • Incident data • Road closure information
CCTV Monitoring	• Traffic signal functional monitoring • Traffic signal operations monitoring • Special event management • Emergency management/disaster operations • Incident verification • Incident management
Security/Access	• Full user security and access control • Multiple security levels • System administrators will assign user rights

Requirement	Functions Provided
Interface with Other ITS Components	• Software should interface with CCTV cameras, DMSs, information kiosks, etc. • Software should allow users to monitor/control other ITS devices
User Interface	• Mouse-driven GUI • Map-based, geographically correct GUI • Standards-based
Operations and Maintenance	• Easy to operate • Should not require dedicated staff • Provide automated database management and network monitoring • Provide troubleshooting tools and assistance

DEPLOYMENT OF ITS TECHNOLOGIES

One of the user requirements of an ATMS, as defined previously, is the use of ITS technologies to manage congestion, enhance safety, and improve mobility. At a minimum, the County has expressed interest in installing CCTV cameras.

The County will use CCTV cameras for traffic monitoring, incident verification, effective incident response, emergency and disaster management operations, roadway maintenance, construction monitoring, signal display verification, and general public safety.

The County should consider implementing DMSs for the primary use of providing information during an incident or event. Another candidate traveler information technology is the implementation of an Internet travelers web site. Many ATMSs also offer these functions as an option.

CENTRAL SYSTEM ALTERNATIVES

The functional requirements developed for an ATMS are the yardsticks for vendor selection through an established procurement process. Three alternative types of software models for the ATMS central control are available as described below:

- Commercial of the Shelf (COTS) software
- COTS with modifications
- Custom software

COTS Software

This option is viable for the County ATMS, and is the most cost-effective and efficient solution with low risk. Many established vendors, including Siemens, Econolite, and Trafficware could provide an off-the-shelf system with varying degrees of satisfaction in terms of the requirements they meet. A typical COTS software package can be purchased for approximately $50,000 to $300,000, depending on features selected and number of intersections to be controlled.

COTS Software with Modifications

This is also a viable option. However, it is not as cost-effective as COTS software. If significant software enhancements are necessary to accommodate all the County's desired functional requirements, this will increase the cost of the central control software. Any of the established vendors could modify their software to add additional capabilities and meet the user requirements. The advantages of this alternative are:

- More user requirements can be met through this approach in comparison to an off-the-shelf software package.
- In comparison to the custom software development approach, this approach has less deployment risk and is more cost-efficient since parts of the software being used would already have been developed, tested, and deployed elsewhere.
- Software enhancements may be considered in the future for integration of the ATMS with other central systems or adding extra modules to include ITS technologies mentioned earlier. COTS software with modifications will start at $100,000 and up, depending upon the requested features.

Custom Software

A custom central control software development that would provide the central traffic management system with the listed user and functional requirements might not be cost-effective, but will be highly responsive to the user requirements. Custom software is the most expensive, typically from $250,000 to more than $1,000,000, depending upon the requested features. This alternative is not feasible for Sumter County.

VENDOR SELECTION

The user needs and functional requirements for the Sumter County ATMS software package defined in this section comprise the criteria used for the selection of vendors. Other objective and subjective criteria, such as cost, previous vendor performance, and risk/liability concerns are important considerations. The following paragraphs define the major criteria that will be considered for vendor selection.

If the software is procured through a FDOT design project, the County will not be able to select the vendor they want. Therefore, it is important that the County ensure that the requirements of the central control software be specified so that whatever system is procured, it will provide the features the County desires.

Functional Requirements

The functional requirements previously discussed are the major factors in the evaluation of a central control software package and form the basis of vendor selection. The final selection of the central software will also take into account a combination of the additional factors discussed here. When the Request for Proposals (RFP) is prepared for the system, it will need to include the request for documentation of these criteria. This will also need to be accounted for in the grading criteria for the proposals.

State-of-the-Art System

This is required to assure that the maximum level of functionality is available and that the system has a long useful life before it becomes obsolete. Several vendors may meet this criterion since they are constantly upgrading their product and are striving to meet current and emerging standards.

High Availability (Off-the-Shelf)

While this factor can be at odds with "state-of the-art", it is important because it protects the jurisdiction from being a custom, one-of-a-kind installation. It also ensures that the software has been field-tested. Off-the-shelf can have various meanings, including if the County decides to take an existing package and have the vendor add specialty functionality to it.

Reputable System Suppliers

The selected vendors for the central control software should have NTCIP-compliant systems deployed in the United States. Vendors should have had their products in the market for more than three years. Sumter County should be able to interview current users to determine the functionality of their product.

Cost

If a COTS system is used, cost savings will be realized, as no (or minimal) software modifications will be necessary for compatibility, and there will be time/cost savings in preparing the RFP documents and vendor selection. If specialized software development is desired, costs can rapidly rise.

Liability and Risk

Generally, vendors ask for an indemnification and hold-harmless agreement releasing them (as vendors) of any liability. It should be noted that the architecture of most central control systems eliminates the software as a single point of failure, thereby releasing vendors from any liability. Generally, all central control software performs error checking to some degree on timings, database entries, and automatic logging of system events. Vendor products generally undergo extensive testing to eliminate software errors and ensure a quality system as required for International Organization for Standardization (ISO) 9001 compliance. Further, all major vendors carry professional liability insurance.

ISO 9001 Compliance

Documented evidence for ISO 9001 testing and certification for vendor products is a desired part of acquiring operationally tested software and hardware systems. This will greatly reduce procurement risk to the County and improve quality and reliability. Vendors with a reputable product should be invited to submit a proposal. It should be noted that ISO 9001 certification does not apply to the product specifically, but to the processes used by the vendor to develop the product.

Interface Requirements and Ability

NTCIP Standard 2306 - Application Profile for Extensible Markup Language (XML) in ITS Center to Center (C2C) Communications defines an application profile for communications between transportation management systems using Internet standards based on the XML. It is important to note that today most manufacturers may have implemented only desired portions of the Traffic Management Data Dictionary (TMDD) for the data elements to be exchanged between TMCs and/or other central control software. The capabilities of a central control software fully compliant with the NTCIP communications protocols may have limited features. Therefore, vendors created "enhanced" traffic data dictionary elements beyond the NTCIP standards to meet the demands of the client.

For an additional cost, many vendors will implement a custom C2C exchange to ensure capability between systems. However, with most agencies today serviced with high speed Ethernet networks, a remote client of the central control software or redundant synchronized system of the same vendor is more likely to occur between multiple agencies. The ability of a vendor's central control software for providing this capability should be part of the central control software discussion, evaluation, and selection.

Integration with Other ITS Devices

Major vendors provide central control software that fully integrates CCTV camera and DMS operations with their traffic control system. However, many jurisdictions use vendor-supplied or specialized software to operate and control ITS devices.

Licensing Issues

Most vendors have some type of standard licensing agreement that would protect the intellectual property rights of software that has been developed independent of any contract with an agency. A few vendors may provide the source code upon request, but void any warranty if another party recompiles the code. Others will place the source code in escrow in case the company is unable to support the software. Most commercial vendors should be willing to negotiate a license that will cover software installations not only within the County, but also within the FDOT District Five area.

Conversion and Integration

The timings in the existing controllers will need to be downloaded and saved, and then uploaded into the new system. The vendor contract should stipulate that the vendor is responsible for this conversion as part of the integration process.

Regional Compatibility

There will need to be a high level of communication between the systems in the region to promote efficient handling of traffic during events with a regional impact. This will be especially important along the US 27/441 corridor.

Remote Monitoring Centers

The software needs to be able to support remote monitoring stations. The FDOT District Five RTMC in Orlando may need access to the system, in addition to possible access being required at the Emergency Operations Center (EOC) or at law enforcement offices. These remote centers may need to be able to view the video from the CCTV cameras, and some may require control features as well.

SECTION 11

TRAFFIC MANAGEMENT CENTER

11. TRAFFIC MANAGEMENT CENTER

A core element of a municipality's ATMS is the TMC. If the TMC is to be effective, it should be functional, cost-effective, and laid out to provide useful information to traffic control and other personnel in a timely manner. Coupling this philosophy with identified system requirements created a conceptual design for an effective and cost-efficient TMC for Sumter County.

It is understood that the Sumter County ATMS will not be staffed full-time. This makes it important that the control hardware and the video display be easily accessible to the staff assigned to monitor the system. Otherwise, it will be an unused element of the County's transportation management plan.

The TMC will begin small, with just a couple of monitors on a desk. As the County continues to grow and the number of signals increases, the ATMS will expand and the TMC will grow with it. Therefore, the Sumter County facility needs to be designed for complete functionality and with the possibility of expansion. For the TMC layout, the physical space, hardware, software, video monitoring, and communication/control system were taken into account. Research into available space within the existing Public Works building that can be effectively utilized to house a proposed TMC will be performed. This document provides the physical space and functional requirements of this facility.

PHYSICAL SPACE REQUIREMENTS

It will be necessary to optimize any new TMC space for its various functions. Items to be considered are special structural requirements, special height requirements (such as for video display devices), and Heating, Ventilation, and Air Conditioning (HVAC) requirements. A common configuration is to divide the TMC space into a communications room and an operations control room. The communications room is typically located behind the video wall, allowing a single clean environmentally controlled environment for the sensitive communications equipment and the video control display system for the video wall. For the Sumter County TMC, it is recommended that available space within the existing Public Works building be utilized to the greatest extent possible and keep any modifications to a minimum.

In this section, the following physical requirements are discussed:

- Control room
  - Furnishings
  - Traffic monitoring system
- Communications room (system communication/control hardware)
  - Communication facilities
- HVAC facilities
- Maintenance facilities
- Electrical and UPS facilities
- Conference/Crisis/Media facilities
- Records storage (video, etc.)
- Restrooms
- Kitchen/Break room facilities
- Parking facilities
- Reception/Public information/Security

Control Room

The heart of a TMC is the control room. The size and form of this space and its relationship to other spaces and personnel is critical. Identifying the key personnel and their roles relating to the operation and management of the control room determines each individual's proximity and access to this space. This, in particular, would be critical to Sumter County because there will not be a full-time operator working in the control room.

The size and shape of the space depends on the number and design of the operator workstations. Ergonomics would be an important element in providing a comfortable work environment for the TMC operators. Studies have been done and the international standard ISO 11064 deals with the ergonomic design of control rooms. The guidelines dictate viewing angles from a seated position at an operator workstation to the video wall displays. These guidelines help to define the ceiling height of the control room's space and the location of each operator workstation relative to the video wall.

A covered trench could house electrical and network communications conduit, eliminating tripping hazards from cords or poles that would otherwise have to be placed on the floor. Floors and aisle ways would need to comply with the American with Disabilities Act (ADA) as required by law. Additional power and telephone outlets should be provided at the operator workstation locations. If a centralized building UPS exists, it will provide a continuous source of power to the computer workstations allowing continued communication and operation in the event of a power failure. If the Public Works building does not have a UPS or generator, a UPS will have to be added for the system equipment. Additionally, conduits for power and communication outlets should be provided to connect the equipment rack to a printer location.

All of these guidelines should be kept in mind as the ATMS expands and the County decides to build a control room for system operation. For the initial setup, it is recommended Sumter County utilize available space large enough to contain the recommended operator workstation with minimal modifications to the space. The recommended control room will provide the necessities for the County to operate the system on a part-time basis.

Furnishings

New furnishings are typically selected and acquired to efficiently and effectively use the available space. Operator workstations, storage systems, and printers for the TMC typically are designed to meet the space and personnel operational requirements. The furnishings should create a comfortable, pleasant, efficient, and ergonomically correct environment for the staff.

The operator workstations consists of an operator console and a computer workstation. The average price of an operator console is approximately $9,000, without advanced options such as integrated electrical and power raising and lowering of work surfaces. An example operator console is shown in Figure 17. Bookshelves or drawers should be included to store system related materials. Typically, a modular type system is utilized so there is flexibility in storage and seating configurations.

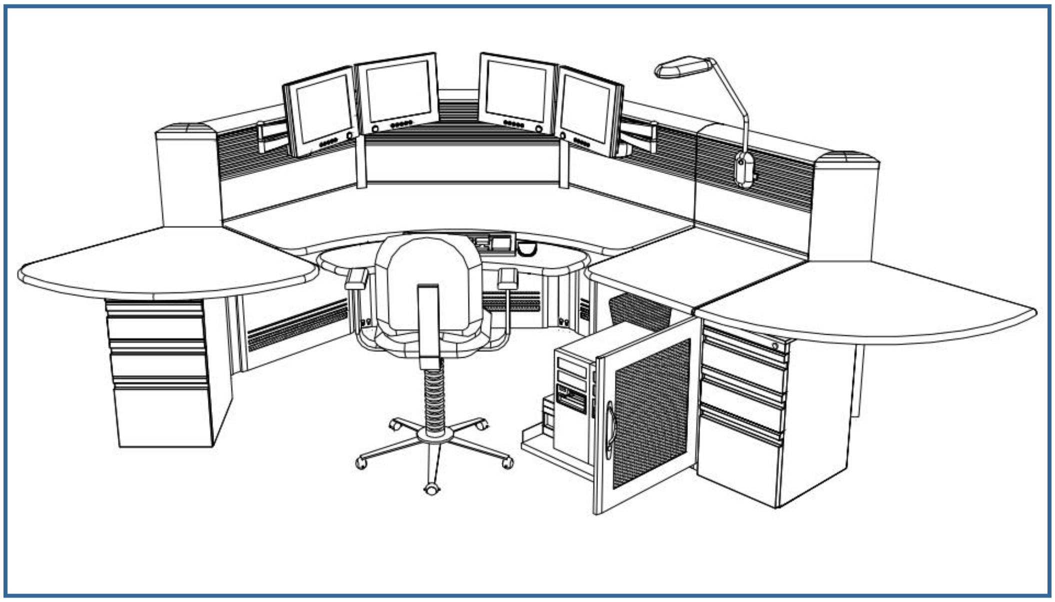


Figure 17: Example Operator Console

Computer workstations located in the control room are powerful machines capable of handling several video feeds on two to four monitors. Graphics cards for these workstations can account for the bulk of the pricing for a typical TMC control room workstation. It is typical to spend $10,000 to $12,000 per workstation, including three or four Liquid Crystal Display (LCD) monitors.

For the Sumter County TMC, it is recommended that the initial operator workstation setup consist of a single standard office desk outfitted with a computer workstation consisting of two display devices for viewing the system. The recommended setup will provide the necessities for the County to operate the system on a part-time basis.

Traffic Monitoring System

A traffic monitoring system is a crucial part of operations. It allows the TMC operators to monitor simultaneous video feeds from the sources throughout the County and other sources such as adaptive timing changes, controller operations, and network monitoring software. There are three basic methods of viewing the displays that are generated from the central control software:

- Standard LCD monitors on an office desk

- A video wall of light emitting diode (LED) panels
- A LED cube type video wall

The simplest and least expensive option is to utilize standard LCD monitors. The standard LCD monitors will require no special mounting hardware as the monitors will be placed on an office desk. The monitors will not require any special software as well. A limitation to the standard LCD monitors is the number of monitors is dictated by the amount of space on the office desk. This determines the amount of information from the central control software that can be displayed at a single moment.

Another method for viewing displays generated from the central control software is flat panel LED video walls, as shown in Figure 18. These flat panel monitors mount directly on the wall. The panels are manufactured with minimal sides so that they can be mounted next to each other with minimal seams; usually around five to seven millimeters. They can also scale one image across several panels.

Figure 18: Flat Panel LED Video Wall

The advantage to this design is that less space is required to operate and service the screens. A typical commercial LED panel will list in the neighborhood of $7000 per panel. A disadvantage of this system is they are not as seamless as the LED cube type systems because of the small frame around the monitors. Color, dimming, and white balance variation may exist between individual LED panels. Some manufacturers have software and sensors to help set up the wall color and brightness uniformity. Over time, however, the brightness will change as well as the color, which will require a re-calibration with external sensors and a laptop. New technologies are being introduced into the market that will allow displays to measure and make automatic adjustments with the help of built-in sensors.

Some LED systems may also tie displays together with single rack-mounted electronics modules. While they have a few advantages, such as reduced points of failure, the failure of that single module could cause several panels to become inoperable at once.

Another important consideration is replacement monitors. Generally, these displays are not easily serviceable so replacement units should be on hand in the event of a failure. Industry guidelines suggest having one spare panel for each nine units incorporated into the display wall. Future replacement panels may also cause difficulties as LED technology rapidly progress.

The third basic method for viewing displays generated from the central control software is the LED cube type video wall. The wall includes cube-type rear projection monitors or "cubes" mounted in racks to provide a seamless screen that is capable of displaying multiple streams on one cube or combining multiple cubes to display a single larger image. Access to service the monitors on the video wall is essential. For a room that utilizes video projection technology, a video projection room behind the video wall is required to allow servicing of the monitors. The size of this room is dependent on the type of monitors selected. In general, most large display monitors require approximately three to five feet of space for installation and servicing. For projection technologies, the room behind the monitors should be dark and unlit, unless active servicing is in progress. Devices using bulbs which generate high heat will also require additional cooling to be in place in this area. Newer projection systems are available, with the option of using LED bulbs reducing heat and increasing bulb life.

A disadvantage of the LED cube type system is they are more expensive to purchase and maintain over the LED flat panel type systems. The cost for a display similar to the one under construction in Figure 19 can be in the neighborhood of $750,000.

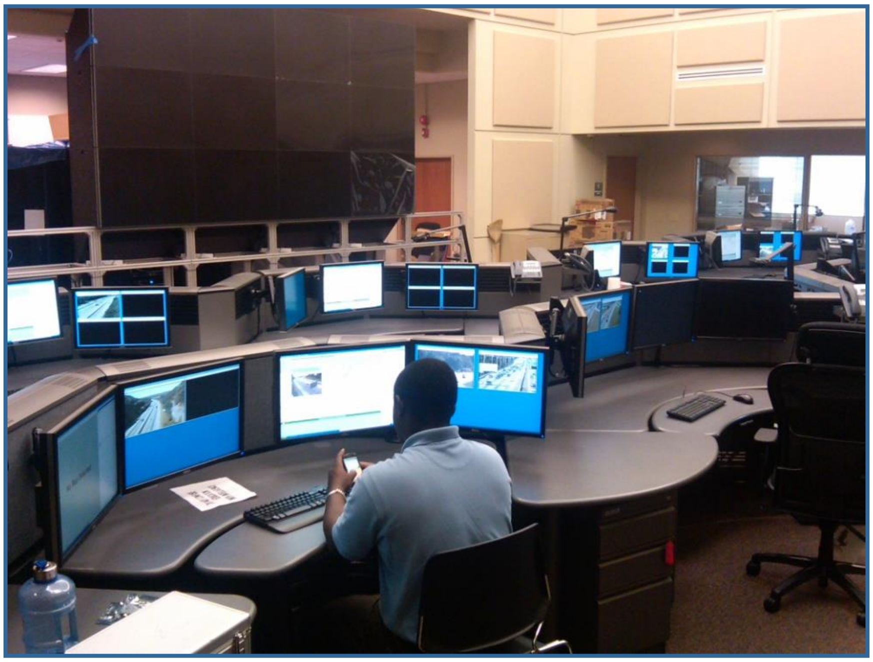


Figure 19: Cubed TMC Video Wall under Construction

It is anticipated that Sumter County will start with standard LCD monitors on a standard office desk and, as the system grows, will eventually install some type of video wall. The standard LCD monitors will be the least expensive option while also providing the necessities of a traffic monitoring system.

Communications Room (System Communication/Computer Hardware)

Equipment used to provide communications to the facilities and to field equipment such as the fiber hubs, transceivers, switches, etc. would be located within the communications room of the facility. The computer servers and peripheral equipment that will operate the traffic control system, video system, and other ITS components would also be located in this room. This equipment has unique power, cooling, and space requirements that affect the overall minimum requirements for the communications room and, indirectly, the utility rooms. In addition, if wireless communications are used, additional equipment would be needed in the communications room. Other requirements of the communications room include conduits to feed the remainder of the TMC. Ladder racks would be suspended from the ceiling to accommodate rack to rack communications, and horizontal cross connect cabling.

For the initial setup, the communications equipment will be housed at the The Villages Sumter County Service Center in Wildwood with the other server equipment maintained by the County's IT Consultant. This setup will be most efficient for the maintenance of the server equipment as the County IT Consultant is already located at this facility.

Communication Facilities

A unique requirement for support of the communication and control interfaces is an area to pull and terminate fiber optic cable within the building. This area will require proper ventilation for a human working environment, with ample space for cable trays and other cable termination equipment. In the Sumter County facility, this area could be a section of the communications room.

HVAC Facilities

The HVAC system for the TMC should be zoned to recognize the control room, the communications room, and the video wall, as applicable. Air entering these sections of the building should be directed through filters capable of removing 50 percent of any particle of dust, pollen, etc. larger than 0.12 microns. Since the TMC will be a part of a larger building, Sumter County HVAC consultants will need to confirm the HVAC is sufficient for the additional TMC equipment.

Maintenance Facilities

In most TMCs, there is a regular need to perform system maintenance within the building. This can range from simple cable fabrication to board level repair of equipment. To support these tasks, workbenches for bench testing equipment may be provided in or near the computer room. In addition, adequate space needs to be provided for the storage of equipment and supplies to support this activity. Adequate lighting and power should be made available to the technician area, as well as access to the system network.

Because Sumter County contracts out the signal maintenance, it is recommended the ITS maintenance be accomplished the same way, at least initially. Until the County brings this function in-house, maintenance facilities will not be needed.

Electrical and UPS Facilities

A UPS room is essentially a room for a large on-line battery system. Unless properly engineered, it can consume large amounts of space and be expensive. Typically, batteries are used to provide power for a short interval until an emergency generator can begin operating. Proper ventilation must be supplied to any room with batteries.

Properly sizing the emergency generator will require identification of a core of TMC functions that are essential, particularly in the aftermath of a natural disaster that disrupts normal traffic patterns and traffic flow. Since these facilities will be part of a larger building with an existing generator, the generator should be evaluated to ensure the core TMC functions do not exceed the maximum load allowance.

Conference/Crisis/Media Facilities

A room for the purpose of gathering and discussing crisis situations (e.g., traffic incidents) should be incorporated within the control room or in a separate room (e.g., main conference room) preferably with a view into the control room. In addition, space for public information use and the potential for media operators during special events should be considered. In a typical TMC, there is a large conference room with a view into the control room. There may also be several small conference rooms for general use. Unless a separate TMC is built, the Public Works conference room will serve these purposes.

Records Storage (Video, etc.)

With the addition of an ATMS, there will be an increased need for storage of supplies, paper files, electronic files, and video files. However, these increased requirements should be easily addressed in the space of the existing facility.

Restrooms

Since the facility will be located in the Public Works building and no additional staff will be added, the restrooms in the building will be sufficient. However, if the operation grows and additional staff are hired, this is an issue that may have to be evaluated at that time.

Kitchen/Break Room Facilities

An area for staff to eat and take breaks is provided in the existing building.

Parking Facilities

Parking requirements are determined by the County's zoning code. Most areas require one space for every 200 to 250 square feet of gross building floor area. In addition, the Florida Accessibility Code for Building Construction, Section 4.1.2(5) (a), requires a specific number of handicap-designated spaces based on the total number of parking required by the zoning code. Agency vehicles can occupy a considerable amount of available parking area. If a large number of agency vehicles are to be located on the facility site, the user needs for parking can exceed the number of parking spaces required by code. The overall needs for the building are determined not just by the TMC operations, but the building as a whole. Because no additional staff will be initially added, the existing parking facilities will be sufficient.

Reception/Public Information/Security

For the initial installation, no security is required, although it would be preferable if the traffic control equipment and the communication equipment are located in locked rooms. This will provide sufficient security. The reception desk in the entrance lobby can serve the functions of providing information, and monitoring and controlling those entering and leaving the facility. If a dedicated traffic control facility is built in the future, card key or proximity key systems should be used to control access to secure areas such as the control room and computer room. Various levels of access should be definable per card key.

FUNCTIONAL REQUIREMENTS

In this section, the following functional requirements are discussed:

- Hours of Operation
- Administrative Staff
- Operations Staff
- Maintenance Staff

Hours of Operation

In order to provide coverage of both the AM and the PM peak periods, the County TMC should be in operation from 7:00 AM to 6:00 PM. These hours can be split among multiple staff, one covering the early period and one covering the late period. Observation of the system does not have to be continuous, but someone should always be responsible. The TMC could be in operation for additional hours during special events, major incidents, or severe weather.

Administrative Staff

It is not anticipated there will be a need for an administrative person associated with the TMC. Any administrative needs could be filled by personnel fulfilling other facilities functions, such as the receptionist's desk.

Operations Staff

Sumter County has expressed the desire to utilize part-time operators. Shifts for the part-time operators could be staggered to cover both times of peak traffic and special events. One person should work the morning shift and the other should work the afternoon shift. Their duties will be to monitor and adjust approved signal timings, and report and respond to any issues that arise during their shift. The operators can be existing staff that already have other duties. They will monitor the system as other duties allow, but it should be on a regular basis.

Maintenance Staff

There are two types of maintenance associated with a TMC: the maintenance of the building (i.e., HVAC, plumbing, etc.) and the maintenance of the computer systems and associated equipment. It is not anticipated that the ATMS will create additional maintenance requirements on the building. However, when necessary, contractors should be escorted in any secure areas, and their work coordinated around operational requirements.

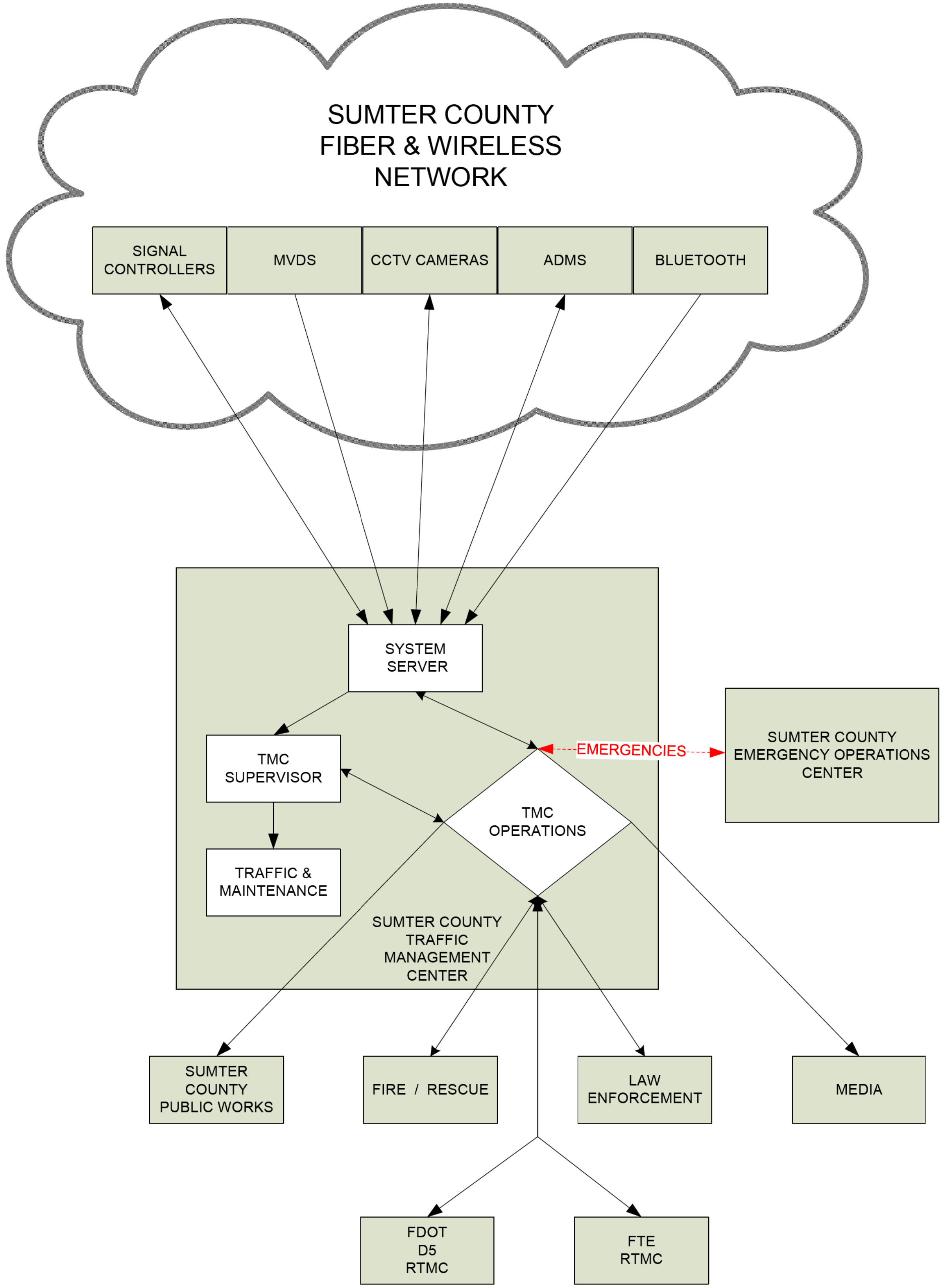
Personnel maintaining the computer systems may be permanently located in the facility, but it is not imperative. Modern equipment does not require continual maintenance, and the Sumter County IT staff could be utilized to perform any necessary services.

The equipment maintenance personnel will come into the building on an as-needed basis. If the equipment maintenance personnel are County employees in their respective facilities, they will generally have free access to the building areas, although the computer area should remain secure.

SYSTEM ARCHITECTURE

The County TMC will collectively process information from data sources within the region. Fiber optic cables installed as part of the initial implementation and in the future will feed the TMC servers information for sources directly affecting public safety and traffic flow efficiency. The information on these servers will provide a way for the TMC operators to visually monitor and classify anomalies from ITS and traffic systems.

TMC operators will monitor Sumter County and FDOT video feeds, adaptive timing information, traffic controller operation, network availability, and county radio frequencies. They will best serve the public by observing, classifying, and reporting any anomalies to be dealt with by the proper organization or department as well as make temporary adjustments in signal timing. Incident Response Plans should be developed to provide an action framework response to incidents that occur on I-75, the Florida's Turnpike, or County roads. Information should also be disseminated to the traveling public through various media outlets and the County's ADMSs, once deployed, as warranted. A standard information flow chart is shown in Figure 20. Standard operating procedures should be in-place on whom to call and/or what actions to execute during different incidents. Events should be recorded in a database for further analysis and continuous improvement.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 20: SUMTER COUNTY TMC SYSTEM INFORMATION FLOW	**Date**	03/23/17

SECTION 12

COMMUNICATIONS

12. COMMUNICATIONS

In order to operate the County's signals as an ATMS, a communications network is needed to allow the TMC to talk with each intersection. The communication system is the most important element of an ATMS and typically represents about half the cost of the entire system. The TMC operators rely on the communications network of the ATMS to provide continuous information so that they can effectively monitor the network and respond quickly when changes occur in the traffic patterns due to incidents, planned events, or when the system reports a component failure.

An ATMS requires a reliable communications network that can distribute data throughout the coverage area. There are significant bandwidth requirements for an ATMS communications network. These requirements are typically driven by the transmission of video on the network. Typically, 90 percent of the bandwidth used by an ATMS is due to video distribution. All other devices on the network that only transmit data—for example, traffic controllers or detection systems—take up a very small portion of the bandwidth.

Communications over a physical media link is typically the most reliable for continuous communications. For the Sumter County ATMS, 98 percent of the device locations that need to be connected to the network are in relatively close proximity to a proposed physical media link and should be connected using this method. However, due to the size of the county, there may be remote locations where it is not cost-effective to have hardwired communications; therefore, a hybrid approach needs to be taken. For the segments that can't be cost-effectively hardwired, wireless communications or leased bandwidth on a communication provider's network will be utilized. As the County ATMS is expanded, it may be possible to deploy additional hardwire communications infrastructure. The suggested deployment of the system will be addressed in the implementation plan document provided as part of this Master Plan.

This section describes and addresses the following design requirements needed for a communications network:

- Alternate Communication Media
- Network Technology
- Network Connection Methodology

- Network Topology

This document specifies how the communications network should be constructed and how it will define the required hardware.

MEDIA

Because of its known reliability and high bandwidth capacity, it is anticipated that fiber optic cable will ultimately connect a vast majority of the devices in the Sumter County ATMS. It is cost-effective to use fiber optic cable between closely located devices; however, due to the large geographical area which must be covered, a few devices will be too far from the cable to be economically connected to the fiber. An alternate mode will be needed to connect these devices to the communications backbone. There are several alternative methods to accomplish this. A discussion of media options and their advantages and disadvantages is included in this section.

Fiber Optic Cable

Fiber optic cable has quickly become the medium of choice for communication networks, particularly in the telecommunications and transportation industries. Fiber optic cable is an effective medium for transmitting large bandwidth applications like video. Fiber optic cable has dropped in price to where it is reasonable to design an entire network using it, except when covering long distances in order to reach relatively few devices.

Fiber optic cable is manufactured with a small number of individual fibers contained within buffer tubes. These tubes are arranged concentrically along the longitudinal axis of a central Kevlar strength member. The tubes provide protection for the individual fibers from crushing, stretching, bending, and water incursion. Each buffer tube can contain from 1 to 24 individual fibers, with 6 and 12 fibers being the most common construction. Cables are manufactured with fiber counts in multiples of the number of fibers in each buffer tube. Fiber optic cable is manufactured in two basic types: single mode and multi-mode. The modes refer to the number of "propagation modes" (angles of light travel) though the fiber. Multi-mode fiber has a larger core and the light rays can traverse the fiber at different angles. In general, multi-mode fiber is used for relatively short distances such as a multi-story building or data center, and single mode fiber is better suited for longer distances.

Agency-owned Fiber Optic Cable

Fiber optic cable installed or purchased by an agency such as the Sumter County traffic department is owned by the agency. The agency is responsible for the maintenance and care of the system. Agency owned fiber is the most common type of option as there are no re-occurring cost associated with the physical cable after the initial capital and maintenance cost.

Leased Fiber Optic Cable

One option available in some areas is leased fiber optic cable. Some communications providers can provide “dark fiber”, which is fiber without any electronics attached. This is available for a monthly fee. In general, the end user is responsible for lighting the fiber with electronic transmission equipment, and the communications provider is responsible for maintenance of the fiber. As an example, in Sumter County, The Villages has dark fiber available for lease that could be utilized by the county.

Dedicated Leased Telephone Line Service

Dedicated phone lines were often used in the past when the agency did not wish to spend the time and money to install their own infrastructure and bandwidth needs were low. Low-speed data can be supported over dedicated telephone line circuits. Dedicated leased lines are connected and “live” at all times, whether they are being used at the moment or not. Several factors have made this option undesirable, such as the need for high bandwidth for video, the recurring monthly costs, and the general movement by the carriers away from dedicated copper circuits. Costs for the lines can be fairly expensive, and are based on the distances involved for each circuit and the particular phone company’s rates.

Dial-up Telephone Service

Dial-up telephone lines are identical to the familiar telephone lines used for voice communication in residences and businesses. Dial-up lines differ from dedicated telephone lines in that they are used only when needed. Dial-up lines offer limited bandwidth and are useful only for low-speed data needs.

With dial-up technology, a phone line is brought into the cabinet and assigned a standard 10-digit telephone number as if it is a residence or business. Typically, it terminates in a standard RJ-11 phone jack. A two-wire modem, plugged into the jack and connected to the control equipment, can initiate (dial out) or receive a call (auto answer).

Dial-up lines have proven to be relatively successful in distributed systems. One potential drawback is that the telephone service is not secure from other telephone network users, leaving the system vulnerable to computer hackers. Some modems employ a simple security algorithm. Only the incoming calls from a known modem with an identification code built into the hardware will be answered by the called modem. Dial-up lines also do not present the opportunity for real-time monitoring of an entire system. They are still a viable option for some purposes, however, such as feeding audio messages to a Highway Advisory Radio (HAR) transmitter site.

Telephone companies provide dial-up lines for ITS devices at a monthly fee, which is usually set through negotiation between the telephone company and the jurisdiction operating the system. The monthly rate for dial-up lines is typically similar to a standard business rate (average of $50), which is generally less than the rate for dedicated leased lines.

Wireless

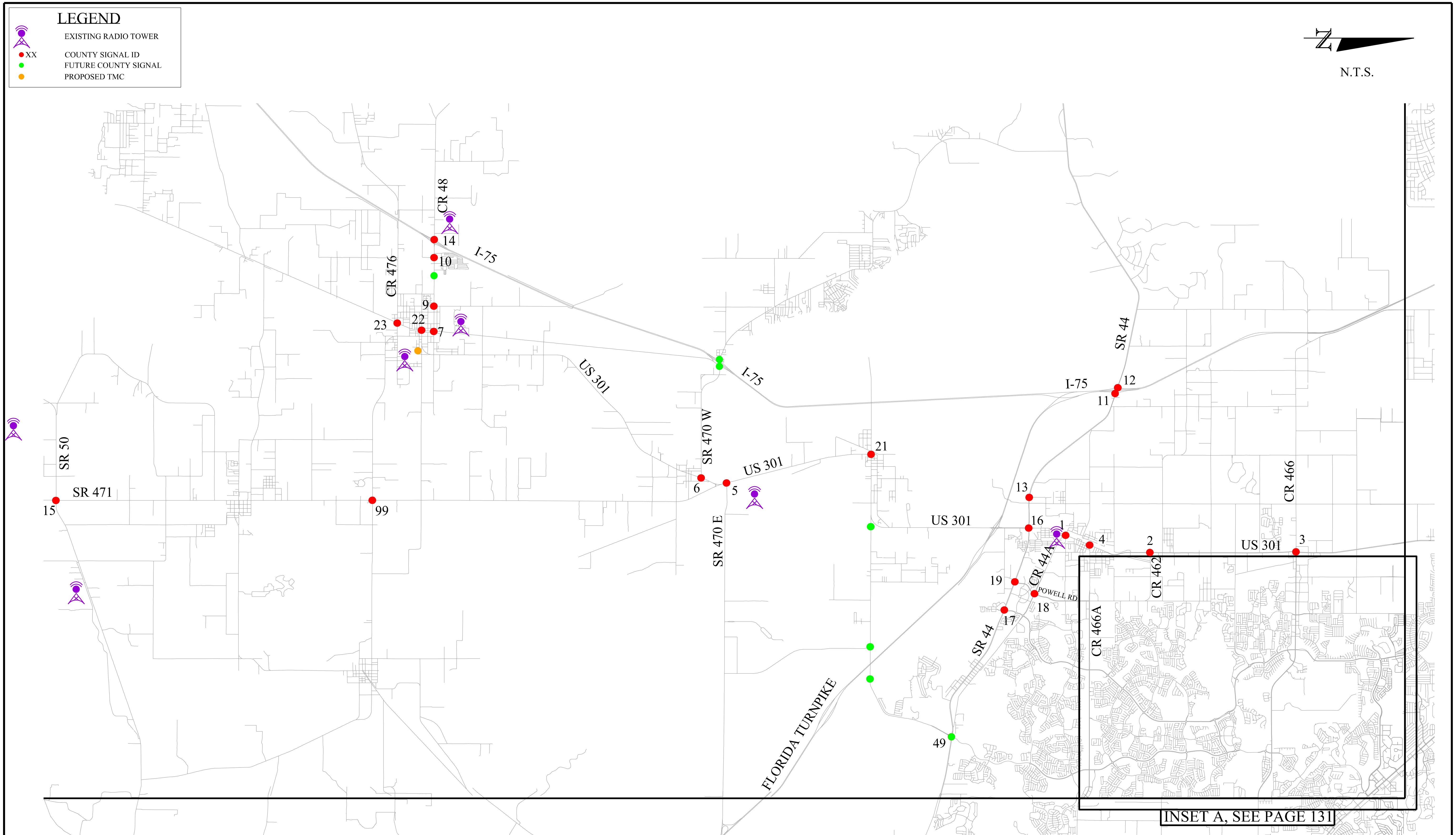
Radio communications in ITS applications have grown in use and performance in recent years. This is due primarily to a 1985 FCC authorization of several bands using Spread Spectrum Radio (SSR) for use in the commercial arena. SSR utilizes frequencies in the 902 to 928 Megahertz (MHz), 2.4 Gigahertz (GHz), and 5.8 GHz ranges. These frequencies are in the Industrial, Scientific, and Medical (ISM) bands and have been set aside for use by industry, schools, and hospitals. The FCC has made these frequencies available without the necessity of a formal FCC-issued license. The only requirement is that the equipment be “type accepted” by the FCC. An additional frequency allocation at 4.9 GHz was also made available for “public safety” use in 2002. A license is required, but it covers an entire geographical area.

A primary issue of using any of these bands is interference. For the ISM bands, since there is no formal license, all users share the frequencies without priority. A private citizen’s cordless telephone has equal rights to the frequency as a jurisdiction's ITS. The proper choice of frequencies and antennas can mitigate this potentially severe interference problem. For the 4.9 GHz band, use must be coordinated with other users in the area, but this is generally a small number of known users. Some agencies have also used fixed microwave (licensed) to serve as high-capacity backbone links between groups of wired or wirelessly connected intersections. Sumter County currently has a license to operate on the microwave bandwidth and has several towers located throughout the county. The locations are shown in Figure 21.

Wireless Technical Considerations

Figure 22 is a sample of the wireless network coverage between two remote devices on a system. In order to achieve successful communications, the signal must be within the acceptable decibel with respect to milliwatts (dBm) range, have a minimum fade margin of 20.00 dB, and have a clear Fresnel zone. As can be seen in Figure 23, the fade margin is acceptable at 26.97 dB. Figure 24 shows the clear Fresnel zone. By having an acceptable fade margin and Fresnel zone, the signal will be strong enough to transmit between the antennas.

The data transmission capability of the IEEE 802.11 standard is between 1.6 Megabits per second (Mbps) and 2 Mbps. The IEEE 802.11b standard has the capability of a throughput of 11 Mbps. 802.11g has the capability of 54 Mbps, 802.11n has a maximum data rate of 600 Mbps, and 802.11ad has a theoretical maximum data rate of 6.75 Gigabits per second (Gbps). In practice, however, all of these technologies deliver lower rates (about 50 percent less) than their maximums. The higher rates associated with 802.11n and 802.11ad allow radio to overcome some of the latency issues incurred with older radio installations. Other problems related to radio are data loss due to error correction and congestion caused by disrupted communication between the transmitter and the receiver.



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Drawing Title	FIGURE 21: EXISTING SUMTER COUNTY TOWERS MAP (PAGE 1 OF 2)

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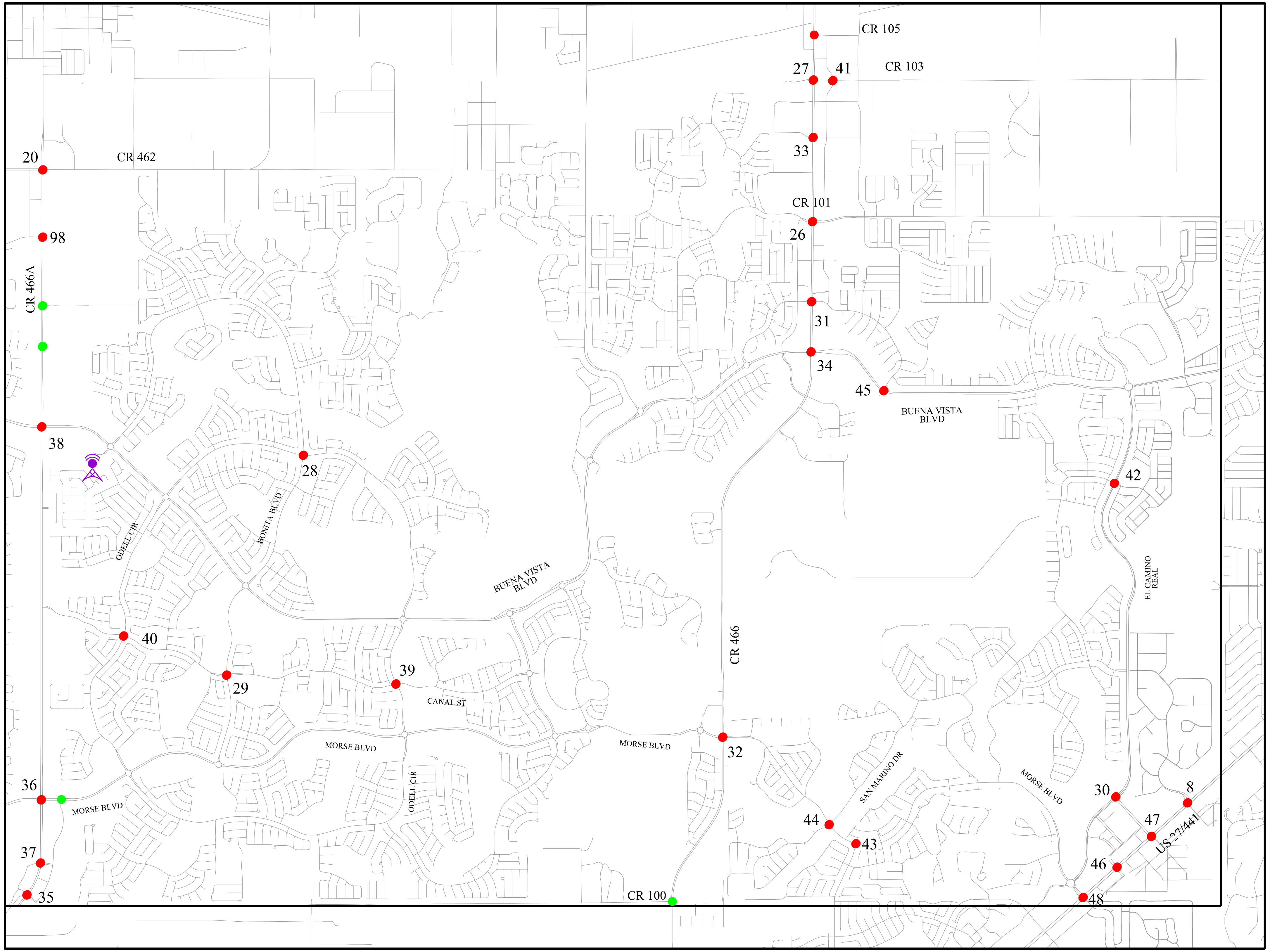
INSET A

LEGEND

- EXISTING RADIO TOWER
- XX COUNTY SIGNAL ID
- FUTURE COUNTY SIGNAL
- PROPOSED TMC

N.T.S.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 21: EXISTING SUMTER COUNTY TOWERS MAP (PAGE 2 OF 2)

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Title: V:\0116002 - Sumter County ATMS Phase 2\Project Working Files\Documents\Task II - Master Plan Document\Figures\Master Plan Figures\Figure 21 - Sumter County Towers Map.dgn
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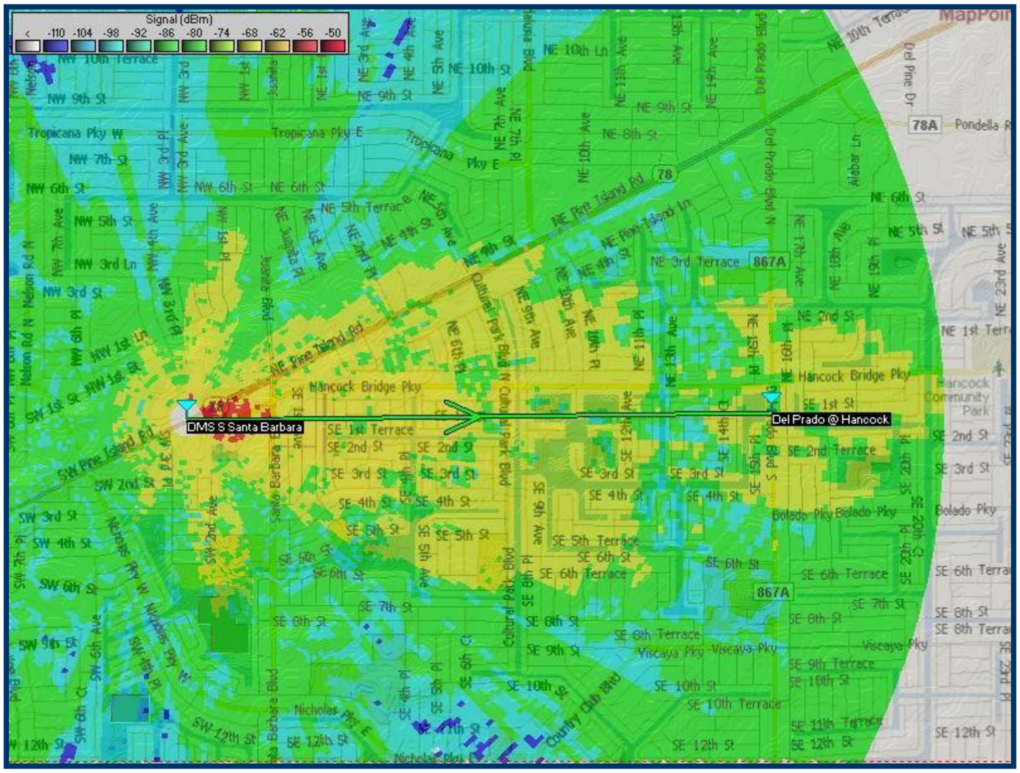


Figure 22: Wireless Network Coverage

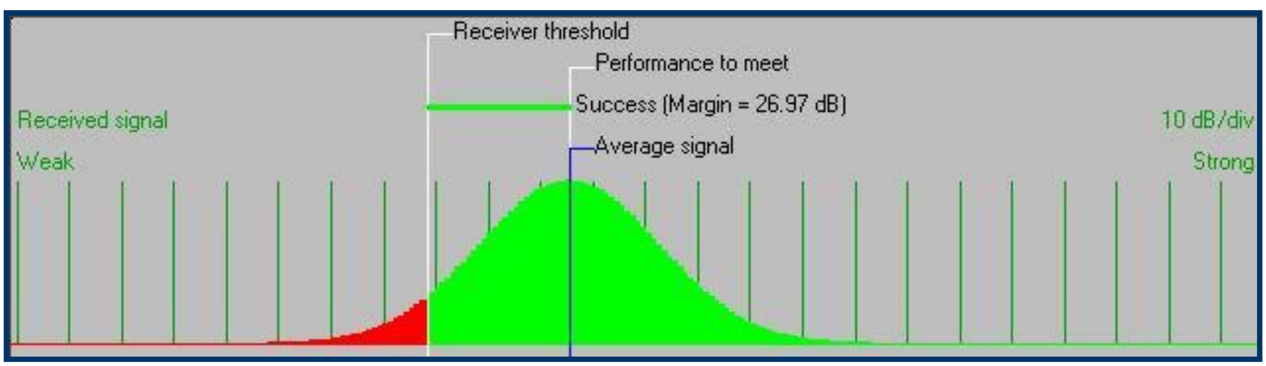


Figure 23: Signal Distribution

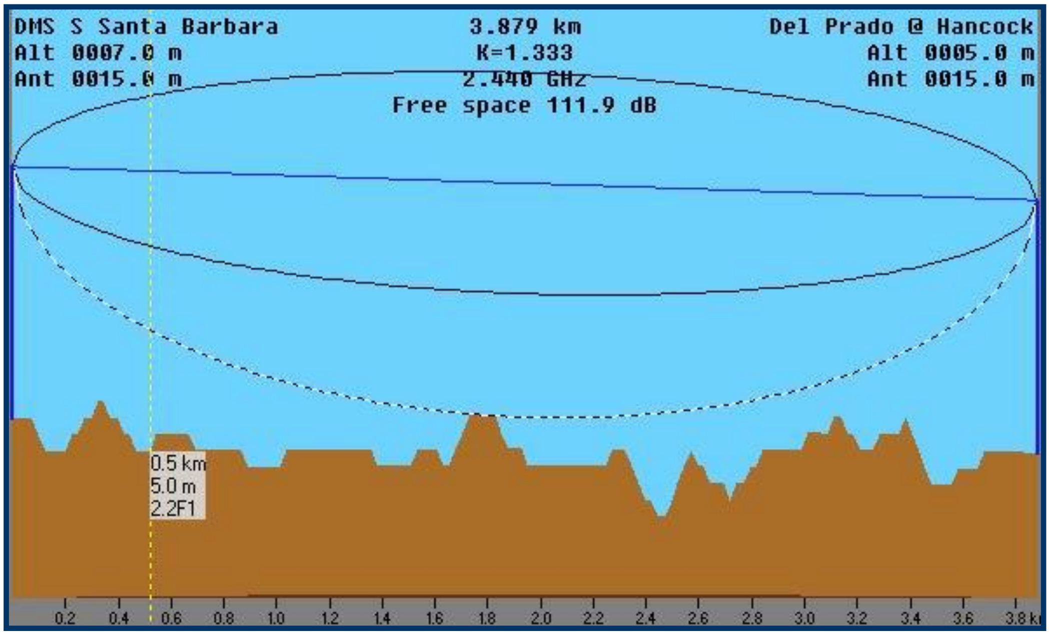


Figure 24: Fresnel Zone

Advances in telecommunications have helped to reduce the many issues associated with using radio as a primary communications medium. In the Kansas City area, Operation Green Light currently uses a 5.8 GHz radio system that is part of their traffic control system. The traffic controllers pass data to backhaul sites using 18 GHz microwave to connect to the traffic control center. This system is supporting over 600 intersections, and the network supports CCTV camera images as well. Most of the wireless links deployed today utilize off-the-shelf technologies that have seen widespread deployment in commercial settings.

The Sumter County ATMS can achieve similar results utilizing a radio network with directional antennas for some of the links. Remote devices can easily integrate into the communication system using radio systems installed with directional antennas pointed back to a radio unit attached to the fiber network or to a receiver at the TMC. This is a cost-effective approach to communicate with the devices in remote areas.

Cellular Data Services

The various cellular providers offer data services of varying capacity and price. Services range from about 100 kilobits per second (kbps) to several Mbps, and the offerings change often.

Advantages of using cellular services include a low initial cost and minimal maintenance costs. However, cellular services are subject to disruption caused by storms, and the service areas may be limited and can vary based on provider.

4G Services

Carriers are currently deploying what is known as “4G” services, such as WIMAX (World Interoperability for Microwave Access) and LTE (Long Term Evolution). 4G services support peak data rates of 100 Mbps downlink and 50 Mbps on the uplink. 4G coverage varies by carrier, but devices are backwards compatible with older 3G and 2G networks, which have a greater coverage area. 3G service data rates are typically 3.1 Mbps downlink and 1.8 Mbps on the uplink. A 4GB per month data plan will cost approximately $45.

Wireless Internet Service Providers

Beyond the typical carrier cellular service providers, a Wireless Internet Service Provider (WISP) offers a tailored solution for agencies that do not wish to maintain their own wireless infrastructure. A WISP will provide wireless internet services typically on set pricing terms dependent on the number of locations, bandwidth allowances, and data usage. Unlike the typical cellular carrier, a WISP will typically provide and service the necessary wireless equipment to maintain connectivity. The service frees the local agencies from the overhead and maintenance responsibilities of a wireless communications network. Another benefit of a WISP is that outdated hardware will be replaced by the vendor as new technologies are developed. Additionally, by using a WISP, budgeting can be simplified as pricing will be documented in the contract agreement.

Application Service Providers

One step above a WISP is an application service provider built for traffic signal and ITS system management. Products such as Miovision’s Spectrum deliver an end-to-end turnkey management solution for an agency’s signal system. Wireless 4G LTE hardware inside the traffic signal cabinet collects data and provides remote access for the signal and ITS equipment. The data can be accessed and managed remotely on an internet cloud platform using a web-based portal system and/or an agency’s own software. The service allows remote connectivity using embedded security and virtual private networks. As with a WISP, pricing is dependent on the number of intersections, devices, and services the client wishes to connect, so a monthly or yearly budget can easily be estimated.

Hybrid

In most systems, the type of service and bandwidth required dictates the choice of communications media, and as the different media have different attributes, a hybrid system is often the best fit. Choosing between fiber, radio, dial-up telephone, and cellular data requires an understanding of the strengths and weaknesses of each communication medium. Which is best for the particular link in question depends on the communication requirements and the cost trade-offs associated with the implementation of each. The communication requirement(s) of the remote devices must be identified and the types of information required by the system should be identified. Data and voice have relatively narrow bandwidth requirements and are easily handled by radio or dial-up telephone. Video, which has a much greater bandwidth requirement than either of the other two, is much more difficult to handle.

The choice of link technology should be made based on what provides the best quality output and required bandwidth from the field devices, and is most cost-effective. The different system requirements also indicate that the communications network will be comprised of a mix of the various media.

Protocol Requirements

The effectiveness of any traffic control features included in the Sumter County ATMS will be judged at least in part by the efficiency with which various commands, messages, and data are transmitted to and from the field devices. This means that the system must be able to monitor and communicate with a variety of field devices such as traffic signal controllers, DMS controllers, CCTV controllers, vehicle detection/count stations, and other devices.

NTCIP

A communications protocol is a set of rules for how messages are coded and transmitted between electronic devices. The equipment at each end of a data transmission must use the same protocol in order to successfully communicate. Having several proprietary communications protocols will add considerable stress to the communications infrastructure, which typically is the most expensive component of a traffic signal system. Therefore, the ATMS for Sumter County should have a common interface to support all of the field devices within the system, both existing and proposed.

When developing a network, there are certain standard protocols that must be followed to ensure interoperability between the various types of hardware and software. For networks, these protocols have been defined under the seven-layer Open Systems Interconnection (OSI) model shown in Figure 25.

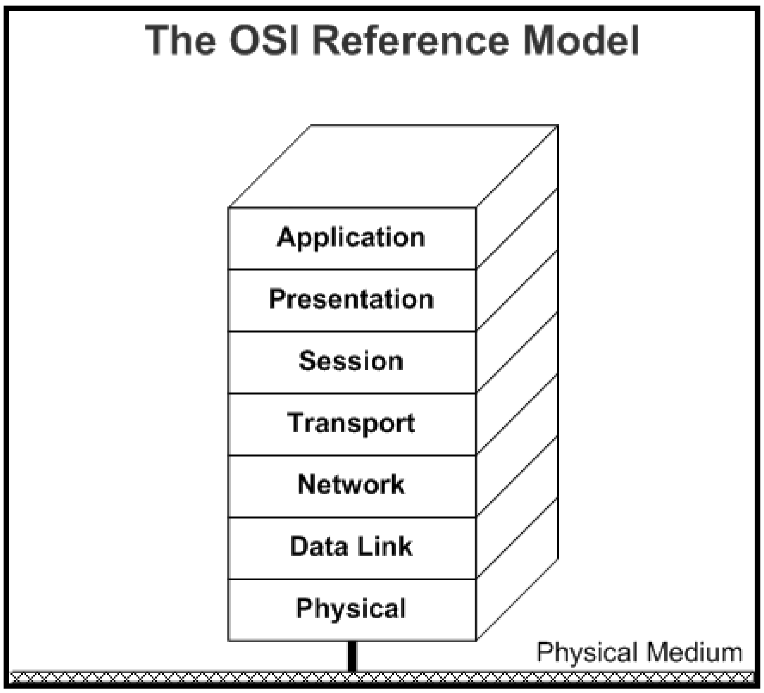


Figure 25: OSI Model

The lower layers concern the physical medium the data is transported on, such as fiber optic cable, and how the data is transported. The commonly used IP is a layer 3 protocol, while the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) are higher up at layer 4. These protocols form the underlying framework for the most common application layer protocol used in ITS, the NTCIP. The NTCIP itself has several protocol levels within it.

The NTCIP was developed to provide a standardized format for interaction between the field devices and the central system. Devices that will be deployed for the Sumter County ATMS should use the NTCIP for communications to help ensure compatibility between devices. The NTCIP is a variation of Simple Network Management Protocol (SNMP). SNMP is also used in many ITS systems as a method of managing the communications infrastructure.

The NTCIP can be defined as a communications standard protocol for interfacing between traffic control devices of all types. The NTCIP will allow true peer-to-peer communications (i.e., any device can communicate directly with any other device), the use of shared communication channels, and the ability to interconnect devices manufactured by different companies. The purpose of the NTCIP is to be a non-proprietary protocol that meets existing traffic control requirements, supports traffic management communications, accommodates future technology growth, and conforms to existing software and communications standards to the maximum extent feasible. This protocol provides a guideline for communication between devices and is not vendor or application specific.

System designers have often faced the problem of placing devices, each having their own unique and proprietary protocol, on the same communications channel. This makes it very difficult to mix equipment from different vendors in the same system and to communicate between systems operated by adjacent cities. For example, a field technician in an emergency situation faced with replacing a controller operating within a proprietary traffic control system must have a controller of the same brand on the repair truck. The agencies must rely on a single supplier of either hardware or software to ensure all components of the system work together. For decades, the lack of interoperability (the ability to connect devices of different types to the same communications medium) and interchangeability between different brands of signal system devices created a host of problems for traffic engineers. Specifications for signal systems had to include an external conversion box (remote communications unit) to translate system communications into controller inputs, or the system software and all the local devices had to be supplied by the same vendor to maintain the compatibility of devices.

Utilization of the NTCIP standard helps to solve these problems by providing a common interface for field devices to communicate. It provides a common standard communications protocol for transmitting data and messages between field devices, and monitoring and control systems that can be used by all vendors and for all types of system devices. One or more vendors may have their own unique and proprietary communications protocols, but these protocols should also comply with the NTCIP standard.

A major benefit of the NTCIP is the ability to provide device interchangeability and compatibility. Device interchangeability and compatibility requires that any two devices of the same type (such as traffic signal controllers, DMS controllers, etc.) operate identically, even if they are from different manufacturers. This aspect of communications is important to allow the best device to be chosen at various stages in a system's growth. It allows the system's owner to take advantage of new developments without having to discard existing devices installed at other points in the system.

As stated earlier, NTCIP uses communication protocols that conform to the OSI model and there are further levels defined within the NTCIP. Utilizing the OSI model as a base foundation and the appropriate choices of communication protocols at different layers of the network model allows the NTCIP to deliver interoperability, interchangeability, and compatibility between systems, devices, and vendors' equipment. The NTCIP defines the data link and physical layers to guarantee interoperability of devices that share a communications link. As long as all devices use the same protocols to represent data and they agree on a common data link packet definition, multiple network layers can be supported on the same communications link.

The NTCIP has further defined levels that are specific to ITS, to help distinguish them from the OSI and Internet layers. These levels are defined in The NTCIP Guide (currently NTCIP 9001 v04.06) and consist of:

- Information Level – This level provides standards for the data elements, objects, and messages to be transmitted (e.g., TCIP, TS3.5, MS/ETMCC, etc.).
- Application Level – This level provides standards for the data packet structure and session management (e.g., SNMP, STMP, DATEX, CORBA, FTP, etc.).

- Transport Level – This level provides standards for data packet subdivision, packet reassembly, and routing when needed (e.g., TCP, UDP, IP).
- Subnetwork Level – This level provides standards for the physical interface (e.g., modem, network interface card, CSU/DSU, etc.) and the data packet transmission method (e.g., HDLC, PPP, Ethernet, ATM, etc.).
- Plant Level – This level consists of the physical transmission media used for communications (e.g., copper wire, coaxial cable, fiber optic cable, wireless).

These standard levels were developed to assist with the unique data and communication requirements of the ITS industry. On-going development work continues within the national ITS industry to review and modify current NTCIP standards to accommodate the fast-changing ITS marketplace and to take advantage of new technologies as they are developed. Where possible, the NTCIP has tried to adopt the existing OSI standards or develop a relationship between the OSI standards and the ITS model. By doing this, the NTCIP has been able to avoid developing totally new communication standards for the ITS industry.

The NTCIP places most of its focus on the application level. This is directly related to the special communication needs of the ITS-related devices used in systems. This has led to the acknowledgement of specific ITS communication needs, which are defined as:

- Continuous, automated, secure, real-time exchange of large volumes of small data packets in a network, where any agency can communicate with any other agency.
- Continuous high volumes of real-time data sent to and from embedded processors in roadside or on-vehicle equipment sharing the same, often low-speed, data channel and requiring low latency.

Types of Devices Supported

The NTCIP was designed with the intention of supporting all types of computer systems and field devices used within the ITS environment. The underlying layers of the communications protocol in the NTCIP can support communications for almost any type of field device. This standard includes a set of messages called object definitions for object types unique to each type of device. For example, CCTV camera control requires a message such as "Pan right 'X' degrees" that is not needed for other devices. However, all devices share a set of global messages such as "Set date and time". The unique messages, combined with the global messages and the underlying layers of the NTCIP (which are also common to all devices), allow the devices to communicate using one standard protocol.

Since all devices use the same fundamental protocol, different types of devices can be mixed on the same communications channel. The NTCIP is independent of the vendor hardware, application, or device used. For example, the NTCIP can be used directly with any type of traffic signal controller as long as the traffic controller software supports the NTCIP standard. This is often referred to as being NTCIP-compliant. Generally, all new controllers provide NTCIP-compliant features. However, most suppliers still support specific features that are not included in NTCIP definitions and are provided as extensions to the standard. Even when the extensions are used, they still utilize the same underlying standard protocols.

System Configurations Supported

One of the fundamental principles of the NTCIP is that it is independent of the way in which a traffic control system is configured. For example, the NTCIP can be used in any of the typical traffic signal system configurations, including distributed and closed-loop.

Early versions of NTCIP assumed that all field devices communicate with a master or central control of some kind. The master may have been a central computer, a field master, or another field device. However, with peer to peer enhancements such as C2C support, communications are supported in which devices are able to talk directly to other local devices without having to wait to be polled. An example of C2C communications is two TMCs that exchange real-time information about the inventory and status of traffic control devices. Additionally, disparate traffic signal systems may exchange information (including second by second status changes) across geographic or traffic system boundaries to achieve timing coordination with other systems.

Types of Data Links Supported

The NTCIP can be used over any type of direct communications link. Examples of different types of communications media that could be used include twisted-pair cable, coaxial cable, fiber optic cable, telephone cable, cellular, and wireless (narrow band, spread spectrum, microwave, etc.). It does not matter whether the communications media is agency-owned, leased, or dial-up.

Any data transmission rate can be used as long as the devices can support those speeds. It does not matter if the communications configuration uses concentrating nodes or multiplexers to combine multiple channels or trunk lines.

Types of Messaging Strategies Supported

The initial version of the NTCIP was based exclusively on polling as a messaging strategy. Polling involves the master sending a request message addressed to a particular device and that device sending back a response message. The field device can speak only when spoken to. The NTCIP allowed a master to broadcast messages to all field devices on a channel simultaneously. The protocol also supports "trap" messages, which are event-driven messages sent by the field device at the next poll. This enables a field device to report unusual events and faults when they occur, without having to send complete status information at every poll. The strategy is still supported in current versions.

Signal System Functions Supported

The NTCIP provides messages or predefined objects as defined by a Management Information Base (MIB) directly supporting the most common functions and features of traffic signal systems, including:

- Setting controller clocks
- Uploading traffic volumes and occupancy
- Instructing controllers to change a particular coordination pattern
- Monitoring signal status such as phase color, phase demand, and detector status
- Monitoring the controller for faults and alarm conditions
- Checking and changing settings in the controller database

These and other supported functions cover most of the features common to modern traffic signal systems, including the dynamic map display of groups of signals and dynamic graphic displays of individual intersections. In this way, the NTCIP has been designed to be very flexible to support the wide variety of current and future configurations and features of ATMSs.

Disadvantages of the NTCIP

The following disadvantages of the NTCIP must be considered when deciding whether or not to implement the NTCIP for a particular project:

- Industry Resistance – The NTCIP standards process relies on the definition of "objects" to provide the interoperability desired. Three groups of objects have been identified - mandatory, optional, and manufacturer-specific. A manufacturer may claim NTCIP compliance if they have implemented only the mandatory objects. If the operating agency wants the functionality provided by one or more of the optional objects, this must be very carefully stated in the project specifications. Additionally, there is subtle industry reluctance to implement the NTCIP completely. The various traffic controller manufacturers will lose some, possibly a major, degree of uniqueness that sets them apart from their competition in a highly competitive market. In recent years, however, the industry has seen the adoption as inevitable and have now generally embraced it. They are still offering unique features through the addition of specialized NTCIP objects.
- High Overhead – The structured message format required by the NTCIP adds significantly to the length, and therefore transmission time, of a message. A traffic signal controller circuit containing eight intersections normally handles a message to and from each intersection once each second and is routinely sent at 1200 baud. This same intersection configuration utilizing the NTCIP format requires a transmission speed of 9600 baud. The speed itself does not pose a problem for a fiber circuit utilizing an Ethernet protocol, but many legacy user-owned copper cable plants cannot handle this higher speed.
- Large Processing Power Requirement – The processing power required to generate the necessary NTCIP format and to interpret this format at the receiving end is significant. Many older controllers do not have the required processing power. This has been one

factor influencing the development of the 2070 and the latest generation of NEMA TS-2 controllers.

NTCIP Acceptance and Deployment

During the early years following the announcement of the development of the NTCIP, there was reluctance to implement it by both the equipment manufacturers and jurisdictions. As more equipment has become available and as projects are successfully implemented, this reluctance is fading. The NTCIP implementation is proceeding at a more rapid pace within the equipment manufacturing community with the advent of IP-addressable units and their greater processing power.

The list of successful projects using the NTCIP is expected to grow as more and better equipment and software are developed that implement the NTCIP. Nevertheless, each system/project must be evaluated to determine if utilization of the NTCIP will contribute to system/project effectiveness.

ITS ARCHITECTURE

The US Department of Transportation (USDOT)-developed National ITS Architecture (NITSA) framework is a standard that provides a common framework for planning, defining, and integrating ITSs throughout the country. Initially, the project was national in scope, utilizing a common language versus a more specific regional language. The concept was to keep the development of the national architecture non-specific. As the architecture matured, administrators realized the architecture needed to be divided for regional, state, and local jurisdictions. This provided the individual governing bodies with flexibility, at the same time giving them a national guideline to reference and uniform standards to incorporate into their ITS strategies and designs, thus ensuring national interoperability between system designs and vendors and the products they provide. The architecture defines the functions, physical entities, and data flows that are required for ITS applications. Furthermore, the NITSA has been divided into five concepts that include:

- User Services and User Service Requirements
- Logical Architecture
- Physical Architecture

- Equipment Packages
- Market Packages

User Services and User Service Requirements

The NITSA defines seven user services bundles that include specific user services. User services represent what the system will do from the perspective of the user. A user might be defined as the public or a system operator.

Table 19, taken from the Key Concepts of the NITSA (as of this writing, located at http://www.iteris.com/itsarch/html/static/keycon.htm), defines the user services which formed the basis for the NITSA development effort. These user services were jointly defined by a collaborative process involving the USDOT and ITS America, with significant stakeholder input. The concept of user services allows the process of system or project definition to begin by thinking about what high level services are provided to address identified problems and needs. New or updated user services have been added to the NITSA over time.

Sumter County currently has services packages defined within the FDOT District Five Regional ITS Architecture which can be found at http://www.consystec.com/florida/d5/web/index.htm.

Table 19: User Services for the NITSA

User Service Bundle	**User Service**
Travel and Transportation Management	• Pre-trip Travel Information • En-route Driver Information • Route Guidance • Ride Matching and Reservation • Traveler Services Information • Traffic Control • Incident Management • Travel Demand Management • Emissions Testing and Mitigation • Highway-Rail Intersection
Public Transportation Management	• Public Transportation Management • En-route Transit Information • Personalized Public Transit • Public Travel Security
Electronic Payment Services	• Electronic Payment Services
Commercial Vehicle Operations	• Commercial Vehicle Electronic Clearance • Automated Roadside Safety Inspection

User Service Bundle	User Service
	• On-board Safety Monitoring • Commercial Vehicle Administrative Processes • Hazardous Material Incident Response • Commercial Fleet Management
Emergency Management	• Emergency Notification and Personal Security • Emergency Vehicle Management • Disaster Response and Evacuation
Advanced Vehicle Control and Safety Systems	• Longitudinal Collision Avoidance • Lateral Collision Avoidance • Intersection Collision Avoidance • Vision Enhancement for Crash Avoidance • Safety Readiness • Pre-crash Restraint Deployment • Automated Highway Systems
Information Management	• Archived Data Function
Maintenance and Construction Management	• Maintenance and Construction Operations

Logical Architecture

The logical architecture is an entity relationship (ER) diagram of a complex traffic organizational flow chart. This tool focuses on the functional aspects of the systems traffic flow, allowing system designers to put emphasis on system functions, informational flows, and improvements to new system designs. A good logical architecture diagram should only provide a guideline and should be independent of technology or system functional implementation. Utilizing the processes defined in the ER diagrams, data flow diagrams (DFDs) can be generated depicting the transportation management functions graphically.

Physical Architecture

The physical architecture is not a detailed design view of the system. It is a physical representation of how the system interacts with the other functional areas of the system design. Furthermore, the physical architecture provides systems implementation support for a single subsystem or multiple subsystems. The interface requirements of the individual or group subsystems can also be defined in the physical architecture, thus allowing the development of the communications configurations between the various transportation management organizations. Figure 26 is an example of the NITSA subsystems interconnection diagram showing the functionality of an overall system/sub-system design. Finally, the last part of the physical architecture defines who will communicate what to whom between the traffic management system entities.

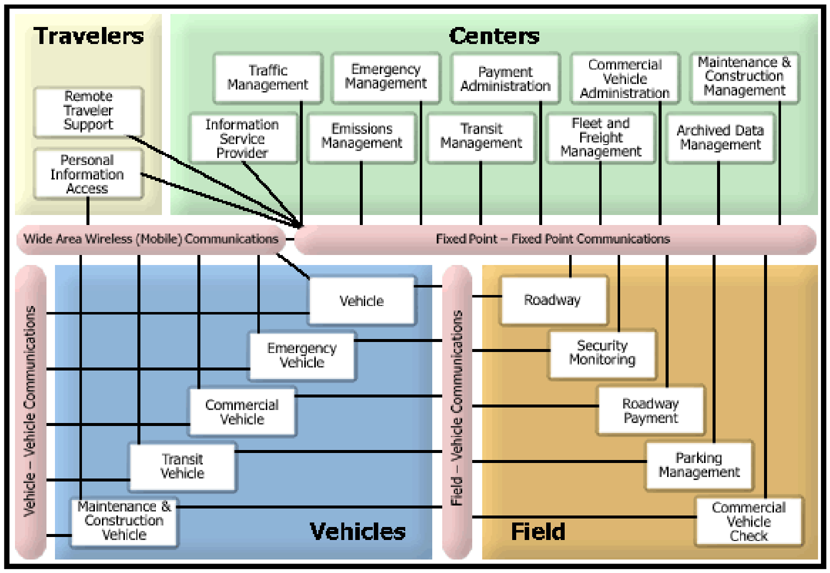


Figure 26: NITSA Subsystems and Communications

Equipment Packages

Equipment packages can best be described as off-the-shelf solutions that normally are not complete solutions. The term equipment package is used to define a set of functions of a particular subsystem that consists of both hardware and software. These are often associated with market packages and consist of equipment packages designed for specific transportation applications and usually meet the requirements of one or two subsystems within the NITSA.

Project Architecture

The USDOT used the Safe Accountable Flexible Efficient Transportation Equity Act - A Legacy for Users (SAFETEA-LU) legislation and now uses the Moving Ahead for Progress in the 21st Century (MAP-21) legislation to require conformance to the NITSA in order to secure federal funding for any new ITS deployment initiative. The goal of the over-all strategy of the NITSA is to guide the implementation of ITS projects to an open architecture. This open architecture will ensure interoperability between system designs, as well as allow vendors the flexibility to meet the needs of the public and private sectors.

A project architecture was developed on October 26, 2016 for Sumter County ATMS using the NITSA and the regional architecture as bases. The regional architecture was developed as part of a statewide effort and was updated January 18, 2016. This process ensures that the expansion of the ATMS will be accomplished within the framework established by the regional, state, and national architectures.

TOPOLOGY

Based on the capacity requirements for most of the ATMS communications network, fiber optic cable should be used to communicate with intersection controllers and ITS equipment to the extent that it is cost-effective. Alternative methods such as wireless or cellular connectivity will be utilized for remote locations where it is not economically feasible to connect to fiber.

Fiber Optic Communications Technologies

The design of fiber optic cable has been stable for many years. What has changed are the methods used to "light up" the fiber and transmit data over the medium. This section will address those methods, which are illustrated in Figure 27**.**

Point-To-Point Technology

The simplest form of using fiber optic cable is to establish a device at each end of the fiber which can send one type of data in one direction. Some devices can also send the data bi-directionally over a single fiber. This type of system is limited in that it usually only sends one signal to one endpoint. Each type of device to be controlled usually needs its own fiber pair. There is no redundancy built into the system, and it is highly inefficient. In spite of these drawbacks, it is still often used for short links from devices into a larger network utilizing more efficient technologies.

Drop and Insert Technology

The next form of system, called drop and insert, is composed of a "daisy-chain" of devices, with each device repeating the signal to the next. Multi-drop multiplexing fiber optic modem devices provide asynchronous data rates up to 38.4 kbps for serial protocols such as RS-232, RS-485 and RS-422. One or more communication modems is connected to a telephone line for communications to the monitoring entity or computer system. This design is more efficient from fiber usage and plain old telephone service (POTS) standpoints than point-to-point service. Many devices can be accommodated by one pair of fibers and data can be relayed from one modem to another until reaching the one connected to main computer system. These systems also allow the network to be configured as a self-healing ring, whereupon a break in the fiber or failure of one device causes data to be rerouted the other direction on the ring, so that there is minimal impact on the network. The redundancy is limited in scope to a single failure. These networks also tend to be proprietary, with different modems and non-interoperable equipment from different vendors. The limitation of data rates make this technology obsolete today.

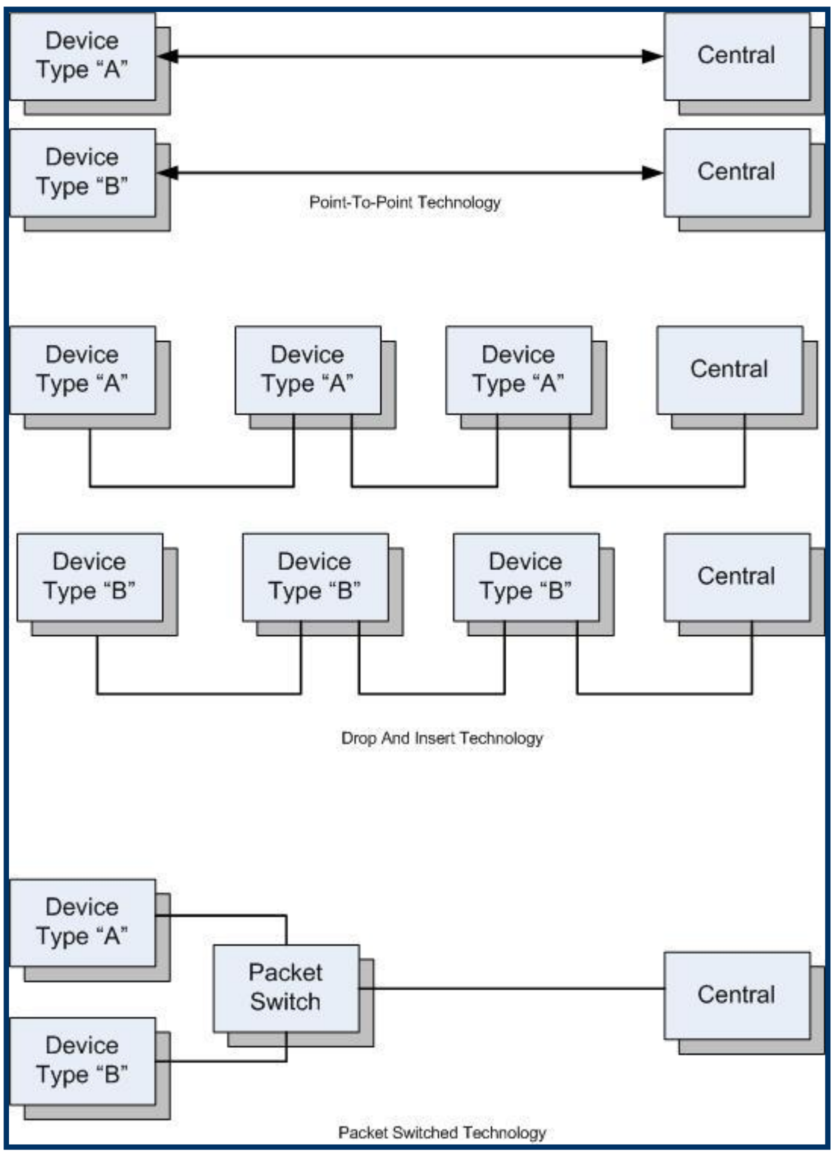


Figure 27: Communications Technologies

Packet-Switched Technology

The telecommunications industry tends to drive changes in the available equipment, and their need for more standardized systems caused several new systems to be developed. These are generally known as packet-switched systems, and many have been developed. Some packet-switched systems that have been developed include:

- X.25
- Frame-Relay
- Asynchronous Transfer Mode (ATM)
- Synchronous Optical Network (SONET)
- Ethernet

For the most part, nearly all of these have been dropped in ITS deployments with the exception of Ethernet. The other technologies have various drawbacks such as limited bandwidth, poor scalability, and excessive costs. Because Ethernet has become the overwhelming choice, this section will focus on that technology.

Ethernet Communications

Nearly all communications systems which are being deployed at this time utilize some form of Ethernet technology. Ethernet was invented in the 1960s and has progressed to be the de facto standard for data communications. It has proven to be highly scalable, and as the number of deployments has grown, the costs have continued to decrease. In addition, there are readily available units manufactured for the extreme environmental conditions commonly encountered in ITS deployments.

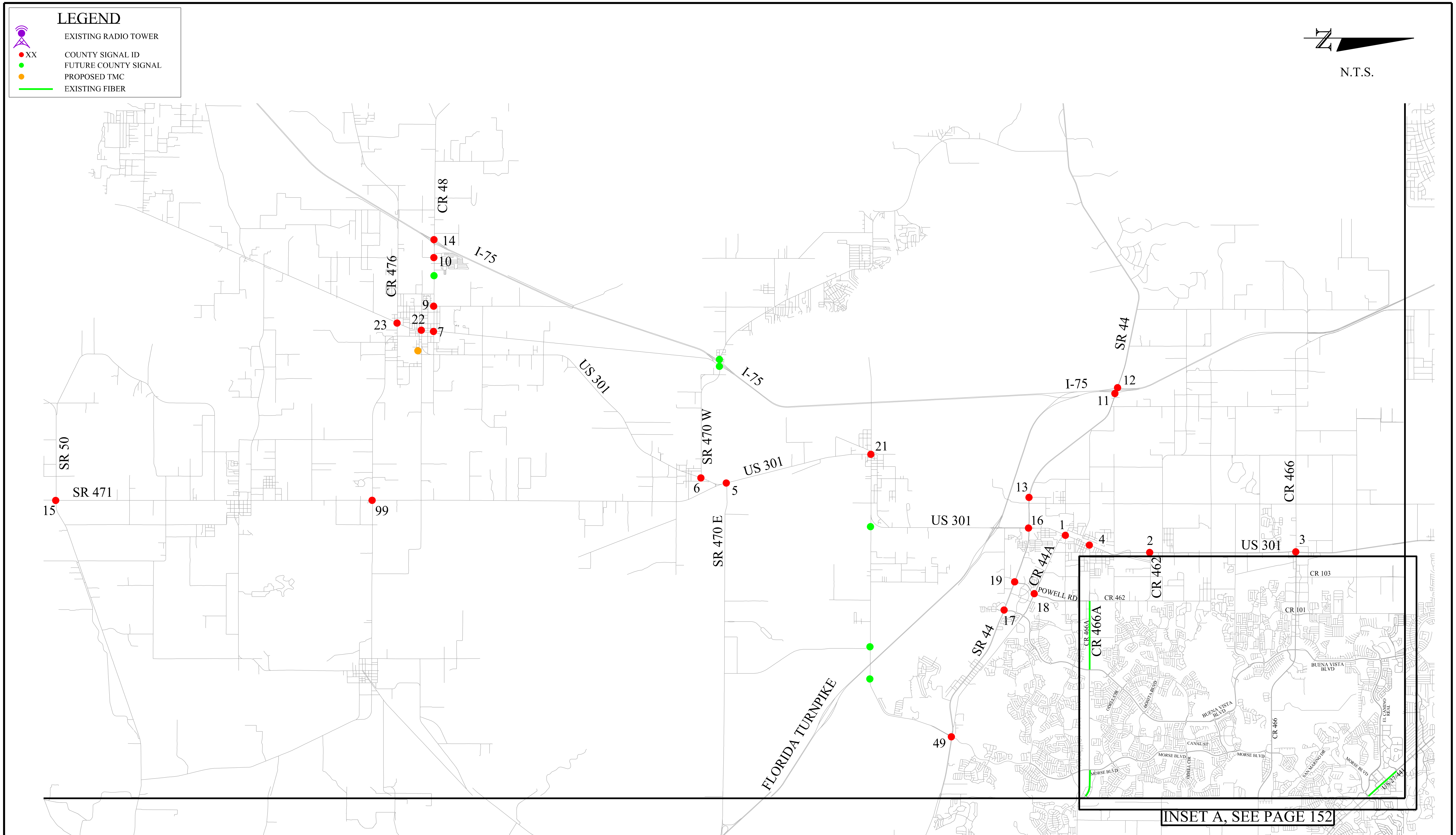
Ethernet networks are generally divided into backbone (or trunk) segments and local segments. Backbone segments generally run between node sites and utilize very high speed connections over longer distances. Local segments usually utilize lower speed connections and connect the field devices to a node site where the data is aggregated onto the backbone.

Many ATMS communications networks are based on a combination of 100 Mbps Fast Ethernet (100Base-TX) for branches and Gigabit Ethernet (GE) for the backbone. Most jurisdictions are now utilizing or planning to use 10 Gigabit Ethernet (10GbE) for their backbone. In the past, the choice of bandwidth was always driven by video. Many ATMS deployments used 6 Mbps as a standard video requirement, but newer standards allow for high quality video over reduced bandwidths. However, new design and deployments must also take into consideration adaptive traffic control technologies, the rapid development of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications as well as autonomous vehicle technologies which may require high speed data rates and bandwidth for exchanging information. Traffic signal controllers and ATMS deployments will be called upon to interface and integrate with these new technologies, providing more efficient traffic flow and increased driver safety.

SUMTER COUNTY TOPOLOGY

Sumter County currently has a limited deployment of multimode fiber optic cable capable of supporting limited traffic management projects. Currently, the County's fiber optic network only provides a communication medium for traffic signal coordination between nearby intersections. The current network uses a point-to-point or drop and insert topology to connect the limited amount of traffic signal controllers. The limited existing infrastructure will be integrated with new single mode fiber optic cable into the ATMS project and become part of a packet switched Ethernet network. Figure 28 shows the existing current Sumter County traffic fiber.

The Sumter County network will need a combination of both fiber optic cable and wireless connections to communicate between all of the devices. In addition to the limited fiber optic infrastructure, Sumter County currently has some backbone wireless communications in place, with very limited bandwidth available for data communications. Because of the low allocated bandwidth limitation, the microwave wireless system is not solely sufficient to support modern technologies.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 28: EXISTING SUMTER COUNTY TRAFFIC FIBER (PAGE 1 OF 2)

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LEGEND

- XX COUNTY SIGNAL ID
- FUTURE COUNTY SIGNAL
- PROPOSED TMC
- EXISTING FIBER

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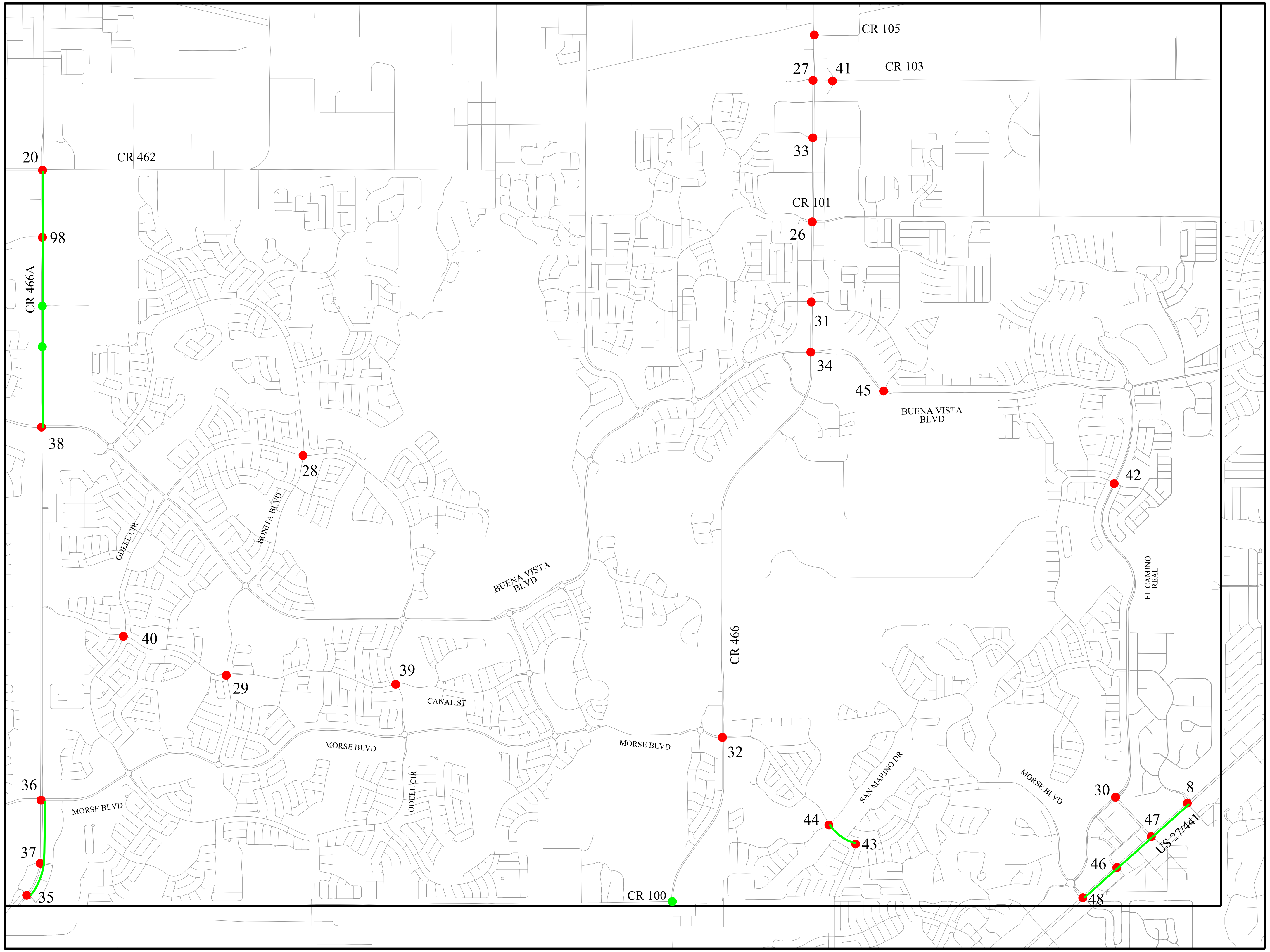

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Project Title	SUMTER COUNTY ATMS MASTER PLAN
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SUMTER COUNTY NETWORK MEDIA

To support and supplement the planned ATMS project, there is existing fiber optic cable available that is owned and maintained by The Villages, a large planned community where a majority of Sumter County's population and commercial businesses reside. The vast majority of Sumter County signals can be connected to The Villages fiber optic network. However, due to the recurring cost associated with leasing dark fiber, it may not an economical long-term solution. The monthly cost for leasing Villages dark fiber is $50.00 per mile for each fiber strand.

Sumter County leases a fiber optic line from Spectrum Networks that connects Wildwood and Bushnell. With the current lease agreement, up to 5 Mbps would be available for the project, with an option to increase the amount of bandwidth leased from Spectrum Networks. The cost associated with increasing the amount of bandwidth is negotiated on the amount of bandwidth required. The Spectrum Networks link will be utilized as a backup link during Phase I implementation.

The County also leases a point-to-point link from CenturyLink that connects Wildwood and Bushnell. It is currently used as a back-up link to the Spectrum Networks and its use may also require increasing the amount of bandwidth that is currently leased to support transporting video. The cost associated with increasing the amount of bandwidth is negotiated on the amount of bandwidth required. At this time, there is no intention to utilize this link for the ATMS system. However, the option will be reevaluated during the design of each ATMS phase.

Sumter County primarily utilizes a Metro Ethernet carrier switched network managed by the County's information technology consultant group to connect County buildings. In the short-term of the ATMS, selected corridors will be connected to the Metro Ethernet by installing fiber optic cable and connecting to the nearest County buildings. These corridors include CR 466, CR 466A, and US 27. Additionally, a few remote locations may also be connected to the Metro Ethernet by installing a fiber optic cable to connected County building locations. The remote locations include:

- Intersection #99, SR 471 & CR 48 – Connected to Sumter County Fairgrounds 4H Building
- Intersections #5 & #6, SR 470 & US 301 – Connected to Sumterville Community Center

The FDOT has dark fiber available along I-75 through Sumter County. A fiber sharing agreement will be sought and drafted with FDOT District Five to provide connections along I-75 from the SR 44 interchange to the CR 48 interchange. The County will be able to connect intersections at the interstate ramps to the I-75 fiber. These intersections include:

- Intersections #11 & #12, SR 44 and I-75
- Future intersections, SR 470 W and I-75
- Intersection #14, CR 48 and I-75

Connections along I-75 will ultimately provide a high speed connection between the northern and southern population centers in Sumter County. The connection will also facilitate the sharing of video and travel time information between Sumter County and FDOT District Five as part of the fiber sharing agreement. Once the connection for the ATMS is established between the proposed TMC in Bushnell and The Villages Sumter County Service Center, the Metro Ethernet connections will remain active to provide route redundancy and to reach those areas that are not serviced by the fiber optic network. The County's Metro Ethernet service will continue to compliment the ATMS network until a complete fiber optic network ring in completed between the proposed TMC and The Villages Sumter County Service Center.

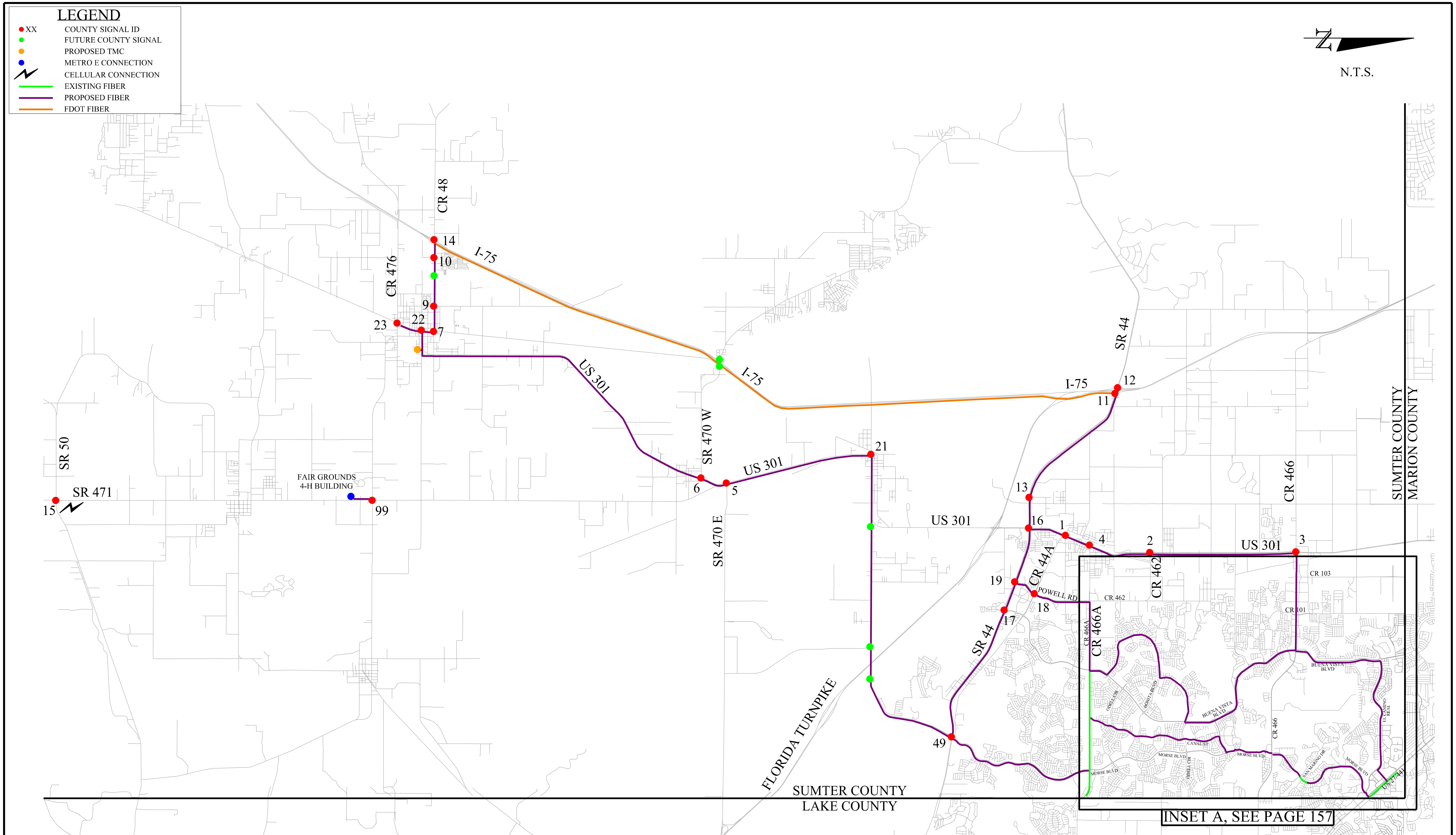
Some outlying devices will be best served by a wireless connection. Intersection #15 may be transmitted to the Linden tower using Ultra High Frequency (UHF) or Super High Frequency (SHF) microwaves, and relayed to the County-owned tower site near Seminole Avenue. There are structural limitations on the towers in Sumter County and a further analysis would be required to verify that the towers are adequate to support the new equipment. Depending on the results of this analysis, it may be more cost efficient to use a 4G or LTE cellular service.

All of these locations will ultimately be part of a dedicated Sumter County ATMS network. The implementation plan was developed to efficiently use future funding in order to connect as many intersections as possible to the network and to create network redundancy, ensuring a highly available and resilient high speed Ethernet network. The ultimate layout is included in Figure 29. As funding becomes available, the final network layout, which will provide high speed redundant connectivity for 98 percent of the Sumter County ATMS, should be implemented.

NETWORK BACKBONE AND LOCAL RINGS

In general, the backbone will use a combination of GE and 10GbE technology, while the field device connections will use Fast Ethernet. The GE branches will feed into the 10GbE aggregated backbone at strategically placed node locations. Node locations serve as aggregation points that collectively channel the GE branches onto the high speed 10GbE express backbone to the TMC. Planning for GE and 10GbE technology will ensure that the system will not be antiquated before it is completed.

At the intersection cabinets located on the fiber route, there will be a GE switch equipped with a minimum of eight 10/100Base-TX ports and two 1000Base-FX single mode ports. This switch will serve as the interface between the field devices (controllers, video encoders, etc.) in the cabinet and the optical network. The equipment in the cabinet will connect to the 10/100Base-TX copper ports of the switch. The switch will convert the copper-based Ethernet signal into a Fast Ethernet optical signal and place the data onto the network via the 1000Base-FX uplink ports. The 1000Base-FX port #1 of the GE switch located at the first cabinet will connect to one of the 1000Base-FX ports of the node switch. The 1000Base-FX port #2 of the first Fast Ethernet switch will connect to the 1000Base-FX port #1 of the Fast Ethernet switch located at the second cabinet. The 1000Base-FX port #2 of the second Fast Ethernet switch will connect to the 1000Base-FX port #1 of the Fast Ethernet switch located at the third cabinet, and so on. Often, multiple fibers are utilized to form different rings in the same cable to spread the load to different ports at the nodes, and to provide a more robust network should a particular node port fail. This ring type of layout is shown in Figure 30. In Sumter County, this may not be universally feasible until the entire planned network has been built. The purpose of using rings is so that communication to the whole ring is not lost in the event of a single switch failure or fiber cut.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 29: SUMTER COUNTY ULTIMATE COMMUNICATIONS MAP (PAGE 1 OF 2)

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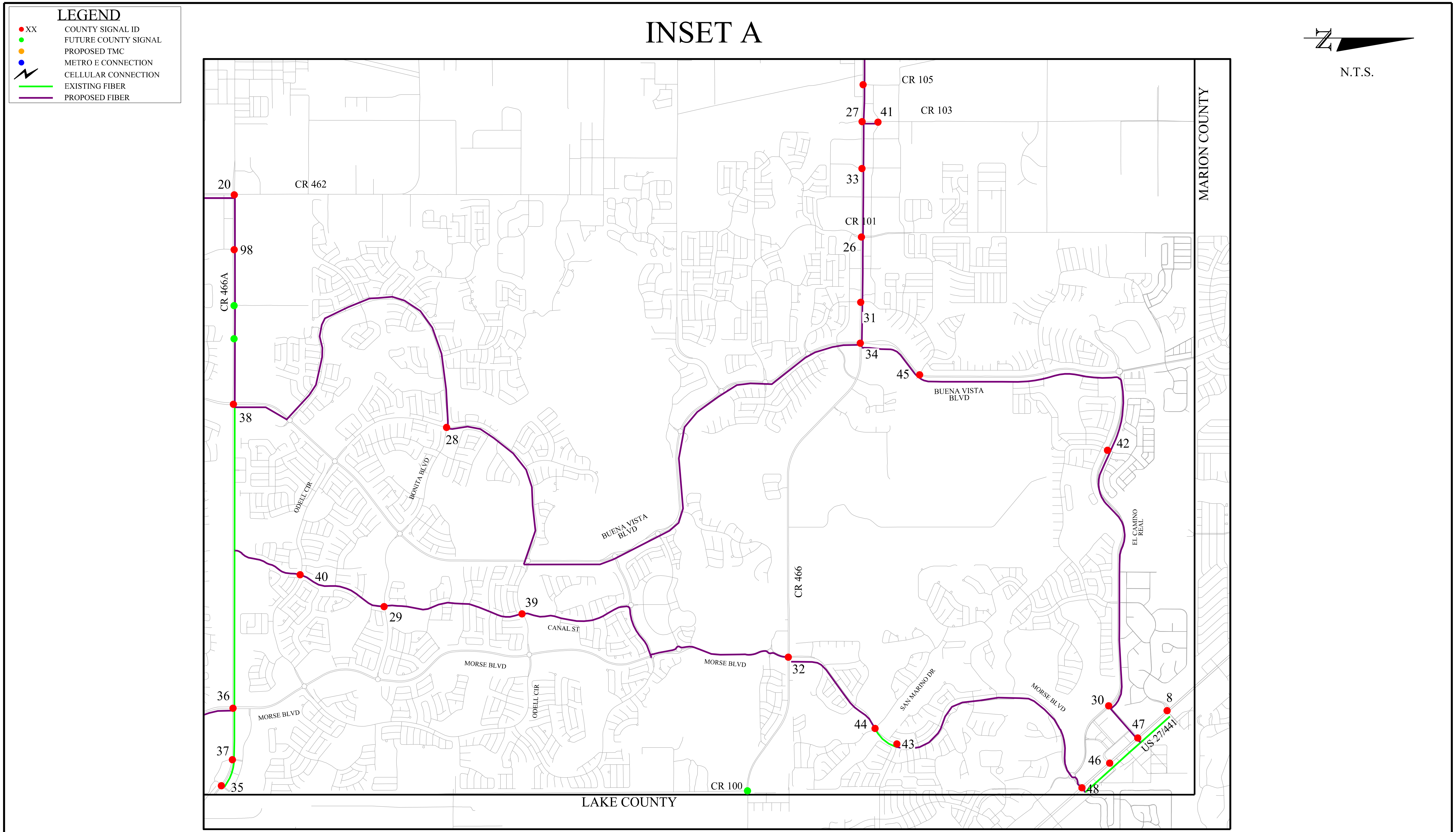

Project Title	SUMTER COUNTY ATMS MASTER PLAN
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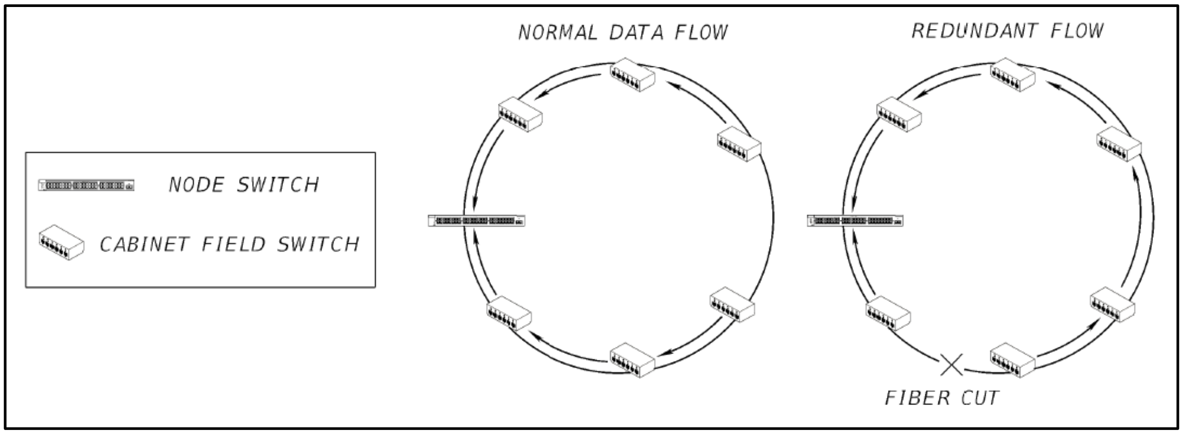


Figure 30: Typical Ring Layout

In the case of a switch failure, only the field devices connected to the failed Ethernet switch are affected and the rest of the field devices remain in communication with the central system.

In the case of a fiber cut in a properly designed network, it is possible that no devices are affected. All the data will then be aggregated from the rings and routed to the TMC via the 10GbE node site. The combination of the GE rings and 10GbE backbone links create a highly redundant network.

When utilizing lower speed Ethernet connections, it was not recommended to connect more than six devices (for seven "hops") in a given Ethernet ring due to latency, which can affect data path recovery, known as Spanning Tree Protocol. With the advent of Rapid Spanning Tree Protocol, this is not as much of a concern. It is important, however, not to saturate a particular link with too much data, and most conservative designs utilize no more than 60 percent of the theoretical link speed.

NODE LOCATIONS

Due to the network layout, it is predicted that ultimately the Sumter County traffic network could suffice with two node locations:

- The Sumter County TMC
- The Villages Sumter County Service Center

The main node located at the Sumter County TMC will provide access and central control from the TMC. The second node location placed at The Villages Sumter County Service Center will serve as an aggregation point for several rings in the area of The Villages, while also providing redundant alternate network pathways between The Villages, the City of Bushnell, and the Sumter County TMC. Figure 31 depicts the planned Sumter County communication rings.

NETWORK CONNECTION METHODOLOGY

The network will be configured to provide services for ITS subsystems such as:

- Traffic Signal Controller system
- CCTV camera system
- DMS system
- Vehicle detectors
- Future ITS devices

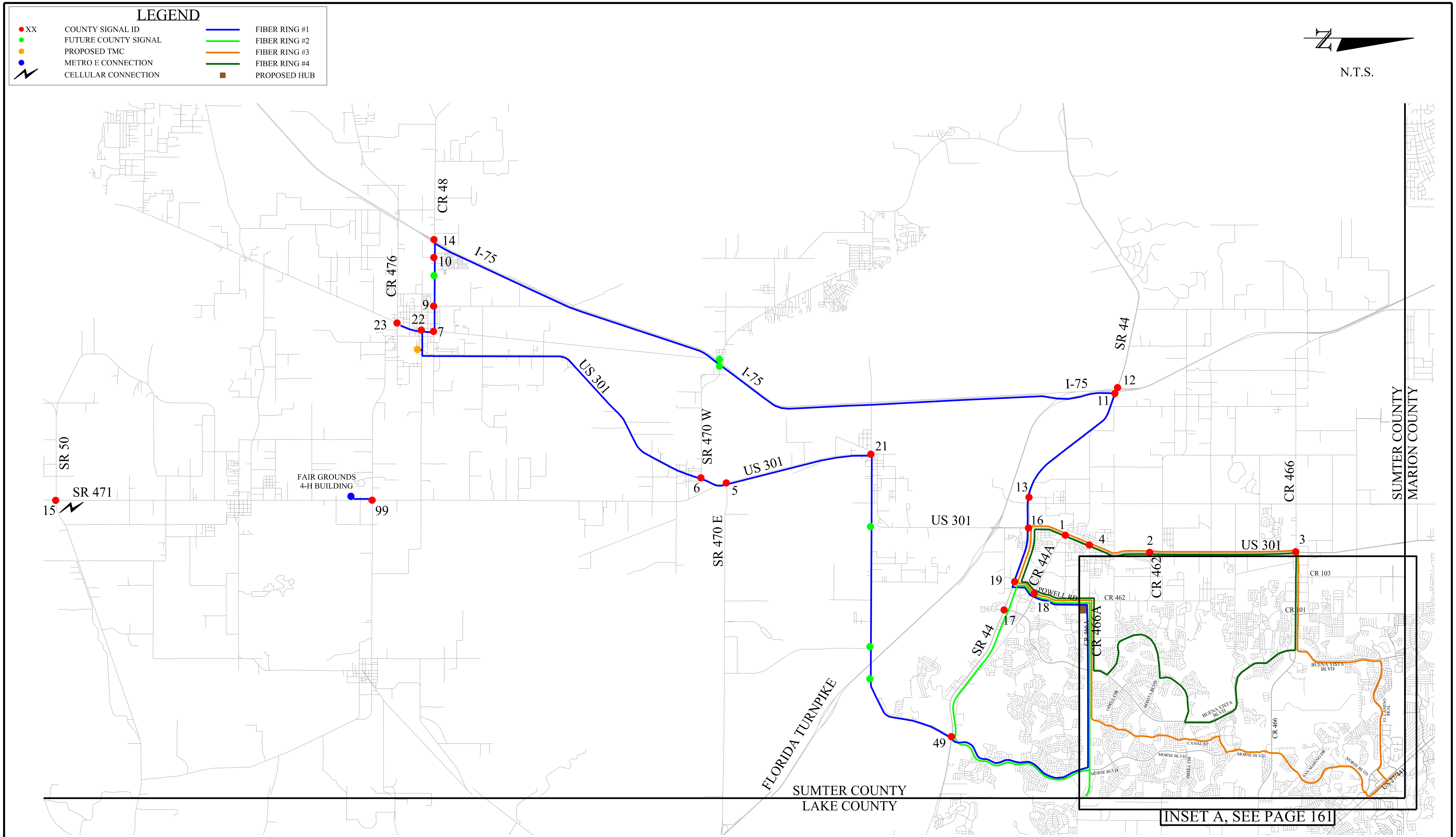
Each cabinet housing ATMS equipment on the fiber route will be connected to the nearest GE switch. Any wireless devices on the system network will be connected to a GE switch at the wireless receiver location.

The available bandwidth on a pair of fibers or wireless link connected in this manner will be analyzed so that locations can be distributed as uniformly as possible. The number of devices on each pair of fibers or wireless link will be assigned based on the requirements shown in Table 20.

Table 20: Bandwidth Allocation

Field Device	Estimated Bandwidth Need (Data/Video)
Camera	1-6 Mbps
Controller	2 kbps
DMS	2 kbps

For a typical ATMS, a 96-strand fiber cable is utilized for the main trunk that connects to the device rings, as well as the backbone between GE and 10 Gbps switches. Cabinet drop cables typically contain 12 fibers, of which 8 are usually terminated in the signal or ITS cabinet.



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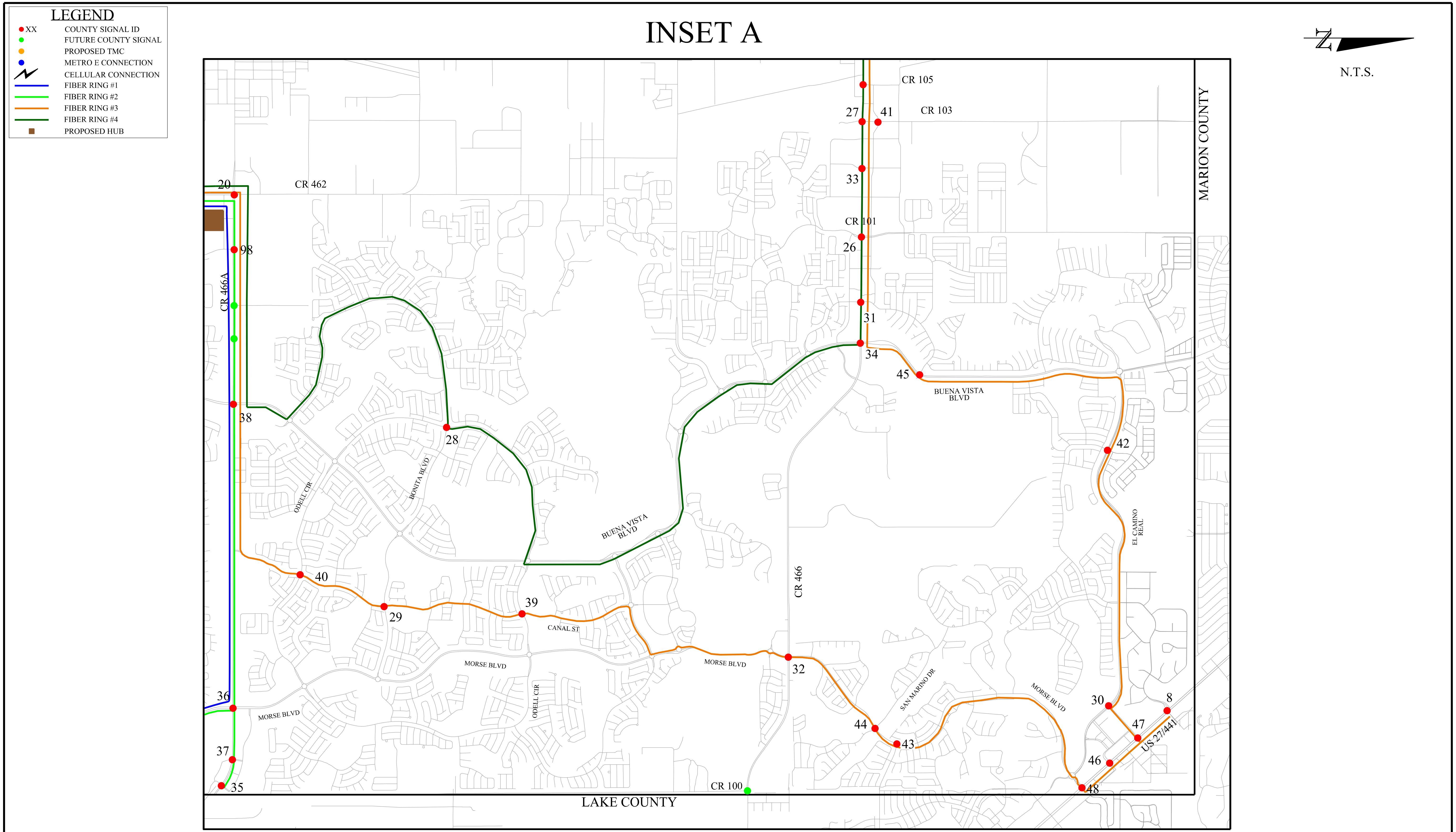
INSET A



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
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Each drop cable will have four fibers, two in and two out, for live connectivity. Four additional fibers are terminated for standby redundancy with the last four fibers designated as spares.

NETWORK PROVISIONING

The FDOT is responsible for coordinating and assigning an addressing scheme for IP devices. Each county is assigned a range of unicast addresses and, if needed, multicast addresses. Sumter County's unicast and multicast address ranges have been determined as a part of FDOT's Re-IP project.

The ranges that will be assigned will cover both unicast devices, such as traffic controllers and DMSs, and multicast devices, such as CCTV cameras. The County can then divide the pools of addresses into subnets, allowing several hosts per subnet. Each fiber ring will contain one or more subnets and each subnet will also contain one or more virtual local area networks (VLANs). Creating VLANS ensures that video traffic will not be passed on a switch port that houses a controller or detector

Each node switch will be programmed at layer three and will be the gateway for each of the attached subnets. Unicast addressing will follow a common scheme such as the "switch plus port" method. In a "switch plus port" scheme, the cabinet managed field Ethernet switch (MFES) has a base address, such as 10.128.100.1. The controller will be assigned the MFES address plus the port number. In this scenario, a controller attached to the switch 10.128.100.1 port 1 will be 10.128.100.1 +1 = 10.128.100.2. Maintenance personnel should be able to determine the IP address of nearly any device connected to the MFES by the IP address of the MFES and its position within the MFES ports. Initially, 12 IP addresses will be allocated for each cabinet to support a combination of devices.

For consistency and ease of maintenance, each MFES will have the same port/device assignments throughout the network. For example, port 1 on the MFES will be for controller use, port 2 for MMU management, port 3 for VID devices, and port 4 for UPS interfacing. Ports 5 through 7 will be used for ITS devices, starting with CCTV cameras and then any subsequent devices such as microwave detectors and Bluetooth readers. The last copper port on each MFES should be reserved for maintenance operations when possible. Additionally, the fiber ports should be connected to the switch in such a manner that the technician should be able to determine the direction of the next cabinet in the ring. For example, fiber port 10 should be connected to the fibers going north or west and fiber port 11 should be connected to fibers going south or east. Likewise, the fiber optic cable buffers should be provisioned consistently when possible. Table 21 displays the fiber optic buffer assignments that will be followed when possible.

Table 21: Fiber Buffer Assignment

Buffer Tube Color	Sumter County Assignment
Blue	Local traffic cabinet and ITS rings
Orange	Local traffic cabinet and ITS rings
Green	10GbE backbone communications
Brown	Gigabit backbone communications
Slate	Future
White	Future
Red	Shared with other agencies
Black	Shared with other agencies

COSTS

Capital Costs

The general costs for communications elements are outlined in Table 22.

Table 22: General Communications Costs

ITEM	UNIT	UNIT COST
Fiber Optic Pull Box (F&I)	Each	$1,188.93
Fiber Optic Splice Vault (F&I)	Each	$2,622.74
96-Fiber Cable, Singlemode (F&I)	Linear Foot	$2.27
12-Fiber Cable, Singlemode (F&I)	Linear Foot	$1.58
ITS Fiber Optic Connection Hardware (Patch Panel, Field Terminated, F&I)	Each	$1,200.00
ITS Conduit (Aboveground) / F&I	Linear Foot	$17.40
ITS Conduit (Underground) / F&I / Open Trench	Linear Foot	$5.65
ITS Conduit (Underground) / F&I / Directional Bore	Linear Foot	$16.35
ITS Conduit (Bridge Mount) / F&I	Linear Foot	$25.57
ITS Managed Field Ethernet Switch, F&I	Each	$2,284.27
ITS Managed Ethernet Hub Switch (Long Haul), F&I	Each	$60,000.00

The installation cost of conduit typically represents the largest portion of creating a network infrastructure. Sumter County should evaluate any current or planned projects for potential opportunities to install conduit as part of the project. Any project along major corridors, such as sidewalk and drainage improvements to road widening projects, provide opportunities to reduce the capital cost of installing infrastructure conduit.

O&M Costs

The USDOT maintains a source database of ITS costs, both capital and O&M (http://www.benefitcost.its.dot.gov/its/benecost.nsf/CostHome). In general, annual O&M costs run between 5 and 15 percent of the capital costs for communications, depending on the elements included.

SECTION 13

RECOMMENDED ATMS ELEMENTS

13. RECOMMENDED ATMS ELEMENTS

Based on the analysis performed during the development of the Sumter County ATMS Master Plan, the following elements should be included in the ATMS.

TRAFFIC SIGNAL CONTROLLERS

The County should establish one brand of NEMA TS2, Type 1 controller as the standard for installation in all traffic signal controller cabinets. While some central control software can communicate with and operate multiple brands of controllers, all of the different control software provide more features and function better if they are connected to controllers of the same brand. The traffic signal controller selected during the ATMS Phase I design will become the standard controller for Sumter County. The standard NEMA TS2, Type 1 controller should have the following attributes:

- Ethernet ready
- Ability to revert to TOD plan if communications is lost
- Ability to alert central control software when signal is in flash
- Meet ATC Standard 5.2b
- DSRC compatible
- Capable of providing advance functionalities with the selected central control software

DETECTION/TRAVEL TIME SYSTEMS

Local intersection detection should be provided on each approach at each intersection. The most cost-effective and reliable solution for intersection detection is VIDs. Currently, the majority of the intersections in Sumter County have VIDs and there are several more that will have VIDs installed in upcoming construction projects. The VIDs may include multiple cameras per intersection or the single 360-degree FOV system. The single camera systems are generally less costly to install due to the reduction in the number of cameras necessary to provide detection at the intersection. Additionally, it would be reasonable to expect that the maintenance requirement for the single 360-degree FOV camera would be reduced over a multiple-camera VID system. Because of this, it is recommended to install the single 360-degree FOV camera at smaller intersections (i.e., intersections with one or two lanes per approach and minimal median width). For intersections that encounter adverse weather conditions, such as fog, a MVDS or infrared detectors should be considered due to their consistent operation despite adverse weather conditions. The VIDs should have the following attributes:

- HD capable camera
- Image stabilization
- Live streaming video over an Ethernet network

Currently, Sumter County has not deployed any advanced detection. The need to deploy advanced detection will depend on the type of traffic control system chosen for the County, particularly if adaptive or responsive control systems are implemented. For a typical advanced detection installation, microwave detectors provide the highest potential for reliability with the least installation cost. MVDSs are effective at evaluating and quantifying traffic patterns within signal control sections in Sumter County. The MVDSs should have the following capabilities:

- Compatible with SunGuide®
- Mean-time between failures of at least 10 years
- Capable of producing multiple data streams
- Capable of producing advance detection for multiple lanes and direction of travel
- Capable of providing count data, as well as speed, classification, occupancy, and volume

Many elements must be considered in the selection of a type of detector for collecting travel time data. The most cost-effective and reliable solution for detection is the use of Bluetooth readers at local intersections. Bluetooth readers should be considered on congested corridors where there is expected to be a greater density of Bluetooth devices in vehicles. The resulting travel time data from the Bluetooth readers can be used to provide travel time information to motorists using a website or DMS. Alarms can be set to notify a system operator that the travel times for a specific corridor have increased beyond a specified threshold. This could be useful for detecting incidents, allowing alternate timing plans to be implemented and minimizing the increase in delay due to the incident. The Bluetooth readers should have the following capabilities:

- Compatible with various software, including SunGuide®
- Compatible with various communications media (i.e., cellular, Ethernet, microwave)
- Able to provide security (i.e., masking or encryption) of learned MAC addresses

The recommended locations for installing Bluetooth readers is shown in Figure 32. The recommended locations are limited to corridors at or near saturated conditions during peak hours that encounter higher than typical crash rates when compared to other corridors throughout Sumter County.

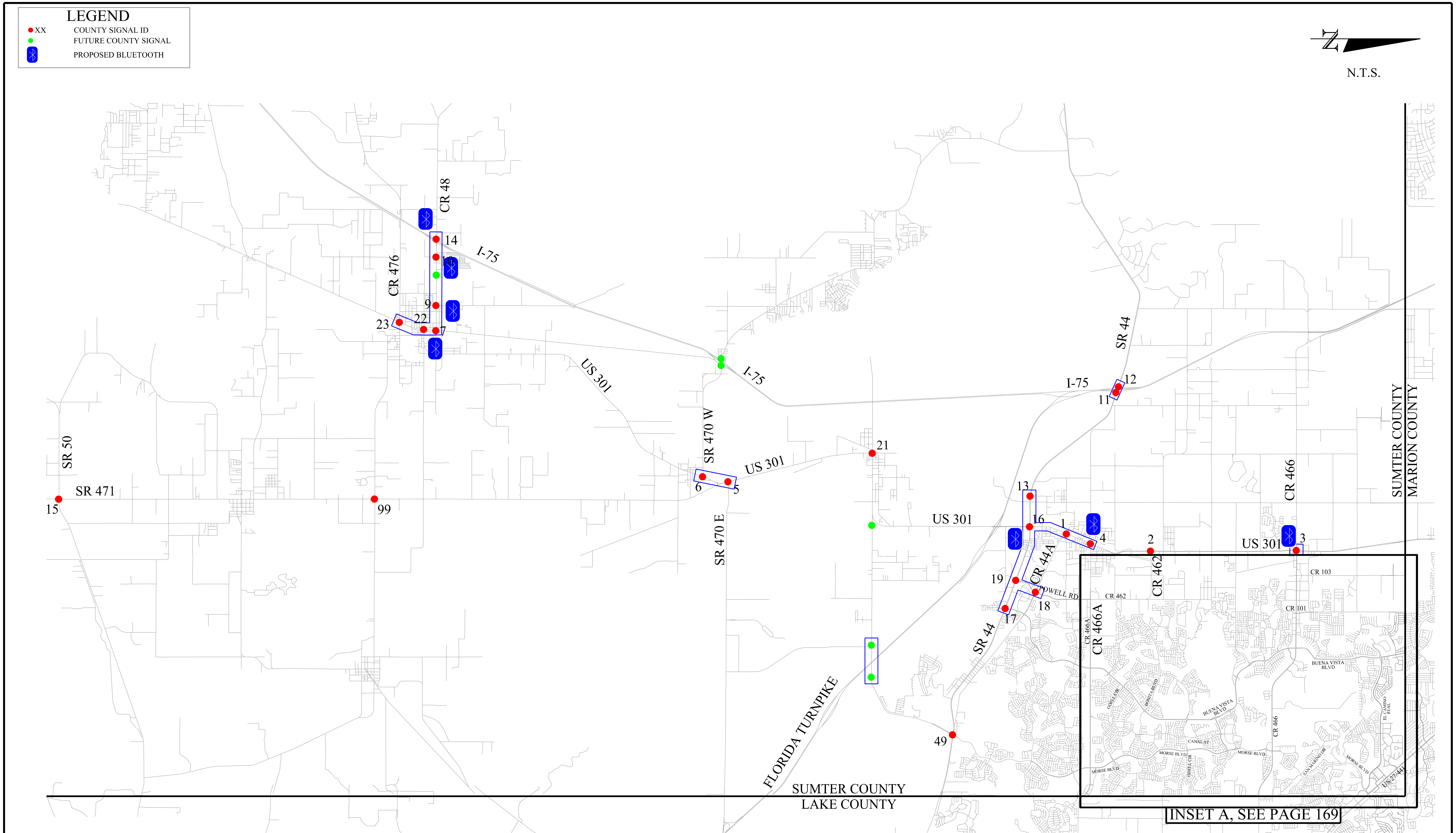
TRAFFIC CONTROL OPTIONS

To meet Sumter County's goals and objectives for traffic control, it is recommended that multiple timing plans be utilized, additional research into corridors for deployment of traffic responsive systems and ATCSs be performed, and coordination between control sections be utilized.

Having the ability to implement a special timing plan based on certain scenarios would be highly beneficial to the County. Because of this, it is recommended that the new central control software be capable of providing at least 32 individual timing patterns. This will allow the County to quickly react to an unexpected event or preplan for an expected event, which will reduce the expected delays for County motorists.

It is highly recommended that corridors with unpredictable volumes be researched further for implementation of traffic responsive operation or an ATCS. It has been determined there are several corridors throughout Sumter County where traffic responsive operation or an ATCS may prove useful due to traffic conditions that often change. The County has stated that the US 27/441 corridor and the CR 466 corridor are potential corridors for implementation of an ATCS. The implementation of an ATCS on the US 27/441 corridor should be coordinated with Marion County and Lake County to ensure optimal signal timing coordination. Additional corridors to be researched for ATCS implementation are the US 301 corridor in Wildwood, the US 301 corridor in Bushnell, and the CR 466A corridor.

It is recommended that coordination between control sections along known commuter routes experiencing predictable traffic patterns be utilized. This will decrease delay along the routes while improving the flow. The ability to coordinate between control sections should be included with the selected central control software.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 32: PROPOSED BLUETOOTH READER LOCATIONS (SHEET 1 OF 2)

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Date	03/23/17
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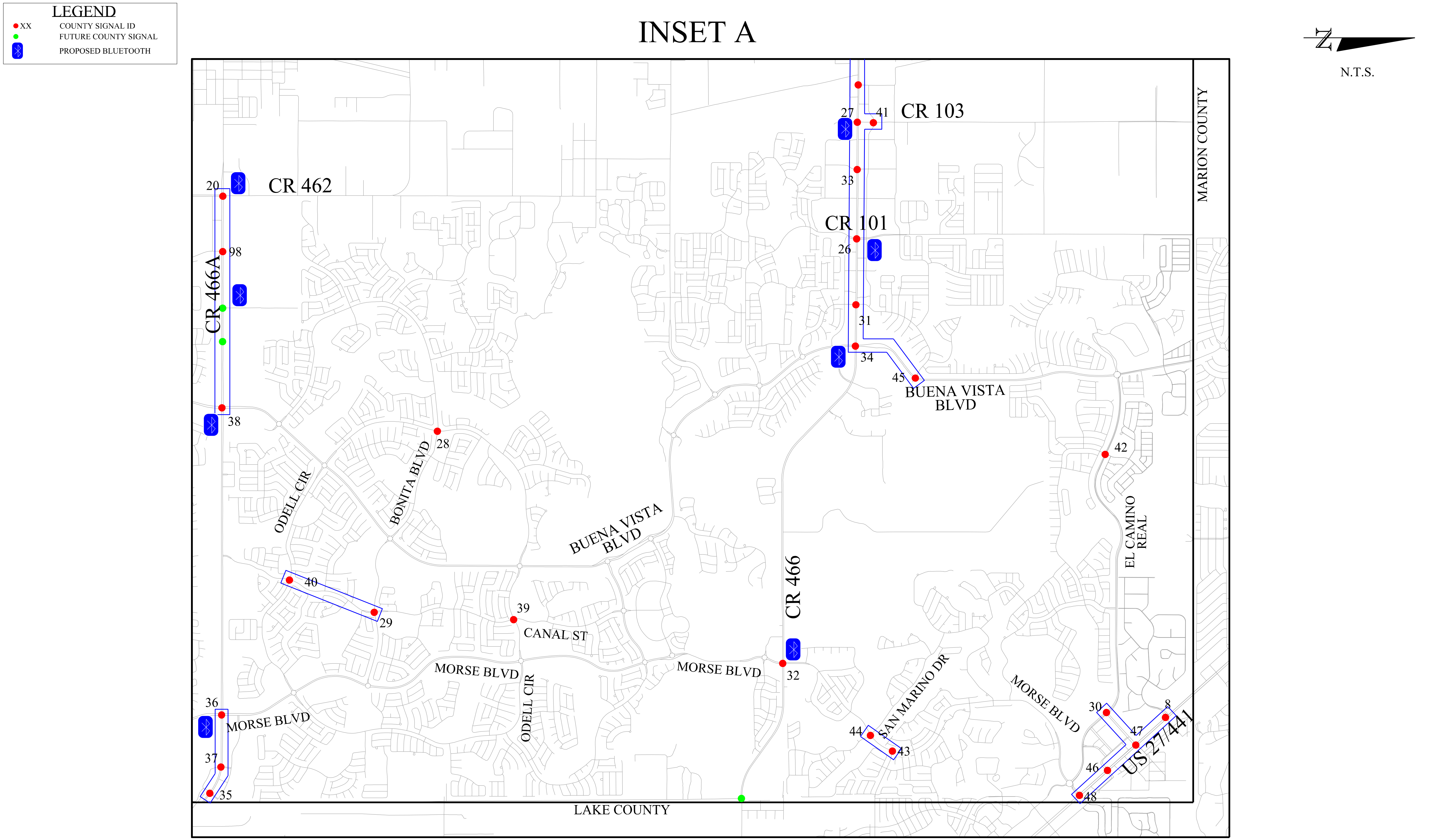

Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 32: PROPOSED BLUETOOTH READER LOCATIONS (SHEET 2 OF 2)

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TRAFFIC MONITORING SYSTEM

It is recommended that Sumter County procure dome HD CCTV cameras for traffic monitoring. The dome housing will provide additional protection from the elements while the HD version will ensure future compatibility and provide a clearer image to the end user. Also, HD CCTV cameras have become so mainstream that the price point between HD CCTV cameras and standard definition CCTV cameras has been closed. The CCTV cameras should have the following features:

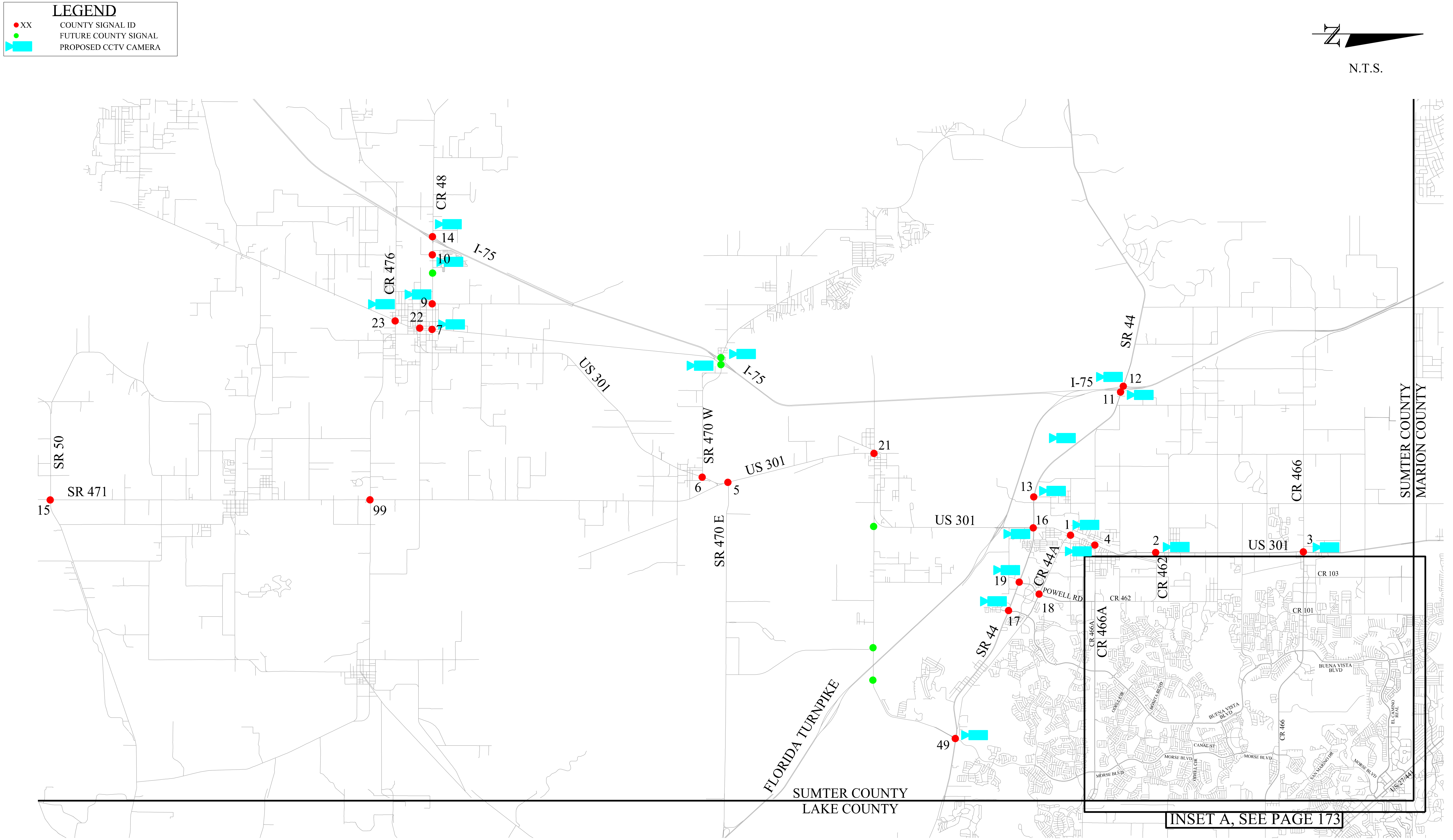
- NTCIP compliant
- Image stabilization
- Low lux operation
- PTZ operation
- Ethernet ready
- Contain a heater or other defogging apparatus
- Capable of both black and white and color modes

It is recommended that CCTV cameras be placed at major intersections to monitor many of the major corridors within Sumter County. These locations are generally related to monitoring traffic flows, incident management, and signal maintenance. Thirty-eight proposed CCTV camera locations are listed in Table 23 and illustrated on Figure 33. The proposed locations will be prioritized to determine how they should be phased for deployment. Because the County has expressed that CCTV cameras are less important than some of the other elements of an ATMS, only a limited number of CCTV camera installations are planned for Phase I of the ATMS.

Table 23: Proposed CCTV Camera Locations

County Signal ID	Main Street	Cross Street
1	S Main Street (US 301)	Lynum Street/Huey Street (CR 44A)
2	US 301	CR 462 E
3	US 301	CR 466
4	US 301	CR 466 A
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)
9	CR 48	N West Street (CR 311)
10	CR 48	Lowery Street

County Signal ID	Main Street	Cross Street
11	SR 44	I-75 NB Off-Ramp
12	SR 44	I-75 SB Off-Ramp
13	SR 44	Industrial Drive
14	CR 48	I-75 SB Off-Ramp
16	US 301	SR 44
17	SR 44	Buena Vista Boulevard/Heritage Boulevard
19	SR 44	Powell Road/Signature Road
20	CR 466A	Powell Road/CR 462 E
23	US 301	Seminole Avenue (CR 48/CR 476)
26	CR 466	CR 101/Belvedere Boulevard
27	CR 466	CR 103/Old School Road
30	El Camino Real	Buenos Aires Boulevard
32	CR 466	Morse Boulevard
34	CR 466	Buena Vista Boulevard
35	CR 466A	Farner Place
36	CR 466A	Morse Boulevard
38	CR 466A	Buena Vista Boulevard
42	El Camino Real	Botello Avenue/Enrique Drive
43	Morse Boulevard	Rio Grande Avenue
44	Morse Boulevard	San Marino Drive
45	Buena Vista Boulevard	Southern Trace/Saddlebrook Lane
47	US 27/441	NE 136th/Buenos Aires Boulevard
48	US 27/441	Morse Boulevard/W Boone Court
49	SR 44	Morse Boulevard
N/A	SR 44	Between I-75 and Industrial Drive
N/A	US 301	SB Turnpike Off-Ramp
TBD	SR 470	I-75 SB Off-Ramp
TBD	SR 470	I-75 NB Off-Ramp
TBD	CR 468	SB Turnpike Off-Ramp
TBD	CR 468	NB Turnpike Off-Ramp



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Project Title	SUMTER COUNTY ATMS MASTER PLAN	**Project No.**	0116002
Drawing Title	FIGURE 33: SUMTER COUNTY PROPOSED CCTV CAMERAS MAP (PAGE 1 OF 2)	**Date**	03/23/17
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FUTURE COUNTY SIGNAL
PROPOSED CCTV CAMERA

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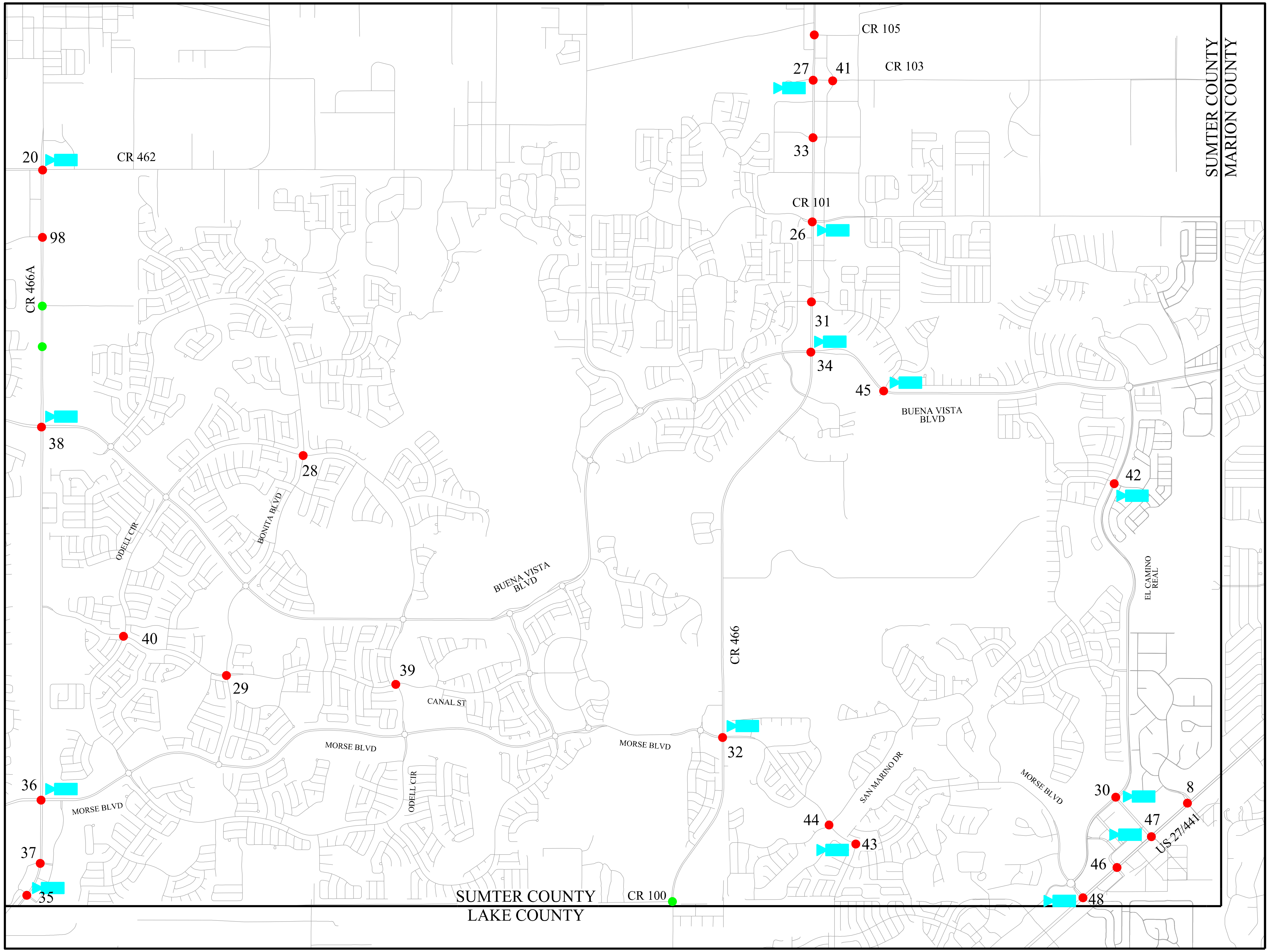

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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 33: SUMTER COUNTY PROPOSED CCTV CAMERAS MAP (PAGE 2 OF 2)

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The exact placement of the equipment will be determined during the design phase. If possible, the CCTV cameras will be installed on existing traffic structures to reduce cost and prevent overcrowding an intersection with utility poles and structures. The final placement of the CCTV cameras will take the following into consideration:

- Pole height
- Coverage angle
- Traffic cabinet (equipment housing)
- Light reflection
- Equipment security

INFORMATION DISSEMINATION

To effectively manage traffic and divert motorists around incidents and areas of heavy congestion, an information dissemination system is needed, which should include ADMSs. Potential locations for ADMSs were evaluated based on a review of the County's roadway network. In general, the following locations in Sumter County would benefit from ADMSs:

- Locations approaching I-75 and Florida's Turnpike to inform motorists of conditions on I-75 and Florida's Turnpike, respectively.
- Locations on US 301 and SR 44 in advance of intersections with roads that provide access to I-75 and Florida's Turnpike.
- Locations on evacuation routes, where ADMSs would help direct motorists leaving evacuation areas and inform them of any unique traffic patterns or conditions.

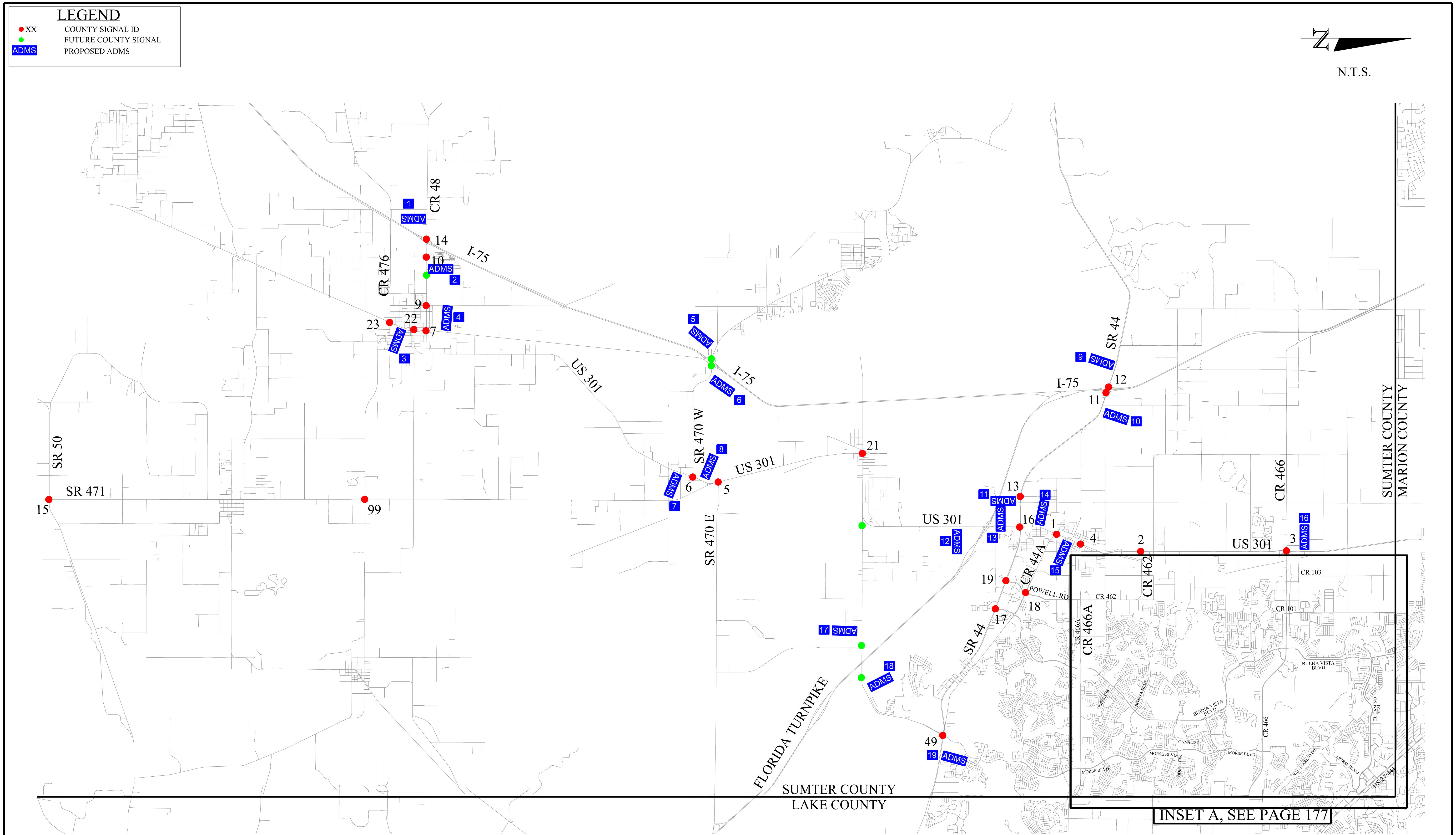
Other locations within the County may also benefit from ADMSs, but the above settings are considered to be the most critical for Sumter County with regard to information dissemination. A list of the proposed locations is reported in Table 24 and illustrated in Figure 34.

Table 24: Proposed ADMS Locations

No.	Main Street	Nearest Cross Street	Approach Direction	Notes
1	CR 48	I-75 SB Off-Ramp	Eastbound	In advance of I-75, Evacuation Route
2	CR 48	I-75 NB Off-Ramp	Westbound	In advance of I-75, Evacuation Route

No.	Main Street	Nearest Cross Street	Approach Direction	Notes
3	US 301	Seminole Avenue (CR 48/CR 476)	Northbound	I-75 incident information in advance of CR 48, Evacuation Route
4	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)	Southbound	I-75 incident information in advance of CR 48, Evacuation Route
5	SR 470 W	I-75 SB Off-Ramp	Eastbound	In advance of I-75, Evacuation Route
6	SR 470 W	I-75 NB Off-Ramp	Westbound	In advance of I-75, Evacuation Route
7	US 301	SR 470 W	Northbound	I-75 incident information in advance of SR 470 W, Evacuation Route
8	US 301	SR 470 W	Southbound	I-75 incident information in advance of SR 470 W, Evacuation Route
9	SR 44	I-75 SB Off-Ramp	Eastbound	In advance of I-75, Evacuation Route
10	SR 44	I-75 NB Off-Ramp	Westbound	In advance of I-75, Evacuation Route
11	SR 44	US 301	Eastbound	Turnpike incident information in advance of US 301, Evacuation Route
12	US 301	Turnpike SB Off-Ramp	Northbound	In advance of Turnpike, Evacuation Route
13	US 301	Turnpike NB Off-Ramp	Southbound	In advance of Turnpike, Evacuation Route
14	US 301	SR 44	Southbound	I-75 or Turnpike incident information in advance of SR 44, Evacuation Route
15	US 301	CR 466A	Northbound	Incident information for CR 466 in advance of CR 466A
16	US 301	CR 466	Southbound	Incident information for CR 466. CR 466A would be alternate route
17	CR 468	Turnpike SB Off-Ramp	Eastbound	In advance of Turnpike
18	CR 468	Turnpike NB Off-Ramp	Westbound	In advance of Turnpike
19	SR 44	Morse Boulevard	Westbound	I-75 or Turnpike incident information in advance of SR 44

The County will need to evaluate and prioritize the ADMS locations. This can be done during future design phases.



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Project Title	SUMTER COUNTY ATMS MASTER PLAN
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ADMS PROPOSED ADMS

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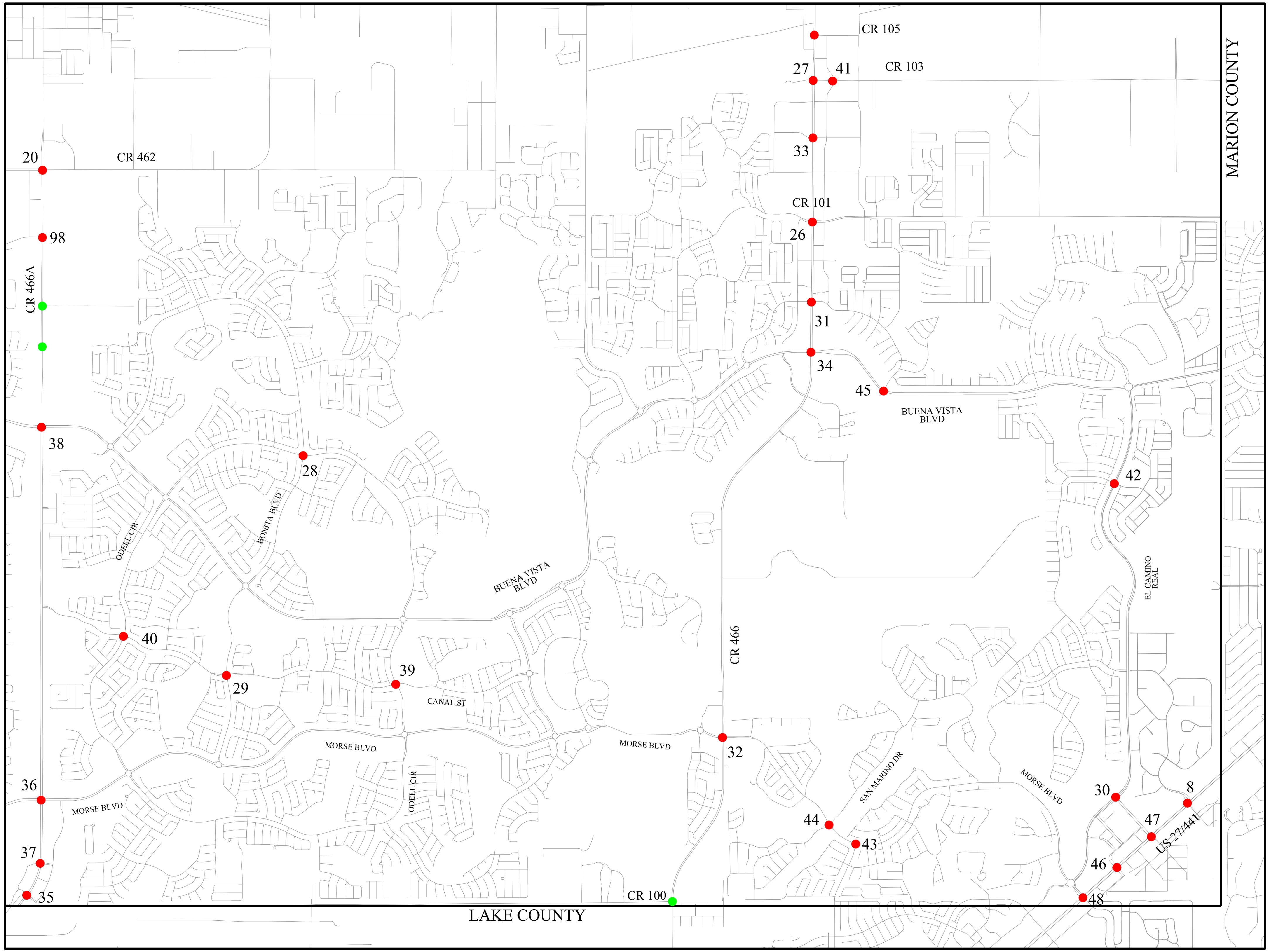

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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 34: SUMTER COUNTY PROPOSED ADMS MAP (PAGE 2 OF 2)

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CENTRAL CONTROL SOFTWARE

Based on Sumter County's user needs and functional requirements of the central control software, a COTS central control software is recommended. A COTS software would meet the desired functions and features while having a relatively low cost compared to the other types of central control software. The COTS central control software should have the following capabilities:

- NTCIP compatible
- Real-time monitoring of the ATMS
- Ability to interface with traffic responsive or traffic adaptive operations
- User-defined alerts
- Ability to integrate ITS technologies

TRAFFIC MANAGEMENT CENTER

Because Sumter County does not currently have a TMC, research into available space within the existing County Public Works Complex will be performed to find a suitable location that meets the physical and functional requirements. By locating the TMC within the existing building, areas for HVAC facilities, maintenance facilities, electrical and UPS facilities, conference rooms, records storage, restrooms, kitchen/break room, parking facilities, and reception would simply require modification, if any change is required.

The control room should be outfitted with an operator workstation consisting of a single standard office desk outfitted with a computer workstation with two standard LCD monitors. This will provide lower maintenance and operational costs than a LED flat panel wall or traditional cube type system. The recommended setup would provide the necessities for the County to operate the system on a part-time basis.

For the initial setup, the communications equipment will be housed at the The Villages Sumter County Service Center in Wildwood with the other server equipment maintained by the County's IT Consultant. This setup will be most efficient for the maintenance of the server equipment as the County IT Consultant is already located at this facility. Environment monitors should be used to monitor the room's temperature and humidity. The room should be enclosed and secured by an access-controlled door. This area could include space to pull and terminate fiber optic cable within the building as well.

The County TMC will provide space for staff working staggered hours to cover both peak periods of traffic. Both morning and evening peak traffic hours should be monitored to improve public safety and traffic congestion.

COMMUNICATIONS

The Sumter County ATMS communications network will evolve as the ATMS is implemented. The initial focus of the communications network is to provide a network connection from the intersections along CR 466 and CR 466A to the Sumter County TMC through the use of existing fiber optic cable, proposed fiber optic cable, and Metro Ethernet connections at County facilities. With the further deployment of the ATMS, additional fiber optic cable will be installed, providing connections from the Sumter County TMC to additional intersections. The additional fiber optic cable will also connect to the FDOT-maintained fiber optic cable along I-75, eliminating the need to utilize the Metro Ethernet as a primary connection. The Metro Ethernet connections will remain active to provide route redundancy and to reach those areas that are not serviced by the fiber optic network. Cellular modems and wireless technology will be utilized to provide a connection to the isolated intersections where it is not cost-effective to create a connection using fiber optic cable. The ultimate communications network will consist of a mixture of proposed fiber optic cable, cellular modems, and/or wireless technology. In order to assist in the implementation of the network, the installation of conduit for fiber optic cable should be included in all future FDOT and County roadway projects. The FDOT Standard Specifications for Road and Bridge Construction Section 630 details the requirements for installing conduit. Figure 29 on page 156 shows the ultimate communications layout.

OTHER FEATURES

The County does not have the desire to implement emergency vehicle pre-emption. However, it is recommended the selected central control software be capable of identifying that intersections are off-line due to the existing railroad pre-emption in order to prevent the system from initiating a failed controller message and attempting to pick up the intersection. Today's controllers are equipped with local pre-emption and with the ability to send a message back to the monitoring system.

SECTION 14

IMPLEMENTATION PLAN

14. IMPLEMENTATION PLAN

The Sumter County ATMS will be implemented in three phases. The design aspect of each phase will consist of the preparation of construction plans that include, but are not limited to, drawings of each signalized intersection sufficient to detail the work to be done, communications cable routing, CCTV camera locations, Bluetooth device locations, ADMS locations, and traffic controller cabinet locations. The contracting method for the construction of Phase I of the ATMS will be completed as a design/bid/build project. The contracting method for the construction of Phases II and III will be determined prior to the respective phase.

PHASE I

The proposed work included in the Phase I implementation was determined through discussions with Sumter County and is based on the limitation of having a $550,000 construction budget. Phase I is focused on priority intersections that would most benefit the public. The components of Phase I will consist of:

- Construct the TMC at the Public Works Complex in Bushnell. This includes the control room featuring work stations and staff. The central control software and servers will be constructed at The Villages Sumter County Service Center in Wildwood. The TMC will have the ability to easily be expanded to handle additional signal systems, DMSs, CCTV cameras, etc. that come on line in future years.
- Interconnect the existing traffic signals along CR 466 from Buena Vista Boulevard to US 301, a total of seven existing signals.
- Interconnect the existing traffic signals along CR 466A from Powell Road to Buena Vista Boulevard and from Morse Boulevard to Farner Place, a total of six existing signals.
- Provide the communications from the signals along CR 466 and CR 466A to the TMC using a secured Metro Ethernet connection between the Public Works Complex in Bushnell and The Villages Sumter County Service Center in Wildwood.
- Install one CCTV camera at CR 466 and CR103/Old School Road.
- Install additional communications infrastructure for future use that would be consistent with this phase if funding permits.

For the two future intersections, it is anticipated that only the signal controllers will require upgrading to ensure compatibility with the selected central control software. The traffic signal cabinet at the intersection of US 301 and CR 466 will receive a UPS. The intersections that are to be included in Phase I are included in Table 25, as well as Figure 35.

Table 25: Phase I Intersections

County ID	Major Street	Minor Street
3	US 301	CR 466
20	CR 466A	Powell Road/CR 462 E
26	CR 466	CR 101/Belvedere Boulevard
27	CR 466	CR 103/Old School Road
31	CR 466	Southern Trace/Tall Trees Lane
33	CR 466	Tatonka Terrace
34	CR 466	Buena Vista Boulevard
35	CR 466A	Farner Place
36	CR 466A	Morse Boulevard
37	CR 466A	Sembler Way/Heald Way
38	CR 466A	Buena Vista Boulevard
98	CR 466A	Pinellas Place
TBD	CR 466	CR 105
Future	CR 466A	NE 57th Drive
Future	CR 466A	Trailwinds Village

Phase I Communications

The Sumter County ATMS project will include the deployment of new fiber optic cable to integrate the ATMS field devices with the new Sumter County TMC through the County's existing Metro Ethernet connections. The existing Metro Ethernet connections are located at various County facilities and provide communication to the Sumter County Public Works building where the Sumter County TMC will be located. Existing conduit and fiber optic cable will be used for portions of the new system.

Phase I requires the installation of approximately 14,800 feet of new interconnect conduit and fiber optic cable, providing connectivity between the Phase I intersections and the TMC. The new interconnect conduit and fiber optic cable are mainly along the CR 466 corridor, and will require boring under roadways, sidewalks, and driveways due to limited available space within the right-of-way.

Phase I CCTV Camera

One CCTV camera will be installed during Phase I. The CCTV camera will provide real-time monitoring capabilities and will be operated and controlled from the TMC through the new communications network. The CCTV camera may be mounted on a new pole or an existing mast arm structure. The CCTV camera system components will include a CCTV camera assembly, a CCTV pole and foundation (if required), and surge protection. Table 26 lists the Phase I CCTV camera location.

Table 26: Phase I CCTV Camera Location

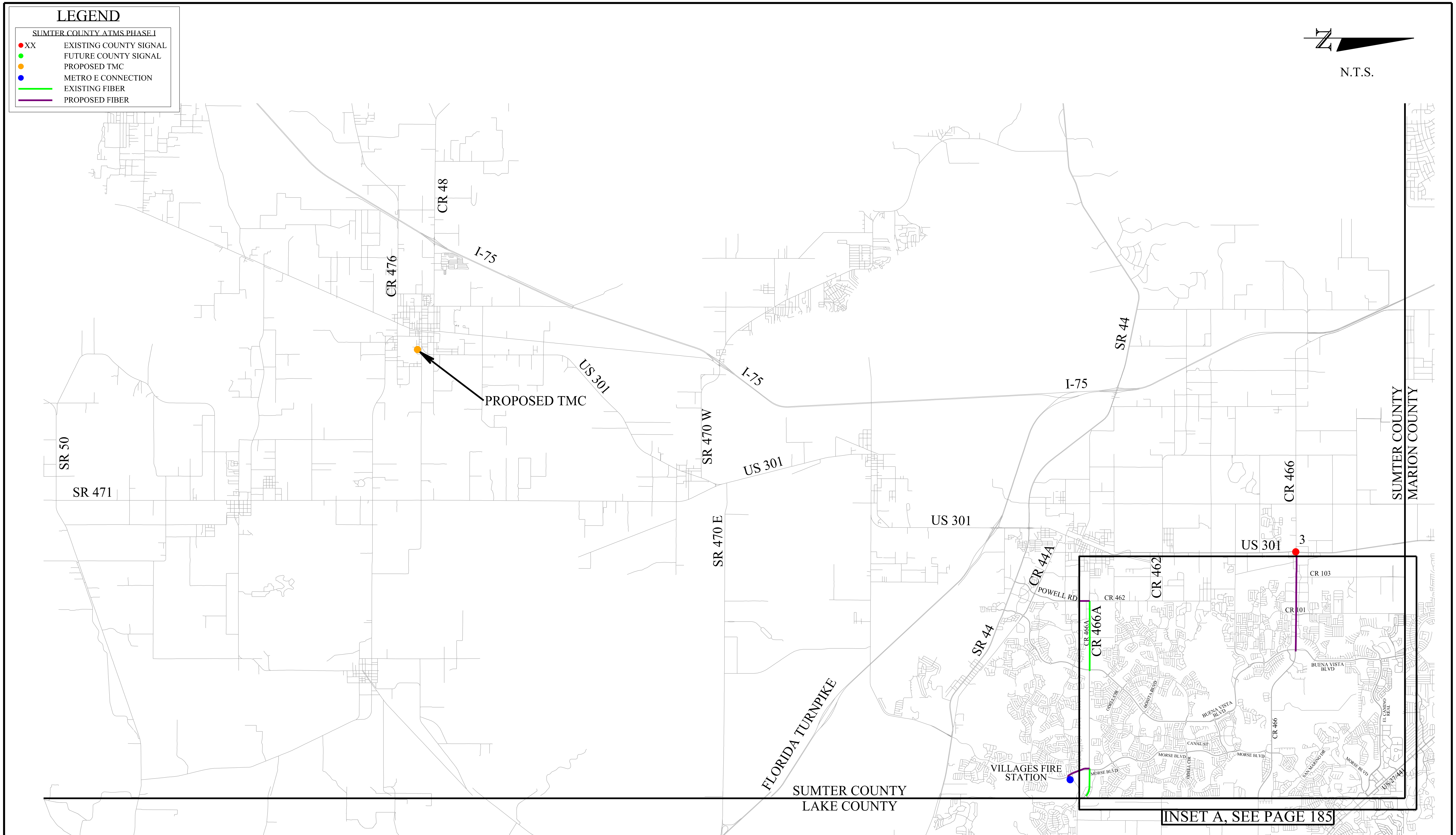
County ID	Main Street	Cross Street
27	CR 466	CR 103/Old School Road

TMC

The Sumter County TMC will play a vital role in the implementation of the ATMS. The County will procure the central control software as a part of Phase I. The Phase I project will include the central control software and hardware, one workstation computer, one workstation desk, two computer monitors, and associated furnishings to accommodate the equipment.

Phase I Cost Estimate

It is estimated that the construction of Phase I will cost approximately $543,565.66. The estimate was developed using averages from FDOT's Basis of Estimations document, past experience, and updated verbal quotes from previous designs. See Table 27 for the detailed cost breakdown for Phase I.



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Drawing Title	FIGURE 35: IMPLEMENTATION PHASE 1 (PAGE 1 OF 2)

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SUMTER COUNTY ATMS PHASE I

- XX EXISTING COUNTY SIGNAL
- FUTURE COUNTY SIGNAL
- METRO E CONNECTION
- EXISTING FIBER
- PROPOSED FIBER
- CCTV CAMERA

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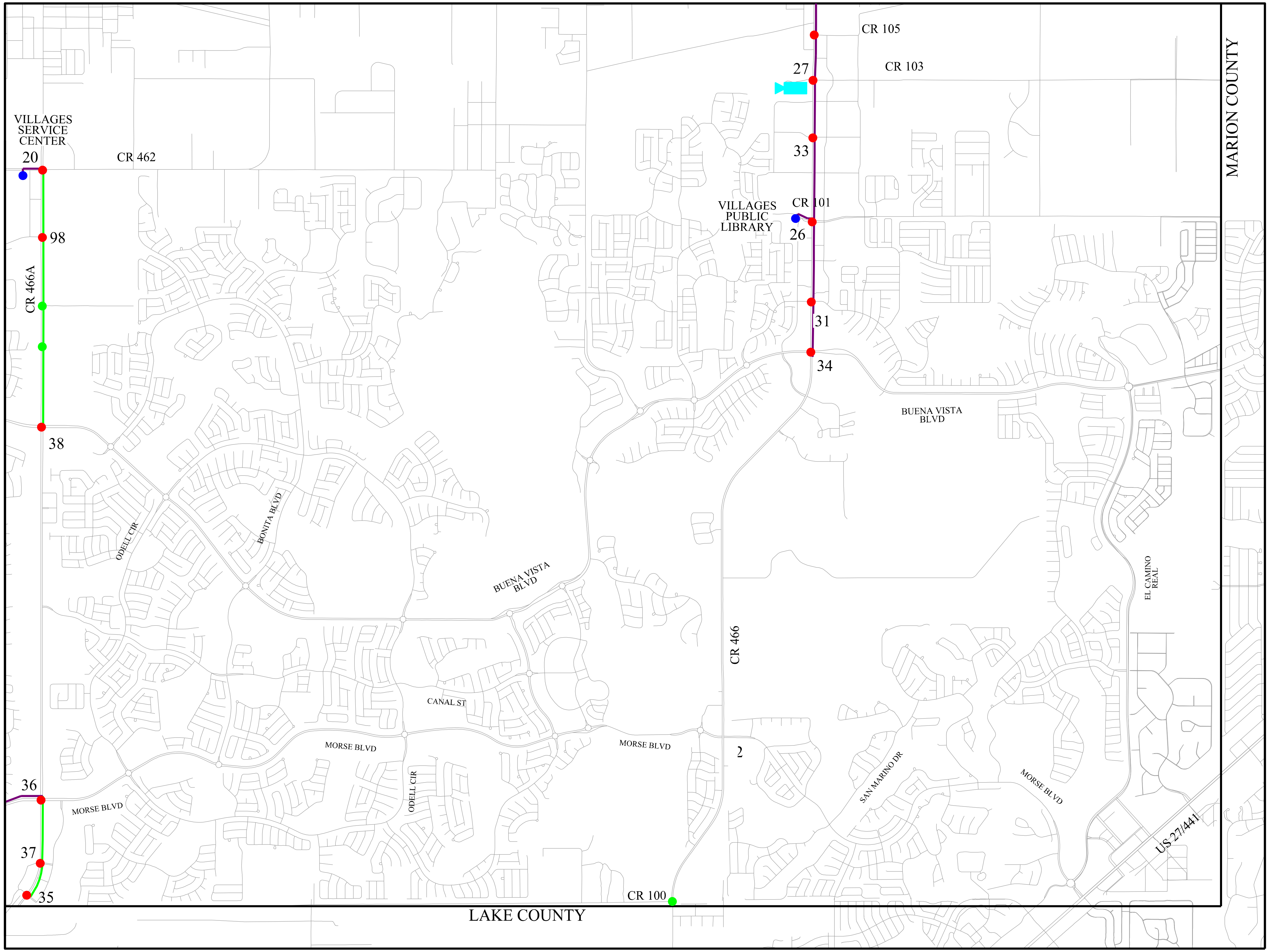

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Project Title	SUMTER COUNTY ATMS MASTER PLAN
Drawing Title	FIGURE 35: IMPLEMENTATION PHASE 1 (PAGE 2 OF 2)

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Table 27: Sumter County ATMS Phase I Cost Estimate

PAY ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
630-2-11	CONDUIT, F&I, OPEN TRENCH	LF	10514	$5.65	$59,406.36
630-2-12	CONDUIT, F&I, DIRECTIONAL BORE	LF	5788	$16.35	$94,627.26
630-2-14	CONDUIT, F&I, ABOVE GROUND	LF	20	$17.40	$348.00
633-1-121	FIBER OPTIC CABLE, F&I, UNDERGROUND, 12 FIBERS	LF	1890	$1.58	$2,986.20
633-1-123	FIBER OPTIC CABLE, F&I, UNDERGROUND, 96 FIBERS	LF	16808	$2.27	$38,154.92
633-2-31	FIBER OPTIC CONNECTION, INSTALL, SPLICE	EA	140	$40.39	$5,654.60
633-3-11	FIBER OPTIC CONNECTION HARDWARE, F&I, SPLICE ENCLOSURE	EA	7	$765.95	$5,361.65
633-3-12	FIBER OPTIC CONNECTION HARDWARE, F&I, SPLICE TRAY	EA	7	$59.92	$419.44
633-3-13	FIBER OPTIC CONNECTION HARDWARE, F&I, PRETERMINATED CONNECTOR ASSEMBLY	EA	84	$94.53	$7,940.52
633-3-16	FIBER OPTIC CONNECTION HARDWARE, F&I, PATCH PANEL- FIELD TERMINATED	EA	7	$1,200.00	$8,400.00
633-8-1	MULTI-CONDUCTOR COMMUNICATION CABLE, F&I	LF	340	$3.48	$1,183.20
635-2-11	PULL & SPLICE BOX, F&I, 13" X 24" COVER SIZE	EA	2	$574.55	$1,149.10
635-2-12	PULL & SPLICE BOX, F&I, 24" X 36" COVER SIZE	EA	19	$1,188.93	$22,978.05
635-2-13	PULL & SPLICE BOX, F&I, 30" X 60" RECTANGULAR OR 36" ROUND COVER SIZE	EA	8	$2,622.74	$20,981.92
639-1-122	ELECTRICAL POWER SERVICE, F&I, UNDERGROUND, METER PURCHASED BY CONTRACTOR	AS	0	$2,962.47	$0.00
639-2-1	ELECTRICAL SERVICE WIRE, F&I	LF	0	$4.82	$0.00
639-3-11	ELECTRICAL SERVICE DISCONNECT, F&I, POLE MOUNT	EA	0	$959.31	$0.00
641-2-12	PRESTRESSED CONCRETE POLE, F&I, TYPE P-II SERVICE POLE	EA	0	$1,648.98	$0.00
641-3-186	CONCRETE CCTV POLE, F&I WITH LOWERING DEVICE, 86'	EA	0	$20,528.57	$0.00
660-6-121	VEHICLE DETECTION SYSTEM- AVI, BLUETOOTH, F&I, CABINET EQUIPMENT	EA	0	$3,934.69	$0.00
660-6-122	VEHICLE DETECTION SYSTEM- AVI, BLUETOOTH, F&I, ABOVE GROUND EQUIPMENT	EA	0	$5,486.34	$0.00
670-5-110	TRAFFIC CONTROLLER ASSEMBLY, F&I, NEMA	AS	0	$14,200.00	$0.00
670-5-600	TRAFFIC CONTROLLER ASSEMBLY, REMOVE CONTROLLER WITH CABINET	AS	0	$498.52	$0.00
671-2-11	TRAFFIC CONTROLLER WITHOUT CABINET, F&I IN EXISTING CABINET, NEMA	EA	15	$3,000.00	$45,000.00
671-2-60	TRAFFIC CONTROLLER, REMOVE- CABINET TO REMAIN	EA	15	$452.40	$6,786.00
676-2-121	ITS CABINET, F&I, POLE MOUNT WITH SUNSHIELD, 336, 24" W X 36" H X 20" D	EA	0	$5,261.45	$0.00
676-2-122	ITS CABINET, F&I, POLE MOUNT WITH SUNSHIELD, 336S, 24" W X 46" H X 22" D	EA	0	$4,953.03	$0.00
682-1-113	ITS CCTV CAMERA, F&I, DOME ENCLOSURE - PRESSURIZED, IP, HIGH DEFINITION	AS	1	$3,600.00	$3,600.00
684-1-1	MANAGED FIELD ETHERNET SWITCH, F&I	EA	15	$2,284.27	$34,264.05
685-1-14	UNINTERRUPTIBLE POWER SUPPLY, F&I, ONLINE/DOUBLE CONVERSION WITH CABINET	EA	1	$5,538.75	$5,538.75
700-8-136	FRONT ACCESS DYNAMIC MESSAGE SIGN, FURNISH & INSTALL- W/UPS, FULL COLOR, 101-200 SF	EA	0	$65,000.00	$0.00
700-10-122	DMS SUPPORT STRUCTURE, F&I, CANTILEVER, 21-30 FT	EA	0	$43,600.00	$0.00
	CENTRAL CONTROL SOFTWARE (includes servers)	EA	1	$80,000.00	$80,000.00
UNIT COST SUBTOTAL					$444,780.02
101-1	*MOBILIZATION*			10%	$44,478.00
	MAINTENANCE OF TRAFFIC			10%	$48,925.80
	PROJECT UNKNOWNS				$0.00
	CONTINGENCY			1%	$5,381.84
CONSTRUCTION TOTAL					$543,565.66
				GRAND TOTAL COST FOR PHASE I =	**$543,565.66**

ALL UNIT PRICES ARE PRESENT DAY COSTS FOR YEAR 2016

PHASE II

Phase II of the Sumter County ATMS will consist of connecting additional intersections to the County's network, as well as creating a hardwired connection with the FDOT-maintained fiber optic cable along I-75. The Metro Ethernet connection established during Phase I will remain active, providing redundancy to the ATMS network. The design of Phase II will focus on providing connectivity to the intersections along CR 48 and SR 44. This includes areas such as The Villages, Wildwood, and Bushnell. The components of Phase II will consist of:

- Connect the Sumter County ATMS to the FDOT District Five RTMC through a hardwire connection to the FDOT-maintained fiber optic cable along I-75.
- Interconnect the traffic signals along the following corridors and provide the fiber optic connection to the TMC:
  - The traffic signals along CR 48 in Bushnell from I-75 to CR 475, five existing signals.
  - The traffic signals along SR 44 from I-75 to Buena Vista Boulevard, seven existing signals.
  - The traffic signals along US 27/441 from Morse Boulevard to NE 138th Lane/CR 109, four existing traffic signals.
- Provide CCTV cameras and Bluetooth readers along the signal corridors in Phase 1 and Phase 2.
- Coordinate the US 27/441 system with the existing ATMS in Marion County along US 441 to provide traffic signal coordination along this corridor through both Sumter and Marion Counties.
- Provide the ability to coordinate the US 27/441 system with the ATMS in Lake County for traffic signal coordination in the US 27/441 corridor.
- Install additional communications infrastructure for future use that would be consistent with this phase

There are 28 intersections in Phase II. Of these 28 intersections in Phase II, 9 will upgrade their traffic signal controllers as a part of Phase I, and have ATMS devices installed under Phase II. Of the other 19 existing intersections, 9 intersections will receive new traffic signal controllers only, and 10 intersections will receive new traffic signal controllers and cabinets. For the future intersections, it is anticipated that only the signal controllers will require upgrading to ensure compatibility with the selected central control software. The traffic signal cabinets along State roads will receive UPS assemblies. The intersections that are to be included in Phase II are listed in Table 28, as well as Figure 36.

Table 28: Phase II Intersections

County ID	Major Street	Minor Street
3	US 301	CR 466
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)
8	US 27/441	NE 138th Lane (CR 109)
9	CR 48	N West Street (CR 311)
10	CR 48	Lowery Street
11	SR 44	I-75 NB Off-Ramp
12	SR 44	I-75 SB Off-Ramp
13	SR 44	Industrial Drive
14	CR 48	I-75 SB Off-Ramp
16	US 301	SR 44
17	SR 44	Buena Vista Boulevard/Heritage Boulevard
18	CR 44A	Powell Road
19	SR 44	Powell Road/Signature Road
20	CR 466A	Powell Road/CR 462 E
22	Main Street (US 301)	W Noble Avenue (US 301)
26	CR 466	CR 101/Belvedere Boulevard
27	CR 466	CR 103/Old School Road
34	CR 466	Buena Vista Boulevard
35	CR 466A	Farner Place
36	CR 466A	Morse Boulevard
38	CR 466A	Buena Vista Boulevard
41	CR 103	Wedgewood Lane
46	US 27/441	Bella Cruz Drive

County ID	Major Street	Minor Street
47	US 27/441	NE 136th/Buenos Aires Boulevard
48	US 27/441	Morse Boulevard/W Boone Court
Future	CR 466A	NE 57th Drive
Future	SR 470 W	I-75 NB Off-Ramp
Future	SR 470 W	I-75 SB Off-Ramp

Phase II Communications

The initial estimates for Phase II are approximately 50,100 feet of new interconnect conduit and fiber optic cable. Existing FDOT fiber optic cable will be used for portions of the new system.

Phase II CCTV Cameras

Phase II will include CCTV cameras located at most of the signalized intersections being connected to the network under Phase II, as well as the planned CCTV camera locations for the signalized intersections under Phase I. This includes the signalized intersections for the various interchanges along I-75. The CCTV cameras will provide coverage for the off-ramps from I-75 with signalized control. The 22 Phase II CCTV camera locations are shown in Table 29, as well as on Figure 36.

Table 29: Phase II CCTV Camera Locations

County ID	Major Street	Cross Street
3	US 301	CR 466
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)
9	CR 48	N West Street (CR 311)
10	CR 48	Lowery Street
11	SR 44	I-75 NB Off-Ramp
12	SR 44	I-75 SB Off-Ramp
13	SR 44	Industrial Drive
14	CR 48	I-75 SB Off-Ramp
16	US 301	SR 44
17	SR 44	Buena Vista Boulevard/Heritage Boulevard
19	SR 44	Powell Road/Signature Road
20	CR 466A	Powell Road/CR 462 E

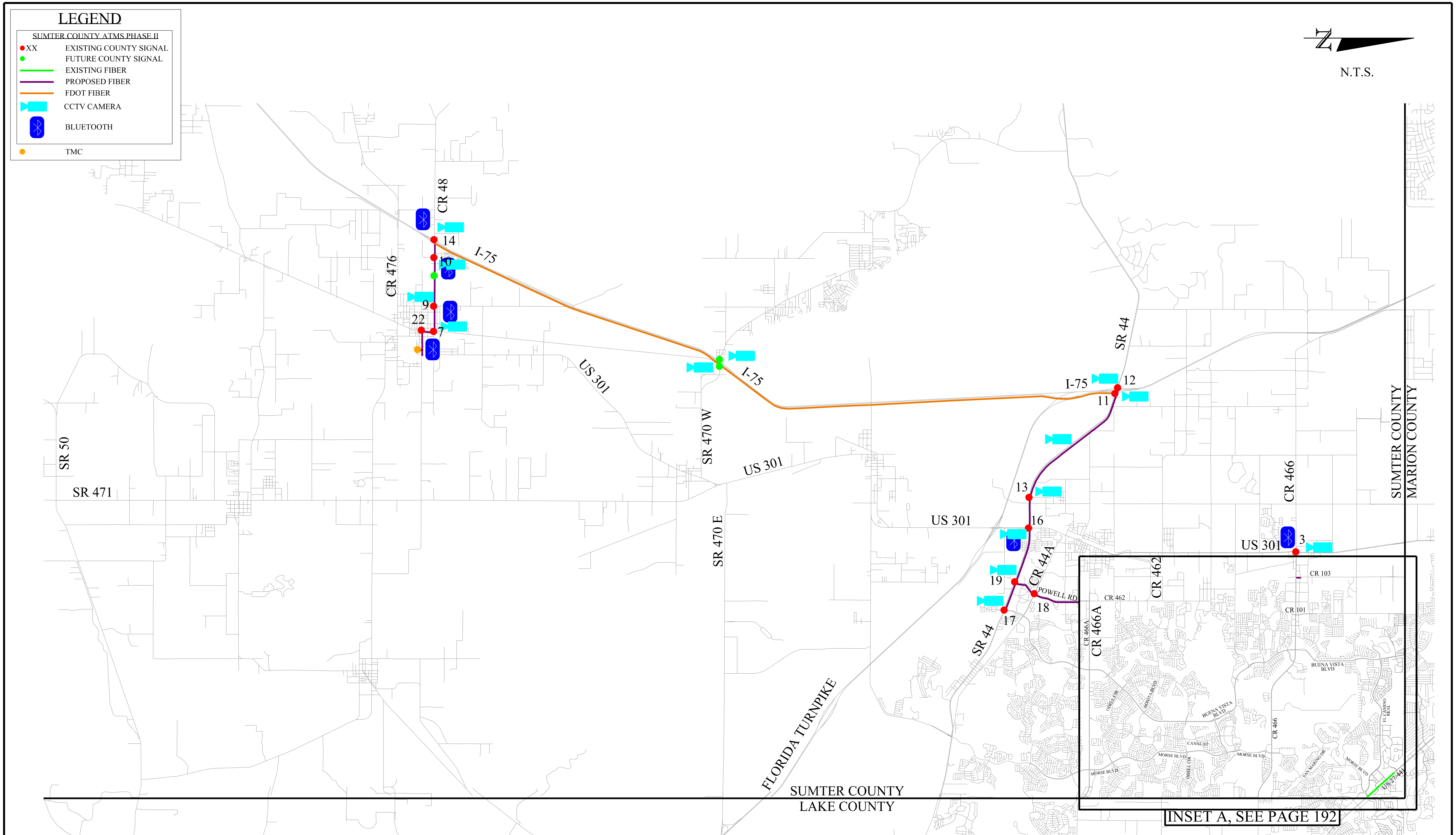
County ID	Major Street	Cross Street
26	CR 466	CR 101/Belvedere Boulevard
34	CR 466	Buena Vista Boulevard
35	CR 466A	Farner Place
36	CR 466A	Morse Boulevard
38	CR 466A	Buena Vista Boulevard
47	US 27/441	NE 136th/Buenos Aires Boulevard
48	US 27/441	Morse Boulevard/W Boone Court
Future	SR 470 W	I-75 NB Off-Ramp
Future	SR 470 W	I-75 SB Off-Ramp
N/A	SR 44	Between I-75 and Industrial Drive

Phase II Bluetooth Devices

Phase II will include Bluetooth devices located at most of the signalized intersections being connected to the network under Phase II, as well as the planned Bluetooth device locations for the signalized intersections under Phase I. This includes the signalized intersections along the CR 466, CR 466A, and CR 48 corridors. The Bluetooth devices will provide data collection for determining the travel-times along the three corridors. The 13 Phase II Bluetooth device locations are listed in Table 30 and shown on Figure 36.

Phase II Cost Estimate

It is estimated that the construction of Phase II will cost approximately $2,006,876.46. The estimate was developed using averages from FDOT's Basis of Estimations document, past experience, and updated verbal quotes from previous designs. See Table 31 for a detailed breakdown of the costs.



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LEGEND

SUMTER COUNTY ATMS PHASE II

- XX EXISTING COUNTY SIGNAL
- FUTURE COUNTY SIGNAL
- EXISTING FIBER
- PROPOSED FIBER
- CCTV CAMERA
- BLUETOOTH

INSET A

N.T.S.

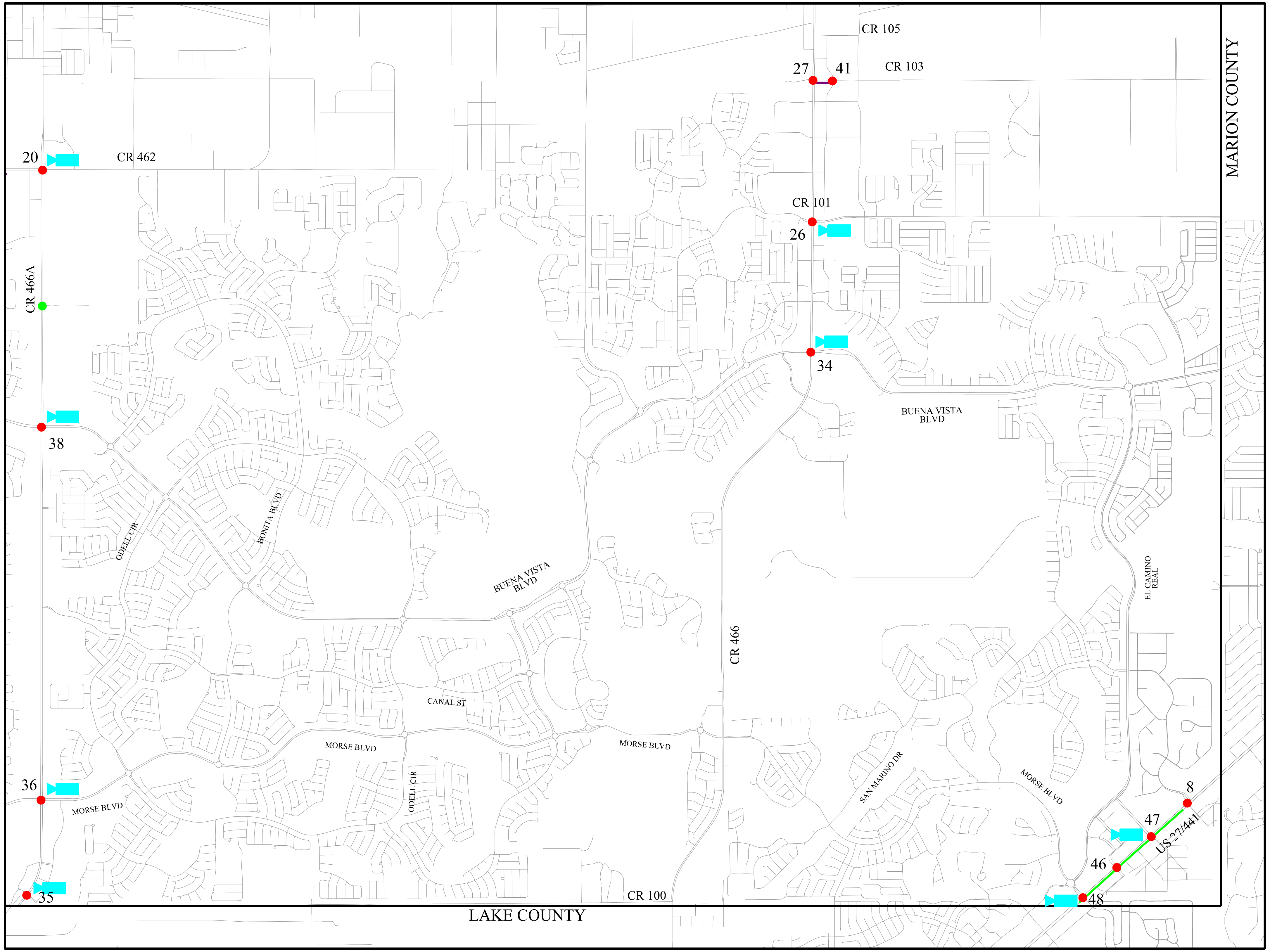

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Table 30: Phase II Bluetooth Device Locations

County ID	Major Street	Cross Street
3	US 301	CR 466
7	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)
9	CR 48	N West Street (CR 311)
10	CR 48	Lowery Street
14	CR 48	I-75 SB Off-Ramp
16	US 301	SR 44
20	CR 466A	Powell Road/CR 462 E
26	CR 466	CR 101/Belvedere Boulevard
27	CR 466	CR 103/Old School Road
34	CR 466	Buena Vista Boulevard
36	CR 466A	Morse Boulevard
38	CR 466A	Buena Vista Boulevard
Future	CR 466A	NE 57th Drive

PHASE III

Phase III of the Sumter County ATMS will include the remaining intersections and devices. These intersections fill in the gaps left by the previous phases. To alert travelers of delays and alternative routes, ADMSs will be deployed as a part of Phase III as well. The components of Phase III will consist of:

- Connect the remaining 20 existing traffic signals in the County to the ATMS.
    - Some signals may require wireless communications.
- Remaining recommended CCTV cameras and Bluetooth readers.
- Install ADMSs at critical locations as determined by Sumter County.

There are 23 intersections included in Phase III. Of the 20 existing intersections in Phase III, 3 intersections will receive new traffic signal controllers only, and 17 intersections will receive new traffic signal controllers and cabinets. For the future intersections, it is anticipated that only the signal controllers will require upgrading to ensure compatibility with the selected central control software. The traffic signal cabinets along State roads will receive UPS assemblies. These intersections are listed in Table 32 and shown on Figure 37.

Table 31: Sumter County ATMS Phase II Cost Estimate

PAY ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
630-2-11	CONDUIT, F&I, OPEN TRENCH	LF	31704	$5.65	$179,128.73
630-2-12	CONDUIT, F&I, DIRECTIONAL BORE	LF	29793	$16.35	$487,112.28
630-2-14	CONDUIT, F&I, ABOVE GROUND	LF	627	$17.40	$10,909.80
633-1-121	FIBER OPTIC CABLE, F&I, UNDERGROUND, 12 FIBERS	LF	6210	$1.58	$9,811.80
633-1-123	FIBER OPTIC CABLE, F&I, UNDERGROUND, 96 FIBERS	LF	56795	$2.27	$128,924.18
633-2-31	FIBER OPTIC CONNECTION, INSTALL, SPLICE	EA	460	$40.39	$18,579.40
633-3-11	FIBER OPTIC CONNECTION HARDWARE, F&I, SPLICE ENCLOSURE	EA	23	$765.95	$17,616.85
633-3-12	FIBER OPTIC CONNECTION HARDWARE, F&I, SPLICE TRAY	EA	23	$59.92	$1,378.16
633-3-13	FIBER OPTIC CONNECTION HARDWARE, F&I, PRETERMINATED CONNECTOR ASSEMBLY	EA	276	$94.53	$26,090.28
633-3-16	FIBER OPTIC CONNECTION HARDWARE, F&I, PATCH PANEL- FIELD TERMINATED	EA	23	$1,200.00	$27,600.00
633-8-1	MULTI-CONDUCTOR COMMUNICATION CABLE, F&I	LF	816	$3.48	$2,839.68
635-2-11	PULL & SPLICE BOX, F&I, 13" X 24" COVER SIZE	EA	57	$574.55	$32,749.35
635-2-12	PULL & SPLICE BOX, F&I, 24" X 36" COVER SIZE	EA	65	$1,188.93	$76,990.15
635-2-13	PULL & SPLICE BOX, F&I, 30" X 60" RECTANGULAR OR 36" ROUND COVER SIZE	EA	24	$2,622.74	$62,945.76
639-1-122	ELECTRICAL POWER SERVICE, F&I, UNDERGROUND, METER PURCHASED BY CONTRACTOR	AS	1	$2,962.47	$2,962.47
639-2-1	ELECTRICAL SERVICE WIRE, F&I	LF	500	$4.82	$2,410.00
639-3-11	ELECTRICAL SERVICE DISCONNECT, F&I, POLE MOUNT	EA	1	$959.31	$959.31
641-2-12	PRESTRESSED CONCRETE POLE, F&I, TYPE P-II SERVICE POLE	EA	1	$1,648.98	$1,648.98
641-3-186	CONCRETE CCTV POLE, F&I WITH LOWERING DEVICE, 86'	EA	1	$20,528.57	$20,528.57
660-6-121	VEHICLE DETECTION SYSTEM- AVI, BLUETOOTH, F&I, CABINET EQUIPMENT	EA	13	$3,934.69	$51,150.97
660-6-122	VEHICLE DETECTION SYSTEM- AVI, BLUETOOTH, F&I, ABOVE GROUND EQUIPMENT	EA	13	$5,486.34	$71,322.42
670-5-110	TRAFFIC CONTROLLER ASSEMBLY, F&I, NEMA	AS	10	$14,200.00	$142,000.00
670-5-600	TRAFFIC CONTROLLER ASSEMBLY, REMOVE CONTROLLER WITH CABINET	AS	10	$498.52	$4,985.20
671-2-11	TRAFFIC CONTROLLER WITHOUT CABINET, F&I IN EXISTING CABINET, NEMA	EA	12	$3,000.00	$36,000.00
671-2-60	TRAFFIC CONTROLLER, REMOVE- CABINET TO REMAIN	EA	12	$452.40	$5,428.80
676-2-121	ITS CABINET, F&I, POLE MOUNT WITH SUNSHIELD, 336, 24" W X 36" H X 20" D	EA	1	$5,261.45	$5,261.45
676-2-122	ITS CABINET, F&I, POLE MOUNT WITH SUNSHIELD, 336S, 24" W X 46" H X 22" D	EA	0	$4,953.03	$0.00
682-1-113	ITS CCTV CAMERA, F&I, DOME ENCLOSURE - PRESSURIZED, IP, HIGH DEFINITION	AS	22	$3,600.00	$79,200.00
684-1-1	MANAGED FIELD ETHERNET SWITCH, F&I	EA	23	$2,284.27	$52,538.21
685-1-14	UNINTERRUPTIBLE POWER SUPPLY, F&I, ONLINE/DOUBLE CONVERSION WITH CABINET	EA	15	$5,538.75	$83,081.25
700-8-136	FRONT ACCESS DYNAMIC MESSAGE SIGN, FURNISH & INSTALL- W/UPS, FULL COLOR, 101-200 SF	EA	0	$65,000.00	$0.00
700-10-122	DMS SUPPORT STRUCTURE, F&I, CANTILEVER, 21-30 FT	EA	0	$43,600.00	$0.00
UNIT COST SUBTOTAL					$1,642,154.05
101-1	*MOBILIZATION*			10%	$164,215.41
	MAINTENANCE OF TRAFFIC			10%	$180,636.95
	PROJECT UNKNOWNS				$0.00
	CONTINGENCY			1%	$19,870.06
CONSTRUCTION TOTAL					$2,006,876.46
				GRAND TOTAL COST FOR PHASE II =	**$2,006,876.46**

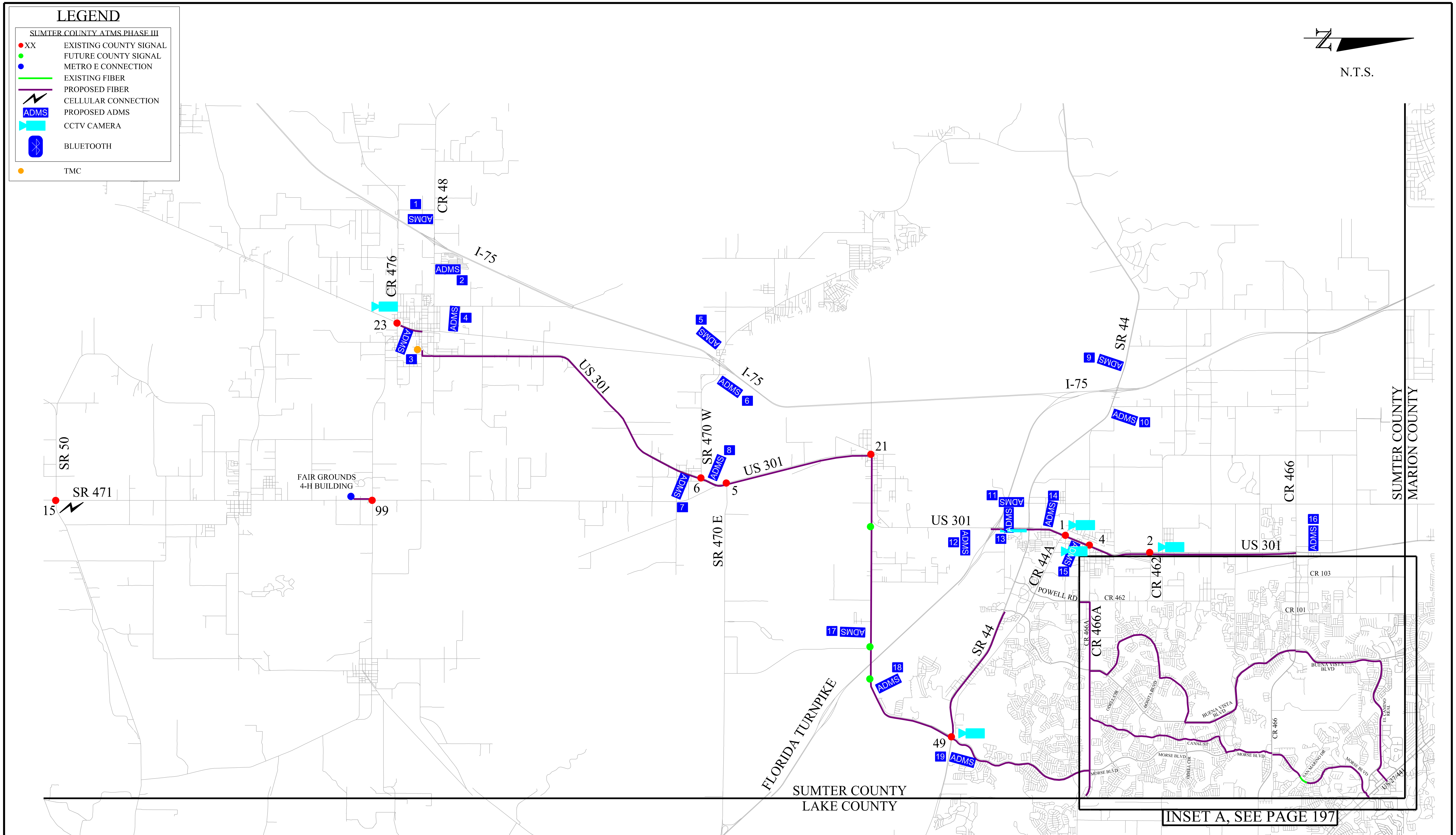
ALL UNIT PRICES ARE PRESENT DAY COSTS FOR YEAR 2016

Table 32: Phase III Intersections

County ID	Major Street	Minor Street
1	S Main Street (US 301)	Lynum Street/Huey Street (CR 44A)
2	US 301	CR 462 E
4	US 301	CR 466 A
5	US 301	SR 470 E
6	US 301	SR 470 W
15	SR 50	SR 471
21	Commercial Street (US 301)	Warm Springs Avenue (US 301)
23	US 301	Seminole Avenue (CR 48/CR 476)
28	Bailey Trail	Street Charles Place
29	Bonita Boulevard	Canal Street
30	El Camino Real	Buenos Aires Boulevard
32	CR 466	Morse Boulevard
39	Odell Circle	Canal Street (North)
40	Odell Circle	Canal Street (South)
42	El Camino Real	Botello Avenue/Enrique Drive
43	Morse Boulevard	Rio Grande Avenue
44	Morse Boulevard	San Marino Drive
45	Buena Vista Boulevard	Southern Trace/Saddlebrook Lane
49	SR 44	CR 468/Morse Boulevard
99	SR 471	CR 48
Future	CR 468	Florida's Turnpike SB On-Ramp
Future	CR 468	Florida's Turnpike NB Off-Ramp
Future	US 301	CR 468

Phase III Communications

The Phase III fiber optic communications cable routes should require less boring than Phase I. However, some intersections in this phase may be farther out from the rest of the control section or isolated. This will require the communications to consist of longer lengths of fiber optic cable or communication using wireless technology. The existing multi-mode fiber optic cable along CR 466A will be replaced with single-mode fiber optic cable under Phase III. The fiber optic cable along US 301 will also provide a critical high speed redundant link between the Public Works Complex in Bushnell and The Villages Sumter County Service Center in Wildwood eliminating the need for the Metro Ethernet connections. There is one intersection that will connect to the network over wireless communication links. The estimates for Phase III are approximately 280,000 feet of new interconnect conduit and fiber optic cable.



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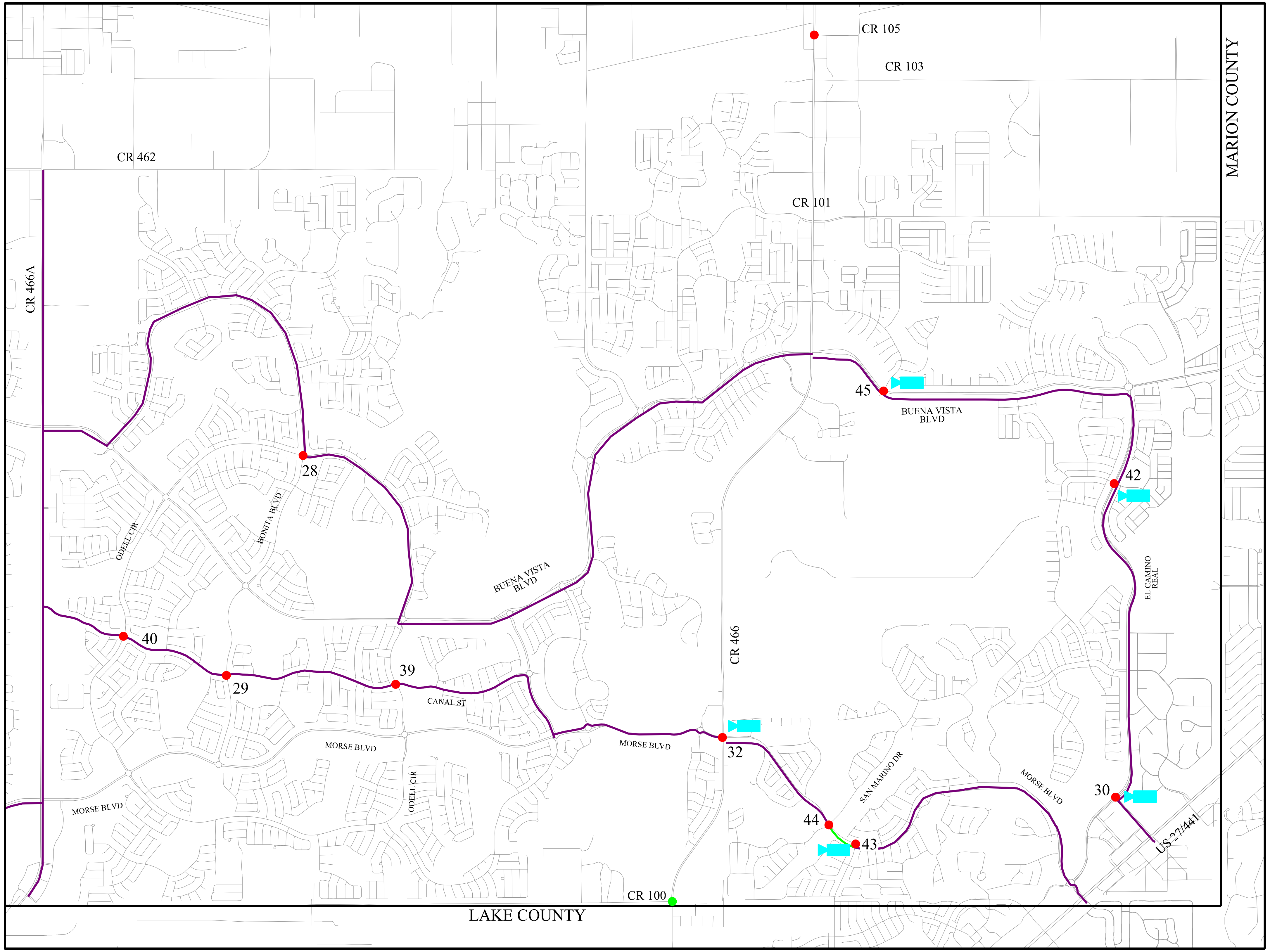
INSET A

LEGEND

SUMTER COUNTY ATMS PHASE III

- XX EXISTING COUNTY SIGNAL
- FUTURE COUNTY SIGNAL
- EXISTING FIBER
- PROPOSED FIBER
- CCTV CAMERA
- BLUETOOTH

N.T.S.



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Phase III CCTV Cameras

Phase III will include CCTV cameras located at most of the signalized intersections being connected to the network under Phase III. The 13 Phase III CCTV camera locations are listed in Table 33 and shown on Figure 37.

Table 33: Phase III CCTV Camera Locations

County ID	Major Street	Cross Street
1	S Main Street (US 301)	Lynum Street/Huey Street (CR 44A)
2	US 301	CR 462 E
4	US 301	CR 466 A
23	US 301	Seminole Avenue (CR 48/CR 476)
30	El Camino Real	Buenos Aires Boulevard
32	CR 466	Morse Boulevard
42	El Camino Real	Botello Avenue/Enrique Drive
43	Morse Boulevard	Rio Grande Avenue
45	Buena Vista Boulevard	Southern Trace/Saddlebrook Lane
49	SR 44	CR 468/Morse Boulevard
Future	CR 468	Florida's Turnpike SB On-Ramp
Future	CR 468	Florida's Turnpike NB Off-Ramp
N/A	US 301	Florida's Turnpike SB On-Ramp

Phase III Bluetooth Device

The Phase III Bluetooth device location is listed in Table 34 and shown on Figure 37.

Table 34: Phase III Bluetooth Device Location

County ID	Major Street	Cross Street
1	S Main Street (US 301)	Lynum Street/Huey Street (CR 44A)

Phase III ADMS

The 19 Phase III ADMSs are listed in Table 35 and shown on Figure 37.

Table 35: Phase III ADMS Locations

DMS No.	DMS Street	Nearest Cross Street	Approach
1	CR 48	I-75 SB Off-Ramp	Eastbound
2	CR 48	I-75 NB Off-Ramp	Westbound
3	US 301	Seminole Avenue (CR 48/CR 476)	Northbound
4	Main Street (CR 48/CR 475)	Belt Avenue (CR 48)	Southbound
5	SR 470 W	I-75 SB Off-Ramp	Eastbound
6	SR 470 W	I-75 NB Off-Ramp	Westbound
7	US 301	SR 470 W	Northbound
8	US 301	SR 470 W	Southbound
9	SR 44	I-75 SB Off-Ramp	Eastbound
10	SR 44	I-75 NB Off-Ramp	Westbound
11	SR 44	US 301	Eastbound
12	US 301	Turnpike SB Off-Ramp	Northbound
13	US 301	Turnpike NB Off-Ramp	Southbound
14	US 301	SR 44	Southbound
15	US 301	CR 466A	Northbound
16	US 301	CR 466	Southbound
17	CR 468	Turnpike SB Off-Ramp	Eastbound
18	CR 468	Turnpike NB Off-Ramp	Westbound
19	SR 44	Morse Boulevard	Westbound

Phase III Adaptive Traffic Control System

Two corridors have been identified as candidates for the implementation of an ATCS. The required vehicle detection system to operate the selected ATCS along the US 27/441 corridor and CR 466 corridor will be deployed as a part of Phase III.

Phase III Cost Estimate

It is estimated that the construction of Phase III will cost approximately $9,282,110.11. This does not include the cost of deploying the ATCSs because the construction costs vary significantly between each ATCS. The estimate was developed using averages from FDOT's Basis of Estimations document, past experience, and updated verbal quotes from previous designs. See Table 36 for the detailed cost breakdown for Phase III.

Table 36: Sumter County ATMS Phase III Cost Estimate

PAY ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
630-2-11	CONDUIT, F&I, OPEN TRENCH	LF	151495	$5.65	$855,943.93
630-2-12	CONDUIT, F&I, DIRECTIONAL BORE	LF	150815	$16.35	$2,465,817.08
630-2-14	CONDUIT, F&I, ABOVE GROUND	LF	1027	$17.40	$17,869.80
633-1-121	FIBER OPTIC CABLE, F&I, UNDERGROUND, 12 FIBERS	LF	12420	$1.58	$19,623.60
633-1-123	FIBER OPTIC CABLE, F&I, UNDERGROUND, 96 FIBERS	LF	301522	$2.27	$684,454.66
633-2-31	FIBER OPTIC CONNECTION, INSTALL, SPLICE	EA	920	$40.39	$37,158.80
633-3-11	FIBER OPTIC CONNECTION HARDWARE, F&I, SPLICE ENCLOSURE	EA	46	$765.95	$35,233.70
633-3-12	FIBER OPTIC CONNECTION HARDWARE, F&I, SPLICE TRAY	EA	46	$59.92	$2,756.32
633-3-13	FIBER OPTIC CONNECTION HARDWARE, F&I, PRETERMINATED CONNECTOR ASSEMBLY	EA	552	$94.53	$52,180.56
633-3-16	FIBER OPTIC CONNECTION HARDWARE, F&I, PATCH PANEL- FIELD TERMINATED	EA	46	$1,200.00	$55,200.00
633-8-1	MULTI-CONDUCTOR COMMUNICATION CABLE, F&I	LF	387	$3.48	$1,346.76
635-2-11	PULL & SPLICE BOX, F&I, 13" X 24" COVER SIZE	EA	65	$574.55	$37,345.75
635-2-12	PULL & SPLICE BOX, F&I, 24" X 36" COVER SIZE	EA	280	$1,188.93	$332,730.98
635-2-13	PULL & SPLICE BOX, F&I, 30" X 60" RECTANGULAR OR 36" ROUND COVER SIZE	EA	47	$2,622.74	$123,268.78
639-1-122	ELECTRICAL POWER SERVICE, F&I, UNDERGROUND, METER PURCHASED BY CONTRACTOR	AS	20	$2,962.47	$59,249.40
639-2-1	ELECTRICAL SERVICE WIRE, F&I	LF	10000	$4.82	$48,200.00
639-3-11	ELECTRICAL SERVICE DISCONNECT, F&I, POLE MOUNT	EA	20	$959.31	$19,186.20
641-2-12	PRESTRESSED CONCRETE POLE, F&I, TYPE P-II SERVICE POLE	EA	20	$1,648.98	$32,979.60
641-3-186	CONCRETE CCTV POLE, F&I WITH LOWERING DEVICE, 86'	EA	1	$20,528.57	$20,528.57
660-6-121	VEHICLE DETECTION SYSTEM- AVI, BLUETOOTH, F&I, CABINET EQUIPMENT	EA	1	$3,934.69	$3,934.69
660-6-122	VEHICLE DETECTION SYSTEM- AVI, BLUETOOTH, F&I, ABOVE GROUND EQUIPMENT	EA	1	$5,486.34	$5,486.34
670-5-110	TRAFFIC CONTROLLER ASSEMBLY, F&I, NEMA	AS	20	$14,200.00	$284,000.00
670-5-600	TRAFFIC CONTROLLER ASSEMBLY, REMOVE CONTROLLER WITH CABINET	AS	20	$498.52	$9,970.40
671-2-11	TRAFFIC CONTROLLER WITHOUT CABINET, F&I IN EXISTING CABINET, NEMA	EA	6	$3,000.00	$18,000.00
671-2-60	TRAFFIC CONTROLLER, REMOVE- CABINET TO REMAIN	EA	6	$452.40	$2,714.40
676-2-121	ITS CABINET, F&I, POLE MOUNT WITH SUNSHIELD, 336, 24" W X 36" H X 20" D	EA	1	$5,261.45	$5,261.45
676-2-122	ITS CABINET, F&I, POLE MOUNT WITH SUNSHIELD, 336S, 24" W X 46" H X 26" D	EA	19	$4,953.03	$94,107.57
682-1-113	ITS CCTV CAMERA, F&I, DOME ENCLOSURE - PRESSURIZED, IP, HIGH DEFINITION	AS	13	$3,600.00	$46,800.00
684-1-1	MANAGED FIELD ETHERNET SWITCH, F&I	EA	46	$2,284.27	$105,076.42
685-1-14	UNINTERRUPTIBLE POWER SUPPLY, F&I, ONLINE/DOUBLE CONVERSION WITH CABINET	EA	10	$5,538.75	$55,387.50
700-8-136	FRONT ACCESS DYNAMIC MESSAGE SIGN, FURNISH & INSTALL- W/UPS, FULL COLOR, 101-200 SF	EA	19	$65,000.00	$1,235,000.00
700-10-122	DMS SUPPORT STRUCTURE, F&I, CANTILEVER, 21-30 FT	EA	19	$43,600.00	$828,400.00
UNIT COST SUBTOTAL					$7,595,213.24
101-1	*MOBILIZATION*			10%	$759,521.32
	MAINTENANCE OF TRAFFIC			10%	$835,473.46
	PROJECT UNKNOWNS				$0.00
	CONTINGENCY			1%	$91,902.08
CONSTRUCTION TOTAL					$9,282,110.11
				GRAND TOTAL COST FOR PHASE III =	**$9,282,110.11**

ALL UNIT PRICES ARE PRESENT DAY COSTS FOR YEAR 2016

It is understood that Phase III has a very high cost estimate that probably exceeds what can be spent on the ATMS during one phase. For this reason, Phase III will be reevaluated at a later time and adjusted based on:

- Phase III ATMS infrastructure installed under other projects.
- Advances in the technologies of ATMS elements.
- Changes in available funding

PROJECT COST ESTIMATE

The cost estimate of the entire Sumter County ATMS project is $11,832,552.23. It is recommended that Sumter County evaluate the phasing of their deployment as funding becomes available.

SECTION 15

FUNDING ANALYSIS

15. FUNDING ANALYSIS

INTRODUCTION

The process of planning, design, construction and operation of an ATMS is a step-by-step process with each step requiring the request and acquisition of financial resources from various entities involved with the project (Sumter County Public Works, FDOT District Five via the Five-Year Work Program and Grant Funding). The work completed to date in the planning process for the Sumter County ATMS and the project funding for Sumter County Public Works to acquire an operational ATMS is described in this chapter.

SUMTER COUNTY ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS) MASTER PLAN – PHASE I (STUDY COMPLETED)

The Sumter County Advanced Traffic Management System Master Plan (ATMSMP) was started in December 2013 and completed in May 2014. The ATMSMP was prepared jointly by Volkert, Inc. and VIBE as a Task Order through the Volkert, Inc. Continuing Services Contract with Sumter County. The cost of the ATMSMP was $50,000 and was funded by Sumter County. The ATMSMP was prepared to:

- Evaluate existing signal hardware and develop standards for future hardware acquisition.
- Begin the process of developing an ATMS in the County.
- Recommend elements to be included in the ATMS.

It was noted that the ATMSMP needs to be consistent with the Code of Federal Regulations 940 which requires a project architecture that is consistent with the National ITS Architecture and ties in with the regional architecture prepared by the FDOT and local neighboring agency architectures.

SUMTER COUNTY ATMSMP – PHASE II (FM: 436365-1-18-01) (STUDY COMPLETED)

The ATMSMP Phase II project was started in March 2016 and was completed in February 2017. The Study was prepared jointly by Volkert, Inc. and VIBE as a Task Order through the Volkert, Inc. Continuing Services Contract with Sumter County. The cost of the Study was $200,000 and was funded by a FDOT Joint Participation Agreement with Sumter County. The Study was prepared to determine the needs, phasing and estimated costs for ITS activities throughout

Sumter County. The study area included state and national roads such as I-75, Florida Turnpike (SR 91), US 301, US 27/441, SR 50, SR 471 and SR 44. The Study also included Sumter County arterial and collector roadways such as CR 48, CR 466, Morse Boulevard, CR 466A, Buena Vista Boulevard and other roadways.

The Master Plan included recommending ITS equipment and connectivity patterns in order to create a standardized and connected County signalization system. Major emphasis was placed on ITS activities along the I-75 and Florida Turnpike corridors, coordination of ITS activities with the FDOT District Five RTMC and the Florida Turnpike RTMC, and coordination of ITS activities in the US 27/441 corridor with Marion and Lake Counties. A major component of the Master Plan was to determine the communications technology and routing for the Sumter County ATMS. Typically, the communications aspect of an ATMS can be 50 percent of the construction costs for the ATMS. Determining the most efficient and cost-effective technology and routing for ATMS communications (fiber optic cable, wireless, etc.) will play a major role in the overall success of the ATMS.

The Master Plan recommended the phasing for the engineering design and construction of the ATMS. Due to the significant costs associated with an ATMS, they are typically designed and constructed in phases. This phased approach allows for the project to be budgeted in the County's capital project budget and the FDOT Five-Year Work Plan. It also provides clearly defined phases for grant funding opportunities.

In conjunction with the completion of the Master Plan, a Lake-Sumter Metropolitan Planning Organization (LSMPO) Project Application Form (PAF) was completed for the Phase 1 design. The PAF is required by the LSMPO in order to request FDOT funding through the FDOT Five-Year Work Program. The PAF requested that funding for the Phase 1 design be budgeted in the FDOT Fiscal Year 2018 (July 1, 2017 – June 30, 2018). Sumter County is budgeting $100,000 in their FY 18 budget (October 1, 2017 – September 30 2018) for the Phase 1 design, and the LSMPO request for FDOT funding for the Phase 1 design will be $100,000. With a completed PAF, FDOT will also be able to explore grant funding possibilities for the Sumter County ATMS.

The design for the Sumter County ATMS will consist of three design phases, as described in the previous section of this Master Plan.

Phase I

Phase I of the ATMS, as described in the previous section, will produce an operable ATMS in Sumter County. This initial ATMS can be expanded as future funding for engineering design and construction becomes available.

Funding requested from FDOT District Five fiscal year 2018 (July 1, 2017 – June 30, 2018) is $100,000 and from Sumter County Public Works fiscal year 2018 (October 1, 2017 – September 30, 2018) is $100,000. Total funding for Phase I design is $200,000.

It is anticipated that the Phase I construction will have a limited budget of approximately $550,000. This would cover the construction activities described above.

Phase II

Phase II will provide a critical link to the FDOT District Five Regional TMC through a hardwire connection to the FDOT-maintained fiber optic cable along I-75 and will connect the traffic signals in Sumter County on additional corridors to the Sumter County ATMS.

Funding requested from FDOT District Five fiscal year 2019 (July 1, 2018 – June 30, 2019) will be $200,000 and $200,000 will be budgeted by the Sumter County Public Works fiscal year 2019 (October 1, 2018 – September 30, 2019). Total funding for Phase II design is $400,000.

Phase III

Phase III will connect the remaining 20 signals throughout the County to the Sumter County ATMS.

Funding will be requested from FDOT District Five fiscal year 2020 (July 1, 2019– June 30, 2020) for $700,000 and $200,000 will be budgeted by Sumter County Public Works fiscal year 2020 (October 1, 2019 – September 30, 2020). Total funding for Phase III design is $900,000.

Funding Beyond Phase III

An ATMS is always a work in progress. The rapid changes in technology and communications associated with ATMS equipment will always require capital funding in future years after the basic ATMS is operational. The engineering design and construction funding described in this chapter is intended to provide a countywide, operational ATMS in Sumter County and does not take into account future funding needs to upgrade and further expand the ATMS after the initial ATMS is operational.

CONSTRUCTION PHASE FUNDING FOR THE SUMTER COUNTY ATMS

Funding for construction of the Sumter County ATMS will follow a phased approach similar to the engineering design. The construction funding for Phase I will be requested for the year following the Phase I design funding. The same approach will be taken for funding the construction of Phases II and III.

Table 37 summarizes the yearly funding requests for the design and construction of the three phases for the Sumter County ATMS. It provides the estimated funding to be requested from Sumter County Public Works and FDOT and/or grant funding.

Table 37 provides for an orderly scheduling/funding for the activities required to design and construct the Sumter County ATMS. This will provide Sumter County Public Works and the FDOT/LSMPO the funding information required for their respective financial planning and budgeting. It also provides an easy to understand blueprint for exploring grant opportunities to fund the design and/or construction of the Sumter County ATMS.

Total requested Sumter County funding (engineering and construction) =	$1,000,000
Total requested FDOT funding (engineering and construction) =	$12,450,000
Total funding for Project (engineering and construction) =	$13,450,000

Table 37: Funding Schedule

Item Funded	**Fiscal Year 2018**	**Fiscal Year 2019**	**Fiscal Year 2020**	**Fiscal Year 2021**
Phase I Engineering Design	**$200,000 (total) Cty = $100,000 FDOT = $100,000**			
Phase I ATMS Construction		**$550,000 (total) Cty = $100,000 FDOT = $450,000**		
Phase II Engineering Design		**$400,000 (total) Cty = $200,000 FDOT = $200,000**		
Phase II ATMS Construction			**$2,100,000 (total) Cty = $200,000 FDOT = $1,900,000**	
Phase III Engineering Design			**$900,000 (total) Cty = $200,000 FDOT = $700,000**	
Phase III Engineering Construction				**$9,300,000 (total) Cty = $200,000 FDOT = $9,100,000**
Total ATMS Funding Requested	**$200,000 (total)** Cty = $100,000 FDOT = $100,000	**$950,000 (total)** Cty = $300,000 FDOT = $650,000	**$3,000,000 (total)** Cty = $400,000 FDOT = $2,600,000	**$9,300,000 (total)** Cty = $200,000 FDOT = $9,100,000

Notes:

1. **FDOT fiscal year is July 1 – June 30 (FY 2018 is July 1, 2017 – June 30, 2018).**
2. **Sumter County fiscal year is October 1 – September 30 (FY 2018 is October 1, 2017 – September 30, 2018).**
3. **Cty is Sumter County Public Works.**
4. **FDOT is the Florida Department of Transportation, District Five.**
5. **Any engineering design and/or construction funding in any fiscal year could be replaced and/or supplemented with grant funding through FDOT or Sumter County.**

APPENDIX A

INTERSECTION FIELD INVENTORY FORM

Intersection Inventory Form

Cover Sheet

Major Street:		Zone:	N/A	Date:	
Minor Street:		Intersection No:		Data Collected By:	

Intersection Inventory Form

Sidewalks

Major Street: ______________________ Zone: N/A Date: __________

Minor Street: ______________________ Intersection No: __________ Data Collected By: __________

* Begin data collection on southbound approach of intersection and work clockwise around intersection. If there is no southbound approach, begin in the northeast quadrant and work clockwise. Take pictures beginning with southbound approach of intersection and working clockwise. Take 2 pictures of each approach; 1 to show approach lane configuration and 1 to show signal heads and pedestrian features. Take 2 pictures of the cabinet; 1 picture of the equipment and 1 picture of the conduits.

NW Corner			***NE Corner***			***SE Corner***			***SW Corner***		
Crosswalks	E-W	N-S	**Crosswalks**	E-W	N-S	**Crosswalks**	E-W	N-S	**Crosswalks**	E-W	N-S
Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Crosswalk Missing			Crosswalk Missing			Crosswalk Missing			Crosswalk Missing		

Picture Number:	**Picture Number:**	**Picture Number:**	**Picture Number:**

Cabinet Picture Number:

Intersection Inventory Form

Signal Compliance

Major Street: ______________________ Zone: N/A Date: __________

Minor Street: ______________________ Intersection No: __________ Data Collected By: __________

NW Corner			***NE Corner***			***SE Corner***			***SW Corner***		
Pedestrian Push Buttons	E-W	N-S	**Pedestrian Push Buttons**	E-W	N-S	**Pedestrian Push Buttons**	E-W	N-S	**Pedestrian Push Buttons**	E-W	N-S
Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Missing Button			Missing Button			Missing Button			Missing Button		
Pedestrian Signal Heads	E-W	N-S	**Pedestrian Signal Heads**	E-W	N-S	**Pedestrian Signal Heads**	E-W	N-S	**Pedestrian Signal Heads**	E-W	N-S
Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Head Missing			Head Missing			Head Missing			Head Missing		
Countdown Ped Head			Countdown Ped Head			Countdown Ped Head			Countdown Ped Head		
Pedestrian Assembly	E-W	N-S	**Pedestrian Assembly**	E-W	N-S	**Pedestrian Assembly**	E-W	N-S	**Pedestrian Assembly**	E-W	N-S
Properly Functioning			Properly Functioning			Properly Functioning			Properly Functioning		

MUTCD Criteria	
One-Way Lanes Present	
If Yes, One-Way Signs Present	
Fire Station Within 500' of Intersection	
If Yes, Are There Emergency Signs	

Intersection Inventory Form

Signal Heads

Major Street: ______________________ Zone: N/A Date: ______________________

Minor Street: ______________________ Intersection No: ______________________ Data Collected By: ______________________

Southbound Approach	***Westbound Approach***	***Northbound Approach***	***Eastbound Approach***
Signal Heads for NB Traffic	**Signal Heads for EB Traffic**	**Signal Heads for SB Traffic**	**Signal Heads for WB Traffic**
This Location OK	This Location OK	This location OK	This location OK
Not Applicable	Not Applicable	Not Applicable	Not Applicable
Distance From Stop Bar < 40'	Distance From Stop Bar < 40'	Distance From Stop Bar < 40'	Distance From Stop Bar < 40'
Distance From Stop Bar > 180'	Distance From Stop Bar > 180'	Distance From Stop Bar > 180'	Distance From Stop Bar > 180'
Lens Dia. < 12" on Head 120'-180' Away	Lens Dia. < 12" on Head 120'-180' Away	Lens Dia. < 12" on Head 120'-180' Away	Lens Dia. < 12" on Head 120'-180' Away
8" Lens on State or High Speed Rd.	8" Lens on State or High Speed Rd.	8" Lens on State or High Speed Rd.	8" Lens on State or High Speed Rd.
Signal Heads < 8' Apart	Signal Heads < 8' Apart	Signal Heads < 8' Apart	Signal Heads < 8' Apart
No Signal Disconnect	No Signal Disconnect	No Signal Disconnect	No Signal Disconnect
Limited Visibilty Distance of Head	Limited Visibilty Distance of Head	Limited Visibilty Distance of Head	Limited Visibilty Distance of Head
Color of Head/Hardware Not Black	Color of Head/Hardware Not Black	Color of Head/Hardware Not Black	Color of Head/Hardware Not Black
4-Section Head Instead of 5-Section	4-Section Head Instead of 5-Section	4-Section Head Instead of 5-Section	4-Section Head Instead of 5-Section
LT Signal Sign Not Used With Red Ball	LT Signal Sign Not Used With Red Ball	LT Signal Sign Not Used With Red Ball	LT Signal Sign Not Used With Red Ball
Improper Installation	Improper Installation	Improper Installation	Improper Installation
Comments	Comments	Comments	Comments
Signal Head Faces, (# of heads w each face type)	**Signal Head Faces, (# of heads w each face type)**	**Signal Head Faces, (# of heads w each face type)**	**Signal Head Faces, (# of heads w each face type)**
12" R - Y - G	12" R - Y - G	12" R - Y - G	12" R - Y - G
12" R - Y - G - Y ←- G ←	12" R - Y - G - Y ←- G ←	12" R - Y - G - Y ←- G ←	12" R - Y - G - Y ←- G ←
12" R - Y - G - Y →-G →	12" R - Y - G - Y →-G →	12" R - Y - G - Y →-G →	12" R - Y - G - Y →-G →
12" R - Y - G - G ←	12" R - Y - G - G ←	12" R - Y - G - G ←	12" R - Y - G - G ←
12" R ←-Y ←- G ←	12" R ←-Y ←- G ←	12" R ←-Y ←- G ←	12" R ←-Y ←- G ←
12" R - Y ←- G ←	12" R - Y ←- G ←	12" R - Y ←- G ←	12" R - Y ←- G ←
12" R - 8" Y - G	12" R - 8" Y - G	12" R - 8" Y - G	12" R - 8" Y - G
Near Side Head	Near Side Head	Near Side Head	Near Side Head
12" R (Flasher)	12" R (Flasher)	12" R (Flasher)	12" R (Flasher)
12" Y (Flasher)	12" Y (Flasher)	12" Y (Flasher)	12" Y (Flasher)
12" G (Down Arrow)	12" G (Down Arrow)	12" G (Down Arrow)	12" G (Down Arrow)
Comments	Comments	Comments	Comments

Intersection Inventory Form

Signal Heads Heights

Major Street: ______________________ Zone: N/A Date: ____________

Minor Street: ______________________ Intersection No: ______ Data Collected By: ____________

* Signal Head #1 is the head closest to the pole

Southbound Approach					***Westbound Approach***					***Northbound Approach***					***Eastbound Approach***				
Signal Head Heights					**Signal Head Heights**					**Signal Head Heights**					**Signal Head Heights**				
Head # 1		ft		in	Head # 1		ft		in	Head # 1		ft		in	Head # 1		ft		in
Head # 2		ft		in	Head # 2		ft		in	Head # 2		ft		in	Head # 2		ft		in
Head # 3		ft		in	Head # 3		ft		in	Head # 3		ft		in	Head # 3		ft		in
Head # 4		ft		in	Head # 4		ft		in	Head # 4		ft		in	Head # 4		ft		in
Head # 5		ft		in	Head # 5		ft		in	Head # 5		ft		in	Head # 5		ft		in
Head # 6		ft		in	Head # 6		ft		in	Head # 6		ft		in	Head # 6		ft		in
Head # 7		ft		in	Head # 7		ft		in	Head # 7		ft		in	Head # 7		ft		in
Head # 8		ft		in	Head # 8		ft		in	Head # 8		ft		in	Head # 8		ft		in
Head # 9		ft		in	Head # 9		ft		in	Head # 9		ft		in	Head # 9		ft		in
Head # 10		ft		in	Head # 10		ft		in	Head # 10		ft		in	Head # 10		ft		in

Intersection Inventory Form

Signs and Pavement Marking

Major Street: ____________________ Zone: N/A Date: __________

Minor Street: ____________________ Intersection No: __________ Data Collected By: __________

Southbound Approach		*Westbound Approach*		*Northbound Approach*		*Eastbound Approach*	
Pavement Markings		**Pavement Markings**		**Pavement Markings**		**Pavement Markings**	
Not Applicable		Not Applicable		Not Applicable		Not Applicable	
No Stop Bar		No Stop Bar		No Stop Bar		No Stop Bar	
Signs **If Existing**		**Signs** **If Existing**		**Signs** **If Existing**		**Signs** **If Existing**	
No Right Turn		No Right Turn		No Right Turn		No Right Turn	
No Left Turn		No Left Turn		No Left Turn		No Left Turn	
Left Turn Signal		Left Turn Signal		Left Turn Signal		Left Turn Signal	
Left Turn Yield on Green Ball		Left Turn Yield on Green Ball		Left Turn Yield on Green Ball		Left Turn Yield on Green Ball	
PED Crossing		PED Crossing		PED Crossing		PED Crossing	
Advanced PED Crossing		Advanced PED Crossing		Advanced PED Crossing		Advanced PED Crossing	
Signal Ahead		Signal Ahead		Signal Ahead		Signal Ahead	
Street Name Sign		Street Name Sign		Street Name Sign		Street Name Sign	

Intersection Inventory Form

Signal Cabinet and Controller

Major Street: ______ Zone: N/A Date: ______
Minor Street: ______ Intersection No: ______ Data Collected By: ______

Cabinet

Cabinet location (corner):		NW, NE, SE, SW, Other, (Specify) ______
Manufacturer:		
Date of Installation:		
Condition:		New, Good, Poor
Size:		IV, V, VI, Other (Specify) ______
Mounting:		Base, Pole, Other (Specify) ______
Material:		Concrete, Quazite, N/A, Other (Specify) ______
Power Location, Nearest Corner:		NW, NE, SE, SW, Other (Specify) ______
Conduit w/Interconnect:		Yes or No
If Yes, Conduit Size:		1", 2", 3", Other (Specify) ______
Spare Conduit:		Yes or No
If Yes, Conduit Size:		1", 2", 3", Other (Specify) ______
Number of Each Spare:		
Best Cab. Entry Point:		New, Existing Comm. Conduit, Spare Conduit
Bottom of Cab. Above Center		Yes or No

Controller

Manufacturer:		
Model Number:		
Date of Installation:		
Condition:		New, Good, Poor

Coordination Device

Present:		Yes or No
Internal:		Yes or No
Manufacturer:		
Model Number:		
Date of Installation:		
Condition:		New, Good, Poor
Cable Type:		6 Pair, Modem, None
Master Location:		Yes or No
Master Controller:		Yes or No Condition: ______ New, Good, Poor
Manufacturer:		
Model Number:		
Date of Installation:		

Conflict Monitor

Manufacturer:		
Model Number:		
Date of Installation:		
Condition:		New, Good, Poor
Channels:		

Intersection Inventory Form

Signal Cabinet and Controller

Major Street: ______________ Zone: N/A Date: ______________

Minor Street: ______________ Intersection No: ______________ Data Collected By: ______________

Controller Phasing

Maximum No. of Phases:		8 or 16
No. of Veh Phases Used:		Veh. 1-16, Ped 1-8 — No. of Ped Phases Used:
Phase 1 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 2 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 3 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 4 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 5 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 6 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 7 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 8 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 9 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 10 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 11 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 12 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 13 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 14 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 15 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Phase 16 Assignment:		NBLT, NB, SBLT, SB, EBLT, EB, WBLT, WB
Ped 1 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 2 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 3 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 4 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 5 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 6 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 7 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB
Ped 8 Assignment:		NB Ped, SB Ped, EB Ped, WB Ped, Exclusive NB, SB, EB, WB

Overlaps

OLA Associated Phases:		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
OLA Associated Phases:		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
OLA Associated Phases:		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
OLA Associated Phases:		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

SOP Number or Sketch Phasing Below: ______________

↑ N

Intersection Inventory Form

Detectors

Major Street: ____________ Zone: N/A Date: ____________

Minor Street: ____________ Intersection No: ________ Data Collected By: ____________

Detectors

Phase Detected	Detection Type, Loop, Video, Other (Specify)	No. of Channels	Mounting, Shelf or Rack

Preemption

Internal:		Yes or No
Manufacturer:		
Model Number:		
Date of Installation:		
Condition:		New, Good, Poor
Type of Preemption:		Railroad, Firestation, Emergency Vehicle, Other (Specify)

APPENDIX B

INTERSECTION FIELD INVENTORY SUMMARY SIGNAL PHASING

County Signal ID	Major Street	Minor Street	Signal Phasing																																
			Max. No. of Phases	No. of Vehicle Phases Used	No. of Ped Phases Used	Phase 1 Assignment	Phase 2 Assignment	Phase 3 Assignment	Phase 4 Assignment	Phase 5 Assignment	Phase 6 Assignment	Phase 7 Assignment	Phase 8 Assignment	Phase 9 Assignment	Phase 10 Assignment	Phase 11 Assignment	Phase 12 Assignment	Phase 13 Assignment	Phase 14 Assignment	Phase 15 Assignment	Phase 16 Assignment	Ped Phase 1 Assignment	Ped Phase 2 Assignment	Ped Phase 3 Assignment	Ped Phase 4 Assignment	Ped Phase 5 Assignment	Ped Phase 6 Assignment	Ped Phase 7 Assignment	Ped Phase 8 Assignment	Overlap A Assoc. Phases	Overlap B Assoc. Phases	Overlap C Assoc. Phases	Overlap D Assoc. Phases	Intersection SOP Number	SOP Comments
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	16	8	2	NBLT	SB	EBLT	WB	SBLT	NB	WBLT	EB										SB Ped						EB Ped					10	
2	US 301	CR 462 E	16	5	2	NBLT	SB		WB	SBLT	NB														WB Ped		NB Ped							Modified 12	
3	US 301	CR 466																																	
4	US 301	CR 466A																																	
5	US 301	CR 470 E	16	2			NB/SB		WB																									Modified 1	
6	US 301	CR 470 W	16	2			NB/SB		EB/WB																									1	
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	16	6	1	SBLT	NB		EB	NBLT	SB		WB														SB Ped							7	
8	US 27/441	NE 138th Ln (CR 109)	16	6	4	SBLT	NB		EB	NBLT	SB		WB										NB Ped		EB Ped		SB Ped		WB Ped					7	
9	SR 48	N West St (CR 311)	16	4	3		WB		NB		EB		SB										WB Ped				EB Ped		SB Ped					1	
10	SR 48	Lowery St	16	3	2		WB		NB		EB														NB Ped		EB Ped							Modified 1	
11	SR 44	I-75 NB Off-Ramp	16	4		EBLT	WB		NB		EB																							15	
12	SR 44	I-75 SB Off-Ramp	16	4		WBLT	EB		SB		WB																							14	
13	SR 44	Industrial Dr	16	4		EBLT	WB				EB		SB																					12	
14	SR 48	I-75 SB Off-Ramp	16	3			EB		SB		WB																							Modified 1	
15	SR 50	SR 471	16	6		EBLT	WB		NB	WBLT	EB		SB																					7	
16	US 301	SR 44	16	8		EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB										WB Ped		NB Ped		EB Ped		SB Ped					10	
17	SR 44	Buena Vista Blvd/Heritage Blvd	16	7		EBLT	WB	SBLT	NB	WBLT	EB		SB																					Modified 7	Same as Intersection 19
18	CR 44A	Powell Rd	16	8		NBLT	SB	EBLT	WB	SBLT	NB	WBLT	EB																					10	
19	SR 44	Powell Rd/Signature Rd	16	7		EBLT	WB	SBLT	NB	WBLT	EB		SB																					Modified 7	
20	CR 466A	Powell Rd/CR 462 E	16	8	1	EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB														EB Ped							10	
21	Commercial St (US 301)	Warm Springs Ave (US 301)	16	2	1		NB/SB		EB/WB														NB Ped											1	
22	Main St (US 301)	W Noble Ave (US 301)	16	5	4	SBLT	NB/SB		EB/WB														NB Ped/SB Ped		EB Ped/WB Ped									Modified 7	
23	US 301	Seminole Ave (CR 48/CR 476)	16	4	1		SB		WB		NB		EB										SB Ped											1	
26	CR 466	CR 101/Belvedere Blvd	16	8	2	EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB												NB Ped		EB Ped							10	
27	CR 466	CR 103/Old School Rd	16	6		EBLT	WB	SB	NB	WBLT	EB																							9	
28	Bailey Tr	St Charles Pl	16	4	2		NB		EB		SB		WB														SB Ped		WB Ped					1	
29	Bonita Blvd	Canal St	16	4	2		WB		SB		EB		NB										WB Ped						NB Ped					1	
30	El Camino Real	Buenos Aires Blvd	16	6		EBLT	WB		NB	WBLT	EB		SB																					9	
31	CR 466	Southern Trace/Tall Trees Ln	16	6			WB	EBLT	NB	WBLT	EB		SB																					7	
32	CR 466	Morse Blvd	16	8		EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB																					10	
33	CR 466	Tatonka Terr	16	6	1	EBLT	WB		NB	WBLT	EB		SB														EB Ped							9	
34	CR 466	Buena Vista Blvd	16	8		EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB																					10	
35	CR 466A	Farner Pl	16	6		EBLT	WB		NB	WBLT	EB		SB																					9	
36	CR 466A	Morse Blvd	16	8		EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB																					10	
37	CR 466A	Sembler Way/Heald Way	16	6		EBLT	WB		NB	WBLT	EB		SB																					9	
38	CR 466A	Buena Vista Blvd	16	8		EBLT	WB	SBLT	NB	WBLT	EB	NBLT	SB																					10	
39	Odell Cir	Canal St (North)	16	4	2		NB		EB		SB		WB										NB Ped		EB Ped									1	
40	Odell Cir	Canal St (South)	16	4	2		EB		SB		WB		NB										EB Ped						NB Ped					1	
41	CR 103	Wedgewood Ln	16	4			NB		EB		SB		WB																					1	
42	El Camino Real	Botello Ave/Enrique Dr	16	6		EBLT	WB	NB	SB	WBLT	EB																			8+5	7+1			Modified 9	
43	Morse Blvd	Rio Grande Ave	16	4		SB	NBRT		WB		NB																								
44	Morse Blvd	San Marino Dr	16	7		SBLT	NB		EB	NBLT	SB	EBLT	WB																					9	
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	16	6		SBLT	NB		EB	NBLT	SB		WB																					7	
46	US 27/441	Bella Cruz Dr	16	6		SBLT	NB		EB	NBLT	SB		WB																					7	
47	US 27/441	NE 136th/Buenos Aires Blvd	16	8	4	NBLT	SB	WBLT	EB	SBLT	NB	EBLT	WB										SB Ped		EB Ped		NB Ped		WB Ped					10	
48	US 27/441	Morse Blvd/W Boone Ct	16	7		SBLT	NB		EB	NBLT	SB	EBLT	WB																					Modified 10	
98	CR 466A	Pinellas Pl	16	4	1		WB		NB	WBLT	EB																EB Ped							12	
99	SR 471	CR 48	16	4			SB		WB		NB		EB																					1	

APPENDIX C

INTERSECTION CONDITION DIAGRAMS

CONDITION DIAGRAM

COUNTY SIGNAL ID: 1 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: S MAIN ST (US 301) AT LYNUM ST/HUEY ST (CR 44A)

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: NJP

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 1-S Main St (US 301) at Lynum St-Huey St (CR 44A).dgn
Name: Art
Date: 5/27/2014 Time: 5:10:32 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 2 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: US 301 AT CR 462 E

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP
HEDGE	TELEPHONE POLE	SIGN (1 POST)
BUILDING	COMBINATION POLE	SIGN (2 POST)
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD

PED. SIGNAL HEAD
RR SIGNAL (W/GATE)
DRAINAGE INLET

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 2-US 301 at CR 462 E.dgn
Name: Art Time: 5:40:33 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 3 COUNTY: SUMTER CITY: OXFORD

INTERSECTION: US 301 AT CR 466

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: NJP

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

CONDITION DIAGRAM

COUNTY SIGNAL ID: 4 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: US 301 AT CR 466A

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: NJP

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 4-US 301 at CR 466A.dgn
Name: Art
Date: 5/27/2014 Time: 5:10:36 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 5 COUNTY: SUMTER CITY: SUMTERVILLE

INTERSECTION: US 301 AT CR 470 E

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 5-US 301 at CR 470 E.dgn
Name: Art
Date: 5/27/2014 Time: 5:10:37 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 6 COUNTY: SUMTER CITY: SUMTERVILLE

INTERSECTION: US 301 AT CR 470 W

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 6-US 301 at CR 470 W.dgn
Name: Art
Date: 5/27/2014 Time: 5:10:38 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 7 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: MAIN ST (SR 48/CR 475) AT BELT AVE (SR 48)

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET

SYMBOLS

TREES
SHRUBS
HEDGE
BUILDING
RIGHT OF WAY LINE
FENCE
GUARDRAIL
POWER POLE
TELEPHONE POLE
COMBINATION POLE
TRAFFIC SIGNAL POLE
HYDRANT
CONTROLLER CABINET
VEHICLE DETECTOR LOOP
SIGN (1 POST)
SIGN (2 POST)
OVERHEAD SIGN
TRAFFIC SIGNAL HEAD
PED. SIGNAL HEAD
RR SIGNAL (W/GATE)
DRAINAGE INLET

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 7-Main St (SR 48-CR 475) at Belt Ave (SR 48).dgn
Name: Art Time: 5:10:39 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 8 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: US 27/US 441 AT NE 138TH LN (CR 109)

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 8-US 27-441 at NE 138th Ln (CR 109).dgn
Name: Art
Date: 5/27/2014 Time: 5:10:41 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 9 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: SR 48 AT N WEST ST (CR 311)

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 9-SR 48 at N West St (CR 311).dgn
Name: Art Time: 5:40:42 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 10 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: SR 48 AT LOWERY ST

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 10-SR 48 at Lowery St.dgn
Name: Art Time: 5:10:43 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 11 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: SR 44 AT I-75 NB OFF-RAMP

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection II-SR 44 at I-75 NB Off-Ramp.dgn
Name: Art Time: 5:0:44 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 12 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: SR 44 AT I-75 SB OFF-RAMP

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 12-SR 44 at I-75 SB Off-Ramp.dgn
Name: Art
Date: 5/27/2014 Time: 5:10:45 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 13 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: SR 44 AT INDUSTRIAL DR

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

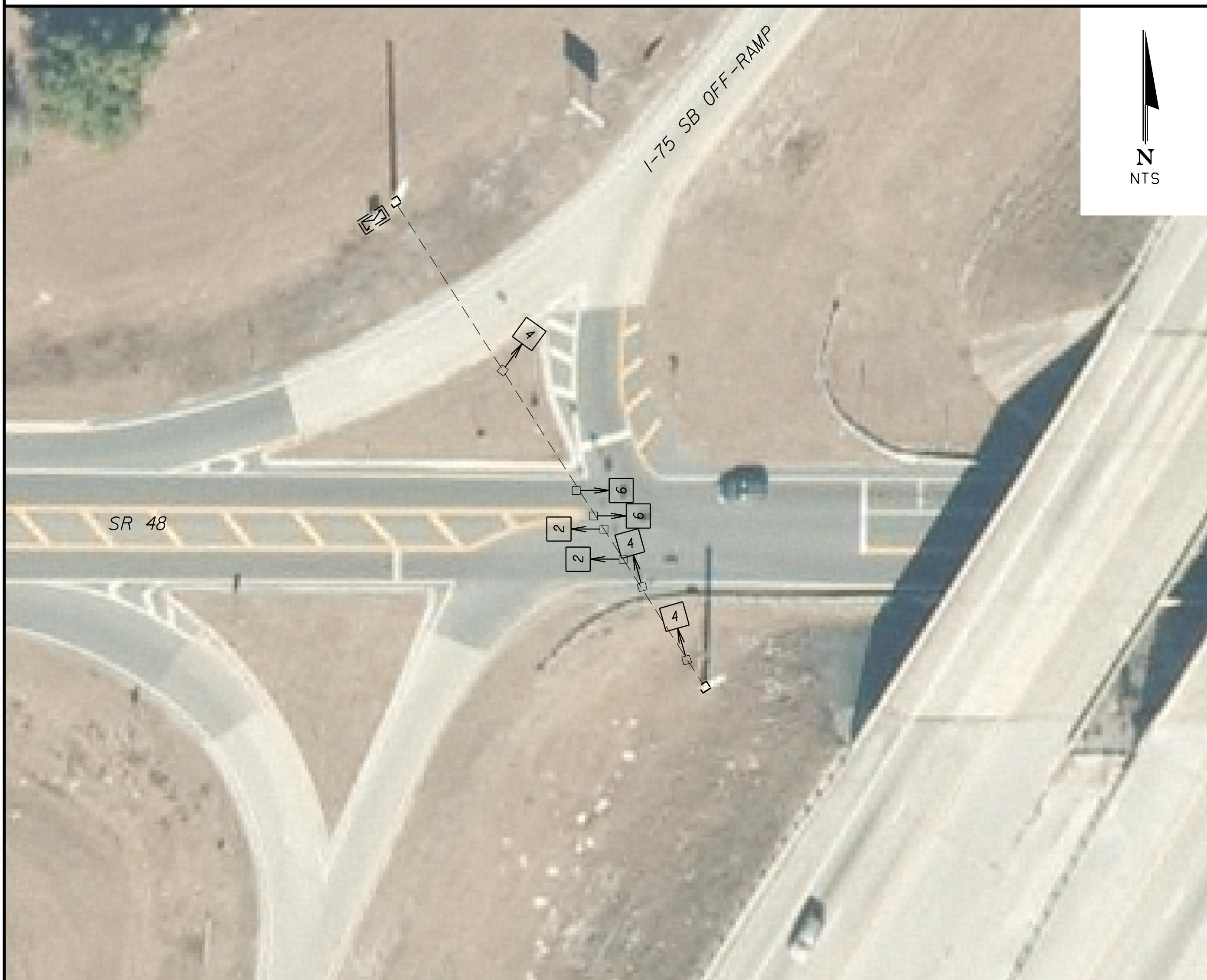
Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 13-SR 44 at Industrial Dr.dgn
Name: Art Time: 5:0:46 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 14 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: SR 48 AT I-75 SB OFF-RAMP

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET



SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 14-SR 48 at I-75 SB Off-Ramp.dgn
Name: Art
Date: 5/27/2014 Time: 5:10:47 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 15 COUNTY: SUMTER CITY: WEBSTER

INTERSECTION: SR 50 AT SR 471

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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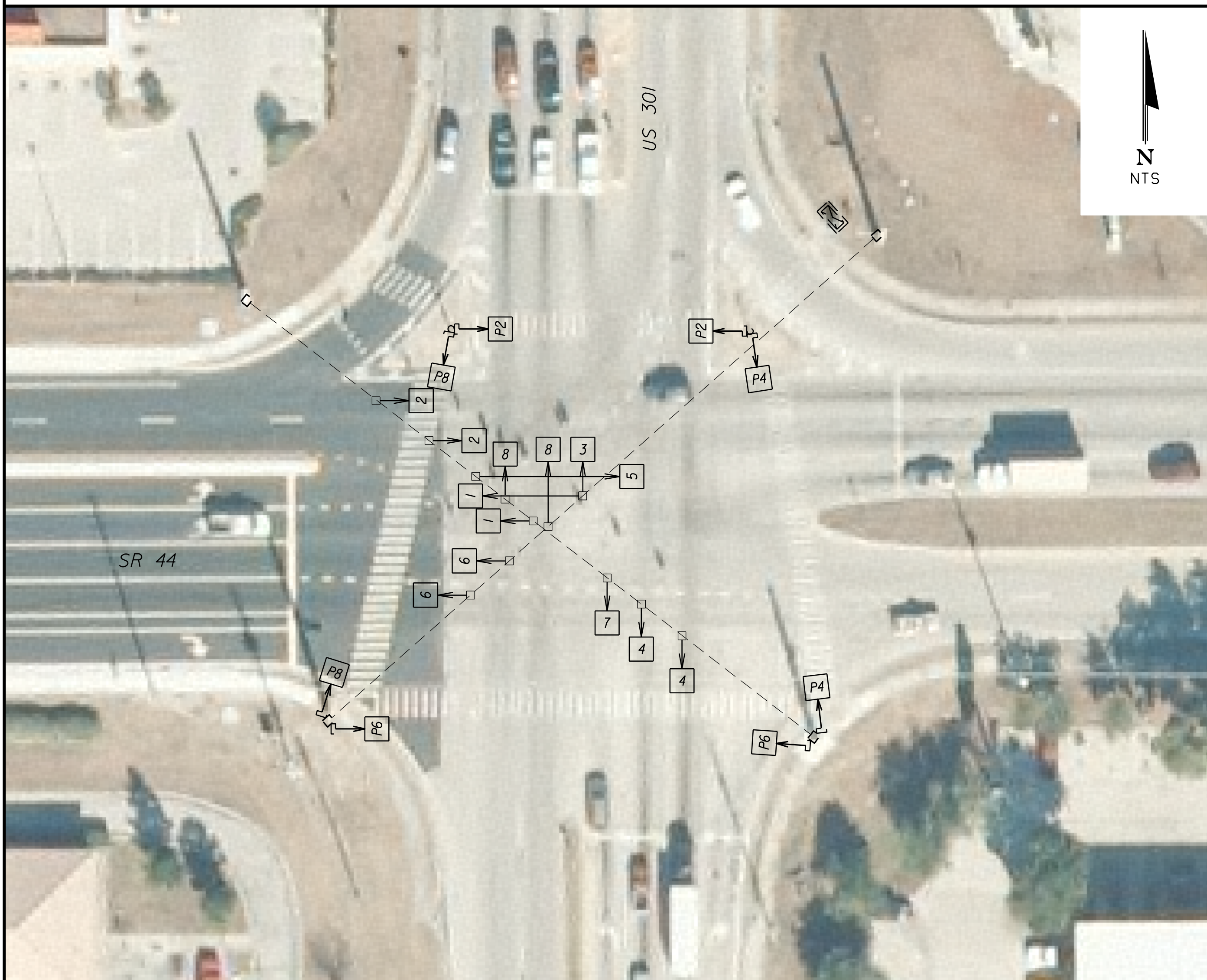
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

CONDITION DIAGRAM

COUNTY SIGNAL ID: 16 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: US 301 AT SR 44

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET



SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 16-US 301 at SR 44.dgn
Name: Art Time: 5:10:50 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 17 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: SR 44 AT BUENA VISTA BLVD/HERITAGE BLVD

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 17-SR 44 at Buena Vista Blvd-Heritage Blvd.dgn
Name: Art Time: 5:10:51 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 18 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: CR 44A AT POWELL RD

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 18-CR 44A at Powell Rd.dgn
Name: Art
Date: 5/27/2014 Time: 5:10:53 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 19 COUNTY: SUMTER CITY: WILDWOOD
INTERSECTION: SR 44 AT POWELL RD/SIGNATURE RD
FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 19-SR 44 at Powell Rd-SignatureRd.dgn
Name: Art Time: 5:10:54 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 20 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: CR 466A AT POWELL RD/CR 462 E

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 20-CR 466A at Powell Rd (CR 462 E).dgn
Name: Art
Date: 5/27/2014 Time: 5:10:55 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 21 COUNTY: SUMTER CITY: COLEMAN

INTERSECTION: COMMERCIAL ST (US 301) AT WARM SPRINGS AVE (US 301)

FIELD REVIEW DATE: 01/16/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 21-Commercial St (US 301) at Warm Springs Ave (US 301).dgn
Name: Art
Date: 5/27/2014 Time: 5:10:57 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 22 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: MAIN ST (US 301) AT NOBLE AVE (US 301)

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 22-Main St (US 301) at Noble Ave (US 301).dgn
Name: Art Time: 5:0:58 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 23 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: US 301 AT SEMINOLE AVE (CR 48/CR 476)

FIELD REVIEW DATE: 01/09/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

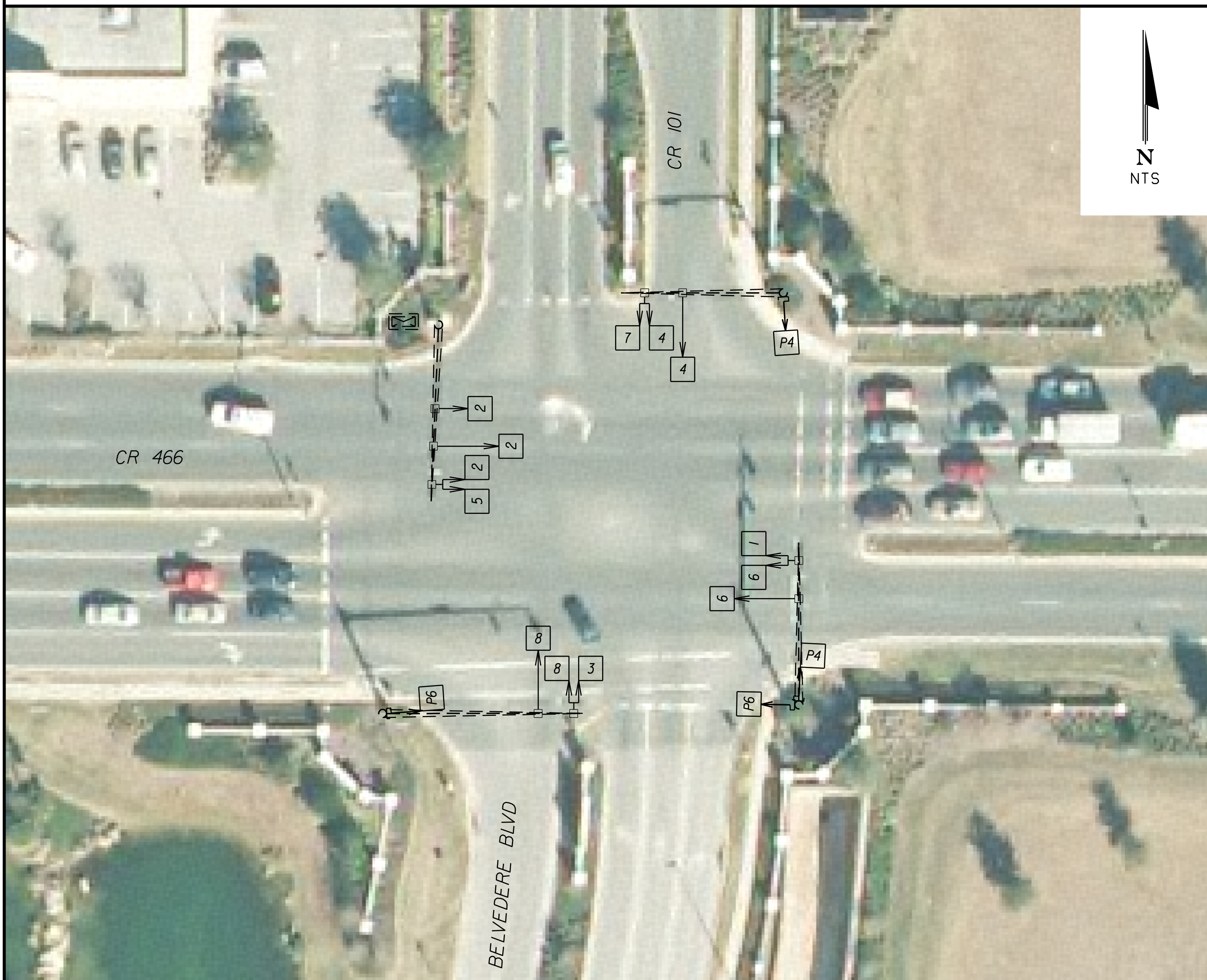
Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 23-US 301 at Seminole Ave (CR 48-CR 476).dgn
Name: Art Time: 5:11:00 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 26 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466 AT CR 101/BELVEDERE BLVD

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET



SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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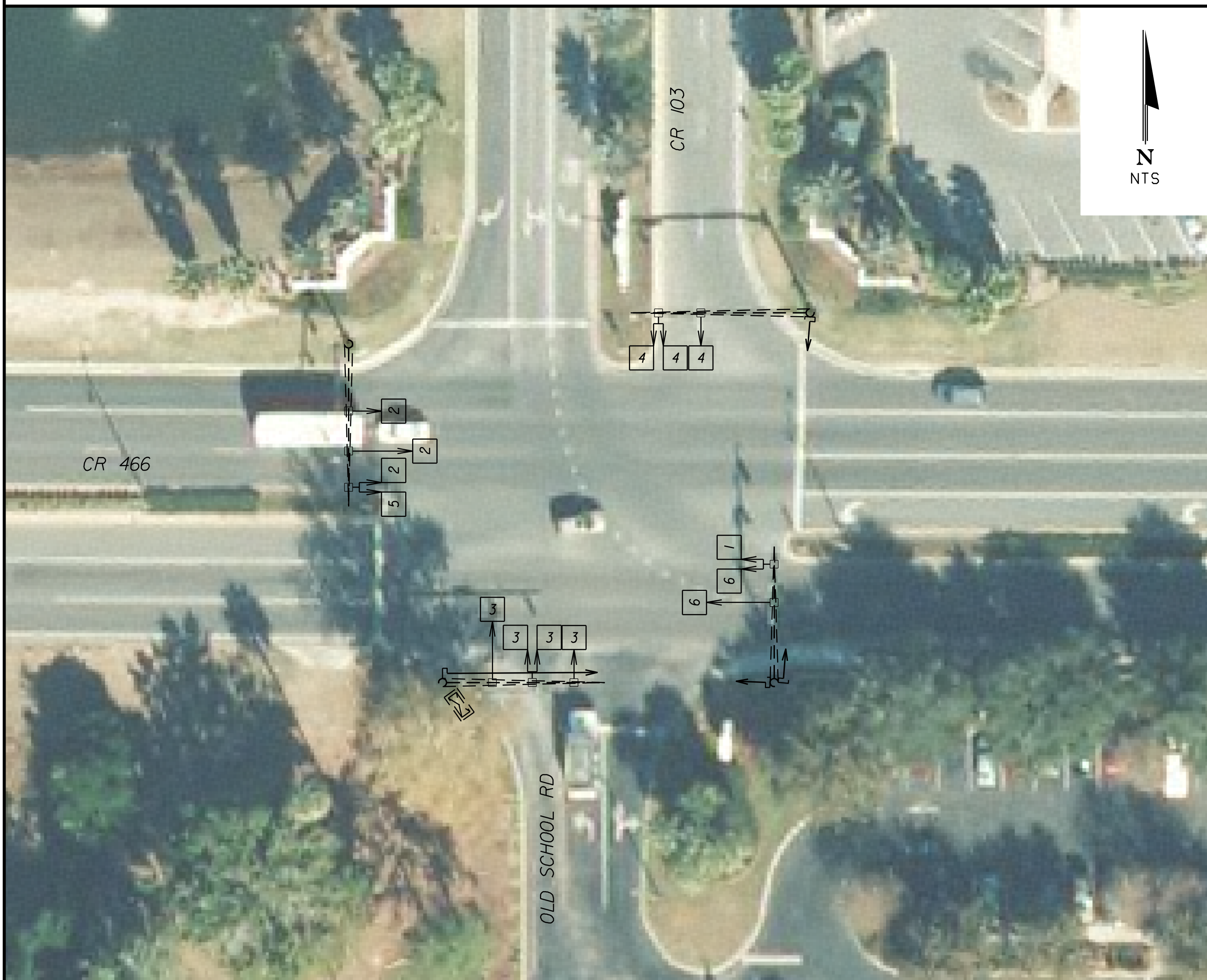
Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

CONDITION DIAGRAM

COUNTY SIGNAL ID: 27 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466 AT CR 103/OLD SCHOOL RD

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: AET



SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 27-CR 466 at CR 103-Old School Rd.dgn
Name: Art Time: 5:11:03 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 28 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: BAILEY TR AT ST CHARLES PL

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES
SHRUBS
HEDGE
BUILDING
RIGHT OF WAY LINE
FENCE
GUARDRAIL
POWER POLE
TELEPHONE POLE
COMBINATION POLE
TRAFFIC SIGNAL POLE
HYDRANT
CONTROLLER CABINET
VEHICLE DETECTOR LOOP
SIGN (1 POST)
SIGN (2 POST)
OVERHEAD SIGN
TRAFFIC SIGNAL HEAD
PED. SIGNAL HEAD
RR SIGNAL (W/GATE)
DRAINAGE INLET

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 28-Bailey Tr at St Charles Pl.dgn
Name: Art Time: 5:11:04 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 29 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: BONITA BLVD AT CANAL ST

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 29-Bonita Blvd at Canal St.dgn
Name: Art Time: 5:11:06 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 30 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: EL CAMINO REAL AT BUENOS AIRES BLVD

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 30-El Camino Real at Buenos Aires Blvd.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:07 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 31 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466 AT SOUTHERN TRACE/TALL TREES LN

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 31-CR 466 at Southern Trace-Tall Trees Ln.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:09 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 32 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466 AT MORSE BLVD

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 32-CR 466 at Morse Blvd.dgn
Name: Art Time: 5:11:10 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 33 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466 AT TATONKA TERR

FIELD REVIEW DATE: 01/17/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 33-CR 466 at Tatonka Terr.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:11 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 34 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466 AT BUENA VISTA BLVD

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN
Project No.	0113008
Drawing Title	CONDITION DIAGRAM
Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 34-CR 466 at Buena Vista Blvd.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:12 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 35 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466A AT FARNER PL

FIELD REVIEW DATE: 01/29/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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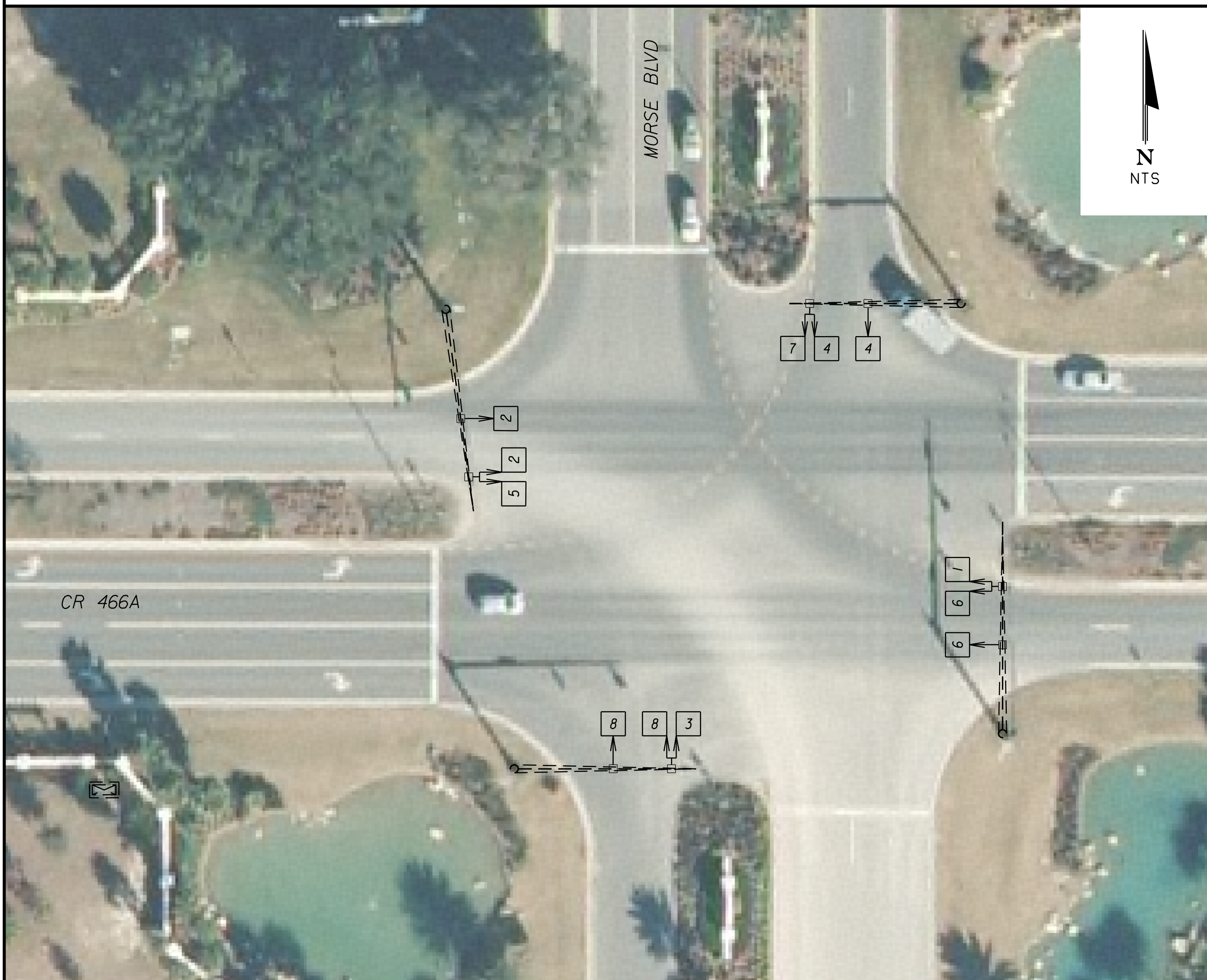
Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

CONDITION DIAGRAM

COUNTY SIGNAL ID: 36 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466A AT MORSE BLVD

FIELD REVIEW DATE: 01/29/2014 PREPARED BY: AET



SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 36-CR 466A at Morse Blvd.dgn
Name: Art Time: 5:11:15 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 37 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466A AT SEMBLER WAY/HEALD WAY

FIELD REVIEW DATE: 01/29/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 37-CR 466A at Sembler Way-Heald Way.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:16 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 38 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 466A AT BUENA VISTA BLVD

FIELD REVIEW DATE: 01/29/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 38-CR 466A at Buena Vista Blvd.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:18 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 39 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: ODELL CIR AT CANAL ST (NORTH)

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 39-Odell Cir at Canal St (North).dgn
Name: Art
Date: 5/27/2014 Time: 5:11:19 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 40 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: ODELL CIR AT CANAL ST (SOUTH)

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

Prepared By :

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 40-Odell Cir at Canal St (South).dgn
Name: Art
Date: 5/27/2014 Time: 5:11:20 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 41 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: CR 103 AT WEDGEWOOD LN

FIELD REVIEW DATE: 01/17/2004 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

Prepared By :

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 41-CR 103 at Wedgewood Ln.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:22 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 42 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: EL CAMINO REAL AT BOTELLO AVE/ENRIQUE DR

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES
SHRUBS
HEDGE
BUILDING
RIGHT OF WAY LINE
FENCE
GUARDRAIL
POWER POLE
TELEPHONE POLE
COMBINATION POLE
TRAFFIC SIGNAL POLE
HYDRANT
CONTROLLER CABINET
VEHICLE DETECTOR LOOP
SIGN (1 POST)
SIGN (2 POST)
OVERHEAD SIGN
TRAFFIC SIGNAL HEAD
PED. SIGNAL HEAD
RR SIGNAL (W/GATE)
DRAINAGE INLET

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

CONDITION DIAGRAM

COUNTY SIGNAL ID: 43 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: MORSE BLVD AT RIO GRANDE AVE

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 43-Morse Blvd at Rio Grande Ave.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:25 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 44 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: MORSE BLVD AT SAN MARINO DR

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 44-Morse Blvd at San Marino Dr.dgn
Name: Art Time: 5:11:26 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 45 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: BUENA VISTA BLVD AT SOUTHERN TRACE/SADDLEBROOK LN

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 45-Buena Vista Blvd at Southern Trace-Saddlebrook Ln.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:27 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 46 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: US 27/441 AT BELLA CRUZ DR

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

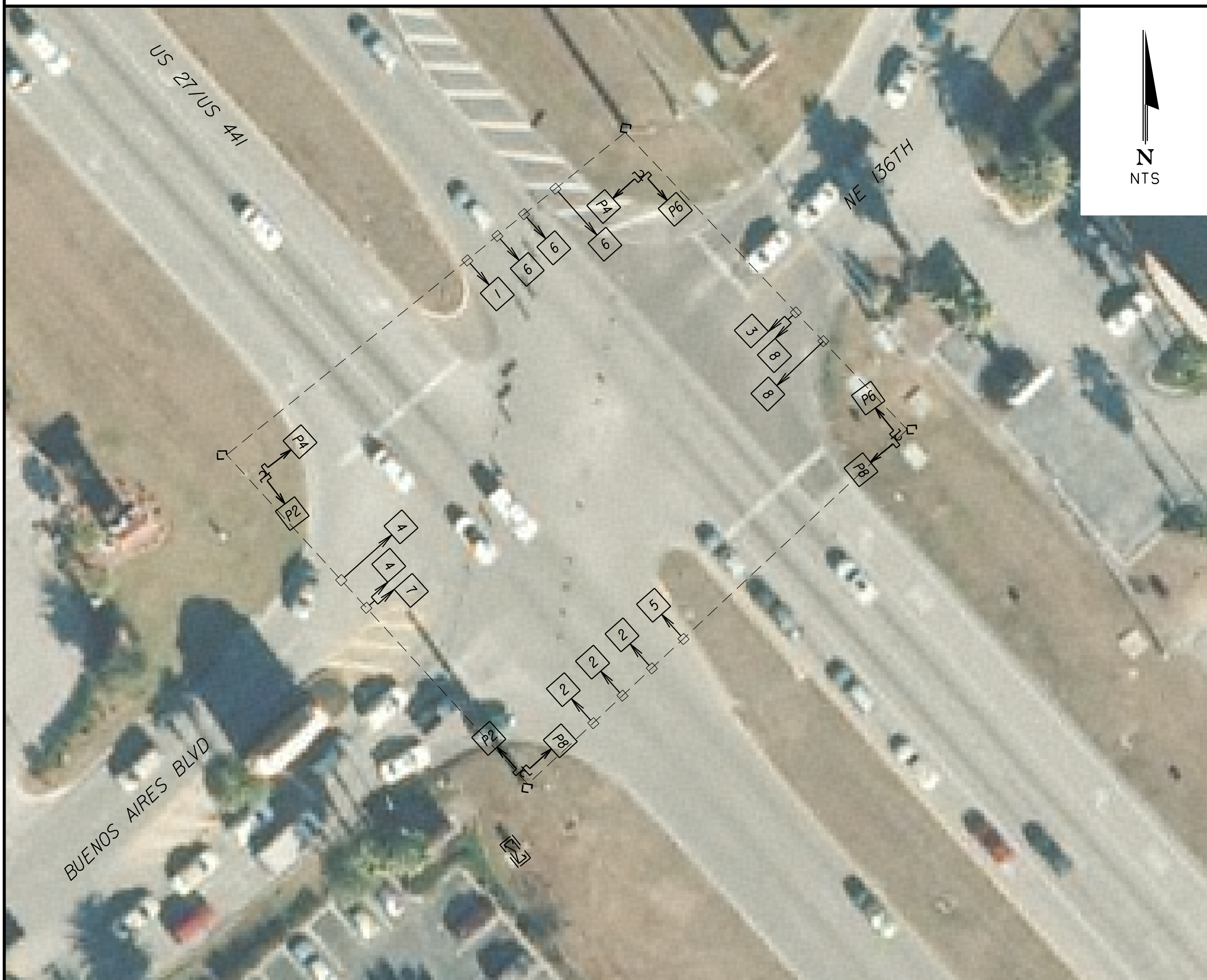
Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 46-US 27-441 at Bella Cruz Dr.dgn
Name: Art Time: 5:11:29 PM
Date: 5/27/2014

CONDITION DIAGRAM

COUNTY SIGNAL ID: 47 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: US 27/441 AT NE 136TH/BUENOS AIRES BLVD

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET



SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

CONDITION DIAGRAM

COUNTY SIGNAL ID: 48 COUNTY: SUMTER CITY: THE VILLAGES

INTERSECTION: US 27/441 AT W BOONE CT/MORSE BLVD

FIELD REVIEW DATE: 01/23/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	**Project No.**	0113008
Drawing Title	CONDITION DIAGRAM	**Date**	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 48-US 27-441 at Morse Blvd-W Boone Ct.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:32 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 98 COUNTY: SUMTER CITY: WILDWOOD

INTERSECTION: CR 466A AT PINELLAS PL

FIELD REVIEW DATE: 01/30/2014 PREPARED BY: AET

SYMBOLS

TREES	GUARDRAIL	CONTROLLER CABINET	PED. SIGNAL HEAD
SHRUBS	POWER POLE	VEHICLE DETECTOR LOOP	RR SIGNAL (W/GATE)
HEDGE	TELEPHONE POLE	SIGN (1 POST)	DRAINAGE INLET
BUILDING	COMBINATION POLE	SIGN (2 POST)	
RIGHT OF WAY LINE	TRAFFIC SIGNAL POLE	OVERHEAD SIGN	
FENCE	HYDRANT	TRAFFIC SIGNAL HEAD	

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 98-CR 466A at Pinellas Pl.dgn
Name: Art
Date: 5/27/2014 Time: 5:11:33 PM

CONDITION DIAGRAM

COUNTY SIGNAL ID: 99 COUNTY: SUMTER CITY: BUSHNELL

INTERSECTION: SR 471 AT CR 48

FIELD REVIEW DATE: 01/30/2014 PREPARED BY: AET

SYMBOLS

TREES		GUARDRAIL		CONTROLLER CABINET		PED. SIGNAL HEAD	
SHRUBS		POWER POLE		VEHICLE DETECTOR LOOP		RR SIGNAL (W/GATE)	
HEDGE		TELEPHONE POLE		SIGN (1 POST)		DRAINAGE INLET	
BUILDING		COMBINATION POLE		SIGN (2 POST)			
RIGHT OF WAY LINE		TRAFFIC SIGNAL POLE		OVERHEAD SIGN			
FENCE		HYDRANT		TRAFFIC SIGNAL HEAD			

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Project Title	SUMTER COUNTY ATMS ITS MASTER PLAN	Project No.	0113008
Drawing Title	CONDITION DIAGRAM	Date	05/28/14

Title: \\VIBESTORAGE\Public\0113008 - Sumter County\Project Working Files\Condition Diagrams\Intersection 99-SR 471 at CR 48.dgn
Name: Art
Date: 5/30/2014 Time: 5:16:14 PM

APPENDIX D

INTERSECTION FIELD INVENTORY SUMMARY

SIGNAL CABINET AND CONTROLLERS

			Signal Cabinet																					
County Signal ID	Major Street	Minor Street	Location (Corner)	Location (Other)	Manufacturer	Installation Date	Condition	Cabinet Size	Cabinet Size (Other)	Mounting Type	Mounting Type (Other)	Mounting Material	Mounting Material (Other)	Nearest Power Location	Power Location (Other)	Conduit w/Interconnect	Conduit Size	Conduit Size (Other)	Spare Conduit	Spare Conduit Size	Spare Conduit Size (Other)	Quan. Of Spare Conduit	Best Cabinet Entry Point	Bottom of Cabinet Above Center
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	NW		Peek	3/2001	Good	V		Base		Concrete		NW					Y	2		3	Spare Conduit	Y
2	US 301	CR 462 E	NE		Temple		Good	V		Base		Concrete		NE					Y	2		3	Spare Conduit	Y
3	US 301	CR 466																						
4	US 301	CR 466A																						
5	US 301	CR 470 E	SW		Peek	2/1998	Good	IV		Base		Concrete		SW					Y	2		5	Spare Conduit	Y
6	US 301	CR 470 W	NW		Peek		Good	IV		Base		Concrete		NW					Y	2		3	Spare Conduit	Y
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	NW		Control Specialists Company	3/1996	Good	V		Base		Concrete		NW					Y	2		2	Spare Conduit	Y
8	US 27/441	NE 138th Ln (CR 109)	SW		Suncoast Metal Fabricators	5/2005	Good	V		Base		Concrete		SW		Y	2							Y
9	SR 48	N West St (CR 311)	NE		Control Specialists Company	7/2006	Good	V		Base		Concrete		NE					Y	2		5	Spare Conduit	
10	SR 48	Lowery St	SW		Control Specialists Company	6/2005	Good	V		Base		Concrete		SW					Y	2		1	Spare Conduit	
11	SR 44	I-75 NB Off-Ramp	NE		Transportation Control Systems	9/1999	Good	V		Base		Concrete		NE					Y	2		2	Spare Conduit	Y
12	SR 44	I-75 SB Off-Ramp	SW		Transportation Control Systems	9/1999	Good	V		Base		Concrete		SW					Y	2		1	Spare Conduit	
13	SR 44	Industrial Dr	SE		Suncoast Metal Fabricators	11/1996	Good	V		Base		Concrete		SE					Y	2		3	Spare Conduit	
14	SR 48	I-75 SB Off-Ramp	NW		Control Specialist Company	4/2006	Good	V		Base		Concrete		NW					Y	2		7	Spare Conduit	
15	SR 50	SR 471	SE		Control Specialists Company	10/2000	Good	V		Base		Concrete		SE					Y	2		2	Spare Conduit	
16	US 301	SR 44	NE		Control Specialists Company	6/2010	Good	V		Base		Concrete		NE					Y	2		3	Spare Conduit	Y
17	SR 44	Buena Vista Blvd/Heritage Blvd	SW		Control Specialists Company	10/2009	Good	V		Base		Concrete		SW					Y	2		5	Spare Conduit	
18	CR 44A	Powell Rd	NW		Control Specialists Company	1/2009	Good	V		Base		Concrete		NW					Y	2		6	Spare Conduit	Y
19	SR 44	Powell Rd/Signature Rd	SE		Temple		Good	V		Base		Concrete		SE					Y	2		4	Spare Conduit	
20	CR 466A	Powell Rd/CR 462 E	NE		Control Specialists Company	9/2010	Good	V		Base		Concrete		NE		Y	2		Y	2		2		Y
21	Commercial St (US 301)	Warm Springs Ave (US 301)	NE		Suncoast Metal Fabricators	3/1994	Good	Other	II	Pole		NA		NE									New	Y
22	Main St (US 301)	W Noble Ave (US 301)	NE		Peek	11/1997	Good	IV		Base		Concrete		NE					Y	2		3	Spare Conduit	Y
23	US 301	Seminole Ave (CR 48/CR 476)	NE		Control Specialists Company	7/2005	Good	V		Base		Concrete		NE					Y	2		2	Spare Conduit	Y
26	CR 466	CR 101/Belvedere Blvd	NW		Suncoast Metal Fabricators	6/2003	Good	V		Base		Concrete		NW					Y	2		5	Spare Conduit	Y
27	CR 466	CR 103/Old School Rd	SW		Suncoast Metal Fabricators	6/2003	Good	V		Base		Concrete		SW					Y	2		4	Spare Conduit	Y
28	Bailey Tr	St Charles Pl	NE		Control Specialists Company	9/2004	Good	V		Base		Concrete		NE					Y	2		5	Spare Conduit	Y
29	Bonita Blvd	Canal St	NE		Southern Manufacturing	1/2006	Good	V		Base		Concrete		NE					Y	2		4	Spare Conduit	Y
30	El Camino Real	Buenos Aires Blvd	NE		Suncoast Metal Fabricators	8/2002	Good	V		Base		Concrete		NE					Y	2		5	Spare Conduit	Y
31	CR 466	Southern Trace/Tall Trees Ln	SE		Southern Manufacturing	3/2005	Good	V		Base		Concrete		SE					Y	2		6	Spare Conduit	Y
32	CR 466	Morse Blvd	NW		Suncoast Metal Fabricators	6/2003	Good	V		Base		Concrete		NW					Y	2		5		Y
33	CR 466	Tatonka Terr	SW		Southern Manufacturing	1/2007	Good	V		Base		Concrete		SW					Y	2		5	Spare Conduit	Y
34	CR 466	Buena Vista Blvd	NE		Suncoast Metal Fabricators	4/2003	Good	V		Base		Concrete		NE										Y
35	CR 466A	Farner Pl	NW		Control Specialists Company	9/2006	Good	V		Base		Concrete		NW		Y	2		Y	2		5		Y
36	CR 466A	Morse Blvd	SW		Control Specialists Company	9/2006	Good	V		Base		Concrete		SW		Y	2		Y	2		4		Y
37	CR 466A	Sembler Way/Heald Way	NW		Control Specialists Company	9/2006	Good	V		Base		Concrete		NW		Y	2		Y	2		4		Y
38	CR 466A	Buena Vista Blvd	SW		Control Specialists Company	9/2006	Good	V		Base		Concrete		SW		Y	2		Y	2		4		Y
39	Odell Cir	Canal St (North)	NW		Control Specialists Company	9/2004	Good	V		Base		Concrete		NW					Y	2		6	Spare Conduit	Y
40	Odell Cir	Canal St (South)	SE		Control Specialists Company	1/2006	Good	V		Base		Concrete		SE					Y	2		5	Spare Conduit	Y
41	CR 103	Wedgewood Ln	SE		Southern Manufacturing	1/2006	Good	V		Base		Concrete		SE					Y	2		4	Spare Conduit	Y
42	El Camino Real	Botello Ave/Enrique Dr	NW		Suncoast Metal Fabricators	8/2002	Good	V		Base		Concrete		NW					Y	2		7	Spare Conduit	Y
43	Morse Blvd	Rio Grande Ave	NW		Control Specialists Company	11/2006	Good	V		Base		Concrete		NW		Y	2		Y	2		5		Y
44	Morse Blvd	San Marino Dr	NW		Temple		Good	V		Base		Concrete		NW		Y	2		Y	2		5		Y
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	NE		Southern Manufacturing	8/2005	Good	V		Base		Concrete		NE					Y	2		4	Spare Conduit	Y
46	US 27/441	Bella Cruz Dr	NE		Suncoast Metal Fabricators	5/2002	Good	V		Base		Concrete		NE		Y	2		Y	2		5		Y
47	US 27/441	NE 136th/Buenos Aires Blvd	SW		Southern Manufacturing	6/1997	Good	V		Base		Concrete		SW		Y	2		Y	2		1		Y
48	US 27/441	Morse Blvd/W Boone Ct	NE		Southern Manufacturing Company	2/1995	Good	V		Base		Concrete		NE		Y	2		Y	2		4		Y
98	CR 466A	Pinellas Pl	NE		Transportation Control Systems	8/2013	Good	V		Base		Concrete		NE					Y	2		6	Spare Conduit	Y
99	SR 471	CR 48	NE		Control Specialists Company	4/2011	Good	V		Base		Concrete		NE					Y	2		4	Spare Conduit	Y

County Signal ID	Major Street	Minor Street	Signal Controller																					
			Controller				Coordination Device													Conflict Monitor				
			Manufacturer	Model Number	Installation Date	Condition	Present	Internal	Manufacturer	Model Number	Installation Date	Condition	Cable Type	Master Location	Master Controller	Condition	Manufacturer	Model Number	Installation Date	Manufacturer	Model Number	Installation date	Condition	Channels
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	Eagle	ATC NX		Good														EDI	NSM-12		Good	12
2	US 301	CR 462 E	Siemens	M50		Good														EDI	MMU-16E		Good	16
3	US 301	CR 466																						
4	US 301	CR 466A																						
5	US 301	CR 470 E	Peek	3000		Good														EDI	SSM-12LEC		Good	12
6	US 301	CR 470 W	Eagle	EPAC 300		Good														EDI	SSM-12LEC		Good	12
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	Eagle	EPAC 300		Good														EDI	NSM-12L		Good	12
8	US 27/441	NE 138th Ln (CR 109)	Peek	3000E		Good														Transyt	12ELRA		Good	12
9	SR 48	N West St (CR 311)	Eagle	ATC NX		Good														EDI	MMU-16E		Good	16
10	SR 48	Lowery St	Eagle	ATC NX		Good														EDI	SSM12LE-C		Good	12
11	SR 44	I-75 NB Off-Ramp	Eagle	EPAC 300		Good														EDI	NSM-12		Good	12
12	SR 44	I-75 SB Off-Ramp	Eagle	ATC NX		Good														Transyt Corporation	1200		Good	12
13	SR 44	Industrial Dr	Peek	3000	12/1996	Good														Peek	Double Diamond	3/2009	Good	16
14	SR 48	I-75 SB Off-Ramp	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
15	SR 50	SR 471	Eagle	EPAC 300		Good														EDI	SSM-12LEC		Good	12
16	US 301	SR 44	Siemens	M50		Good														EDI	MMU-16LE		Good	16
17	SR 44	Buena Vista Blvd/Heritage Blvd	Siemens	M50		Good														EDI	MMU-16E		Good	16
18	CR 44A	Powell Rd	Siemens	M50		Good														EDI	MMU-16LE		Good	16
19	SR 44	Powell Rd/Signature Rd	Siemens	M50		Good														EDI	MMU-16LEIP		Good	16
20	CR 466A	Powell Rd/CR 462 E	Siemens	M50		Good														EDI	MMU-16LE		Good	16
21	Commercial St (US 301)	Warm Springs Ave (US 301)	Eagle	ATC NX		Good														EDI	NSM-12		Good	12
22	Main St (US 301)	W Noble Ave (US 301)	Siemens	M50		Good														EDI	NSM-12		Good	12
23	US 301	Seminole Ave (CR 48/CR 476)	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
26	CR 466	CR 101/Belvedere Blvd	Peek	3000E	7/2003	Good														EDI	NSM-12L	7/2003	Good	12
27	CR 466	CR 103/Old School Rd	Eagle	EPAC 300		Good														EDI	SSM-12LE		Good	12
28	Bailey Tr	St Charles Pl	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
29	Bonita Blvd	Canal St	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
30	El Camino Real	Buenos Aires Blvd	Peek	3000E	8/2002	Good														Peek	Double Diamond	8/2002	Good	16
31	CR 466	Southern Trace/Tall Trees Ln	Eagle	ATC NX	3/2005	Good														EDI	SSM-12LEC	3/2005	Good	12
32	CR 466	Morse Blvd	Peek	3000E	6/2003	Good														Peek	Double Diamond	6/2003	Good	16
33	CR 466	Tatonka Terr	Eagle	ATC NX	1/2007	Good														EDI	SSM-12LEC	1/2007	Good	12
34	CR 466	Buena Vista Blvd	Peek	3000E	4/2003	Good														Peek	Double Diamond	4/2003	Good	16
35	CR 466A	Farner Pl	Eagle	ATC NX / MARC 300		Good														EDI	SSM-12LEC		Good	12
36	CR 466A	Morse Blvd	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
37	CR 466A	Sembler Way/Heald Way	Eagle	EPAC 300		Good														EDI	SSM-12LEC		Good	12
38	CR 466A	Buena Vista Blvd	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
39	Odell Cir	Canal St (North)	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
40	Odell Cir	Canal St (South)	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
41	CR 103	Wedgewood Ln	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
42	El Camino Real	Botello Ave/Enrique Dr	Peek	3000E	8/2002	Good														Peek	Double Diamond	8/2002	Good	16
43	Morse Blvd	Rio Grande Ave	Eagle	ATC NX		Good														EDI	SSM-12LEC		Good	12
44	Morse Blvd	San Marino Dr	Eagle	ATC NX / MARC 300		Good														EDI	MMU-16E		Good	16
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	Eagle	ATC NX	12/2005	Good														EDI	SSM-12LEC	12/2005	Good	12
46	US 27/441	Bella Cruz Dr	Peek	3000		Good														Peek	Double Diamond		Good	16
47	US 27/441	NE 136th/Buenos Aires Blvd	Peek	3000E		Good														Peek	Double Diamond		Good	16
48	US 27/441	Morse Blvd/W Boone Ct	Peek	3000E	12/2005	Good														Transyt	12EL	2/2006	Good	12
98	CR 466A	Pinellas Pl	Siemens	M50		Good														EDI	MMU-16LEIP		Good	16
99	SR 471	CR 48	Siemens	M50		Good														EDI	MMU-16LE		Good	16

APPENDIX E

INTERSECTION FIELD INVENTORY SUMMARY

DETECTORS

County Signal ID	Major Street	Minor Street	Detectors																																					
			Phase Detected (Pos. 1)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 2)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 3)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 4)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 5)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 6)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 7)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Phase Detected (Pos. 8)	Detector Type	No. of Channels	Det. Mount (Shelf, Rack)	Preemption Internal	Preemption Manufacturer	Preemption Model Number	Preemption Installation Date	Preemption Condition	Preemption Type
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	1	Loop	1	Shelf	2	Loop	1	Shelf	3	Loop	1	Shelf	4	Loop	1	Shelf	5	Loop	1	Shelf	6	Loop	1	Shelf	7	Loop	1	Shelf	8	Loop	1	Shelf	Y					Railroad
2	US 301	CR 462 E	2	Loop	2	Rack	1	Loop	2	Rack	4	Loop	2	Rack	2/5	Loop	2	Rack	6	Loop	2	Rack	6	Loop	2	Rack														
3	US 301	CR 466																																						
4	US 301	CR 466A																																						
5	US 301	CR 470 E	2	Loop	1	Shelf	2	Loop	1	Shelf	2	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	2	Shelf																		
6	US 301	CR 470 W	2	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	1	Shelf																										
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	1	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	1	Shelf	4	Loop	1	Shelf	5	Loop	1	Shelf	6	Loop	1	Shelf	8	Loop	1	Shelf					Y					Railroad
8	US 27/441	NE 138th Ln (CR 109)	1/2/5/6	Video	4	Rack	4/8	Video	4	Rack																														
9	SR 48	N West St (CR 311)	6	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	1	Shelf	2	Loop	1	Shelf	6	Loop	1	Shelf	8	Loop	1	Shelf														
10	SR 48	Lowery St	2	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	1	Shelf	4	Loop	1	Shelf	2	Loop	1	Shelf	6	Loop	1	Shelf	6	Loop	1	Shelf										
11	SR 44	I-75 NB Off-Ramp	4	Video	16	Rack	2	Video	16	Rack	1/6	Video	16	Rack																										
12	SR 44	I-75 SB Off-Ramp	4	Video	16	Rack	2	Video	16	Rack	1/6	Video	16	Rack																										
13	SR 44	Industrial Dr	1	Loop	1	Shelf	6	Loop	1	Shelf	2	Loop	1	Shelf	8	Loop	1	Shelf	8	Loop	1	Shelf																		
14	SR 48	I-75 SB Off-Ramp	6	Loop	1	Shelf	2	Loop	1	Shelf	2	Loop	1	Shelf	6	Loop	1	Shelf	6	Loop	1	Shelf	4	Loop	1	Shelf														
15	SR 50	SR 471	1	Loop	1	Shelf	2	Loop	1	Shelf	3/Fault	Loop	1	Shelf	4	Loop	1	Shelf	5	Loop	1	Shelf	6	Loop	1	Shelf	8	Loop	1	Shelf										
16	US 301	SR 44	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
17	SR 44	Buena Vista Blvd/Heritage Blvd	1/2/5/6	Video	4	Rack	3/4/8	Video	4	Rack																														
18	CR 44A	Powell Rd	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
19	SR 44	Powell Rd/Signature Rd	1/2/5/6	Video	4	Rack	3/4/8	Video	4	Rack																														
20	CR 466A	Powell Rd/CR 462 E	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
21	Commercial St (US 301)	Warm Springs Ave (US 301)	2	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	1	Shelf	4	Loop	1	Shelf	2	Loop	1	Shelf																		
22	Main St (US 301)	W Noble Ave (US 301)	1	Loop	1	Shelf	2	Loop	1	Shelf	2	Loop	1	Shelf	4	Loop	1	Shelf	2	Loop	1	Shelf	2/2	Loop	2	Shelf	4	Loop	1	Shelf					Y					Railroad
23	US 301	Seminole Ave (CR 48/CR 476)	6	Loop	2	Shelf	2/2	Loop	2	Shelf	4	Loop	1	Shelf	4	Loop	1	Shelf	2	Loop	1	Shelf	6/6	Loop	2	Shelf	8	Loop	1	Shelf					Y					Railroad
26	CR 466	CR 101/Belvedere Blvd	1/2/3/4/5/6/7/8	Video	8	Rack																																		
27	CR 466	CR 103/Old School Rd	1/2/3/4/5/6	Video	8	Rack																																		
28	Bailey Tr	St Charles Pl	2/6	Video	4	Rack	4/8	Video	4	Rack																														
29	Bonita Blvd	Canal St	2/6	Video	4	Rack	4/8	Video	4	Rack																														
30	El Camino Real	Buenos Aires Blvd	1/2/4/5/6/8	Video	128	Shelf																																		
31	CR 466	Southern Trace/Tall Trees Ln	2/5/1/6	Video	4	Rack	4/8	Video	4	Rack																														
32	CR 466	Morse Blvd	1/2/3/4/5/6/7/8	Video	128	Shelf																																		
33	CR 466	Tatonka Terr	1/6/2/5	Video	4	Rack	4/8	Video	4	Rack																														
34	CR 466	Buena Vista Blvd	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
35	CR 466A	Farner Pl	1/2/5/6	Video	4	Rack	4/8	Video	4	Rack																														
36	CR 466A	Morse Blvd	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
37	CR 466A	Sembler Way/Heald Way	1/2/5/6	Video	4	Rack	4/8	Video	4	Rack																														
38	CR 466A	Buena Vista Blvd	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
39	Odell Cir	Canal St (North)	2/6	Video	4	Rack	4/8	Video	4	Rack																														
40	Odell Cir	Canal St (South)	2/6	Video	4	Rack	4/8	Video	4	Rack																														
41	CR 103	Wedgewood Ln	2/6	Video	4	Rack	4/8	Video	4	Rack																														
42	El Camino Real	Botello Ave/Enrique Dr	1/2/3/4/5/6/7/8	Video	8	Rack																																		
43	Morse Blvd	Rio Grande Ave	1/2/6	Video	4	Rack	4	Video	4	Rack																														
44	Morse Blvd	San Marino Dr	1/2/5/6	Video	4	Rack	4/7/8	Video	4	Rack																														
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	1/2/5/6	Video	4	Rack	4/8	Video	4	Rack																														
46	US 27/ 441	Bella Cruz Dr	1/2/5/6	Video	4	Rack	4/8	Video	4	Rack																														
47	US 27/ 441	NE 136th/Buenos Aires Blvd	1/2/5/6	Video	4	Rack	3/4/7/8	Video	4	Rack																														
48	US 27/ 441	Morse Blvd/W Boone Ct	6	Loop	1	Shelf	6	Loop	1	Shelf	6	Loop	1	Shelf	1	Loop	1	Shelf	2	Loop	1	Shelf	2	Loop	1	Shelf	6	Loop	1	Shelf	7	Loop	1	Shelf						
98	CR 466A	Pinellas Pl	2/5/6	Video	4	Rack	4	Video	4	Rack																														
99	SR 471	CR 48	2/6	Video	4	Rack	4/8	Video	4	Rack																														

APPENDIX F

INTERSECTION FIELD INVENTORY SUMMARY

SIGNAL HEADS

			Signal Heads																																																				
			Southbound Approach														Westbound Approach														Northbound Approach														Eastbound Approach													
County Signal ID	Major Street	Minor Street	Signal Head OK	Signal Head NA	Head < 40' from Stop Bar	Head > 180' from Stop Bar	Lens Dia < 12", 120' - 180' Away	8" Lens on State or High Speed Rd	Heads < 8' Apart	No Signal Disconnect	Limited Visibility Distance of Head	Color of Head/Hardware Not Black	4 Section Head Instead of 5 Section	LT Signal Sign Not Used With Red Ball	Improper Installation	Comments	Signal Head OK	Signal Head NA	Head < 40' from Stop Bar	Head > 180' from Stop Bar	Lens Dia < 12", 120' - 180' Away	8" Lens on State or High Speed Rd	Heads < 8' Apart	No Signal Disconnect	Limited Visibility Distance of Head	Color of Head/Hardware Not Black	4 Section Head Instead of 5 Section	LT Signal Sign Not Used With Red Ball	Improper Installation	Comments	Signal Head OK	Signal Head NA	Head < 40' from Stop Bar	Head > 180' from Stop Bar	Lens Dia < 12", 120' - 180' Away	8" Lens on State or High Speed Rd	Heads < 8' Apart	No Signal Disconnect	Limited Visibility Distance of Head	Color of Head/Hardware Not Black	4 Section Head Instead of 5 Section	LT Signal Sign Not Used With Red Ball	Improper Installation	Comments	Signal Head OK	Signal Head NA	Head < 40' from Stop Bar	Head > 180' from Stop Bar	Lens Dia < 12", 120' - 180' Away	8" Lens on State or High Speed Rd	Heads < 8' Apart	No Signal Disconnect	Limited Visibility Distance of Head	Color of Head/Hardware Not Black	4 Section Head Instead of 5 Section	LT Signal Sign Not Used With Red Ball	Improper Installation	Comments
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	Y														Y														Y														Y													
2	US 301	CR 462 E	Y														Y														Y															Y												
3	US 301	CR 466																																																									
4	US 301	CR 466A																																																									
5	US 301	CR 470 E	Y														Y														Y															Y												
6	US 301	CR 470 W	Y														Y														Y														Y													
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	Y														Y														Y														Y													
8	US 27/441	NE 138th Ln (CR 109)	Y														Y														Y														Y													
9	SR 48	N West St (CR 311)	Y														Y														Y														Y													
10	SR 48	Lowery St		Y													Y														Y														Y													
11	SR 44	I-75 NB Off-Ramp		Y																																																							
12	SR 44	I-75 SB Off-Ramp															Y															Y																										
13	SR 44	Industrial Dr	Y														Y															Y																										
14	SR 48	I-75 SB Off-Ramp	Y														Y															Y													Y													
15	SR 50	SR 471	Y														Y														Y														Y													
16	US 301	SR 44																																																								
17	SR 44	Buena Vista Blvd/Heritage Blvd	Y														Y														Y														Y													
18	CR 44A	Powell Rd	Y														Y														Y														Y													
19	SR 44	Powell Rd/Signature Rd	Y														Y														Y														Y													
20	CR 466A	Powell Rd/CR 462 E	Y																									Y			Y														Y													
21	Commercial St (US 301)	Warm Springs Ave (US 301)	Y														Y														Y																Y											
22	Main St (US 301)	W Noble Ave (US 301)	Y														Y														Y														Y													
23	US 301	Seminole Ave (CR 48/CR 476)	Y														Y														Y														Y													
26	CR 466	CR 101/Belvedere Blvd	Y														Y														Y														Y													
27	CR 466	CR 103/Old School Rd	Y														Y														Y														Y													
28	Bailey Tr	St Charles Pl	Y														Y														Y														Y													
29	Bonita Blvd	Canal St	Y														Y														Y														Y													
30	El Camino Real	Buenos Aires Blvd	Y														Y														Y														Y													
31	CR 466	Southern Trace/Tall Trees Ln	Y														Y														Y														Y													
32	CR 466	Morse Blvd	Y														Y														Y														Y													
33	CR 466	Tatonka Terr	Y														Y														Y														Y													
34	CR 466	Buena Vista Blvd	Y														Y														Y														Y													
35	CR 466A	Farner Pl	Y														Y														Y														Y													
36	CR 466A	Morse Blvd	Y														Y														Y														Y													
37	CR 466A	Sembler Way/Heald Way	Y														Y														Y														Y													
38	CR 466A	Buena Vista Blvd	Y														Y														Y														Y													
39	Odell Cir	Canal St (North)	Y														Y														Y														Y													
40	Odell Cir	Canal St (South)	Y														Y														Y														Y													
41	CR 103	Wedgewood Ln	Y														Y														Y														Y													
42	El Camino Real	Botello Ave/Enrique Dr	Y														Y														Y														Y													
43	Morse Blvd	Rio Grande Ave	Y															Y													Y														Y													
44	Morse Blvd	San Marino Dr	Y														Y														Y														Y													
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	Y														Y														Y														Y													
46	US 27/441	Bella Cruz Dr	Y														Y														Y														Y													
47	US 27/441	NE 136th/Buenos Aires Blvd	Y														Y														Y														Y													
48	US 27/441	Morse Blvd/W Boone Ct	Y														Y														Y														Y													
98	CR 466A	Pinellas Pl		Y													Y														Y														Y													
99	SR 471	CR 48	Y														Y														Y														Y													

County Signal ID	Major Street	Minor Street	Signal Head Faces (No. of Heads with each face type)																											
			Southbound Approach							Westbound Approach							Northbound Approach							Eastbound Approach						
			12" R - Y - G	12" R - Y - G - Y< - G<	12" R - Y - G - Y> - G>	12" R - Y - G - G<	12" R< - Y< - G<	12" R - Y< - G<	Comments	12" R - Y - G	12" R - Y - G - Y< - G<	12" R - Y - G - Y> - G>	12" R - Y - G - G<	12" R< - Y< - G<	12" R - Y< - G<	Comments	12" R - Y - G	12" R - Y - G - Y< - G<	12" R - Y - G - Y> - G>	12" R - Y - G - G<	12" R< - Y< - G<	12" R - Y< - G<	Comments	12" R - Y - G	12" R - Y - G - Y< - G<	12" R - Y - G - Y> - G>	12" R - Y - G - G<	12" R< - Y< - G<	12" R - Y< - G<	Comments
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	1	1						1	1						1	1						1	1					
2	US 301	CR 462 E	1	1						2							1	1												
3	US 301	CR 466																												
4	US 301	CR 466A																												
5	US 301	CR 470 E	2							2							2													
6	US 301	CR 470 W	2							2							2							2						
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	1	1						2							1	1						2						
8	US 27/441	NE 138th Ln (CR 109)	2							3				1			2							3				1		
9	SR 48	N West St (CR 311)	2							2							2							2						
10	SR 48	Lowery St								2							2							2						
11	SR 44	I-75 NB Off-Ramp								3							2				2			2				2		
12	SR 44	I-75 SB Off-Ramp	4							2				2										3						
13	SR 44	Industrial Dr	2							2														2				1		
14	SR 48	I-75 SB Off-Ramp	3							2														2						
15	SR 50	SR 471	2							1	1						2							1	1					
16	US 301	SR 44	2				1			2				1			2				1			2				2		
17	SR 44	Buena Vista Blvd/Heritage Blvd	1	1						1	1						2							1	1					
18	CR 44A	Powell Rd	1	1						1	1						1	1						1	1					
19	SR 44	Powell Rd/Signature Rd	1	1						1	1						2							1	1					
20	CR 466A	Powell Rd/CR 462 E	1	1						2					1		1	1						1	1					
21	Commercial St (US 301)	Warm Springs Ave (US 301)	2							2							2							2						
22	Main St (US 301)	W Noble Ave (US 301)	1	1						2							2							2						
23	US 301	Seminole Ave (CR 48/CR 476)	2							2							2							2						
26	CR 466	CR 101/Belvedere Blvd	1	1						2	1						1	1						1	1					
27	CR 466	CR 103/Old School Rd	1	1			1			2	1						1	1						1	1					
28	Bailey Tr	St Charles Pl	2							2							2							2						
29	Bonita Blvd	Canal St	2							2							2							2						
30	El Camino Real	Buenos Aires Blvd	1	1						1	1						1	1						1	1					
31	CR 466	Southern Trace/Tall Trees Ln	2							1	1						2							1	1					
32	CR 466	Morse Blvd	1	1						1	1						1	1						1	1					
33	CR 466	Tatonka Terr	1	1						2				1			1	1						2				1		
34	CR 466	Buena Vista Blvd	1	1							1	1					1	1							1	1				
35	CR 466A	Farner Pl	1	1						1	1						1	1						1	1					
36	CR 466A	Morse Blvd	1	1						1	1						1	1						1	1					
37	CR 466A	Sembler Way/Heald Way	1	1						1	1						1	1						1	1					
38	CR 466A	Buena Vista Blvd	1	1						1	1						1	1						1	1					
39	Odell Cir	Canal St (North)	2							2							2							2						
40	Odell Cir	Canal St (South)	2							2							2							2						
41	CR 103	Wedgewood Ln	2							2							2							2						
42	El Camino Real	Botello Ave/Enrique Dr		1	1					1	1							1	1					1	1					
43	Morse Blvd	Rio Grande Ave	1	1													1		1					2						
44	Morse Blvd	San Marino Dr	1	1						1	1						1	1						1	1					
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	1	1						2							1	1						2						
46	US 27/441	Bella Cruz Dr	2				1			2							2				1			2						
47	US 27/441	NE 136th/Buenos Aires Blvd	3				1			1	1						3				1			1	1					
48	US 27/441	Morse Blvd/W Boone Ct	2				1			2							2				1			1	1					
98	CR 466A	Pinellas Pl								1						1-4 Section with Flashing yellow left turn arrow	2							2						
99	SR 471	CR 48	2							2							2							2						

APPENDIX G

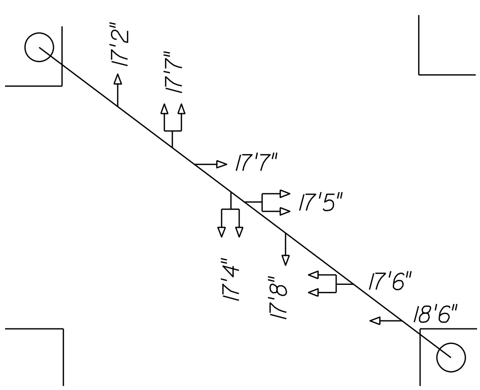
INTERSECTION SIGNAL HEAD HEIGHT MEASUREMENTS

SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS

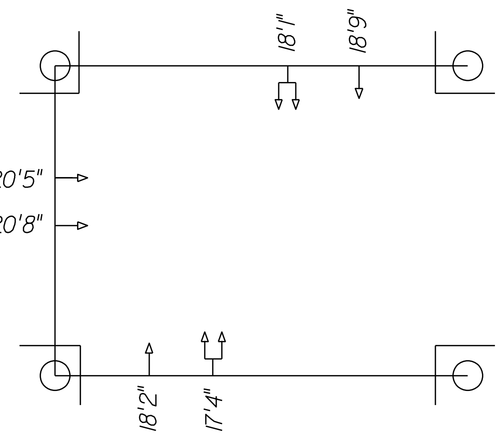
N

NTS

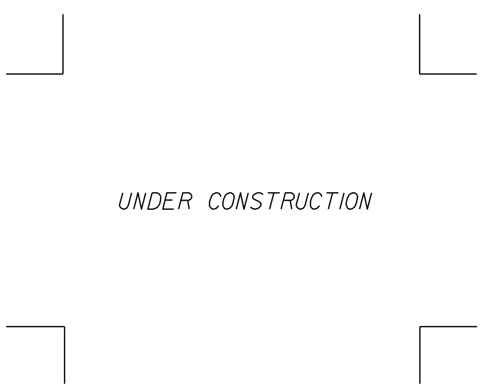
COUNTY SIGNAL ID: 1
S MAIN ST (US 301) AT
LYNUM ST/HUEY ST (CR 44A)



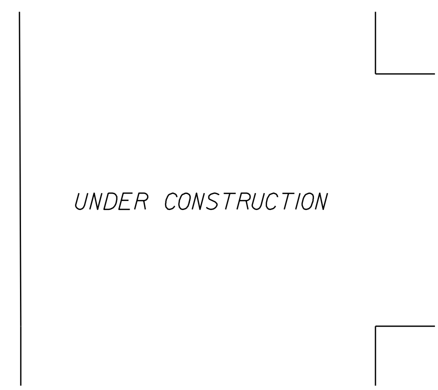
COUNTY SIGNAL ID: 2
US 301 AT
CR 462 E



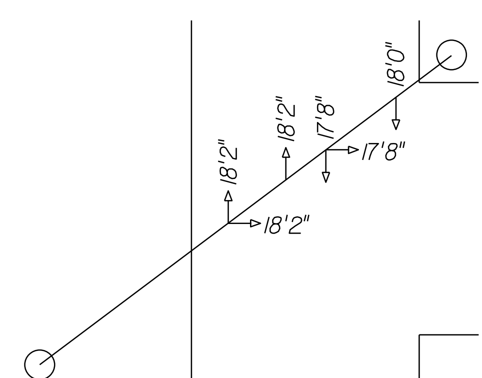
COUNTY SIGNAL ID: 3
US 301 AT
CR 466



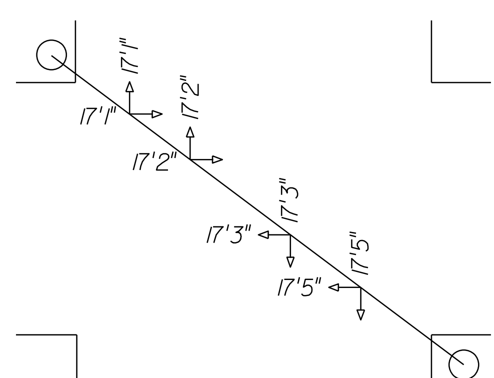
COUNTY SIGNAL ID: 4
US 301 AT
CR 466A



COUNTY SIGNAL ID: 5
US 301 AT
CR 470 E



COUNTY SIGNAL ID: 6
US 301 AT
CR 470 W



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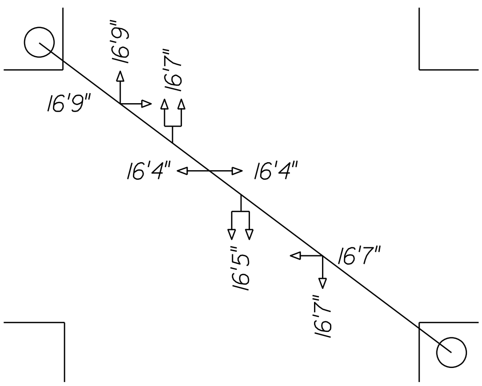
Name: Admin
Date: 2/18/2014 Time: 1:21:33 PM

SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS

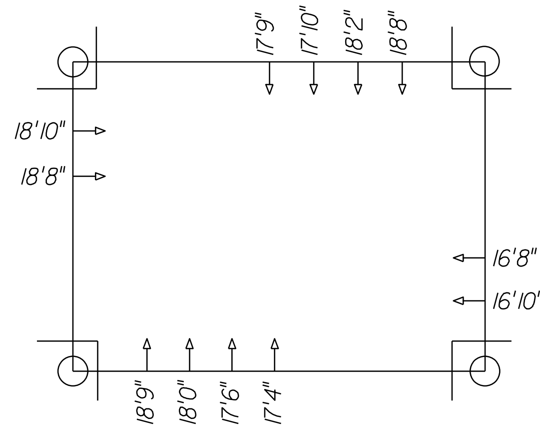
N

NTS

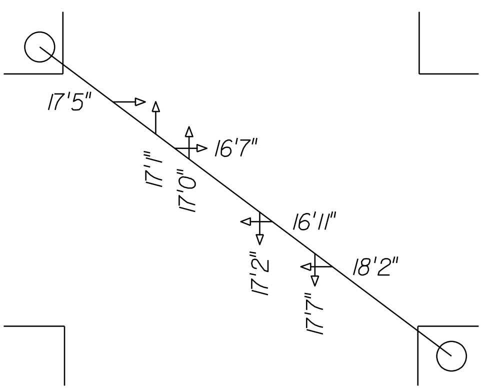
COUNTY SIGNAL ID: 7
MAIN ST (SR 48/CR 475)
AT BELT AVE (SR 48)



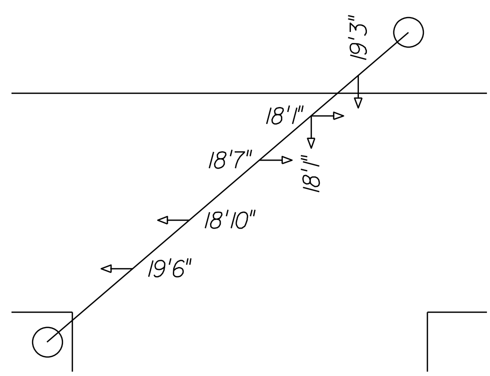
COUNTY SIGNAL ID: 8
US 27/441 AT
NE 138TH LN (CR 109)



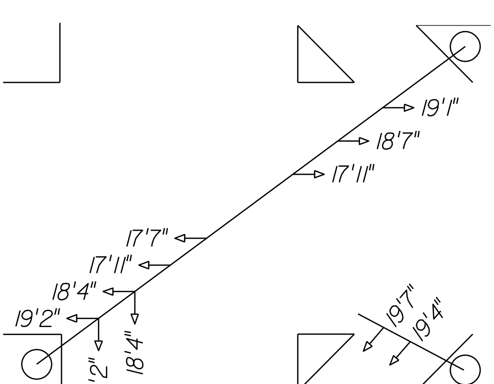
COUNTY SIGNAL ID: 9
SR 48 AT
N WEST ST (CR 311)



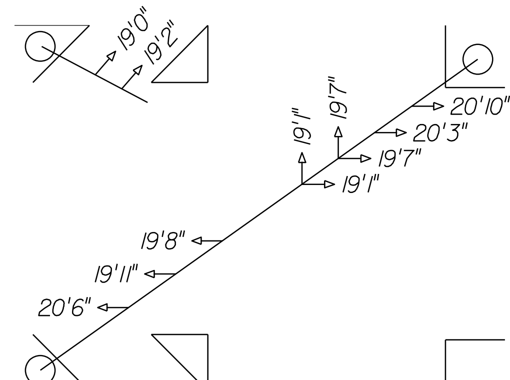
COUNTY SIGNAL ID: 10
SR 48 AT
LOWERY ST



COUNTY SIGNAL ID: 11
SR 44 AT
I-75 NB OFF-RAMP



COUNTY SIGNAL ID: 12
SR 44 AT
I-75 SB OFF-RAMP



SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS

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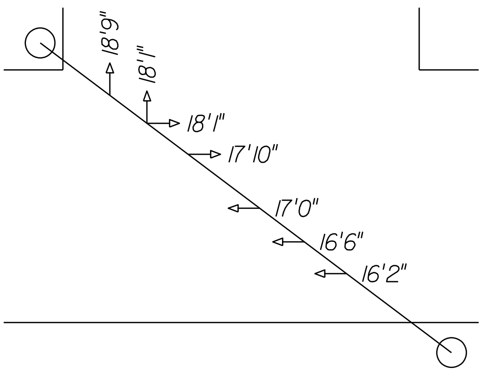
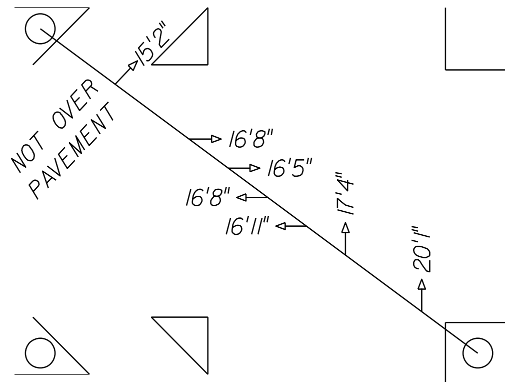
NTS

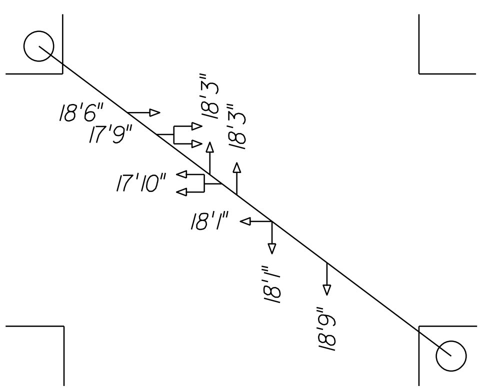
COUNTY SIGNAL ID: 13
SR 44 AT
INDUSTRIAL DR



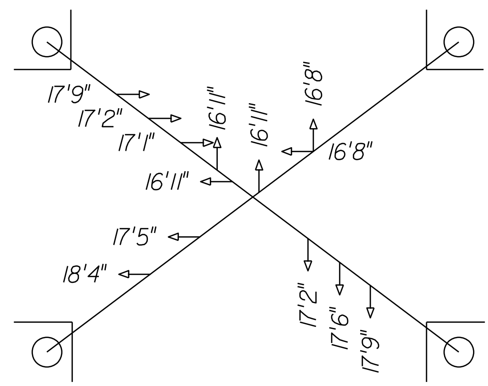
COUNTY SIGNAL ID: 14
SR 48 AT
I-75 SB OFF-RAMP



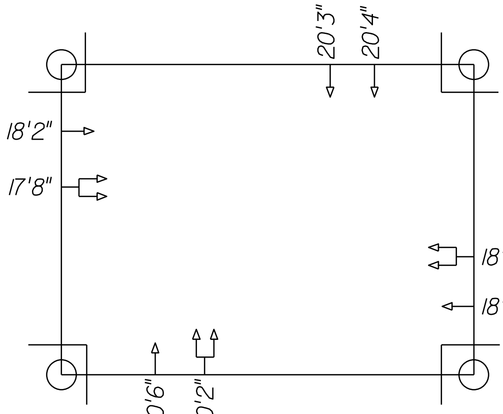
COUNTY SIGNAL ID: 15
SR 50 AT
SR 471



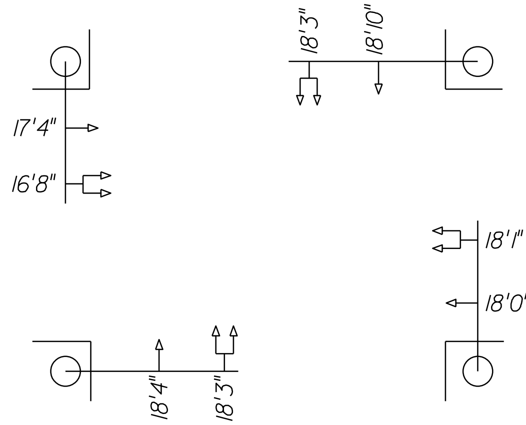
COUNTY SIGNAL ID: 16
US 301
AT SR 44



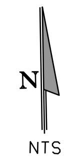
COUNTY SIGNAL ID: 17
SR 44 AT
BUENA VISTA BLVD/HERITAGE BLVD



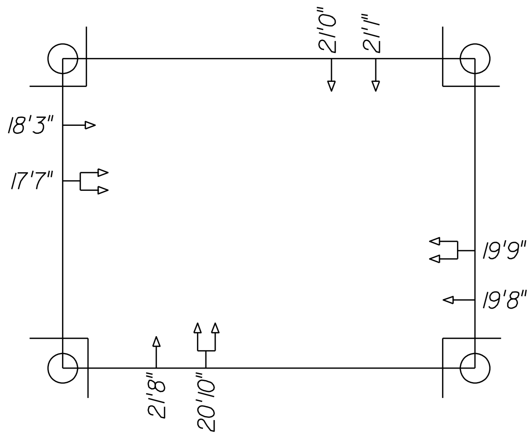
COUNTY SIGNAL ID: 18
CR 44A AT
POWELL RD



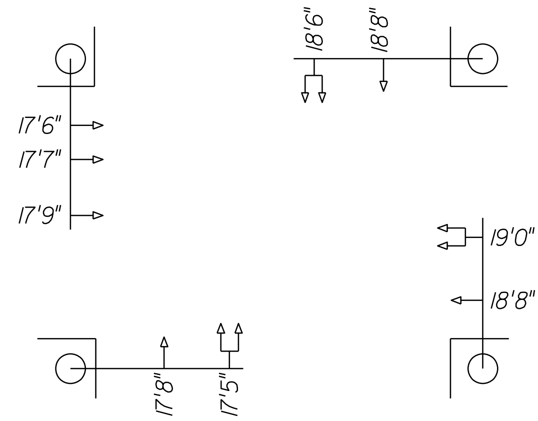
SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS



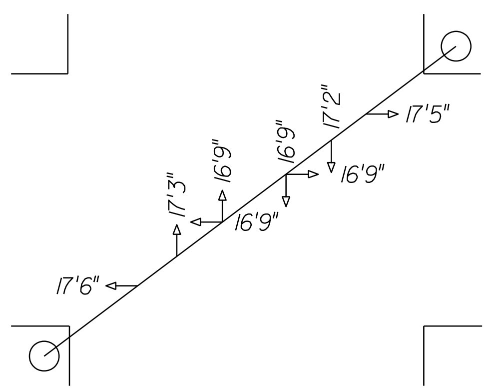
COUNTY SIGNAL ID: 19
SR 44 AT
POWELL RD/SIGNATURE RD



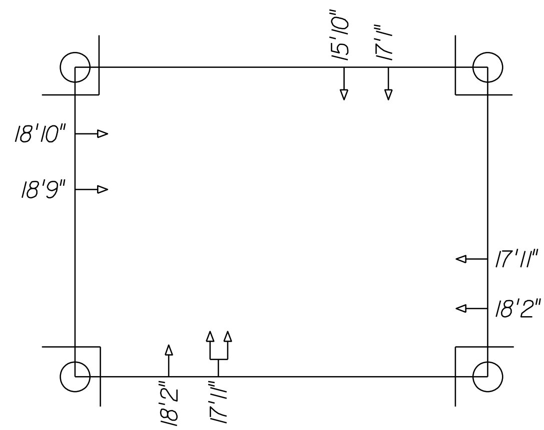
COUNTY SIGNAL ID: 20
CR 466A AT
POWELL RD/CR 462 E



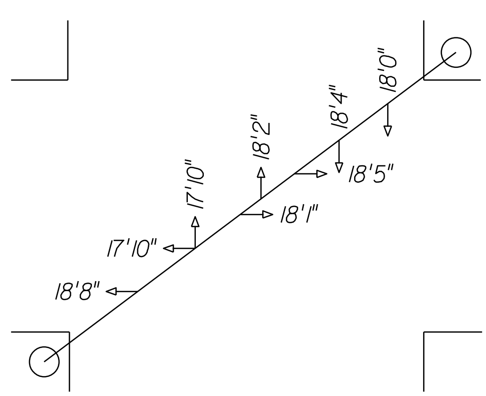
COUNTY SIGNAL ID: 21
COMMERCIAL ST (US 301) AT
WARM SPRINGS AVE (US 301)



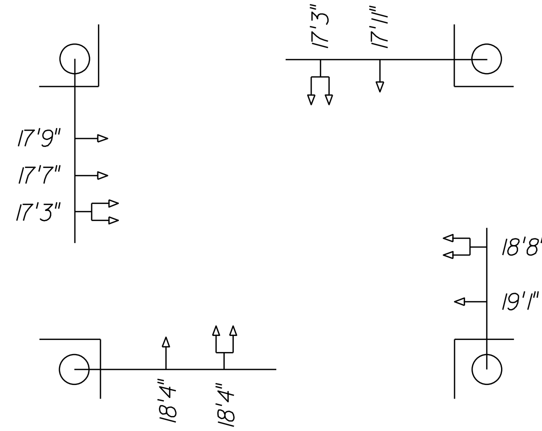
COUNTY SIGNAL ID: 22
MAIN ST (US 301) AT
NOBLE AVE (US 301)



COUNTY SIGNAL ID: 23
US 301 AT
SEMINOLE AVE (CR 48/CR 476)



COUNTY SIGNAL ID: 26
CR 466 AT
CR 101/BELVEDERE BLVD



SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS

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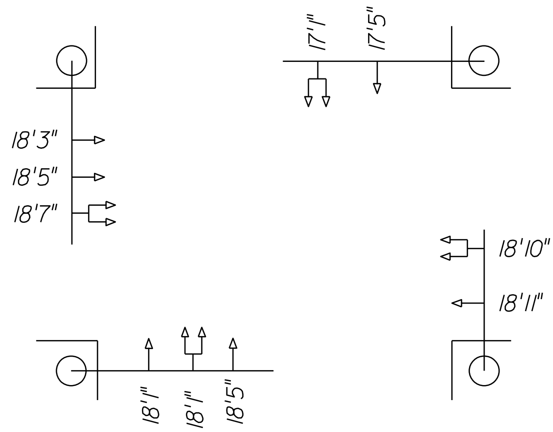
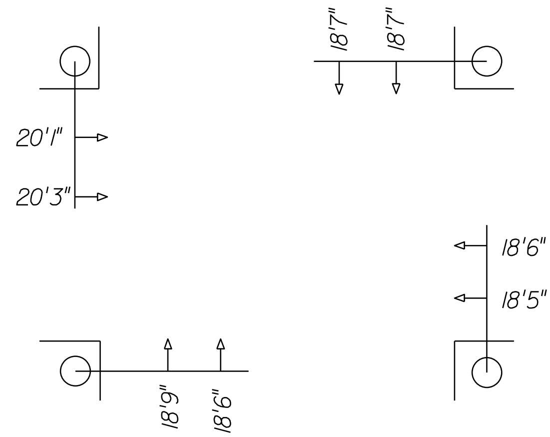
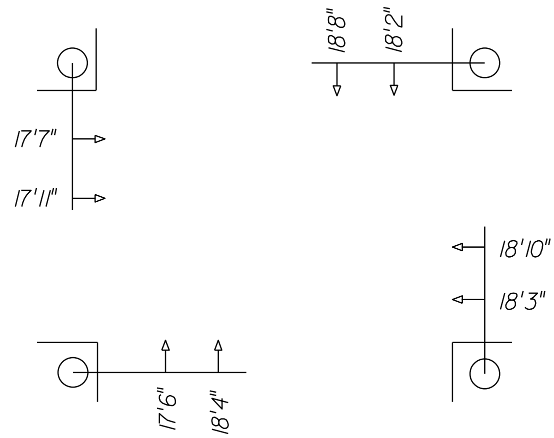
COUNTY SIGNAL ID: 27
CR 466 AT
CR 103/OLD SCHOOL RD



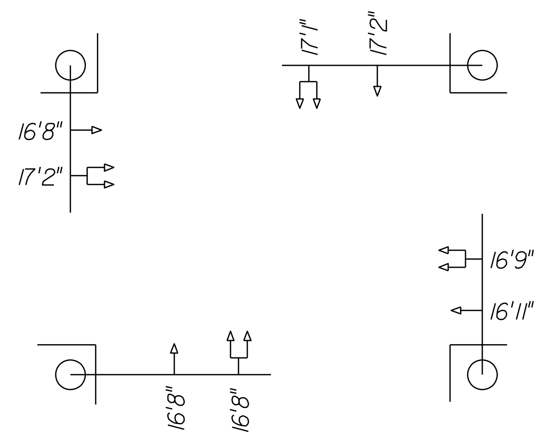
COUNTY SIGNAL ID: 28
BAILEY TR AT
ST CHARLES PL



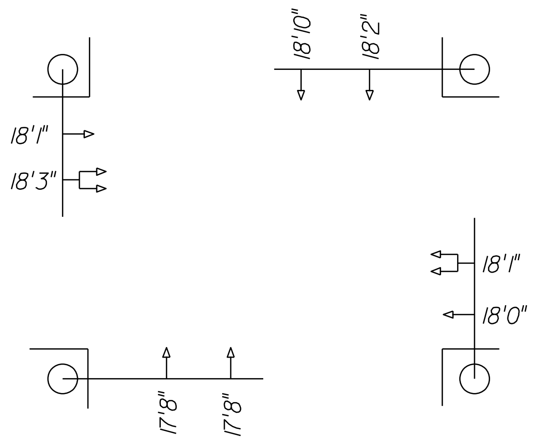
COUNTY SIGNAL ID: 29
BONITA BLVD AT
CANAL ST



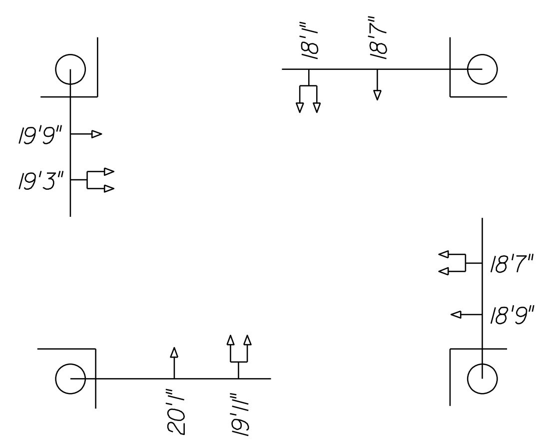
COUNTY SIGNAL ID: 30
EL CAMINO REAL AT
BUENOS AIRES BLVD



COUNTY SIGNAL ID: 31
CR 466 AT
SOUTHERN TRACE/TALL TREES LN



COUNTY SIGNAL ID: 32
CR 466 AT
MORSE BLVD



SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS

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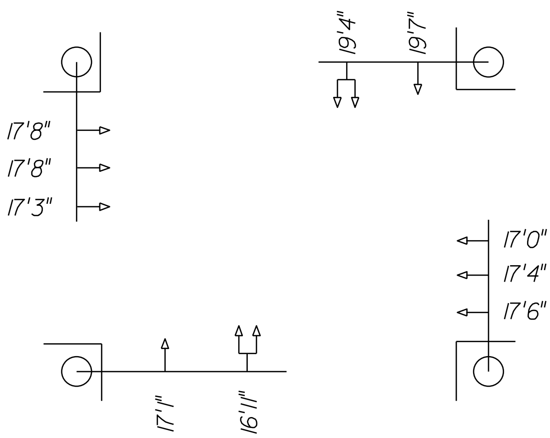
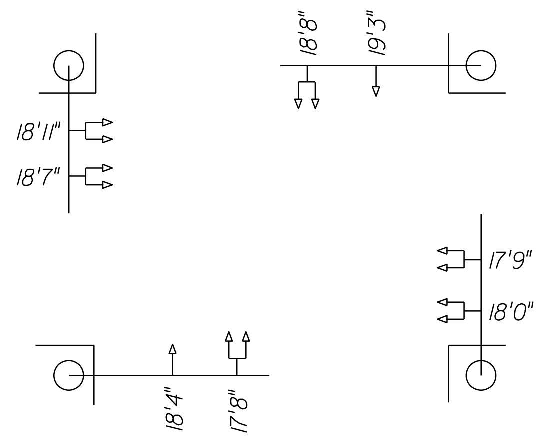
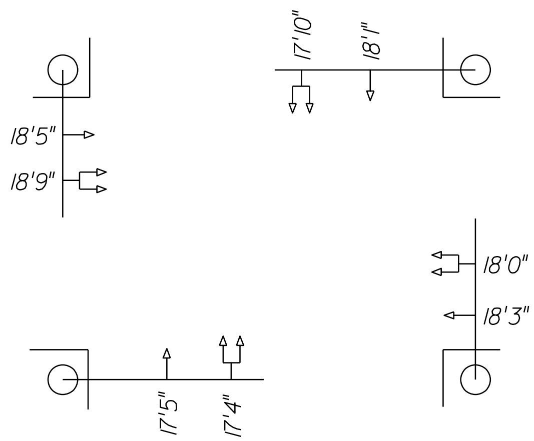
COUNTY SIGNAL ID: 33
CR 466 AT
TATONKA TERR



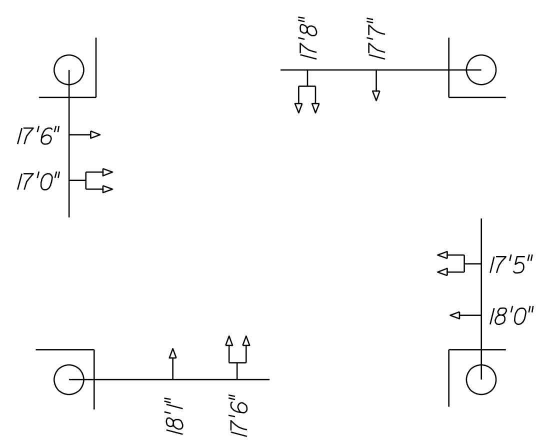
COUNTY SIGNAL ID: 34
CR 466 AT
BUENA VISTA BLVD



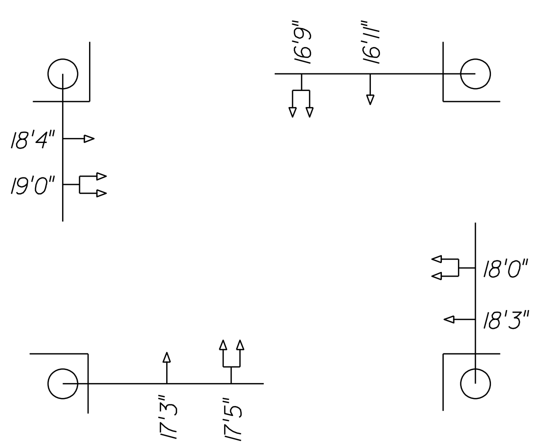
COUNTY SIGNAL ID: 35
CR 466A AT
FARNER PL



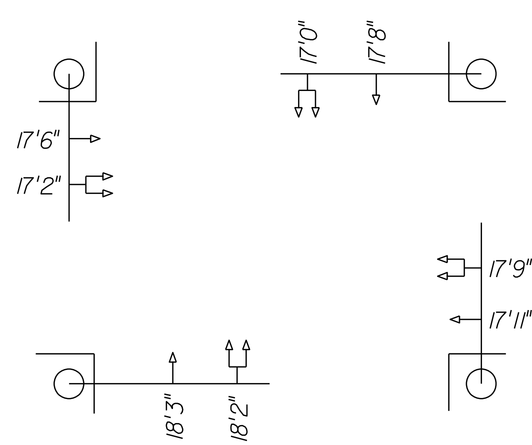
COUNTY SIGNAL ID: 36
CR 466A AT
MORSE BLVD



COUNTY SIGNAL ID: 37
CR 466A AT
SEMBLER WAY/HEALD WAY



COUNTY SIGNAL ID: 38
CR 466A AT
BUENA VISTA BLVD



SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS

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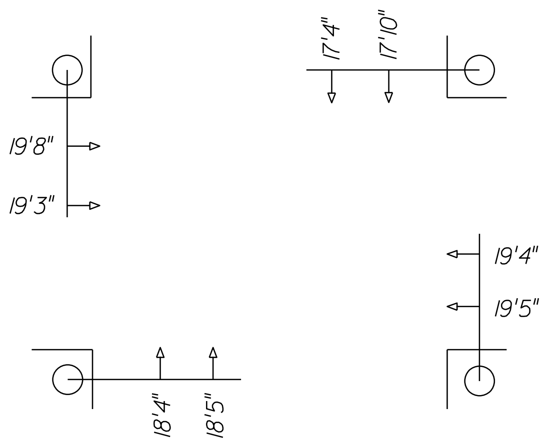
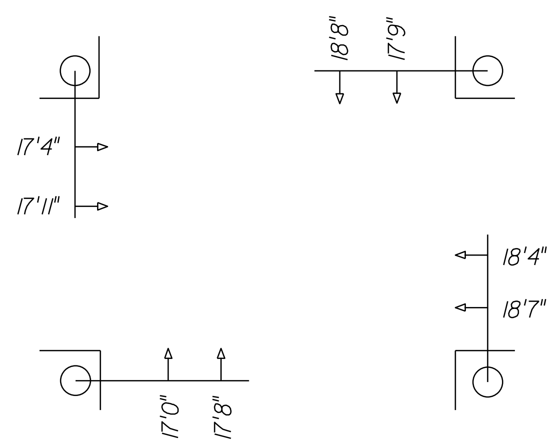
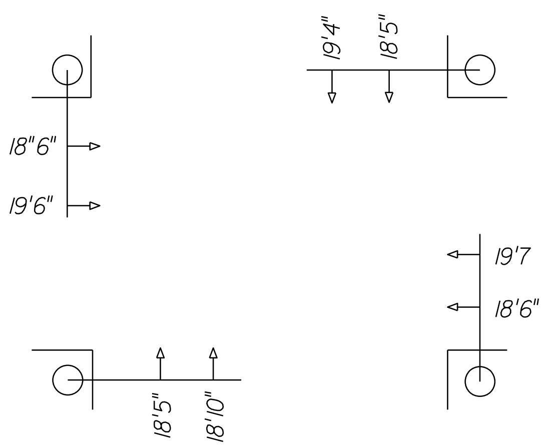
COUNTY SIGNAL ID: 39
ODELL CIR AT
CANAL ST (NORTH)



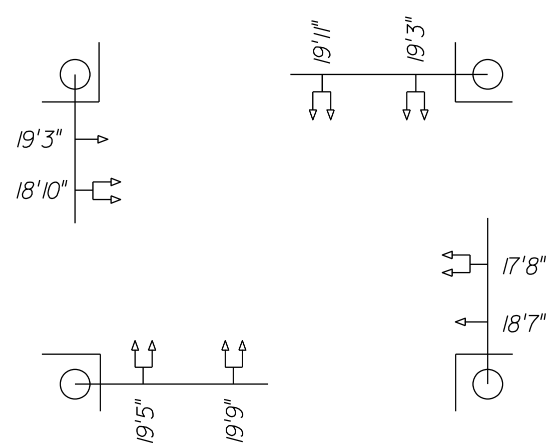
COUNTY SIGNAL ID: 40
ODELL CIR AT
CANAL ST (SOUTH)



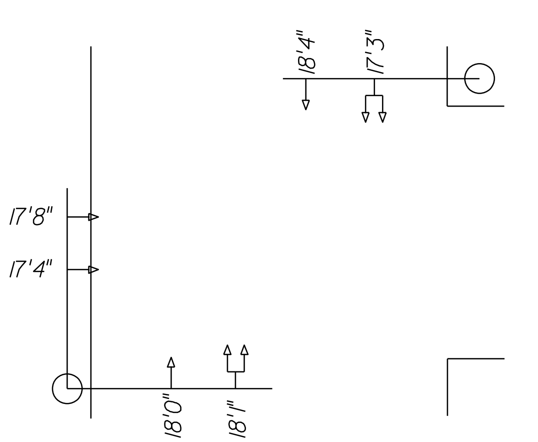
COUNTY SIGNAL ID: 41
CR 103 AT
WEDGEWOOD LN



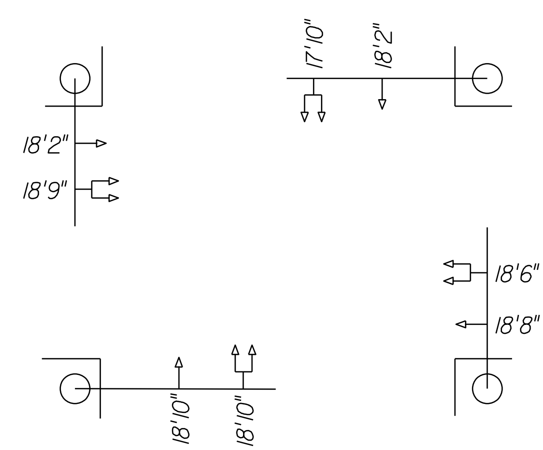
COUNTY SIGNAL ID: 42
EL CAMINO REAL AT
BOTELLO AVE/ENRIQUE DR



COUNTY SIGNAL ID: 43
MORSE BLVD AT
RIO GRANDE AVE



COUNTY SIGNAL ID: 44
MORSE BLVD AT
SAN MARINO DR



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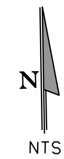
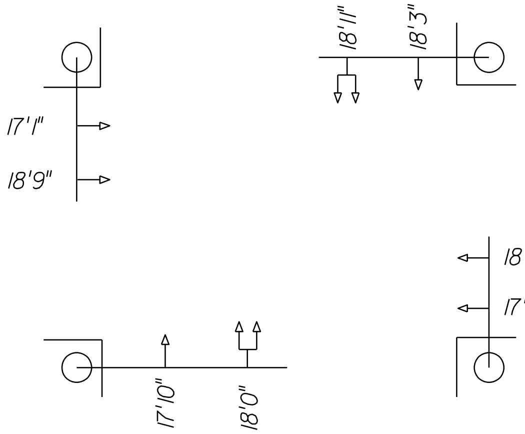
Date: 2/18/2014 Time: 1:21:34 PM

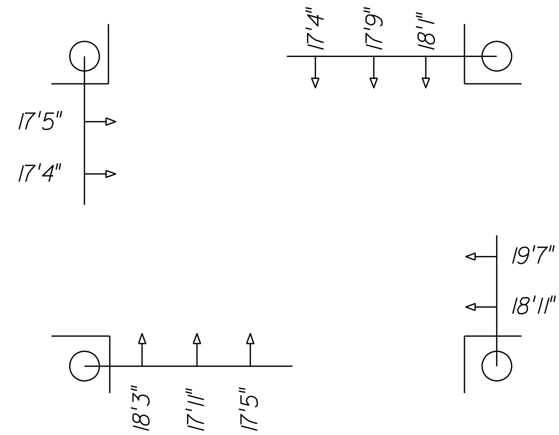
SUMTER COUNTY ATMS
ITS MASTER PLAN
SIGNAL HEAD HEIGHTS



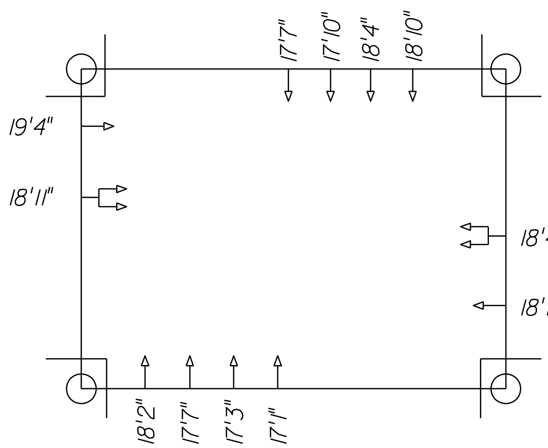
COUNTY SIGNAL ID: 45
BUENA VISTA BLVD AT
SOUTHERN TRACE/SADDLEBROOK LN



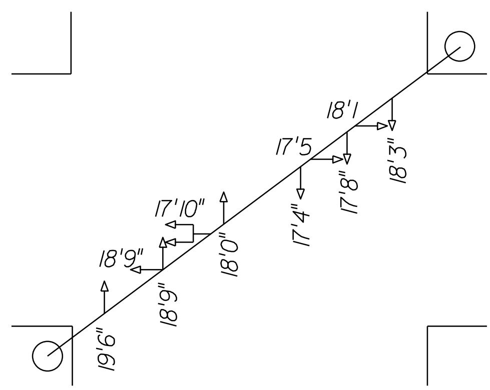
COUNTY SIGNAL ID: 46
US 27/441 AT
BELLA CRUZ DR



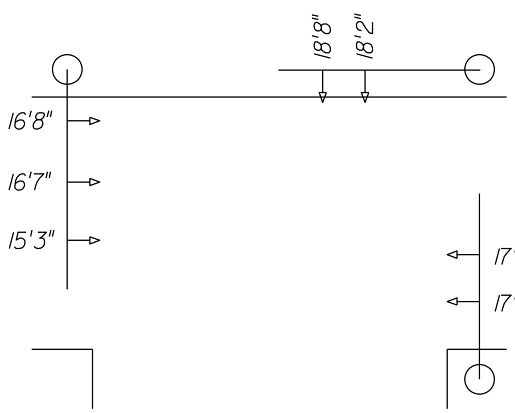
COUNTY SIGNAL ID: 47
US 27/441 AT
NE 136TH/BUENOS AIRES BLVD



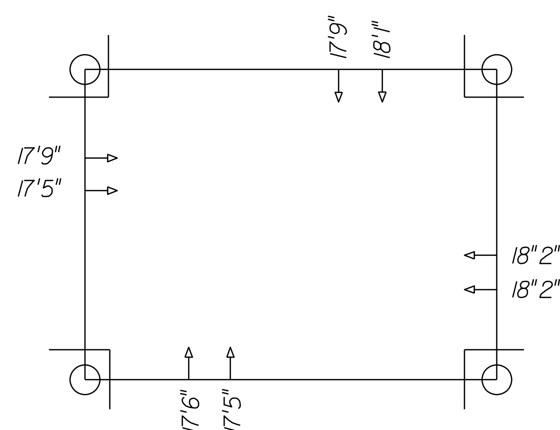
COUNTY SIGNAL ID: 48
US 27/441 AT
W BOONE CT/MORSE BLVD



COUNTY SIGNAL ID: 98
CR 466A AT
PINELLAS PL



COUNTY SIGNAL ID: 99
SR 471 AT
CR 48



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APPENDIX H

INTERSECTION FIELD INVENTORY SUMMARY

SIGNS AND PAVEMENT MARKING

County Signal ID	Major Street	Minor Street	Signs and Pavement Marking																																							
			Southbound										Westbound										Northbound										Eastbound									
			Pavement Marking NA	Missing Stop Bar	No Right Turn	No Left Turn	Left Turn Signal	Left Turn Yield on Green Ball	Ped Crossing	Advanced Ped Crossing	Signal Ahead	Street Name Sign	Pavement Marking NA	Missing Stop Bar	No Right Turn	No Left Turn	Left Turn Signal	Left Turn Yield on Green Ball	Ped Crossing	Advanced Ped Crossing	Signal Ahead	Street Name Sign	Pavement Marking NA	Missing Stop Bar	No Right Turn	No Left Turn	Left Turn Signal	Left Turn Yield on Green Ball	Ped Crossing	Advanced Ped Crossing	Signal Ahead	Street Name Sign	Pavement Marking NA	Missing Stop Bar	No Right Turn	No Left Turn	Left Turn Signal	Left Turn Yield on Green Ball	Ped Crossing	Advanced Ped Crossing	Signal Ahead	Street Name Sign
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)			Y				Y	Y		Y			Y							Y				Y			Y	Y		Y							Y			Y
2	US 301	CR 462 E										Y									Y	Y										Y	Y									
3	US 301	CR 466																																								
4	US 301	CR 466A																																								
5	US 301	CR 470 E									Y	Y									Y	Y											Y									
6	US 301	CR 470 W																													Y	Y									Y	Y
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)				Y			Y			Y		Y								Y			Y							Y							Y	Y		Y
8	US 27/441	NE 138th Ln (CR 109)										Y										Y										Y										Y
9	SR 48	N West St (CR 311)										Y										Y										Y										Y
10	SR 48	Lowery St	Y																Y	Y		Y							Y			Y							Y			Y
11	SR 44	I-75 NB Off-Ramp	Y																																							
12	SR 44	I-75 SB Off-Ramp																					Y																			
13	SR 44	Industrial Dr										Y										Y	Y																			Y
14	SR 48	I-75 SB Off-Ramp										Y			Y							Y	Y													Y					Y	Y
15	SR 50	SR 471									Y	Y									Y	Y									Y	Y									Y	Y
16	US 301	SR 44							Y	Y		Y							Y	Y	Y	Y										Y										Y
17	SR 44	Buena Vista Blvd/Heritage Blvd										Y										Y										Y										Y
18	CR 44A	Powell Rd										Y										Y										Y										Y
19	SR 44	Powell Rd/Signature Rd									Y	Y										Y										Y										Y
20	CR 466A	Powell Rd/CR 462 E										Y										Y										Y										Y
21	Commercial St (US 301)	Warm Springs Ave (US 301)										Y										Y										Y										Y
22	Main St (US 301)	W Noble Ave (US 301)				Y						Y										Y			Y							Y										Y
23	US 301	Seminole Ave (CR 48/CR 476)				Y						Y										Y			Y							Y										Y
26	CR 466	CR 101/Belvedere Blvd							Y	Y		Y							Y	Y		Y							Y	Y		Y										Y
27	CR 466	CR 103/Old School Rd								Y		Y							Y			Y										Y								Y		Y
28	Bailey Tr	St Charles Pl										Y										Y										Y										Y
29	Bonita Blvd	Canal St										Y										Y										Y										Y
30	El Camino Real	Buenos Aires Blvd										Y										Y										Y										Y
31	CR 466	Southern Trace/Tall Trees Ln										Y										Y										Y										Y
32	CR 466	Morse Blvd										Y									Y	Y										Y									Y	Y
33	CR 466	Tatonka Terr										Y										Y										Y										Y
34	CR 466	Buena Vista Blvd										Y									Y	Y									Y	Y									Y	Y
35	CR 466A	Farner Pl										Y										Y										Y										Y
36	CR 466A	Morse Blvd									Y	Y										Y										Y										Y
37	CR 466A	Sembler Way/Heald Way										Y									Y	Y										Y									Y	Y
38	CR 466A	Buena Vista Blvd									Y	Y									Y	Y										Y										Y
39	Odell Cir	Canal St (North)										Y										Y										Y										Y
40	Odell Cir	Canal St (South)										Y										Y										Y										Y
41	CR 103	Wedgewood Ln																																								
42	El Camino Real	Botello Ave/Enrique Dr										Y										Y										Y										Y
43	Morse Blvd	Rio Grande Ave									Y	Y										Y									Y	Y	Y									
44	Morse Blvd	San Marino Dr										Y										Y										Y										Y
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln									Y	Y						Y				Y									Y	Y						Y				Y
46	US 27/441	Bella Cruz Dr										Y										Y										Y										Y
47	US 27/441	NE 136th/Buenos Aires Blvd									Y	Y										Y									Y	Y										Y
48	US 27/441	Morse Blvd/W Boone Ct									Y	Y										Y										Y										Y
98	CR 466A	Pinellas Pl	Y																			Y										Y										Y
99	SR 471	CR 48	Y									Y	Y									Y	Y									Y	Y									Y

APPENDIX I

INTERSECTION FIELD INVENTORY SUMMARY

SIDEWALKS

County Signal ID	Major Street	Minor Street	Sidewalks															
			NW Corner				NE Corner				SE Corner				SW Corner			
			E-W Crosswalk NA	N-S Crosswalk NA	E-W Crosswalk Missing	N-S Crosswalk Missing	E-W Crosswalk NA	N-S Crosswalk NA	E-W Crosswalk Missing	N-S Crosswalk Missing	E-W Crosswalk NA	N-S Crosswalk NA	E-W Crosswalk Missing	N-S Crosswalk Missing	E-W Crosswalk NA	N-S Crosswalk NA	E-W Crosswalk Missing	N-S Crosswalk Missing
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	Y			N	Y	Y				Y	N				N	N
2	US 301	CR 462 E		Y	N				N	N			Y	N		Y	Y	
3	US 301	CR 466																
4	US 301	CR 466A																
5	US 301	CR 470 E	Y	Y			Y	Y			Y	Y			Y	Y		
6	US 301	CR 470 W	Y	Y			Y	Y			Y	Y			Y	Y		
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	Y			N	Y			Y	Y			Y	Y			N
8	US 27/441	NE 138th Ln (CR 109)			N	N			N	N			N	N			N	N
9	SR 48	N West St (CR 311)			N	N		Y	N			Y	N				N	N
10	SR 48	Lowery St	Y	Y			Y			N			N	N		Y	N	
11	SR 44	I-75 NB Off-Ramp	Y	Y			Y	Y			Y	Y			Y	Y		
12	SR 44	I-75 SB Off-Ramp	Y	Y			Y	Y			Y	Y			Y	Y		
13	SR 44	Industrial Dr	Y	Y			Y	Y			Y	Y			Y	Y		
14	SR 48	I-75 SB Off-Ramp	Y	Y			Y	Y			Y	Y			Y	Y		
15	SR 50	SR 471	Y	Y			Y	Y			Y	Y			Y	Y		
16	US 301	SR 44			N	N			N	N			N	N			N	N
17	SR 44	Buena Vista Blvd/Heritage Blvd	Y	Y			Y	Y			Y	Y			Y	Y		
18	CR 44A	Powell Rd	Y	Y			Y	Y			Y	Y			Y	Y		
19	SR 44	Powell Rd/Signature Rd	Y	Y			Y	Y			Y	Y			Y	Y		
20	CR 466A	Powell Rd/CR 462 E	Y	Y			Y	Y				Y	N			Y	N	
21	Commercial St (US 301)	Warm Springs Ave (US 301)	Y	Y			Y			N	Y			N	Y	Y		
22	Main St (US 301)	W Noble Ave (US 301)			N	N			N	N			N	N			N	N
23	US 301	Seminole Ave (CR 48/CR 476)	Y			N	Y	Y			Y	Y			Y			N
26	CR 466	CR 101/Belvedere Blvd	Y	Y			Y			N			N	N		Y	N	
27	CR 466	CR 103/Old School Rd	Y	Y			Y			Y			N	Y		Y	N	
28	Bailey Tr	St Charles Pl			N	N		Y	N		Y	Y			Y			N
29	Bonita Blvd	Canal St		Y	N				N	N	Y			N	Y	Y		
30	El Camino Real	Buenos Aires Blvd	Y	Y			Y	Y				Y	Y			Y	Y	
31	CR 466	Southern Trace/Tall Trees Ln	Y	Y			Y	Y			Y	Y			Y	Y		
32	CR 466	Morse Blvd	Y	Y			Y	Y			Y	Y			Y	Y		
33	CR 466	Tatonka Terr	Y	Y			Y	Y				Y	N			Y	N	
34	CR 466	Buena Vista Blvd	Y	Y			Y	Y			Y	Y			Y	Y		
35	CR 466A	Farner Pl	Y	Y			Y	Y			Y	Y			Y	Y		
36	CR 466A	Morse Blvd	Y	Y			Y	Y			Y	Y			Y	Y		
37	CR 466A	Sembler Way/Heald Way	Y	Y			Y	Y			Y	Y			Y	Y		
38	CR 466A	Buena Vista Blvd	Y	Y			Y	Y			Y	Y			Y	Y		
39	Odell Cir	Canal St (North)	Y	Y			Y			N			N	N		Y	N	
40	Odell Cir	Canal St (South)	Y	Y			Y			N			N	N		Y	N	
41	CR 103	Wedgewood Ln	Y	Y			Y	Y			Y	Y			Y	Y		
42	El Camino Real	Botello Ave/Enrique Dr	Y	Y			Y	Y			Y	Y			Y	Y		
43	Morse Blvd	Rio Grande Ave	Y	Y			Y	Y			Y	Y			Y	Y		
44	Morse Blvd	San Marino Dr	Y	Y			Y	Y			Y	Y			Y	Y		
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	Y	Y			Y	Y			Y	Y			Y	Y		
46	US 27/441	Bella Cruz Dr	Y	Y			Y	Y			Y	Y			Y	Y		
47	US 27/441	NE 136th/Buenos Aires Blvd			N	N			N	N			N	N			N	N
48	US 27/441	Morse Blvd/W Boone Ct	Y	Y			Y	Y			Y	Y			Y	Y		
98	CR 466A	Pinellas Pl	Y	Y			Y	Y				Y	N			Y	N	
99	SR 471	CR 48	Y	Y			Y	Y			Y	Y			Y	Y		

APPENDIX J

INTERSECTION FIELD INVENTORY SUMMARY

SIGNAL COMPLIANCE

County Signal ID	Major Street	Minor Street	Signal Compliance																																																	
			NW Corner												NE Corner												SE Corner												SW Corner												MUTCD Criteria			
			Ped Push Buttons				Ped Signal Heads						Assembly		Ped Push Buttons				Ped Signal Heads						Assembly		Ped Push Buttons				Ped Signal Heads						Assembly		Ped Push Buttons				Ped Signal Heads						Assembly					
			E-W NA	N-S NA	E-W Missing Button	N-S Missing Button	E-W NA	N-S NA	E-W Head Missing	N-S Head Missing	E-W Count Down Head	N-S Count Down Head	E-W Properly Functioning	N-S Properly Functioning	E-W NA	N-S NA	E-W Missing Button	N-S Missing Button	E-W NA	N-S NA	E-W Head Missing	N-S Head Missing	E-W Count Down Head	N-S Count Down Head	E-W Properly Functioning	N-S Properly Functioning	E-W NA	N-S NA	E-W Missing Button	N-S Missing Button	E-W NA	N-S NA	E-W Head Missing	N-S Head Missing	E-W Count Down Head	N-S Count Down Head	E-W Properly Functioning	N-S Properly Functioning	E-W NA	N-S NA	E-W Missing Button	N-S Missing Button	E-W NA	N-S NA	E-W Head Missing	N-S Head Missing	E-W Count Down Head	N-S Count Down Head	E-W Properly Functioning	N-S Properly Functioning	One Way Lane Present	One Way Sign Present	Fire Station Present	Emergency Sign Present
1	S Main St (US 301)	Lynum St/Huey St (CR 44A)	Y			N	Y			N		Y		Y	Y	Y			Y	Y								Y	N			Y	N		Y		N				N	N			N	N	Y	Y	Y	Y				
2	US 301	CR 462 E		Y	N			Y	N		Y		Y				N	N			N	N	Y	Y	Y	Y			Y	N			Y	N		Y	N	Y		Y	Y			Y	Y				N					
3	US 301	CR 466																																																				
4	US 301	CR 466A																																																				
5	US 301	CR 470 E	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
6	US 301	CR 470 W	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
7	Main St (SR 48/CR 475)	Belt Ave (SR 48)	Y			N	Y			N		Y		Y	Y	Y			Y	Y							Y	Y			Y	Y							Y			N	Y			N		Y		Y				
8	US 27/441	NE 138th Ln (CR 109)			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	Y	Y				
9	SR 48	N West St (CR 311)			N	N			N	N	Y	Y	Y	Y		Y	N			Y	N		Y		Y			Y	N			Y	N		Y		Y				N	N			N	N	Y	Y	Y	Y				
10	SR 48	Lowery St	Y	Y			Y	Y							Y			N	Y			N		Y		Y			N	N			N	N	Y	Y	Y	Y		Y	N			Y	N		Y		N					
11	SR 44	I-75 NB Off-Ramp	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	N		
12	SR 44	I-75 SB Off-Ramp	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	N		
13	SR 44	Industrial Dr	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
14	SR 48	I-75 SB Off-Ramp	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y		
15	SR 50	SR 471	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
16	US 301	SR 44			N	N			N	N	Y	Y	N	N			N	N			N	N	Y	Y	N	Y			N	N			N	N	Y	Y	N	Y			N	N			N	N	Y	Y	Y	N				
17	SR 44	Buena Vista Blvd/Heritage Blvd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
18	CR 44A	Powell Rd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
19	SR 44	Powell Rd/Signature Rd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
20	CR 466A	Powell Rd/CR 462 E	Y	Y			Y	Y							Y	Y			Y	Y								Y	N			Y	N		Y		Y			Y	N			Y	N		Y		Y					
21	Commercial St (US 301)	Warm Springs Ave (US 301)	Y	Y			Y	Y							Y			N	Y			N		Y		Y	Y			N	Y			N		Y		Y	Y	Y			Y	Y										
22	Main St (US 301)	W Noble Ave (US 301)			N	N			N	N	Y	Y	N	Y			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	N	Y			N	N			N	N	Y	Y	Y	Y				
23	US 301	Seminole Ave (CR 48/CR 476)	Y			N	Y			N		Y		Y	Y	Y			Y	Y							Y	Y			Y	Y							Y			N	Y			N		Y		Y				
26	CR 466	CR 101/Belvedere Blvd	Y	Y			Y	Y							Y			N	Y			N		Y		Y			N	N			N	N	Y	Y	Y	N		Y	N			Y	N		Y		Y					
27	CR 466	CR 103/Old School Rd	Y	Y			Y	Y							Y			Y	Y			N				N			Y	Y			N	N			N	N		Y	Y			Y	N				N					
28	Bailey Tr	St Charles Pl			N	N			N	N	Y	Y	Y	Y		Y	N			Y	N		Y		Y		Y	Y			Y	Y							Y			N	Y			N		Y		Y				
29	Bonita Blvd	Canal St		Y	N			Y	N				Y				N	N			N	N			Y	Y	Y			N	Y			N				Y	Y	Y			Y	Y										
30	El Camino Real	Buenos Aires Blvd	Y	Y			Y	Y							Y	Y			Y	Y								Y	Y			Y	Y				N			Y	Y			Y	Y				N					
31	CR 466	Southern Trace/Tall Trees Ln	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
32	CR 466	Morse Blvd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
33	CR 466	Tatonka Terr	Y	Y			Y	Y							Y	Y			Y	Y								Y	N			Y	N		Y		Y			Y	N			Y	N		Y		Y					
34	CR 466	Buena Vista Blvd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
35	CR 466A	Farner Pl	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
36	CR 466A	Morse Blvd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
37	CR 466A	Sembler Way/Heald Way	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
38	CR 466A	Buena Vista Blvd	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
39	Odell Cir	Canal St (North)	Y	Y			Y	Y							Y			N	Y			N				Y			N	N			N	N			N	Y		Y	N			Y	N				Y					
40	Odell Cir	Canal St (South)	Y	Y			Y	Y							Y			N	Y			N		Y		Y			N	N			N	N	Y	Y	Y	Y		Y	N			Y	N		Y		Y					
41	CR 103	Wedgewood Ln	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
42	El Camino Real	Botello Ave/Enrique Dr	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
43	Morse Blvd	Rio Grande Ave	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
44	Morse Blvd	San Marino Dr	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
45	Buena Vista Blvd	Southern Trace/Saddlebrook Ln	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
46	US 27/441	Bella Cruz Dr	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
47	US 27/441	NE 136th/Buenos Aires Blvd			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	Y	Y			N	N			N	N	Y	Y	Y	Y				
48	US 27/441	Morse Blvd/W Boone Ct	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										
98	CR 466A	Pinellas Pl	Y	Y			Y	Y							Y	Y			Y	Y								Y	N			Y	N		Y		Y			Y	N			Y	N		Y		Y					
99	SR 471	CR 48	Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y							Y	Y			Y	Y										

APPENDIX K

ADVANCED TRAFFIC CONTROLLER MANUFACTURERS

CATALOG INFORMATION

ATC Controller

Peek Advanced Traffic Controllers

Peek Intersection

Overview

The ATC controller line from Peek Traffic is the next generation in advanced transportation control. These controllers utilize the latest in advanced embedded technology to provide the reliable and flexible operation required in today's advanced traffic control operations. The Peek ATC's innovative features, such as memory management control, allow for implementation of process isolation to ensure operational integrity.

Using an X86-based hardware platform and Real Time Operating System makes the IQ ATC extremely flexible, allowing for rapid software implementation and modification. Application software upgrades are made extremely easy using the high-speed Ethernet port.

With these advanced features housed in remarkably compact units, the ATC controllers from Peek Traffic set a new benchmark for performance and versatility.

Peek ATC controllers use NTCIP communications natively and are entirely compatible with Peek's IQ Central® central traffic management system.

Available Models

- CBD (Central Business District) Model available for applications with cabinet space limitations
- NEMA TS/2 Type 1 and Type 2 Models available for a wide range of applications

Peek ATC CBD Controller

Peek ATC TS/2 Type 2 Controller

Features

- X86 based hardware platform with floating point and 8KB cache
- Linux Operating System with memory management for process isolation
- Compliant with NTCIP 1201, 1202
- 2070 compatible modem slot with full modem flow control support
- 100MHz clock speed
- LCD display for status and diagnostics
- High speed USB port (optional)
- Infrared port (optional)

Specifications

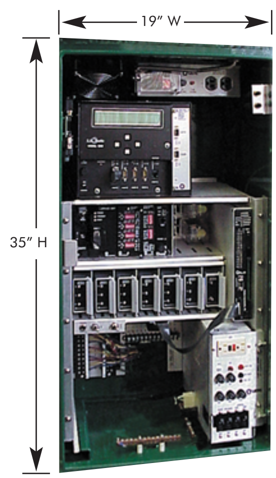
Property	Description
Dimensions:	3000 PC CBD 8″H x 10″W x 10″D (203 x 254 x 254mm)
	3000 PC TS2 8″H x 13″W x 10″D (203 x 330 x 254mm)
Weight:	13.2 pounds (6.0 kg) ....CBD
	12.8 pounds (5.8 kg) TS2
Power requirements:	95 to 135VAC 60Hz ± 3 Hz
	25 VA nominal
Environment:	35°F to + 165°F
	37°C to + 74°C
	0 95% relative humidity
Memory:	8MB Flash memory
	32MB SDRAM
	256KB SRAM
NTCIP compliant:	The traffic application software is NTCIP software compliant ensuring easy integration into any NTCIP or ITS traffic control system. The Peek ATC controllers also interface with IQ Central®, Peek Traffic's central control system, which interfaces to both legacy Peek & USTC controllers as well as NTCIP compliant devices.

Specifications

Property	Description
Computer interfacing:	Intersections configuration is made easy with the available laptop computer interface software (IQ Link™), allowing for prior configuration and rapid download in the field. Or, download from an NTCIP compliant central system, such as IQ Central. Store the configuration on a portable "flash drive" and download in the field in seconds.
Communications:	Communication connectivity is easily achieved with multiple communication options available
	6 serial ports; SDLC support on 2 ports, RS 485 support on 1 port (jumper selectable)
	10/100 Base T Ethernet
	2070 compatible modem slot with full modem control support
	High speed USB port (optional)
	Infrared port (optional)

These options allow for interfacing to numerous communication infrastructures including:

- Existing 1200 baud twisted pair
- High speed serial (RS232) up to 115kbps
- Fiber optic modems
- Wireless systems
- LAN/WAN applications



Peek CBD controller installed in an ASTC-6 pole-mounted cabinet (door removed)

PEEK

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U.S. Traffic Corporation

U.S. Traffic Corporation
4025 E. La Palma Ave., Anaheim, CA 92807

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96-155-3

SIEMENS

usa.siemens.com/mobility

m60 Series ATC

The Advanced Traffic Controller for NEMA-style cabinets

Description

The Siemens m60 series ATC complies with the industry's latest Advanced Traffic Controller (ATC) standard 5.2b. Built on the proven m50 hardware architecture, combined with powerful industry-leading SEPAC software, the Linux-based m60 series ATC provides a host of functions to meet the needs of traffic agencies of all sizes. The m60 series ATC provides multiple Ethernet, USB and other industry-specific interfaces, facilitating both backwards and forwards compatibility. The m60 series ATC also enables easy hosting of third-party applications. In addition, the m60 series ATC exceeds industry standards by providing usability features that include the new Siemens Multiview Display concept (SMD) with real-time active status, context-sensitive HELP screens and user-programmable favorite buttons. The m60 series ATC is truly a nerve center for the connected intersection of the future.

Features

- Exceeds ATC standard 5.2b compliance
- Active TFT backlit LCD display with Siemens Multiview Display Technology
- Modular ATC Communications hub
- Convenient field upgrade packages
  - Linux upgrade package
  - m50 USB upgrade package
  - m60 ATC upgrade package
  - m60 NEMA upgrade package

Benefits

The Siemens m60 series ATC provides a vast array of benefits compared to other similar products in the industry.

At the heart of the m60 series ATC is the Siemens Multiview Display (SMD) concept. The SMD provides the user with multiple time-saving mechanisms to operate and program traffic controllers. For ease of operation, the 16 line display is split into an active programming view at the top and a dynamically updated active status view – or the context-sensitive HELP – at the bottom. This dual view enables users to dynamically visualize the impact of their programming changes on the overall efficiency of the intersection.

In addition, the ability to program customized function buttons to a specific menu item ensures quick navigation, making the operation of an m60 series ATC fast and efficient.

Having built upon the proven Siemens m50 hardware platform, the m60 series ATC offers a range of possibilities to address financial and technological constraints faced by traffic agencies.

Controllers by Siemens

Central Processor Unit (CPU)

- Open architecture platform with standard Linux operating system
- MPC 8270 266MHz processor
- 512MB FLASH, 64MB DRAM and 2MB SRAM
- TOD Clock with automatic daylight savings time adjustment
- Power supply will power the SRAM during power failures
  - – Supports SEPAC controller software
  - – SD memory card
  - – Operating System: Linux 2.6.39

Keyboard and Display

- Siemens Multiview Display with dual view screens
  - – 5 1/8 inch active TFT display
  - – Easily removable display and keypad
  - – Easily identifiable, discrete HELP button
  - – Real-time context sensitive HELP screens
  - – User programmable function buttons F1 to F5
- Removable LED backlit LCD with 16 lines of 40 characters with adjustable contrast
- Emulation of terminal per Joint NEMA/AASHTO/ITE Standard
- Key quantity and function per Joint NEMA/AASHTO/ITE Standard

m60 ATC Communications Module

- 10 Base-T Ethernet with built-in switch and 4 front panel RJ-45 connectors
  - – ENET1 and ENET2 network switches
  - – 5 10/100 TCP/IP ports
- 4 USB 2.0 Ports and a Datakey Port
- Dedicated GPS - SP8 Port (9pin EIA-574)
- Unique MAC address assigned by the Institute of Electrical and Electronic Engineers (IEEE)
- EIA-232 port for uploading/downloading applications software and OS updating
- Single and multi-mode fiber optic options
- 1200 bps Frequency Shift Keying (FSK) modem (optional)
  - – Datakey

Communication

- SDLC
- Serial Port
- FSK Modem

Hardware Specifications

- Dimensions
- Power Supply
- Temperature

Controller Housing

- 7 slots with card guides for standard size Versa Modules
- 2 slots with card guides for standard Joint NEMA/AASHTO.ITE ATC modems (optional) or ATC Communication Module or USB Plate
- Polycarbonate construction (excluding back panel), rear mounting tabs and aluminum power supply mounting plate for electrical grounding
- Carrying handle

All Siemens controllers and accessories are built with the highest standards in quality and manufacturing. With a long standing history of technological innovations, well renowned customer service, and high quality products and services, Siemens is the leader in traffic technology products and solutions. For more information on our product line see our website at ***www.usa.siemens.com/mobility.***

Material	Description
m60 Series Basic Controller	
TYZ:EPAC6138M62	NEMA m62 Controller - Base Unit w/o Communication Modules, Optional Modules or Software Options - 16 Line Multiview Display - Linux Processor
Communication Modules	
TYZ:AAD16481-002	2070-7A Module RS232 TEES 2009
ACP15026P001	Internal FSK Modem - Half Duplex
TYZ:AAD15026-002	Internal FSK Modem - Full Duplex
TYZ:AAD15288-013	Port 3 RS232 Module - Datakey 8MB
TYZ:AAD15288-014	Port 3 RS232 Module - SMF Module - Datakey 8MB
TYZ:AAD15288-015	Port 3 RS232 Module - MMF Module - Datakey 8MB
m60 Series Optional Modules	
TYZ:AAD17048-001	m60 ATC Communications Module
TYZ:PDM08602-001	USB Plate for standard NEMA
Software Options	
TYZ:MBU15805-455	SEPAC NTCIP LINUX VERSION 4.55
TYZ:MBU16037-355	SEPAC ECOM LINUX VERSION 3.55
m60 Series Upgrade Kits	
TYZ:MBV17084-001	M50 LINUX UK - m50/m60 Linux Engine Board - m50 Field I/O Board w USB
TYZ:MBV17085-001	m62 NEMA UK - m52 OS9 to m62 Linux Upgrade Kit - Linux Processor - 16 Line Multiview Display - Field I/O Board Rev 2.1 - USB Plate
TYZ:MBV17086-001	m62 ATC UK - m62 NEMA to m62 ATC Upgrade Kit - m60 ATC Communications Module - m62 Backplane - m60 Power Supply - Cable Set
m60 Series Modules and Spare Parts	
TYZ:AAD17047-001	m60 16 Line Display
TYZ:AAD14877-006	m60 Power Supply Module
TYZ:AAD17048-001	m60 ATC Communications Module
PXX07659-001	m50/m60 Linux Engine Board
TYZ:ACP17049-001	m60 Backplane

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SIEMENS

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Model 2070E ATC Controller Series

Standard outside, power inside

The Model 2070E ATC Controller Series features open architecture hardware that meets the Caltrans 2009 TEES specification. Ideal to fit the needs of any size market, the hardware can be upgraded to operate with a Linux platform and is interchangeable with standard 170 controllers. Its modular design allows for continued progression to adapt to new needs and updated specifications quickly and easily.

The 2070E ATC controller offers easily interchangeable options in processing, communications and I/O hardware. Its open architecture with standard OS-9™ operating system makes it capable of running Siemens SEPAC™ and NextPhase Local Controller Software or a variety of other software applications.

Versatile and durable, the 2070E Controller supports cross-vendor compatibility between hardware and software and is designed and built to handle the unattended operation in harsh environments.

Benefits

- Supports cross-vendor compatibility between hardware and software
- Versatile with multiple processing, communications, and I/O hardware module options
- Easily upgradable and quickly customized with modular design
- Designed and built for unattended operation in harsh environments
- Interchangeable with standard 170 controllers

Siemens 2070E ATC Controller Series Features

Standard features

- Meets Caltrans 2009 TEES specification
- Rack-mounted to fit into any Caltrans style cabinet.
- Back-of-cabinet wiring and access available
- Open architecture platform with standard OS9™ operating system
- Standard software modules from multiple sources
- 2 slots available for choice of dual serial, FSK, and fiber optic, EIA232 or 485 modems
- High speed serial communications to CPU

Technology

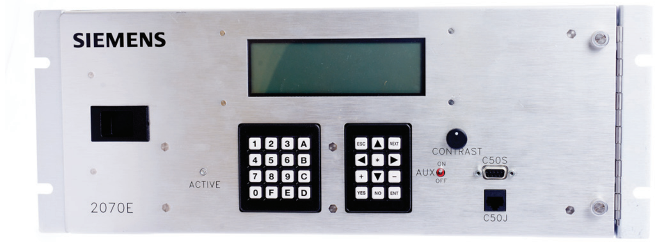
- Motorola MC68EN360, 32 bit, 24.576 MHz Microprocessor
- Memory: 8MB DRAM, 8MB Flash and 1MB SRAM
- EIA 485 Bus Interface
- 10 Base-T Ethernet Port with multi-port network switch
- Datakey - KC4210PCB Keyceptacle (TM), support up to 32Mb Datakey
- Time of Day Clock
- Power requirements of not more than 1 A of +5VDC & 250 mA of ISO +12 VDC.
- Parallel I/O Ports -- 64 bits each input and output
- SDLC compatible communication with CPU Module
- External EIA 485 Net

Upgraded (2070-1C module) features

- USB 1.1 port on the front of the controller
- Freescale Power Quicc II Pro with e200 core, 266MHz microprocessor
- 36Mb Flash, 64Mb DRAM, and 2Mb SRAM memory
- 2 Built-in 10/100 Base-T Ethernet with IP addressing.

Accessories

- 2070-6A & B Async/Modem Serial Comm Module
- 2070-7A & B Async/Sync Serial Comm Module
- 2070-4A Power supply module
- 2070-2A Field I/O Module
- 2070-2B Field I/O Module
- 2070-3B Front Panel Display (FPA)
- 2070-1C CPU (Linux).



Hardware Versions

Unit Version	Description	Hardware
2070V	Provides directly driven VME and mates to 170 & ITS cabinets	Unit Chassis, 2070-1A TB, 2070-1A MCB, 2070-2A FI/O,2070-3A Front Panel, 2070-4 Power Supply, and 2070-5 VME Cage Assembly
2070E	LITE Unit mates to the 170 & ITS cabinets	Unit Chassis, 2070-1E CPU, 2070-2A (2B if ITS CABINET), FI/O, 2070-3B Front Panel and 2070- 4 Power Supply
2070LX	LX Unit mates to the 170 & ITS cabinets	Unit Chassis, 2070-1C CPU, 2070-2A (2B if ITS Cabinet),FI/O, 2070-3B Front Panel and 2070- 4 Power Supply

Siemens is your partner to develop an intelligent and economical transportation solution that will increase the quality of life in your city by improving safety, energy efficiency and traffic-flow, while generating capital that can be invested in additional infrastructure upgrades. With the most comprehensive portfolio of integrated transportation products, services and solutions, Siemens keeps America moving.

Siemens reserves the right to alter any of the Company's products or published technical data relating thereto at any time without notices.

Siemens Industry, Inc.
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Austin, Texas 78754
Tel: +1.512.837.8300
Fax: +1.512.837.0196

www.usa.siemens.com/mobility

Cobalt ATC Traffic Controller

▹ ▹ an unmatched combination of ATC controller open architecture functionality with the latest handheld technology & applications

About Cobalt

The traffic signal controller represents one of the most important intelligent technology and communication components of a signalized intersection. As such, today's advanced traffic signal controller must integrate leading edge electronics, while supporting industry standards and specifications. Econolite continues its tradition of offering the most advanced and innovative technologies with the Cobalt™ family of Advanced Transportation Controllers (ATC).

Fully meeting the industry's ATC standard 5.2b and proposed standard 6.10, Cobalt is designed to provide an unmatched combination of ATC controller open architecture functionality with the latest handheld technology and applications. Cobalt also features a breakthrough hardened seven-inch touchscreen user interface matched with a Linux-based operating system, making programming and access to functions easiest in the industry.

At A Glance

- Revolutionary, large seven-inch color TFT LCD display
- Touch-screen display for intuitive, graphical programming
- High brightness and contrast display for better outdoor readability than any other controller on the market
- Linux, open architecture real-time multi-tasking operating system
- Alternative Web browser-based user interface allows remote programming and status observation (with appropriate network connection)

ECONOLITE®

Cobalt ATC Hardware

Cobalt ATC controllers may be configured with Econolite's robust *Cobalt Touch* or *Cobalt ASC* application software package, or other Linux application software meeting current ATC standards. OS software upgrades can be made easily by USB memory stick, SD card, or Ethernet via Econolite's Windows software installation application.

Cobalt includes a high-power, Linux-based Engine Board that is compliant with the ATC 5.2b and proposed 6.10 standard for a NEMA standard TS2 Type-1 or Type-2 I/O connectors: four Ethernet ports, two USB ports, and an SD Card slot. Additionally, ***Cobalt's*** seven-inch color, high brightness TFT LCD module with touch screen capabilities is readable in direct sunlight, can be operated with gloved hands, and is not affected by condensation or water drops.

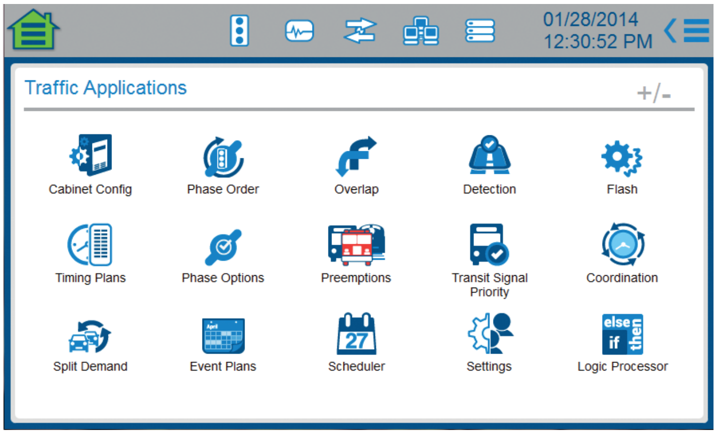
Hardware Details

- Supports Econolite Linux-based software or other pre-qualified ATC/Linux software
- ATC Engine Board
  - *Fully compliant with the ATC Standard version 5.2b and proposed ATC Standard 6.10*
  - *233MHz PowerQUICC II Pro-processor that provides 10 times more processing power than previous generation controller processor*
  - *128Mbytes of DDR2 DRAM memory for application and OS program execution*
  - *64 Mbytes of FLASH for storage of OS Software and user applications*
  - *2MB of SRAM memory for non-volatile parameter storage*
- Two integral Ethernet switches for two networks, ENET1 and ENET2• Advanced Graphics Controller
  - *Enables **Cobalt's** enhanced graphics user interface*
  - *Touch screen capability means the keyboard never has to be used*
  - *Replaces traditional text menu selection with graphical selections*
- Two USB 2.0 ports used to:
  - *Update application software*
  - *Upload or download configuration*
  - *Upload logged data*
- Datakey socket for an optional 3.3V Datakey, 2 through 32MB
- SD Memory Card socket
- CPU Active LED
- Three communications ports standard:
  - *NEMA-ATC SDLC serial port 1*
  - *25 pin serial port 2*
  - *9 pin console serial port*
- Built in speaker for enhanced audio controller feedback
- Integral carrying handle in back of controller
- Power Supply
  - *Meets all requirements of ATC standard v6.10.*
  - *External 24VDC protected by a self-resetting electronic fuse*
- Operating system
  - *Linux 2.6.3x or later kernel and Board Support Package (BSP)*
  - *Compliant to ATC Standard V. 5.2.b Annex B specifications*

Hardware Options

- Two user interface options:
  - *Advanced Display with graphics and touch-screen (Standard)*
  - *Basic Display with text and textual menus only—no touch or graphics (Option)*
- Two models,
  - *TS2 type 2 connectors*
  - *TS2 type 1 connector*
- Communications module options:
  - *FSK Module that can be configured for RS232 operation*
  - *2070 TEES 2009 standard 6A, 6B, and 7A plug-in modules*
- Datakey 3.3V, 2 through 32MB

Capabilities



Control Features

- 16 phases, 8 configurable concurrent groups in 4 timing rings
- 16 pedestrian phases that can be configured as pedestrian overlaps
- Exclusive pedestrian operation
- Dynamic max operation
- Extendable walk and pedestrian clearance
- Advanced Walk
- Bike input and green timing
- Adaptive red clearance

Coordination Features

- 120 coordination patterns, each with its own cycle, offsets and split plan selection
- 120 split plans, each with its own coordinated phases, vehicle and pedestrian recall and phase omits
- Offset and split entries displayed in percent or seconds
- Automatic permissive periods
- Fixed or floating force-off
- Crossing arterial coordination
- Quick-sync feature

Preemption Features

- Ten preemption sequences. Each may be configured as priority, first-come-first-serve, or bus preemption operation
- ECPI interlock to provide added monitoring
- Railroad gate-down input and timing.
- Conditional delay when entering preemption
- Multiple exit preemption options
  - *Exit to selected exit phase*
  - *Exit to coordination (no transition)*
  - *Exit to interrupted pedestrian phase*
  - *Exit to interrupted vehicle phase*
  - *Use timing from an exit timing plan once, then the normal timing plan*
  - *Exit to a selected phase first then to free or coordination (selectable)*
  - *Exit free for one complete cycle then resume coordination (no transition)*
  - *Exit to the phases where the most drivers have waited the longest*

Time Base Features

- 200 schedule programs, configurable for any combination of months, days of the week, and days of the month
- Fixed or floating exception day programs that override the day plan event on a specific day
- 50 day plan events that can use any of the 100 action plans
- 100 action plans that can be used by any of the 50 day plans

Status Display Features

- Keyboard selection of detailed dynamic status displays for each of the main controller unit functions including: controller, coordinator, preemptor, time base, detectors, and MMU

Detector Features

- 64 vehicle detectors
- 16 system or speed detectors
- Unique detector types and operation
- Individually assignable to phase and functions
- Lock/non-lock function by detector
- 4 detector plans
- 4 detector diagnostics plans
- Logging of volume and/or occupancy assignable by detector
- 4 pedestrian diagnostic plans

Logging Features

- Separate buffers for detector activity, detector failures, controller events, and MMU events
- Logged data can be:
  - *Viewed on front panel*
  - *Retrieved via a RS-232 terminal port, USB flash drive, or SD Card*
  - *Transferred via telemetry to a traffic management center*

Systems

- NTCIP level 2 compliance
- Supports Centracs®, Aries® and TS2 NTCIP Level 2-compliant central applications

Cobalt Software Options

Cobalt Touch Software (requires Cobalt ATC hardware including the Advanced Graphics Controller)

- All the ASC/3-LX Software features, plus the following:
  - *Full-color graphic interface with touch-screen capability*
  - *Provides menu selection using touch selections.*
  - *Programming uses touch data entry allowing touch gestures to select yes/no, select enable/disable, pull-down list selections and more*
  - *Screen can be swiped to advance to another screen*

ASC/3-LX Software (General)

- Field-proven for over 8 years
- Allows for an agency-specific default database
- Automatic backup of controller database to optional Datakey or manual back up to USB flash drive
- Context sensitive help
- Hyperlink feature allows jumping from a status field to the screen where data is defined
- 100-statement logic processor to test inputs, outputs or timers and take actions based on the results

Optional Software

- Transit Signal Priority
- Centracs Adaptive

Basic Specifications

- ▷ Temperature
  - -34.6°F to +165°F (-37°C to +74°C)
- ▷ Power
  - 110VAC @ 50/60 HZ or optional 220/240 VAC @ 50/60 HZ
  - Fuse protection for either 110 or 220/240V
  - Protection for the 24VDC supply is provided by a resettable electronic fuse
- ▷ Dimensions
  - 14.84"W x 8.50"H x 6.13"D

Trafficware
Engineered by Naztec

Model 980 ATC

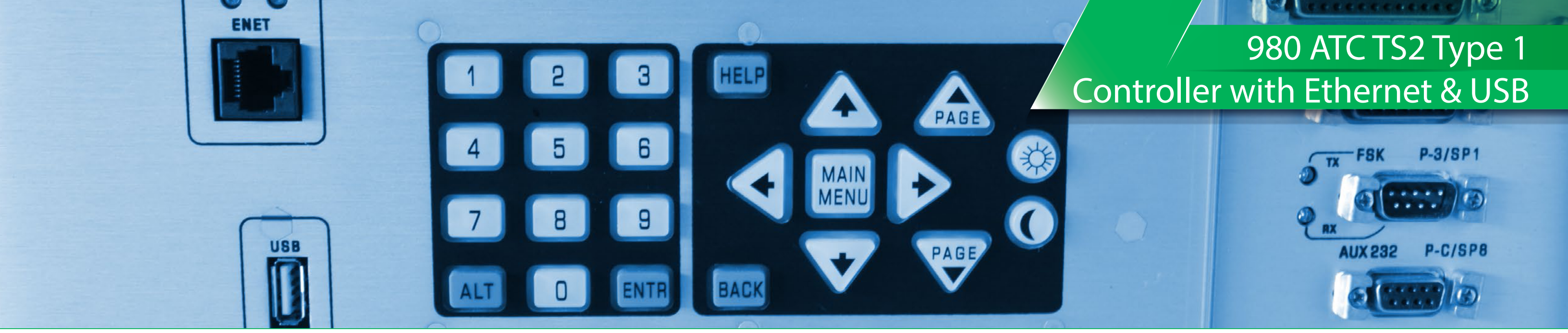
TS2 Type 1 Controller
with Ethernet & USB

Traffic Adaptive Controller

The Series 900 ATC Traffic Signal Controller is designed using state of the art electronics to ensure reliability, a long life, and superb performance in all signal control applications.

Design of the Series 900 ATC Controller is based on the ATC and NEMA TS2 standards and includes advanced functionality for complex phasing, detector processing, coordination, preemption, communications, adaptive timing, and systems operation as a master or a secondary controller.

The advanced LCD display and menu-driven software provide a user-friendly approach to programming and access. Built-in diagnostics permit rapid evaluation of operational status. The on-board Flash File System allows software upgrades without PROM replacements. The front panel mounted USB port facilitates the upgrade process and file access with ease and the Ethernet-enabled controller allows communication across a TCP/IP network.



Product Features & Specifications

FEATURES	
Flash File System	The Series 900 Controller is easily configured to various firmware versions through the utilization of Flash File System, which eliminates the need for obsolete EPROM technology. A complete traffic controller firmware update requires only seconds. No hardware changes or EPROM replacements are required.
Master/Secondary	Operation in a Closed Loop System requires only one Series 900 Controller to be located at the master cabinet. Both the master and secondary functions are simultaneously provided by a single controller.
Display	A backlit, 8-line by 40-character LCD display provides full-menu screens for eased data entry. Optimum contrast and brightness are automatically maintained by temperature-compensating circuitry. The menu-driven format and context sensitive help screens eliminate the need for special codes or front panel identification characters.
Easily Serviced	The modular design of the Series 900 Controller allows quick sub-assembly level problem isolation. Printed circuit board components are clearly labeled with silk-screen. No specific tools or extender cards are needed for troubleshooting.
Real-Time Clock	The real-time clock maintains accurate timing by utilizing a “super capacitor” and crystal-controlled circuitry, which allows for 0.005% accuracy.
NTCIP Objects	The Trafficware 980 Controller incorporates the NTCIP Standard Objects and many additional objects that allow for enhancements to standard ATC operating features as well as entirely new ones. Sixteen phases, sixteen overlaps, ten compatible phases per phase, alternative programming by time-of-day, and many other features provide extreme flexibility to handle the most challenging traffic control situations.
Keyboard	A custom 23-key keypad containing four (4) red function keys, ten (10) white numeric keys, seven (7) cursor and menu navigation keys, and two (2) LCD contrast adjustment keys.
Diagnostics	Built-in diagnostics provide for improved maintenance and easier repairs. It allows operator tests on all input and output signals, RAM devices, memory, LCD, keypads, etc.
Communications	Four (4) EIA-232 ports and an optional FSK modem are available. These ports are keyboard programmable with selectable baud rates up to 115K with full and half duplex options. Various communication configurations allow the user multiple interfaces to other cabinet devices: conflict monitor, preemption equipment, detectors, GPS, modems, notebooks, printers, etc. An RS-485 SDLC Port is available for applications using the NEMA TS2 Port 1 interface and a USB 2.0 Full Speed interface is available for software updates and file transfer.

HARDWARE SPECIFICATIONS	
Voltage	89 to 135 VAC
Frequency	60 +/- 3 Hz
Temperature	-30° F to 165° F
Humidity	95% max, non-condensing
Dimensions	10.50”H x 14.75”W x 8.38”D

Sumter County
Advanced Traffic Management System (ATMS) Master Plan

Systems Engineering Management Plan (SEMP)



Systems Engineering Management Plan for: *Sumter County ATMS*

Version: ***1.0***

Approval date:

Form FM-SE-09 Project Systems Engineering Management Plan Template. Effective 11/30/2015

DOCUMENT CONTROL PANEL		
File Name:	*Sumter County ATMS SEMP*	
File Location:	\Documents\Task 10 - SEMP and ConOps	
Version Number:	1.0	
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Created By:	Nathan Poole, PE, VIBE	10/26/16
Reviewed By:	Jay Calhoun, PE, VIBE	11/8/16
	Jay Calhoun, PE, VIBE	11/18/16
	Jay Calhoun, PE, VIBE	11/30/16
	Brian Kanely, PE, Volkert	12/14/16
	Katie King, PE, Metric Engineering	12/20/16
Modified By:	Nathan Poole, PE, VIBE	11/15/16
	Nathan Poole, PE, VIBE	11/23/16
	Nathan Poole. PE, VIBE	1/27/16
Approved By:		

Table of Contents

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List of Acronyms and Abbreviations

ADMS .... Arterial Dynamic Message Sign
ATMS .... Advanced Traffic Management System
CCTV .... Closed Circuit Television
CEI .... Construction, Engineering, and Inspection
CFP .... Cost Feasible Plan
ConOps .... Concept of Operations
CPM .... Critical Path Method
FAC .... Florida Administrative Code
FDOT .... Florida Department of Transportation
FDR .... Final Design Review
GPS .... Global Positioning System
ITS .... Intelligent Transportation System
ITSFM .... ITS – Facility Management Tool
LAP .... Local Agency Program
MOE .... Measure of Effectiveness
MOP .... Measure of Performance
MTR .... Minimum Technical Requirement
MVDS .... Microwave Vehicle Detection System
ORR .... Operations Readiness Review
O&M .... Operations and Maintenance
PDR .... Preliminary Design Review
PERT .... Project Evaluation and Review Technique
PITSA .... Project Intelligent Transportation System (ITS) Architecture
PM .... Project Manager
QA .... Quality Assurance
QC .... Quality Control
QM .... Quality Management
RITSA .... Regional Intelligent Transportation System (ITS) Architecture
RTVM .... Requirements Traceability Verification Matrix
SEMP .... Systems Engineering Management Plan
SEP .... Systems Engineering Process
SITSA .... Statewide Intelligent Transportation System (ITS) Architecture
SRR .... System Requirements Review
TSP .... Technical Special Provision
TRR .... Test Readiness Review
VDS .... Video Detection System

1 Document Overview

This document is the Systems Engineering Management Plan (SEMP) for the Sumter County Advanced Traffic Management System (ATMS). A SEMP is a plan that helps manage and control a project utilizing systems engineering processes (SEP). The SEMP identifies what items are to be developed, delivered, integrated, installed, verified, and supported.

The document is organized as follows:

- Section 2 – Need for a SEMP
- Section 3 – Applicable Documents
- Section 4 – Systems Engineering Processes
- Section 5 – Project Management and Control

2 Need for a SEMP

The Florida Department of Transportation (FDOT) requires high-risk intelligent transportation systems (ITS) projects using federal funds to use SEP.[1] The SEMP documents how systems engineering will be used for ITS project management.

Florida's Statewide SEMP is used as a reference in the creation of this SEMP.

2.1 Project Identification

Project Name: Sumter County ATMS

Financial Project Identification: 436365-1-18-01

Federal Aid Project Number: N/A

2.2 Purpose and Scope

This document serves as the SEMP for the Sumter County ATMS in FDOT District Five. It provides planning guidance for the technical management, procurement, installation, and acceptance of the field devices associated with the Sumter County ATMS projects. The projects will include the deployment of advanced traffic management system (ATMS) devices such as closed circuit television (CCTV) cameras, arterial dynamic message signs (ADMSs), microwave vehicle detection systems (MVDSs), video detection systems (VDSs), and communications infrastructure throughout Sumter County.

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[1] FDOT Procedure titled Systems Engineering and ITS Architecture (Topic No 750-040-003). Available online at http://www.dot.state.fl.us/proceduraldocuments/procedures.shtm.

Further details of the projects can be obtained by reviewing other documents, such as the Concept of Operations (ConOps) and the Sumter County ATMS Master Plan.

2.3 Technical Project Summary Schedule

Advertisement for Services:	TBD
Selection of Consultant for Services:	TBD
Design:	TBD
Advertisement for Construction:	TBD
Bid Opening/Letting:	TBD
Notice to Proceed (NTP):	TBD
Construction:	TBD

2.4 Relationship to Other Plans

2.4.1 Relationship to Florida's Ten-Year ITS Cost Feasible Plan

The Ten-Year ITS Cost Feasible Plan (CFP) is a ten-year program and resource plan that identifies ITS projects in the overall context of Florida's ITS Corridor Implementation Plans.[2] It represents a commitment of state- and District-managed ITS funds to provide a coordinated statewide program to develop ITS infrastructure on Florida's major intrastate highways. The FDOT's current Ten-Year ITS CFP is available online at http://www.dot.state.fl.us/trafficoperations/ITS/Projects_Deploy/Ten-Year_CFP.shtm.

The Sumter County ATMS project is not included in the Ten-Year ITS CFP.

2.4.2 Relationship to Florida's Statewide ITS Architecture

The Sumter County ATMS is not included in the District Five regional ITS architecture (RITSA), which was developed as part of the Statewide ITS Architecture (SITSA). As part of this SEMP, the necessary information will be provided to get the Sumter County ATMS added to the RITSA.

[2] The FDOT's ITS Corridor Implementation Plans are available online at http://www.dot.state.fl.us/trafficoperations/ITS/Projects_Deploy/CFP/CFP_Legacy.shtm .

More information on the current SITSA is available online at http://www.consystec.com/florida/default.htm.

2.4.3 Relationship to Other "On-project" Plans

An "on-project" plan related to this SEMP is the Sumter County ATMS Master Plan. The Sumter County ATMS Master Plan provides recommendations for the implementation of ATMS elements throughout the County. The projects related to this SEMP are to follow the recommendations provided in the Sumter County ATMS Master Plan.

3 Applicable Documents

The following documents, of the exact issue shown, form a part of this document to the extent specified herein. In the event of a conflict between the contents of the documents referenced herein and the contents of this document, this document shall be considered the superseding document.

Florida's Statewide Systems Engineering Management Plan, Version 2, March 7, 2005	FDOT Traffic Engineering and Operations Office, ITS Section, http://www.fdot.gov/traffic/ITS/Projects_Deploy/SEMP/PDF/050315_D1-10_V2.pdf
Sumter County ATMS Master Plan, January 2017	VIBE
Sumter County ConOps, November 2016	VIBE

4 Systems Engineering Processes

The typical SEP will be followed in the Sumter County ATMS projects. These processes are:

- Developing the project ITS architecture
- Creation of high-level requirements
- Creation of detailed requirements
- Trade-off studies, gap analyses, or technology assessments
- Technical reviews
- Risk identification, assessment, and mitigation
- Creation of the requirements traceability verification matrix (RTVM)
- Creation of performance measure metrics
- System test, integration, and acceptance planning

4.1 Developing the Project Intelligent Transportation System Architecture

The Sumter County ATMS is not identified in the FDOT District Five RITSA. The Sumter County ATMS should be added to the FDOT District Five RITSA with the following service packages:

Service Packages	
Advanced Traffic Management Systems	
ATMS01-18	**Network Surveillance**
ATMS02-04	**Traffic Probe Surveillance**
ATMS03-17	**Traffic Signal Control**
ATMS06-17	**Traffic Information Dissemination**
ATMS07-04	**Regional Traffic Management**
ATMS08-08	**Traffic Incident Management System**

In determining the service packages for the Sumter County ATMS, the service packages listed under FDOT District Five RITSA were reviewed for applicability. The applicability was determined by the recommended ATMS elements included in the Sumter County ATMS Master Plan.

4.2 Creating High-Level Functional Requirements

The ConOps for the Sumter County ATMS identifies goals and objectives as well as the functional requirements for the proposed Sumter County ATMS. Also, the roles and responsibilities of the stakeholder agencies are described and related to the Sumter County ATMS.

4.3 Creating Detailed Requirements

The Sumter County ATMS projects will be low-bid design-bid-built projects. The detailed technical requirements will be developed and included in the specifications. The required technologies for the projects will be defined by the respective plans and specifications package and the FDOT Standard Specifications.

4.4 Performing Trade-off Studies, Gap Analyses, or Technology Assessments

Trade-off studies are performed to solve any complex problem where there is more than one selection criterion and to provide a documented decision rationale for review. The evaluation of the requirements issues provides a basis for defining the objectives of the trade-off study. Trade-off studies are performed in order to have a timely impact on the project so that changes can be made without costly redesign.

When the same product or system can be built using different technologies, a technology assessment is completed to determine the right technology to use to build the product in the given situation.

Trade-off studies and technology assessments were conducted by the developer of the Sumter County ATMS Master Plan. The technologies to be used in the Sumter County ATMS are defined by the Sumter County ATMS Master Plan. Because of the rapid changes that occur in ITS technology, during the design phase of the project, a technology assessment will be performed to determine if the technology in the Sumter County ATMS Master Plan remains the most applicable technology. The designer's recommendations will be presented to the County for validation.

A gap analysis focuses on determining the gap that exists between existing system capabilities and the desired system to be implemented. Because Sumter County does not have an existing system, a gap analysis was not performed.

4.5 Performing Technical Reviews

Technical reviews will be required to properly accomplish work items that are to be completed for the Sumter County ATMS project. Reviews that will be conducted as part of this project include but are not limited to:

- Project Kick-off
- ConOps Review
- System Requirements Review
- Preliminary Design Review
- Final Design Review
- Test Readiness Review
- Hot Wash-Up Review
- Operational Readiness Review

4.5.1 Project Kick-off

The Design Consultant will review the Sumter County ATMS Master Plan with Sumter County and their representatives. This review includes looking at the scope of services, overall schedule, and budget for the project. The review will also provide an opportunity to reach an agreement on how the project will be managed.

4.5.2 ConOps Review

The ConOps helps to translate user needs into a common vision for how the system will operate in the user's environment. The ConOps will be reviewed by the project stakeholders and will include the following products:

- Draft ConOps document
- Hypothetical system architecture
- Potential risk items

4.5.3 System Requirements Review (SSR)

SSRs are held to determine the functional baseline for the Sumter County ATMS. Multiple SRRs have been held during the development of the Sumter County ATMS Master Plan. The reviews were the responsibility of the consultant developing the Sumter County ATMS Master Plan. Sumter County and the stakeholders were included in SRRs. Products that were reviewed at the SRR include:

- Draft Technical Documents to be included in ATMS Master Plan

4.5.4 Preliminary Design Review (PDR)

The PDR emphasizes how the system design meets the system requirements. Emphasis at the systems level is what the system has to do, not how the system does it. This review will be performed by Sumter County and/or their representative and will include the review of the following products:

- Final Sumter County ATMS Master Plan
- Preliminary System Design
- High Level diagram of Functional Architecture
- High Level diagram of Physical Architecture
- Risk Items

4.5.5 Final Design Review (FDR)

The FDR is an important step because it is the gateway leading the construction of the project. Any final changes or modifications should have been made prior to the review. This review will be performed by Sumter County and/or their representative and will include the review of the following products:

- Final Project Design Plans and Specifications
- Draft Test Plans
- Functional Architecture
- Physical Architecture
- Risk Items

4.5.6 Test Readiness Review (TRR)

The TRR is a formal review conducted before starting a formal acceptance test of the system. It describes the objectives and contents of the review; when it should be held; and who should attend. The Contractor is responsible for this review, and the products to be reviewed at the TRR include:

- Final Test Plans
- Preliminary installation and checkout plan

- Test support equipment needs
- Risk items

4.5.7 Hot Wash-Up Review

This review is held immediately after the ITS acceptance testing is concluded to obtain a consensus on the testing results and to discuss any major discrepancies. The hot wash-up review lays the foundation for the ITS acceptance test report and the resulting corrective action plan, if one is needed. The meeting is the responsibility of the Construction Engineering and Inspection (CEI) consultant and involves the Contractor’s Project Manager (PM) and test director, the Sumter County PM, and any other key decision makers who have influence over the system’s acceptance.

4.5.8 Operational Readiness Review (ORR)

The ORR is held before full-scale deployment and operations of an ITS project. The ORR focuses on all the elements that need to be completed prior to operating the system. Topics range from training status to operations and maintenance procedures. The disposition of acceptance test discrepancies is reviewed and a final determination is made to proceed with the operation of the system while minor discrepancies are being corrected. This review is the responsibility of the CEI to coordinate with the Contractor, the Sumter County PM, and any other key decision makers who have influence over the system’s acceptance.

4.6 Identifying, Assessing, and Mitigating Risk

4.6.1 Risk Identification

The risk management process provides an efficient method for each person working on the projects to identify potential risks. Risk items will be identified and documented based on an analysis of the functional requirements as they apply to the project’s contractual and technical requirements, as well as plans. All project sources will be continually interrogated for timely risk identification. The Sumter County PM or their representative will validate the identified risk and make it a part of risk reporting by assigning responsibility to each risk item.

4.6.2 Risk Assessment

Basic project risk assessment consists of identifying individual risks, categorizing the risk, determining the risk level, and recommending an approach to risk solution. Risk is defined as low, medium, and high:

- “Low Risk” defines an area in which technical and project metrics are within plan or tolerances identified with the specifications.

- "Medium Risk" defines an area in which one or more major technical or performance metrics are out of tolerance, but within the maximum established limits for low-impact recovery techniques.
- "High Risk" defines an area with potential serious failures in accomplishment which requires major milestone re-planning, or intensive reallocations of personnel and resources.

The level ranking of identified risks determines the priority and urgency of attention given. Risk items are assigned to key individuals who are responsible for developing and executing individual risk management plans and reporting status. The mitigation status of identified medium and high risk areas is reported at status meetings until each risk is resolved.

4.6.3 Risk Mitigation

The Sumter County PM and/or their representatives will develop effective mitigation plans with the assistance of other key individuals. These individuals initiate mitigation actions, continually monitor the mitigation progress, and perform follow-up activities, as required. The Sumter County PM and/or their representatives will maintain mitigation action plans, procedures, schedules, and responsibility definitions.

Mitigation action plans are required for all medium risk and high risk items. These plans assign specific actions to specific individuals to achieve detailed and correct analyses of each addressed risk and execute corrective actions. The Sumter County PM and/or their representatives will formulate and issue these directive plans and monitor progress against these directives.

4.7 Creating the Requirements Traceability Verification Matrix (RTVM)

The RTVM consists of the functional, performance, and environmental requirements for the projects. The requirements are derived from the FDOT Standard Specifications, Project Specifications, and County Standard Specifications. The Sumter County PM or their representative will use the RTVM to accurately track the stakeholder's requirements during all phases of the Sumer County ATMS projects. The RTVM for the respective project will be developed during the project design phase and monitored throughout all phases of the project.

4.8 Creating Performance Measure Metrics

There are two ways to evaluate how well a system design meets its requirements. One is by defining measures of effectiveness (MOEs) and the other is by defining measures of performance (MOPs). The stakeholders will use MOEs to measure satisfaction with products produced by the technical effort while the MOPs are the engineering performance measures that provide the design requirements needed to satisfy the MOEs. Through the development of the ATMS Master Plan, Sumter County was responsible for the creation of the MOEs and MOPs, and will be responsible for testing the MOEs and MOPs.

The MOEs for the Sumter County ATMS projects are:

- Reductions in congestion and lost business revenue while increasing public safety. This includes, but is not limited to:
  - Reliability of the communications network connecting the traffic signal controllers
- The ability to verify alarms produced by the central control software and citizen complaints related to the traffic signals. This includes, but is not limited to:
  - Strategic location of CCTV cameras throughout the County
  - Reliability of the CCTV cameras
- The ability of the ADMSs to inform the traveling public of travel related information for the respective route. This includes, but is not limited to:
  - Reliability of the ADMSs
  - Reliability of the communication links to the ADMSs
  - Strategic location of the ADMSs
  - Accuracy of information posted on ADMSs

The MOPs that are to be used during the Sumter County ATMS projects are:

- Successful completion of the ADMS, CCTV camera, and fiber optic cable testing requirements as stated in the applicable FDOT Standard Specifications determined by the Project Letting Date and required by Sumter County.
- Equipment procured for the projects meets the requirements within the applicable FDOT Standard Specifications as determined by the Project Letting Date as well as any additional technical requirements within the project-specific specifications.
- Device layout follows recommendations within the Sumter County ATMS Master Plan

4.9 Conducting System Testing, Integration, Verification, Validation, and Acceptance Planning

The Contractor will be required to demonstrate to Sumter County and FDOT District Five through testing plans and criteria how each of the selected products, subsystems, and overall ITS meet the functional requirements as defined for each project. The following documents are inputs to the test planning process:

- Contract Requirements (Specifications, Technical Special Provisions, etc.)
- RTVM
- Project Schedule
- A test plan outline

Testing will include, but is not limited to, each of the main components of the ATMS (CCTV cameras, ADMSs, MVDSs, VDS, fiber optic cable, Ethernet switches, controller cabinets, etc.). The Contractor will be responsible for developing final test plans for all testing required to formally accept the respective project. The results of the testing will have a clear pass/fail indication. Testing of the equipment and system will follow the phased process below:

- Factory Acceptance Test
- Standalone Test
- Subsystem Test
- ATMS Acceptance Test

Testing will provide verification and documentation that all requirements as defined in this document, contract documents, and the requirements defined in the test plan are met.

4.9.1 Test Approach

The test plans and test procedures together shall provide a two-step description of each test. The test plans will provide a high-level functional summary of the methods used for verifying each feature of the system being tested. The test procedures will detail the step-by-step activities associated with each test. The following information will be included in the test plan:

- An implementation plan and detailed schedule
- Record-keeping procedures and forms
- Procedures for monitoring, correcting, and retesting variances
- Procedures for stopping and restarting the testing due to failures
- Procedures for controlling and documenting all changes made after the start of testing
- A list of individual tests to be performed, the purpose of each test segment, and the appropriate functional design specification reference describing the feature being tested
- Test Evaluation/Traceability Matrix
- Identification of special hardware or software tools or test equipment to be used during the test
- Copies of any certified test data to be used in lieu of testing

4.9.2 Test Schedules

The Contractor will submit the test plans, testing procedures, and forms to Sumter County for review at least 45 calendar days prior to performing the associated tests. Sumter County will review submitted test procedures and forms, and will provide comments or approval to the Contractor within 20 calendar days after receiving the testing documentation.

4.9.3 Test Tools

The Contractor will furnish and maintain all required test equipment necessary to conduct the testing.

4.9.4 Test Facility

The Contractor will notify Sumter County of the time, date, and place of each test at least 21 calendar days prior to the date the test is planned. All Contractor personnel requiring access to the

Sumter County TMC will be submitted to Sumter County for approval of access. Advance notice will be provided to Sumter County of times when personnel will require access.

4.9.5 Subsystem Tests

The subsystem tests will be performed based on the construction project milestones. These tests will verify for all subsystems being tested that all requirements defined in the equipment functional requirements have been met. These tests will be performed utilizing the project field equipment and new communications system. The test will demonstrate full control of the field device(s) from the Sumter County TMC with the communications channels, as well as the functionalities of local/remote trouble shooting/diagnostics specified in the equipment functional requirements.

During the test, the Contractor will provide qualified personnel to support the diagnosing and repair of system equipment during the operational test, as required. The personnel will be available for this support within 24 hours of notification of the need for their services.

The Contractor will prepare test plans for the individual subsystem tests required for this project. The test plans will be prepared based on the testing requirements identified in the FDOT Standard Specifications. The test plans will include, as a minimum, the following information:

- Date, time, location, and estimated duration of test
- Name of designated witnesses
- Description of subsystem to be tested – showing a test of every function of the equipment or system to be tested
- Test equipment list
- Test objectives
- Expected results – A description of the expected operation outputs and test results including a Test Evaluation/Traceability Matrix
- Test sequence details – A step-by-step outline of the test sequence to be followed
- Test result forms – Data forms to be used to record all data and quantitative results obtained during the test
- Connection diagrams wherever applicable
- Software - A copy of all diagnostic software shall be supplied by the Contractor to Sumter County with full documentation

4.9.6 ATMS Acceptance Test

The ATMS Acceptance Test will consist of all the project subsystems operable from the Sumter County TMC. The project subsystems will operate continuously for a period of 30 consecutive calendar days without failure of any subsystem, ATMS device, or ancillary component. This ATMS Acceptance Test of the complete project is an additional test to all of the other tests required in the relevant sections of the FDOT Standard Specifications and the Supplemental Specifications that are applicable to this project. The ATMS Acceptance Test will commence upon successful completion of all required subsystem testing.

The Contractor will notify Sumter County in writing 14 calendar days prior to the scheduled date of the ATMS Acceptance Test. The ATMS Acceptance Test will not be performed without prior written approval from Sumter County.

5 Project Management and Control

The project management and control needed to successfully complete the project on schedule and in budget will be required from Sumter County, the Design Consultant, and the Contractor as each will have their own respective responsibilities. The responsibilities can be divided into different stages of the project. Figure 1 shows the various stages of the project. The Sumter County PM may elect to contract a consultant to perform or assist with the tasks listed under their responsibilities.

The responsibilities of the Sumter County PM or County Representative include:

- Conduct Project Kick-off
- Define PITSA
- Publish ConOps
- Define High-level Requirements Analysis
- Define Procurement Process
- Select and Award Contract
- Conduct System Acceptance
- Perform Operations & Maintenance (O&M)
- Develop Lessons Learned
- Develop Future ITS Projects

The responsibilities of the Design Consultant include:

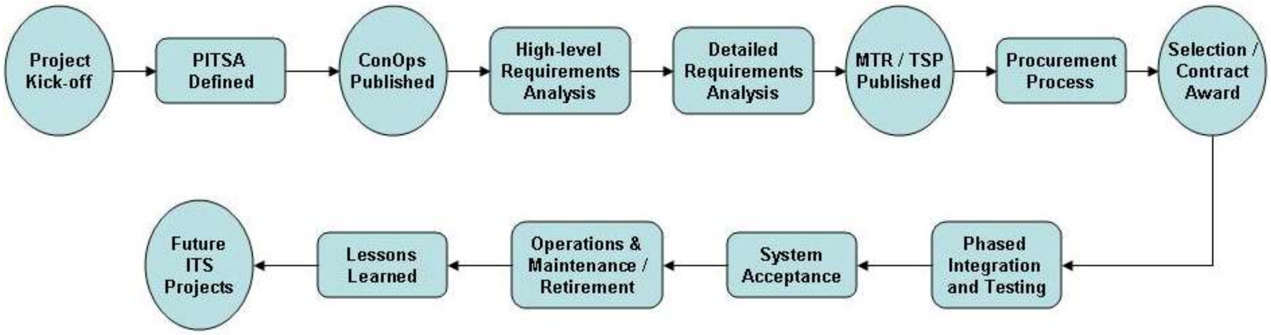
- Perform Detailed Requirements Analysis
- Publish MTR/TSP

The responsibilities of the Contractor include:

- Perform Phased Integration and Testing

The management of the Sumter County ATMS projects can be performed by either the FDOT or by Sumter County through the Local Agency Program (LAP). If the projects are managed by the FDOT, the procurement process will be handled by the FDOT. If the projects are managed by Sumter County through the LAP, the procurement process will be handled by Sumter County. Project management through the LAP program provides Sumter County greater authority with the procurement of a consultant for the design services of a project, and the procurement of a contractor for the construction of a project.

Figure 1 – ATMS Project Stages



The following areas will be covered in this section:

- Organization structure
- Managing the schedule with a project evaluation and review technique (PERT) chart, and the critical path method (CPM)
- Procurement management
- Risk management
- Subcontractor management
- Engineering specialty integration
- Monthly project status reviews
- Change management
- Quality management (QM)
- Systems acceptance
- O&M / upgrade / retirement
- Lessons learned

5.1 Organization Structure

5.1.1 Design Phase

5.1.1.1 Sumter County Management Team

The Sumter County management team consists of County employees and a network management consultant. This team will provide direction and oversight to ensure that the design of the respective project details a fully operational system that will integrate and interoperate within the existing RITSA, and meet the functional requirements developed for the project.

5.1.1.2 Design Consultant Management Team

The Design Consultant will provide project documentation that includes design plans, technical specifications, and engineer's cost estimates to ensure a complete, fully functional system is provided. The system will interoperate within the existing RITSA and meet the functional requirements developed for the respective project.

5.1.2 Construction Phase

5.1.2.1 Sumter County Management Team

The Sumter County management team is comprised of County employees, a CEI consultant, and a network management consultant. This team will provide direction, oversight, inspection, and submittals review to ensure that the Contractor delivers a fully operational system that integrates and interoperates within the existing RITSA, and meets the functional requirements developed for the respective project.

5.1.2.2 Contractor Management Team

The Contractor will provide quality assurance/quality control (QA/QC), construction, integration, testing, and training to ensure a complete, fully functional system that interoperates within the existing RITSA. The Contractor will be required to provide an organizational structure defining the various responsibilities of the respective project's implementation.

5.2 Managing the Schedule with the Project Evaluation and Review Technique and the Critical Path Method

A project scheduling software package will be utilized to manage the design phases of the projects.

The construction phase will be managed with a project schedule using the critical path method, a two-week look ahead, and cost tracking. The CEI will ensure compliance with both the schedule and cost tracking during the construction phase. The schedule will be developed as an interrelated event list with duration times for each task and the program will determine and highlight the critical path (the path with zero float time). This provides the user with insight into the project schedule and identifies the areas that may require additional management oversight to ensure successful project completion. The critical path will be recalculated as data are entered to show the impact of schedule changes and to allow for "what if" analysis.

The project schedules will be developed with coordination between the Contractor, the Sumter County PM, and the CEI. An initial set of critical dates will be developed by the Sumter County PM and the CEI. This initial schedule will be fine-tuned when the Contractor is selected.

5.3 Procurement Management

Florida statutes and administrative rules prescribe a formal process to follow for acquiring products or services in accordance with the planned technical effort and requirements. The Sumter County ATMS projects will be let under the design-bid-build format. The procurement of the Sumter County ATMS projects can be managed by the FDOT, or Sumter County can decide to manage the procurement of the projects through the LAP. In both cases, the professional services of a consultant is acquired for the design of the project, and a contractor is acquired for the construction of the project.

5.3.1 Professional Services

The professional services of a consultant will be acquired to perform the design of the project. This can be done using the services of a consultant the County already has under contract, or the County can hire a consultant specifically for the ATMS design either through the FDOT or using the LAP process.

If the County decides to procure a design consultant through the FDOT, the information below details the process of acquiring professional services under Section (§) 287.055 of the Florida Statutes, Rule 14-75 of the Florida Administrative Code (FAC); and the FDOT's Procedure 375-030-002. There are seven steps in the process:

- Letters of response are received.
- The FDOT project manager long lists to 10 consultants.
- The selection team or committee shortlists to three consultants.
- The technical proposals are reviewed.
- The selection team ranks firms 1, 2, and 3 based on published selection criteria.
- A contract with the first ranked firm is negotiated. If no agreement is reached, negotiations with the second ranked firm begin, or the procurement is cancelled and reissued.
- A written agreement or contract is developed.

If the County decides to procure a design consultant through the LAP, the FDOT's LAP Manual defines the processes for procuring a consultant for professional services. If the estimated project construction cost exceeds $325,000, the Competitive Negotiations/Qualifications-Based Selection process as defined in Section 18.4 of the FDOT's LAP Manual is to be used for selecting the professional services contract. This process requires the professional services contract to be formally advertised with a Scope of Services defining the expected services to be performed, technical requirements for the project, and the necessary qualifications of the consultants. The steps below represent the multi-phase procurement process.

- Letters of response are received.
- The County project manager long lists to 10 consultants.
- The selection team or committee shortlists to three consultants.
- The technical proposals are reviewed.

- The selection team ranks firms 1, 2, and 3 based on published selection criteria.
- A contract with the first ranked firm is negotiated. If no agreement is reached, negotiations with the second ranked firm begin, or the procurement is cancelled and reissued.
- A written agreement or contract is developed.

Should the County choose to procure with the single step process, the first three steps above would be omitted.

If the estimated project construction cost is less than $325,000 and the total contract amount is less than $150,000, the Small Purchase or Simplified Acquisition process as defined in Section 18.5 of the FDOT's LAP Manual is to be used for selecting the professional services contract. With this process, the professional services contract is exempt from formal advertisement. Although exempt from formal advertisement, a minimum of three qualified consultants must be considered and ranked in order of qualifications. The qualified consultants are ranked by Sumter County, and negotiations begin with the most qualified consultant.

5.3.2 Construction

The Sumter County ATMS projects will either be advertised by the FDOT or by Sumter County through the LAP. In both cases, the projects will be let as pay-item based Low-Bid contracts. The Contractor will procure the ATMS equipment. All procurement will adhere to the standards and specifications set forth by the State of Florida, the FDOT, and Sumter County. All procurement will also adhere to specific project requirements defined in the project specifications. The CEI will assist Sumter County and the Contractor with procurement management.

5.4 Risk Management

Sumter County will complete and maintain a Risk Matrix similar to that shown in Appendix A. The risks to be identified are usually from the following categories:

- Cost
- Schedule
- Technical
- Operational
- Organizational

The Design Consultant will be responsible for managing all project risks during the design phases, and the Contractor will be responsible for managing all project risks during the construction phases of the Sumter County ATMS projects. All risks identified as post-construction will be managed by Sumter County. The Risk Matrix will be reviewed periodically, but at a minimum after major reviews of the Sumter County ATMS projects. A Risk Assessment table, as provided in Appendix B, will provide guidance to determining the risk level for each identified risk.

5.5 Subcontractor Management

During design, the Design Consultant is consisted the "Prime" of the project. The Design Consultant may hire or team up with subconsultants. In this scenario, the prime is directly responsible for managing all subconsultants.

During construction, the Contractor is considered the "Prime" of the project. The prime contractor may hire or team up with subcontractors. In such cases, the prime is directly responsible for managing all subcontractors. The Contractor shall provide a subcontractor management plan for Sumter County's review and approval.

5.6 Engineering Specialty Integration

The design, development, and production of a system requires integration across all engineering and programmatic disciplines. This section addresses the integration of specialty engineering disciplines with other disciplines.

Attainable supportability characteristics are defined throughout the design process using design trade-off efforts involving all product design and support disciplines. To achieve the necessary balance of specialty engineering factors within the SEP, System Engineering must define trade-off and decision criteria that adequately address support requirements.

Specialty engineers draw upon an extensive background of data extracted from past and current projects to develop standards, guidelines, and a checklist to support and evaluate the development of the system. These specialists use System Engineering to define and document requirements and work with the functional engineering groups to ensure the necessary supportability features are incorporated into the design.

Specialty engineers generally are brought into the design process at a very early stage, but may be employed as needed to resolve issues. These requirements are then placed into the specifications. These requirements are both quantitative and qualitative. Specialty engineers also review and analyze the evolving design and ensure the incorporation of necessary features such as redundancy, accessibility, etc.

As the system design progresses from requirements interpretation to detailed plans, the involvement and participation of the engineering specialty areas increase. The specialty engineers verify compliance with all specialty area requirements and review data produced throughout the design process. Deficiencies are documented in action items and followed up to assure resolution. The applicable specialty engineers review all plan changes.

Specialty engineers may form a part of the design team. Specialty engineering may be used by Sumter County, the Design Consultant, and the Contractor as needed at various stages of the process.

5.7 Monthly Project Status Reviews

Sumter County will have periodic meetings with the CEI, the Design Consultant, the Contractor, and other agencies as required for the resolution of design and/or construction issues. These meetings may include:

- Action item reviews
- Critical path item status review
- Risk items
- FDOT and Sumter County technical issue resolution
- Permit agency coordination
- Scoping meetings
- Pre-construction meetings
- Utility coordination
- Progress meetings

During design, the Design Consultant will be responsible for providing the project schedule as requested by Sumter County. The Design Consultant will prepare progress reports providing updates to each task. The progress reports will be submitted with the monthly invoicing.

During construction, the CEI, or the Contractor will, on a monthly basis, provide an updated project schedule and written progress reports that describe the action items and the work performed on each task.

5.8 Change Management

Changes may include hardware, maintenance procedures, processes, operations, documentation, computer software, and inventory limits, as well as temporary modifications. The objective of change control management is to maintain consistency and traceability of the design requirements, physical configuration, and changes made to documentation. The following procedure should be followed:

- The impact of a change, if approved or disapproved, should be evaluated and documented.
- A recommendation of how the change should be considered should be provided.
- A recommendation of how the change will be implemented and verified should be provided.
- Any procedures, documentation, and instructions required for incorporating the approved change in the product, as well as its related product configuration information, should be identified.
- Change incorporation and continued consistency with product configuration information that needs to be updated as a result of the change should be verified and a schedule for completion and verification should be proposed.
- Approvals and variances from the baseline product requirements should be identified and documented when implemented.

- All change processing, including decisions, must be documented.
- Documentation of how the requested change will affect the critical path of the project should be provided.
- Notification of change approval or disapproval should be published and provided to all affected parties.

The change management process is illustrated in Figure 2.

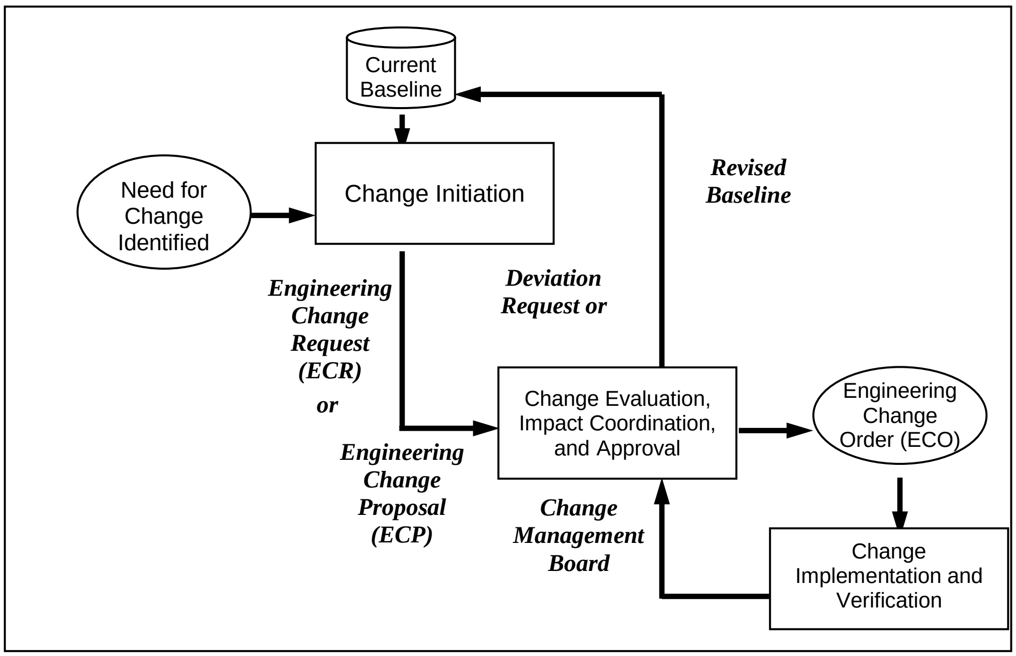


Figure 2 – Change Management Process

5.9 Quality Management

5.9.1 Design

The Design Consultant will be responsible for the professional quality, technical accuracy, and coordination of all surveys, design, drawings, specifications, geotechnical, and other design-related services furnished under the projects.

The Design Consultant will follow the QC procedures defined by their firm to verify and review all design drawings, specifications, and other documentation prepared as part of the projects.

5.9.2 Construction

The Contractor will be responsible for developing and maintaining a Construction QC Plan, which describes their QC procedures to verify, check, and maintain control of key construction processes and materials.

The CEI will be responsible for inspection and submittals review to ensure that the Contractor delivers a fully operational system.

5.10 Systems Acceptance

Upon completion of the testing, Sumter County and the CEI will make a final inspection. If all construction, integration, and all other aspects of the Plans, the device requirements, and the RTVM are found complete and acceptable, the CEI and Sumter County will declare this project complete and inform the Contractor in writing of the final acceptance as of the date of final inspection.

All "As-Built" documents will be produced electronically using MicroStation software by the CEI and submitted to Sumter County as a condition precedent to issuance of written notice of Final Acceptance. As-Built Plans will provide Global Positioning System (GPS) locations of all ITS infrastructure, field elements, pull boxes, and splice boxes. Accuracy requirements for GPS locations shall be sub-foot accuracy in accordance with ITS – Facility Management Tool (ITSFM) data entry requirements, survey accuracy for ADMS vertical dimensions, and GPS in degree-decimal format in accordance with ITSFM data entry requirements. In addition, prior to Final Acceptance, the Contractor shall submit completed ITSFM data entry forms for all new, and remaining ATMS field elements, fiber optic infrastructure, electrical service infrastructure, and network equipment.

Sumter County and the CEI will perform the final inspection of the entire ATMS in the presence of the Contractor's representative. If, during the final inspection, the CEI or Sumter County deems any work unsatisfactory or not conforming to the Plans, specifications, the device requirements, or the RTVM, the CEI will notify the Contractor in writing of the deficiencies. The Contractor will correct these conditions within five working days, unless additional time is granted in writing by the CEI or Sumter County. Upon completion of the Contractor's corrections, the CEI and Sumter County will conduct another final inspection. When the final inspection is approved by the CEI and Sumter County, the CEI or Sumter County will send written notice to the Contractor of the final acceptance of the project.

5.11 Operations and Maintenance, Upgrade, and Retirement

Once a system has been through the acceptance testing process and has been accepted, it moves into the O&M phase. In this phase, system problems could be resolved in one of many ways. A Sumter County employee trained on the system could repair it. Another way is the manufacturer's warranty could be used to get it fixed, but this only applies if the warranty is still valid. Also, Sumter County could contract with an outside agency to maintain the system, similar to the existing contract with Control Specialists. In any case, Sumter County should develop an O&M plan to spell out the details of how the system will be maintained, operated, upgraded, and retired.

5.12 Lessons Learned

In every project, there are lessons to be learned. The County and all who represent the County should document the lessons learned for future guidance. Sometimes, it is feasible to have lessons learned from the project applied to the same project, but usually lessons learned during a project will be valuable guidance for future projects.

DOCUMENT REVISION HISTORY			
Version Number	**Approved Date**	**Description of Change(s)**	**Created/ Modified By**

Appendix A

Sample Risk Matrix

Risk Matrix									
Category ID	**Identified Risks**	**Analysis & Evaluation**					**Existing controls described & evaluated**		**Further Actions**
The area or resource in which the threat affects	**Risk Statement** (e.g. description of each specific risk scenario with regard to people, information, physical assets, finances, reputation, and any other"things you value")	**Likelihood** (1, 2, 3, 4, or 5 -see Sheet 26)	**Severity** (1, 2, 3, 4 or 5 -see Sheet 26)	**Risk Value** (1 -25 -see Sheet 26)	**Risk level** (L, M, H or E -see Sheet 26)	**Accept Risk** (Yes or No)	**What we are doing now to manage or mitgate this risk.**	**Assigned To**	**Further Action Needed & Opportunities for Improvement - Include milestone(s) & target date(s)**
Design									
Construction									
Project Schedule									

Appendix B

Risk Assessment Table

Risk Assessment

Determining the Level of Risk

This chart is used to identify the level of risk and help to prioritize any interventions or control measures.

Step 1. Determine your "risk appetite" – establish your areas of consideration ("things you value") & your "acceptability" thresholds.

Consider the consequences and likelihood for each of the identified risks and use the matrix below to establish a risk level.

	----------------Severity----------------->		
Staff	Minor injury or first aid treatment	Injury requiring treatment by medical practitioner and/or lost time from workplace.	Major injury / hospitalization or some staff unable to fulfill duties
Contractual	Some system requirements not being met	Serveral system requirements not being met	Inability of the system to meet primary functional requirements
Project Cost	Cost overrung offset by underruns	Cost overruns slightly overbudget	Cost overruns significantly over budget
Project Schedule	Intermediate milestones not met, jepordizing major milestones	Major milestons not being met	Late system delivery, possible LD's
Technical Performance	Minor degradation of system performance	Negative impact to features important to the client	System performance unacceptable to the client
	1	2	3

Likelihood	Chance	Frequency	Probability			Minor	Moderate	Major
^	Is expected to occur in most circumstances	Has occurred very often on similar projects or circumstances are such that it will almost certainly happen during this project	>95%	5	Almost Certain	5	10	15
	Will probably occur in most circumstances	Has occurred often on similar projects or cumstances are such that it is likely to happen in during this project	>65%	4	Likely	4	8	12
	Could occur at some time and has happened to similar organizations	Has occurred before on similar projects or is considered to have a reasonable likelihood of occurring during this project	>35%	3	Possible	3	6	9
	Heard of it in the Industry but Rare	Has occurred before in 1 out of 10 projects similar to this project but unlikely to occur during this project	<35%	2	Unlikely	2	4	6
	Never heard of this happening in our industry but its possible (Very Rare)	Has occurred before in 1 out of 100 projects similar to this project but mostly likely will not occur during this project	<5%	1	Rare	1	2	3

High (H)	Acceptable Risk with Mitgation steps in place, recovery steps may need to be put in place.
Medium (M)	Acceptable Risk with Mitgation steps in place, no recovery steps needed.
Low (L)	Acceptable Risk, monitor and control as required, no mitigation necessary.

Note: circumstances are such = little to no currently mitigation in place.

Sumter County Advanced Traffic Management System (ATMS) Master Plan

Concept of Operations (ConOps)

Transportation Systems Management & Operations

Managing and Operating for an Efficient Transportation System

Concept of Operations for: *Sumter County ATMS*

Version: ***1.0***

Approval date:

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Approved By:		

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List of Acronyms and Abbreviations

ADMS .... Arterial Dynamic Message Sign
APL .... Approved Product List
ATCS .... Adaptive Traffic Control System
ATMS .... Advanced Traffic Management System
CCTV .... Closed Circuit Television
ConOps .... Concept of Operations
DMS .... Dynamic Message Sign
FDOT .... Florida Department of Transportation
FHWA .... Federal Highway Administration
FMS .... Freeway Management System
ITS .... Intelligent Transportation Systems
NITSA .... National ITS Architecture
NTCIP .... National Transportation Communications for ITS Protocol
RTMC .... Regional Traffic Management Center
SEMP .... Systems Engineering Management Plan
TERL .... Traffic Engineering Research Lab
TOD .... Time-of-Day
TMC .... Traffic Management Center

1. Overview

The first section of the Concept of Operations (ConOps) document provides four elements: system identification, an overview of the document, a high-level overview of the proposed system, and a brief description of the scope of effort required to take the system from the current state to the final future state of deployment that will be achieved at the conclusion of the proposed deployment. These elements are described in the following sections.

1.1 Identification

The ConOps was prepared for the deployment of the Sumter County Advanced Traffic Management System (ATMS). The Sumter County ATMS includes the deployment of a communications network, traffic signal devices, intelligent transportation system (ITS) devices, and a new Traffic Management Center (TMC).

1.2 Document Overview

The purpose of this document is to provide the project stakeholders with the operational concept for the Sumter County ATMS. This document will communicate Sumter County's operational needs and present an understanding of the operational expectations. This document follows the ConOps template established in the Florida Statewide Systems Engineering Management Plan (SEMP) dated November 2015. The document structure includes:

- Section 1: Overview
- Section 2: Referenced Documentation
- Section 3: Current System Situation
- Section 4: Justification and Nature of the Changes
- Section 5: Concepts for the Proposed System
- Section 6: Operational Scenarios
- Section 7: Summary of Impacts
- Section 8: Analysis of the Proposed System

1.3 System Overview

Sumter County has the goal of providing a fully integrated ATMS to monitor and control traffic flows, detect incidents, and inform motorists of roadway conditions. The Sumter County ATMS project includes the appropriate use of devices along State and County roadways to accomplish the goal. The Sumter County ATMS Master Plan includes documentation of the existing conditions, analysis of available technology, recommendations for the ultimate system in Sumter County, and the implementation plan for the deployment of the system. The main user and maintainer of the Sumter County ATMS will be the Sumter County Public Works Division, although Sumter County will, at least initially, contract out the maintenance of the system. The TMC will operate the Sumter County ATMS, and the TMC will be located at the Sumter County Public Works Division in Bushnell. A high-level overview of the system can be found in Figure 1 and a summary of the ATMS features can be found in Table 1.

Figure 1: High-Level System Overview

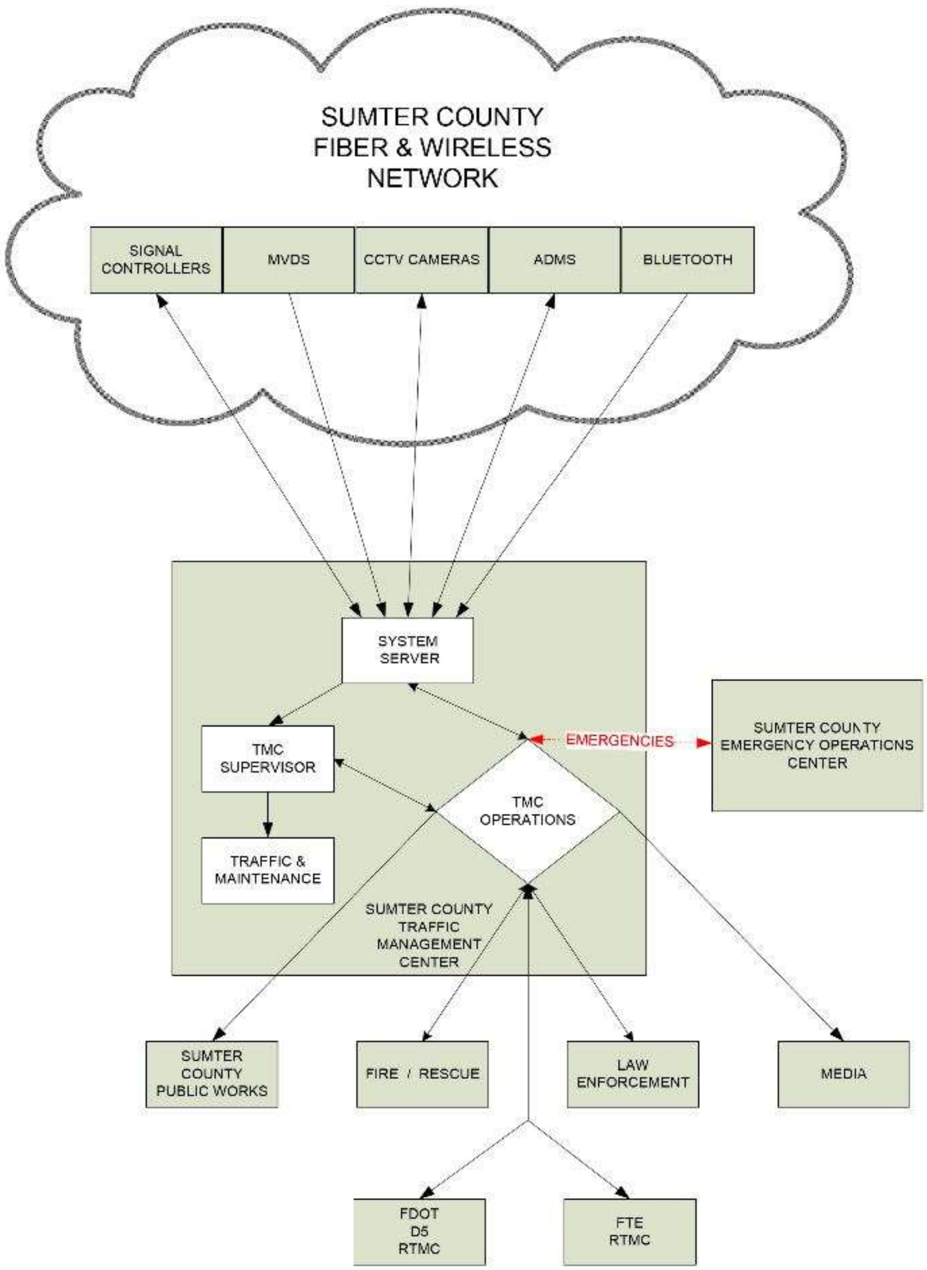

Table 1: Summary of ATMS Features

Feature/Function	Description of Feature/Function	Status
Organize existing signals into an ATMS	Installation of new cabinets, controllers, and software	Planned
Adaptive Signal Control	Hardware and Software for Adaptive Control of signals	Planned
Traffic Monitoring	Use of Closed Circuit Television (CCTV) cameras to monitor traffic conditions	Planned
Detection System	Vehicle detection to monitor traffic for improving efficiency	Planned
Communications Media	Transmit data and video between the TMC and the field devices using fiber optic cable and wireless technology	Planned
Center-to-Center Communications	Communicate with other regional Centers	Planned
Traffic Management Center	Implementation of a new TMC	Planned
Arterial Dynamic Message Signs	Use of signs to provide real-time traveler information to the County's motorists	Planned

2. Referenced Documentation

The following documents are referenced within this document.

Document	Date	Contact
Sumter County ATMS Master Plan	January 2017	Sumter County Public Works Division
Sumter County ATMS SEMP	November 2016	Sumter County Public Works Division

3. Current System Situation

3.1 Background, Objectives, and Scope

There are two major limited-access facilities within the Sumter County limits, I-75 and the Florida's Turnpike. When incidents occur on these facilities, traffic along the County's adjacent full-access facilities become over-saturated with the diverted motorists. With the traffic signals running time-of-day (TOD) plans, the signals cannot adapt to the changing roadway conditions. Sumter County currently does not have an ATMS in place to monitor and control traffic flows, detect incidents, and inform motorists of roadway conditions. Also, the geography of Sumter County is unique in that it is elongated north to south with the northern portion of the county being more developed, and the southern portion of the county being rural. This creates unique requirements for the handling of traffic flows and the maintaining of the traffic signal system.

The objective for the Sumter County ATMS is to provide a means to monitor and control traffic flows, detect incidents, and inform motorists of roadway conditions. The area of focus for the initial implementation of the ATMS will be the County Road 466 corridor, and the County Road 466A corridor, as well as the signalized intersections for the on- and off-ramps at the I-75 interchanges. Additional ATMS elements will be included based upon the most cost-effective improvements that can be achieved with the available project funding.

3.2 Operational Constraints

Currently, Sumter County has no means of monitoring and managing traffic congestion. Implementing an ATMS will provide the County with the means for monitoring and managing traffic congestion for years to come.

3.3 Description of the Current System or Situation

There are two major limited-access facilities within the Sumter County limits, I-75 and the Florida's Turnpike. When incidents occur on these facilities, traffic along the County's adjacent full-access facilities become over-saturated with the diverted motorists. With the traffic signals running TOD plans, the signals cannot adapt to the changing roadway conditions. Sumter County currently does not have an ATMS in place to monitor and control traffic flows, detect incidents, and inform motorists of roadway conditions.

In the northern portion of Sumter County, The Villages is a rapidly growing area. The inflow of new residents and seasonal residents creates a strain on the existing roadway network year-round.

The southern portion of Sumter County is rural, and there are few traffic signals. The long travel distances to these intersections creates slower response times for maintenance personnel to respond to a signal that is in flash or investigate citizen complaints such as a signal skipping over certain movements.

4. Justification and Nature of the Changes

4.1 Justification for Changes

The deployment of an ATMS will enable Sumter County to implement diversion timing plans when incidents on I-75 or the Florida's Turnpike occur. The ATMS will provide cost-effective support by utilizing devices that provide data flows to and from the TMC. By deploying the appropriate ATMS devices on State and County-maintained roadways adjacent to I-75 and the Florida's Turnpike, the County will be able to complement the FDOT's freeway management system (FMS) capabilities for the management of traffic diversions in an efficient and seamless system.

The deployment of an ATMS will help mitigate the traffic congestion problems in the northern portion of Sumter County. The deployment of an ATMS will include CCTV cameras, as well as traffic responsive and, ultimately, traffic adaptive systems. The CCTV cameras will provide the

TMC operator with images of the current traffic conditions, allowing them to make decisions based on real-time conditions. The traffic responsive and traffic adaptive systems will assist the operator in the management of the traffic congestion, particularly if the congestion is due to non-reoccurring traffic volumes. Ultimately, ADMSs will be installed to allow the County to provide real-time travel information to their motorists.

For the southern portion of Sumter County, an ATMS will assist the County in verifying citizen complaints. The operator in the TMC will be able to use CCTV cameras to monitor the signal operation and verify the citizen's complaint prior to sending out maintenance personnel. Should a signal be "kicked" into flash operation, a quick response by maintenance personnel is critical for bringing the signal back into normal operation. As a part of the ATMS, the central control software will monitor the traffic signal controllers' statuses, thus alerting the County of the signals being in flash operation and alerting the nearest maintenance personnel for response.

4.2 Description of the Desired Changes

The traffic signal controllers and intersection detection will be upgraded to bring the traffic signals up to Sumter County's current standards. These new traffic signal devices will be integrated into the new central control software procured by the County. The central control software will greatly increase the control capabilities of the traffic signals. CCTV cameras and ADMSs will be deployed and integrated into the new central control software.

To integrate the new ATMS devices into the new central control software, a communications network will be deployed using a combination of leased fiber optic cable, user-owned fiber optic cable, and wireless communications. The initial deployment of the communications network will focus on providing the ATMS devices along the County Road 466 corridor, and the County Road 466A corridor, as well as the signalized intersections for the on- and off-ramps at the I-75 interchanges with communications, and the ultimate deployment will focus on providing network redundancy and future network capacity.

4.3 Change Priorities

The highest priority of the Sumter County ATMS is upgrading of the traffic signal controllers and the deployment of the communications network along the County Road 466 corridor, and the County Road 466A corridor, as well as the signalized intersections for the on- and off-ramps at the I-75 interchanges. This will provide Sumter County with access and control to the traffic signal controllers. The next highest priority is the installation and integration of CCTV cameras. This will provide the County with the ability to observe real-time traffic conditions and adjust the signal timings accordingly.

4.4 Changes Considered but Not Included

The intent of the Sumter County ATMS is to optimize the movement of people and goods throughout the County on arterial and interstate roadways. As such, there are many enhancements that could be made in an effort to make the system as technologically advanced and robust as possible. The proposed ATMS implementation, technologies, and methodologies have been developed with the understanding that funding for the deployment and operations and maintenance of the system is limited and, as such, must make the best use of the funds available. As a result, anything thought to be excessive in cost or requiring excessive maintenance has been excluded from consideration.

4.5 Assumptions and Constraints

It is assumed that all devices and central control software to be installed will comply with the National Transportation Communications for ITS Protocol (NTCIP) requirements and the devices will be compatible with the central control software. All applicable devices will be listed on the FDOT Statewide Approved Products List (APL), which will ensure they have been tested by the FDOT Traffic Engineering Research Lab (TERL) and certified to meet FDOT Standards.

5. Concepts for the Proposed System

5.1 Background, Objectives, and Scope

There are two major limited-access facilities within the Sumter County limits, I-75 and the Florida's Turnpike. When incidents occur on these facilities, traffic along the County's adjacent full-access facilities become over-saturated with the diverted motorists. With the traffic signals running TOD plans, the signals cannot adapt to the changing roadway conditions. Sumter County currently does not have an ATMS in place to monitor and control traffic flows, detect incidents, and inform motorists of roadway conditions. Also, the geography of Sumter County is unique in that it is elongated north to south with the northern portion of the county being more developed, and the southern portion of the county being rural. This creates unique requirements for the handling of traffic flows and the maintaining of the traffic signal system.

The objective for the Sumter County ATMS is to provide a means to monitor and control traffic flows, detect incidents, and inform motorists of roadway conditions. The area of focus for the initial implementation of the ATMS will be the County Road 466 corridor, and the County Road 466A corridor, as well as the signalized intersections for the on- and off-ramps at the I-75 interchanges. Additional ATMS elements will be included based upon the most cost-effective improvements that can be achieved with the available project funding.

5.2 Operational Policies and Constraints

The Sumter County ATMS will have various operational policies and constraints. In order to provide coverage of both the AM and the PM peak periods, the Sumter County TMC will be in operation Monday through Friday, from 7:00 AM to 6:00 PM. These hours will be split among multiple staff, one covering the early period and one covering the late period. Observation of the system will not have to be continuous, but someone will always be responsible. The TMC could be in operation for additional hours during special events, major incidents, or severe weather.

Sumter County has expressed the desire to utilize part-time operators. Shifts for the part-time operators could be staggered to cover both times of peak traffic and special events. One person would work the morning shift and the other would work the afternoon shift. Their duties would be to monitor and adjust approved signal timings, and report and respond to any issues that arise during their shift. All signal timings implemented must be approved by a registered professional engineer. The operators can be existing staff that already have other duties. They would monitor the system as other duties allow, but it should be on a regular basis.

The Sumter County TMC will be constructed within the existing Sumter County Public Works building. As the ATMS grows over time, this facility could create space constraints for proper operation and housing of equipment. However, this is not anticipated to occur in the near future.

5.3 Description of the Proposed System

ATMS devices throughout Sumter County will provide traffic signal control capabilities, traffic monitoring capabilities, traffic incident management capabilities, and enable the dissemination of traffic information. The proposed locations of each of the ATMS devices can be found in the Sumter County ATMS Master Plan. As the ATMS is deployed, the locations of the ATMS devices may change due to stakeholder involvement, budget availability, and design constraints. The ATMS devices will connect to the communications network either wirelessly or via fiber optic network.

5.3.1 Traffic Signals

The traffic signal hardware for all 49 County-maintained traffic signals will be upgraded as necessary to enable communications between the traffic signal hardware and the Sumter County ATMS central control software. This upgrade will include replacing the traffic signal controllers. The traffic signal hardware will communicate either wirelessly or via fiber optic network. The County's preferred technology for intersection detection is video detection, and those intersections that do not currently have video detection will be upgraded. For the intersections that may not operate efficiently with video detection, microwave vehicle detectors and infrared detectors will be used in place of video detection. This could be due to intersections having non-favorable configurations, adverse weather conditions, or sun glare. To enhance the security of the ATMS network, additional security will be utilized for accessing the traffic signal cabinets. The additional security will be in a form greater than a number two key, because the number two key has been the standard key cut for many years. This has resulted in the number two key being commonly possessed and easily obtained. A special cut key for their traffic signal cabinets will be the best method for providing additional security for the ATMS network.

5.3.2 Closed-Circuit Television Cameras

Ultimately, CCTV cameras will be deployed throughout the County to provide traffic monitoring capabilities from the Sumter County TMC. Sumter County will be the only entity to control the CCTV cameras, but the video streams will be shared with the FDOT District 5 Regional Traffic Management Center (RTMC). The CCTV cameras will be able to pan, tilt, and zoom (PTZ) to allow operators to observe traffic patterns, verify incidents, adjust traffic signal timings, and verify the operation of other ATMS devices. While the CCTV cameras will not provide entire coverage of the roadway network, they will provide coverage of major intersections, large stretches of major corridors, and areas known to be prone to congestion or other problems.

5.3.3 Adaptive Traffic Control Systems

As part of the ATMS, selected corridors may be upgraded to use an adaptive traffic control system (ATCS). The various ATCSs collect traffic and pedestrian data from vehicle detection devices and utilize it in real-time to configure the timing of the intersection. The ATCS will adjust the signal timings and offsets to optimize traffic in all directions during normal traffic conditions and congested traffic conditions.

5.3.4 Arterial Dynamic Message Signs

In later phases, the Sumter County ATMS will include the deployment of Arterial Dynamic Message Signs (ADMSs) along arterials. These signs will provide information on the status of I-75, the Florida's Turnpike, and major corridors so travelers can make informed decisions before entering the roadway. These signs can also be used to provide travel information and alerts (America's Missing: Broadcast Emergency Response [AMBER], Silver, etc.) to the public. The FDOT currently owns and controls full-size dynamic message signs (DMSs) on I-75, while the Florida's Turnpike Enterprise owns and controls the full-size DMSs on the Florida's Turnpike. The recommended locations for the ADMSs can be found in the Sumter County ATMS Master Plan.

5.4 Modes of Operation

The standard operation for the Sumter County TMC will be Monday through Friday, from 7:00 AM to 6:00 PM. There will be no full-time staff operating the ATMS from the TMC, and shifts for the part-time operators could be staggered to cover both times of peak traffic and special events. One person would work the morning shift and another would work the afternoon shift.

5.5 User Involvement and Interaction

The operations of the Sumter County ATMS will be the responsibility of Sumter County personnel, and will take place from the proposed TMC located in Bushnell. Once a connection is made with the FDOT, the District 5 RTMC operators will have the ability to view the video feeds from the ATMS's CCTV cameras. For events that affect both limited-access facilities and full-access facilities, the Manager at the Sumter County TMC will be able to communicate with the Manager at the District 5 RTMC. This communication will ensure the proper actions are being taken for managing the event.

The Sumter County TMC operators will be responsible for making any signal timing modifications with the use of pre-approved signal timing plans.

5.6 Support Environment

The maintenance of the ATMS equipment, with the exception of the network equipment, will be contracted out to a maintenance contractor. The maintenance contractor will be responsible for the preventative maintenance as well as the on-call service for repairs. The network equipment will be maintained by the County's IT contractor. The IT contractor will be responsible for the preventative maintenance as well as the on-call service for repairs. The support of the TMC facilities will be performed by the County personnel currently supporting the Sumter County Public Works building.

6. Operational Scenarios

The day-to-day operations and maintenance of the Sumter County ATMS will include numerous operational scenarios that involve utilizing the ATMS. The following is a brief description for each scenario, and how the ultimate Sumter County ATMS may be utilized for each scenario.

6.1 Normal Operations

During normal operations, traffic will be free flow. All cameras will show free-flowing traffic images, the travel time system will not detect any congestion or decreased travel times, and the adaptive timing signal system will maintain its current signaling configuration. There will be no actions required by the operator other than to remain attentive to alerts that could be produced by the system signaling maintenance issues or potential changes in traffic.

6.2 Peak Congestion Operations

During peak congestion operations, traffic will reflect congested conditions. The travel time system will detect the increased traffic travel times, the CCTV camera images will verify the congestion along the impacted corridors, the ATCS will detect increased traffic volumes and adjust the signal timing based on the ATCS in operation. The operator will adjust the signal timing for the intersections without an ATCS. The operator will monitor the camera images, ensure traffic is flowing consistently, and there are no incidents present. If there is an incident present or an obstruction of traffic, for example a disabled vehicle, the operator will need to dispatch the proper personnel and post the incident information on an ADMS upstream of the incident to alert motorists to the situation.

6.3 Incident and Event Operations

During normal or peak congestion operations, an incident can occur causing major delays on roadways. If an incident occurs or there is a local event being held, one or more travel lanes may be impacted and onlookers will slow down to view the incident. This results in traffic slow-downs and congestion in the area of the incident. Camera images will show congested areas at the incident site and areas surrounding the incident. The travel time system will detect increased travel times, the ATMS and adaptive control signal systems will detect increased traffic volumes and the signal timings will be adjusted by operators or automatically depending on the instrumentation. The operator will need to post incident/event information on ADMSs upstream to alert motorists to the situation. The operator will be required to view camera images and potentially take over signal control if there is an intersection blocked. There may also be instances where the operator will need to work with FDOT District 5 RTMC operators under incident conditions, Amber/Silver Alerts, hurricane evacuations, as well as coordinating route plans for major events.

6.4 Maintenance Operations

At the beginning of every shift, the operator should verify that each device has connectivity and optimal uptime. If a device is polled and determined to not be working properly, the operator should contact the proper maintenance personnel and dispatch them to the site for repair. The maintenance worker should coordinate with the operator when the repairs have been made to confirm the device is online and fully functional. Repairs should be performed as soon as possible to ensure the highest percentage of availability for system devices, infrastructure, and components. Delays in repair can result in operators not having the capabilities they need during incidents, events, and/or emergencies.

7. Summary of Impacts

Maintenance of traffic, such as lane closures, during construction of the Sumter County ATMS projects could create temporary impacts on the traveling public. However, once the construction of the ATMS is completed, the traveling public will have an improved roadway network with a more consistent commuting environment.

As the construction of the initial phase of the ATMS is coming to a close and the training on the ATMS for the operators is commencing, norming traffic operations could see an impact due to the learning curve of the central control software. Once the training has been completed for all users, the benefits of the ATMS will be realized as the traffic operations improves.

8. Analysis of the Proposed System

An analysis of the TMC and the selected ATMS elements related to this project was performed as part of the Sumter County ATMS Master Plan. This analysis included the benefits, limitations, advantages, disadvantages, alternatives, and trade-offs of the ATMS elements included in this project.

9. Notes

There are no notes at this time.

10. Appendices

There are no appendices at this time.

11. Glossary

Advanced Traffic Management System (ATMS) – A system comprised of communications media, devices, and components which work together to allow operations personnel to monitor and manage traffic along corridors or throughout regions. ATMS normally refers to a system deployed on arterial roadways rather than a Freeway Management System, which is deployed on limited access facilities.

Concept of Operations – The stakeholders' vision of how the system will operate in actual practice (standard operating procedure). The concept of operation is a document that defines, in sequence, how the subsystems and institutions will operate with each other for each incident or situation. It identifies and defines the roles and responsibilities of the systems and subsystems of each agency, and the physical environment. It is very useful as a starting point for the development of an ITS project. The concept of operations is frequently drawn up as a flow diagram.

Federal Highway Administration (FHWA) – An agency of the USDOT that funds and regulates highway projects.

Intelligent Transportation System (ITS) – Electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a transportation system.

ITS Architecture – Defines how systems functionally operate and the interconnection of information exchanges that must take place between these systems to accomplish transportation services.

National ITS Architecture (NITSA) – A common established national framework for ITS interconnectivity and interoperability.

Stakeholders – Anyone with a vested interest or "stake" in the project or system. This includes public agencies, private organizations, special interest groups and traveling public.

SunGuide® – The software program utilized by all FDOT Districts to monitor and control their ITS devices, create incident reports, view video images, and manage incidents on their system.

Traffic Management Center (TMC) – The hub where all information from an ATMS or FMS system is directed to and disseminated from. TMC Operations personnel reside in the TMC and utilize the data and video images received to monitor and manage traffic and incidents along the roadways being covered by the system.

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