**Intelligent Transportation Systems**

# Bay County Advanced Traffic Management System Phase II Project

# Concept of Operations

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**Version 2**

Prepared for:

Florida Department of Transportation
Traffic Engineering and Operations Office
Intelligent Transportation Systems (ITS) Section
605 Suwannee Street, M.S. 90
Tallahassee, Florida 32399-0450
(850) 410-5600

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| | **Name** | **Date** |
| Created By: | David Chang, PBS&J | February 7, 2005 |
| | Steve Haynie, PBS&J | |
| | Arun Krishnamurthy, PBS&J | |
| | Catherine Miller, PBS&J | |
| | | |
| Reviewed By: | Alf Badgett, PBS&J | February 15, 2005 |
| | David Chang, PBS&J | February 16, 2005 |
| | Ron Meyer, PBS&J | February 18, 2005 |
| | David Chang, PBS&J | March 18, 2005 |
| | Arun Krishnamurthy, PBS&J | March 29, 2005 |
| | David Chang, PBS&J | March 30, 2005 |
| | David Chang, PBS&J | April 18, 2005 |
| | Arun Krishnamurthy, PBS&J | |
| Modified By: | Dave Hodges, PBS&J | February 17, 2005 |
| | Pam Hoke, PBS&J | March 15, 2005 |
| | Arun Krishnamurthy, PBS&J | April 18, 2005 |
| | | |
| | | |
| | | |
| Completed By: | Pam Hoke, PBS&J | April 20, 2005 |

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# List of Acronyms

AFB ........................................ Air Force Base
AIMS ........................................ Accident Information Management Software
ATMS ........................................ Advanced Traffic Management System
B&W ........................................ Black-and-White
C2C ........................................ Center-to-Center
Caltrans ........................................ California Department of Transportation
CCTV ........................................ Closed-Circuit Television
CEI ........................................ Construction, Engineering, and Inspection
CLS ........................................ Closed-Loop System
ConOps ........................................ Concept of Operations
DMS ........................................ Dynamic Message Sign
EIA ........................................ Electronic Industries Alliance
FAA ........................................ Federal Aviation Administration
FDOT ........................................ Florida Department of Transportation
FHWA ........................................ Federal Highway Administration
FHP ........................................ Florida Highway Patrol
FOC ........................................ Fiber Optic Cable
GIS ........................................ Geographic Information System
GPS ........................................ Global Positioning System
GUI ........................................ Graphical User Interface
IP ........................................ Internet Protocol
IT ........................................ Information Technology
ITS ........................................ Intelligent Transportation Systems
MFES ........................................ Managed Field Ethernet Switch
MMU ........................................ Malfunction Management Units
MOT ........................................ Maintenance of Traffic
MS ........................................ Military Specification
MVDS ........................................ Microwave Vehicle Detection System

MVP ........ Machine Vision Processor
NEC ........ National Electrical Code
NEMA ........ National Electrical Manufacturers Association
*NITSA* ........ *National ITS Architecture*
O&M ........ Operations and Maintenance
OTDR ........ Optical Time Domain Reflector
NTCIP ........ National Transportation Communications for ITS Protocol
PC ........ Personal Computer
PTZ ........ Pan/Tilt/Zoom
PWD ........ Public Works Department
RITSA ........ Regional ITS Architecture
RTMC ........ Regional Transportation Management Center
RWIS ........ Road Weather Information System
SEMP ........ Systems Engineering Management Plan
*SITSA* ........ *Statewide ITS Architecture*
SR ........ State Road
TMC ........ Transportation Management Center
UPS ........ Uninterruptible Power Supply
U.S. ........ United States
VID ........ Video Image Detection

# 1. Introduction

Bay County's Advanced Traffic Management System (ATMS) project will utilize the latest intelligent transportation systems (ITS) technology to improve surface transportation efficiency. The project is being developed to serve the communities of Panama City, Springfield, Lynn Haven, and Cedar Grove. It includes the deployment of a fiber optic communication network and closed-circuit television (CCTV) camera system; upgrade of the existing traffic signal controllers operated by Bay County and the City of Panama City along the fiber optic cable (FOC) installation route; and construction and operation of the Bay County Transportation Management Center (TMC).

The ATMS project will be let in two phases, with Phase I consisting of the FOC infrastructure construction, and Phase II consisting of CCTV camera installations, traffic signal controller upgrades along the FOC route, construction of an interim TMC, and integration with the Hathaway Bridge ITS equipment. This project is a partnership of the Florida Department of Transportation (FDOT), Bay County Public Works Department (PWD), Bay District Schools, the City of Panama City, and the Federal Highway Administration (FHWA).

The objectives of this Concept of Operations (ConOps) are to:

- Provide an updated summary of the *Bay County Areawide Computerized Traffic Signal Feasibility Study*.[1]
- Discuss compliance of the project with the Bay County regional architecture.
- Identify the functional requirements for the TMC software.
- Provide recommendations for traffic signals and CCTV cameras based on the site visits conducted.
- Discuss the Hathaway Bridge integration issues.
- Identify the interim TMC operational and institutional issues.

[1] Traffic Engineering, Inc., *Bay County Areawide Computerized Traffic Signal Feasibility Study* (March 1998).

## *1.1 Review of the Bay County Areawide Computerized Traffic Signal Feasibility Study*

Published in 1998, the *Bay County Areawide Computerized Traffic Signal Feasibility Study* inventoried existing equipment, presented conceptual system design considerations, evaluated system alternatives, and recommended an implementation plan.

At the time of the *Feasibility Study*, the FDOT and FHWA were making an effort to update and make available modern coordination-compatible control equipment. These efforts included the installation of new controller and cabinet assemblies virtually ready for a closed-loop system (CLS), and the deployment of a system operated by the Florida Highway Patrol (FHP) on the approaches of the Hathaway Bridge to set up video surveillance cameras and variable message signs. However, as indicated in the *Feasibility Study*, there were no continuous signal timing or traffic data collection programs to maintain current timing and field operations.

At the time of the *Feasibility Study*, needs and operations were evaluated to determine and develop a recommendation for a traffic signal control system. A variety of possible technical solutions were discussed and an initial set of control section groupings was identified utilizing operational and practical criteria. Goals and objectives for the ideal traffic control system were established and defined. Design criteria were created based on a number of factors. A range of functional control system alternatives were considered, including the do-nothing alternative, the CLS alternative, and the ATMS alternative.

Preliminary cost estimates for the design and execution of the do-nothing, CLS, and ATMS alternatives were developed for cost comparisons, and were based only on the deployment of the traffic control system. A utility index was derived to evaluate how each alternative met the project goals and objectives. The result of a worth analysis indicated the CLS alternative with future ATMS upgrade capabilities was the most reasonable option for Bay County. This was considered the recommended alternative.

The study recommended a personal computer (PC)-based, distributed control CLS with a hybrid dial-up fiber optic communication distribution system, and proprietary National Electrical Manufacturers Association (NEMA)-standard architecture field control and communication devices. The NEMA-standard local and system equipment was recommended to sustain compatibility and to take full advantage of equipment installed as part of the FDOT/FHWA projects at that time. Inductive loop vehicle detection sensors at intersections would remain until a more reliable and cost-effective technology was introduced. It was recommended that subsystems and their components be developed to have a design life of at least 10 years and a minimum operating life of 15 years with the exception of the computer equipment. The system would be operated by Bay County and the City of Panama City.

In the seven years since the *Feasibility Study* was published, ITS technology has experienced rapid advancement. As a result, this ConOps document presents the history of the project and updates the recommendations.

The Bay County ATMS project involves implementing a fiber optic communication network that will support existing and future traffic signal control improvements and expansion, along with ITS deployment plans in Bay County. This project will also provide the Bay County School Board with the fiber optic backbone infrastructure necessary to provide for the impending development of a communication network that will support Bay County schools. Phase I of the project, the fiber optic infrastructure deployment, consists of "dark" fiber optic infrastructure that is unlit with no intermediate repeaters or fiber optic transmission equipment attached. The FOC that will be utilized throughout this project will be single-mode fiber and will consist of two 72-strand backbone cables that will be utilized by the Bay County PWD only.

All FOC will be installed along the routes as shown on the Bay County ATMS Phase I Fiber Optic Infrastructure Conceptual Plans. Cable will be routed along several major corridors including State Road (SR) 77 from Lynn Haven to Panama City and United States (U.S.) Highway 98/SR 30 from the Hathaway Bridge through downtown Panama City. The cable route will form rings around the project area for increased redundancy in case one section of the cable is damaged or cut. Designing, furnishing, installing, and testing for all components, including FOC, pull boxes, and conduits, is included in Phase I. This phase does not include network equipment, or the incorporation with traffic signal control or other subsystems.

*Section 2* of this document discusses the compatibility of the ATMS project with the Bay County Regional ITS Architecture (RITSA). The interim TMC and its software issues are presented in *Section 3*. *Section 4* provides an overview of the CCTV locations and issues, while the traffic signal cabinet recommendations are provided in *Section 5*. The integration of the Hathaway Bridge ITS equipment and elements of Phase II are identified in *Section 6*. The video detection system is detailed in *Section 7* and *Section 8* provides the organizational chart for the Bay County Traffic Engineering Division. The conclusion is discussed in *Section 9*.

# 2. Bay County Regional Intelligent Transportation System Architecture

The Bay County RITSA was developed in June 2001 and is documented in *Technical Memorandum No. 4 – Develop ITS Architecture*.[2] The Bay County RITSA is based on the *National ITS Architecture* (*NITSA*)[3] and the FDOT District 3 ITS architecture.

The *Statewide ITS Architecture* (*SITSA*) and District 3 ITS architecture[4] were developed for the FDOT Central Office as required by the FHWA's *Rule 940*[5] and are identified in *Florida's Intelligent Transportation System Strategic Plan Final Report*.[6] *Rule 940* requires that the regional architecture be developed and based on the *NITSA*. *Florida's Intelligent Transportation System Strategic Plan Final Report* also identifies the need to update and maintain the *SITSA* and the supporting standards. More information is also available in the *FDOT Draft Rule 940 Procedures*.[7]

The project team has reviewed the RITSA and the market packages reviewed for conformance under this project are:

- ATMS01 – Network Surveillance
- ATMS03 – Surface Street Control
- ATMS06 – Traffic Information Dissemination
- ATMS08 – Incident Management
- ATMS18 – Road Weather Information System (RWIS)

This project will also comply with the procedures in *Florida's Statewide Systems Engineering Management Plan* (*SEMP*),[8] which provides the instructions and information on technical management and program management to efficiently and effectively conduct projects.

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[2] Transportation Engineering, Inc. (TEI), Bay County Intelligent Transportation Systems Architecture, *Technical Memorandum No. 4, Task D – Develop ITS Architecture* (June 2001).

[3] United States Department of Transportation, *National ITS Architecture*, *Version 5.0*. Available online at http://www.iteris.com/itsarch.

[4] More information regarding Florida's *Statewide ITS Architecture* (*SITSA*) and the District RITSAs is available online at http://www.consystec.com/html.

[5] 23 CFR Parts 655 and 940, *Intelligent Transportation System Architecture and Standards – Final Rule* (January 2001). Available online at http://www.ops.fhwa.dot.gov/its_arch_imp/index.htm.

[6] PB Farradyne, *Intelligent Transportation System Strategic Plan – Final Report* (August 1999). Available online at http://www.dot.state.fl.us/trafficoperations/its/its_default.htm.

[7] *Florida Department of Transportation Draft Rule 940 Procedures in Florida*, *Version 1* (December 2003). FDOT Contract No. C-7772. Available online at http://floridaits.com/Rule_940_Implementation.htm.

[8] *Deliverable 1-10: Technical Memorandum – Florida's Statewide Systems Engineering Management Plan*, *Version 2* (March 2005). FDOT Contract C-7772. Available online at http://floridaits.com/System_Engineering.htm.

# 3. Bay County Transportation Management Center

## *3.1 Interim Facility*

The interim TMC will be located in the northeast corner room of the Bay County PWD building. The interim TMC will have workstations from which operators can monitor and control the CCTV cameras and signal system. The TMC will have a video wall to allow simultaneous viewing of multiple CCTVs. It will also contain the CCTV, DMS, and RWIS monitoring and control equipment from the Hathaway Bridge. In addition to the TMC room, the county traffic operations engineer's office and the room outside the interim TMC will have equipment for display of the CCTV video feeds for other personnel.

The building will require additional electrical outlets and increased electric power capacity for the TMC equipment. The electrical room is in the southeast corner of the building. PBS&J understands that Bay County is considering upgrading the power service to the building though an additional entry point. If this is the case, PBS&J recommends taking power off this alternate electrical power source for the TMC. If this is not the case, PBS&J recommends installing *National Electrical Code*® (*NEC*®)-rated[9] conduit above the false ceiling from the electrical room to the TMC. Power cables would be installed in the *NEC*-rated conduit.

The TMC room also needs more network connections. The CCTV servers, Ethernet®[10] servers, and uninterruptible power supplies (UPS) will be located in the existing server room in the building's southwest corner. The distance between the TMC and the server room is such that it will not present transmission problems for the network cables, which will also be installed in the false ceiling. The TMC will contain PCs associated with the signal system.

## *3.2 Transportation Management Center Software*

The TMC software will allow operators to control the CCTV system, provide incident management responses through DMS activation, and control traffic signals. Currently, Bay County has loop detectors, and video and microwave detection systems at intersections to detect traffic and actuate signals. The TMC software will allow the operator to monitor the current traffic conditions as displayed on the video wall. The TMC software will also be integrated with the Hathaway Bridge project's ITS components, including the DMS units, CCTV cameras, and RWIS stations.

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9 The *National Electrical Code* and *NEC* are registered trademarks of the National Fire Protection Association, Inc.

10 Ethernet is a registered trademark of Xerox Corporation in the United States and/or other countries.

### 3.2.1 Transportation Management Center Software Requirements

The following sections describe the TMC software requirements.

#### 3.2.1.1 Center-to-Field Device Control

At minimum, the TMC software must be able to control the field devices, including CCTV cameras, DMS units, RWIS units, detectors, and signal controllers.

The system operator at the TMC will have the ability to pan, tilt, and zoom the CCTV cameras, and monitor the video received. The pan-tilt-zoom (PTZ) control function will be performed using a joystick or mouse. The system will enable the operator to assign incoming full-motion color video to the intended display devices. The system will be able to communicate with cameras from various CCTV manufacturers and permit the addition of cameras from different manufacturers. The TMC software will be compatible with National Transportation Communications for ITS Protocol (NTCIP™)[11] standards specified for CCTV camera controls.

The TMC software will provide DMS control for operators to respond to incidents and provide traveler information. The sign message library will be user-selectable and user-definable for the operator. The system will be able to communicate with signs from various DMS manufacturers and permit the addition of signs from different manufacturers. The TMC software will communicate using the NTCIP standards specified for DMS via a driver library.

The TMC will be able to communicate with the RWIS that has been installed on the Hathaway Bridge.

The TMC software will support loop, radar, and video detection devices, and accept additional manufacturers' protocols.

The TMC software will provide traffic responsive algorithms to process data from the field and select signal timing patterns from a library.

#### 3.2.1.2 Reporting Feature

The TMC software will support the importing and exporting of data to and from traffic simulation/modeling software to assist in traffic operations. Data to be exchanged will include, but not be limited to, detector data.

[11] NTCIP is a trademark of the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association. More information regarding the NTCIP is available online at http://www.ntcip.org/.

#### 3.2.1.3 Base Map – Geographic Information System Map

The software will support a geographic information system (GIS) interface to allow importing and exporting of map features. The system must be compatible with the ArcView® and ArcInfo®[12] GIS software programs.

#### 3.2.1.4 Alert Feature

The TMC software will support alarm events and allow them to be prioritized by the operator as to type of alert. At a minimum, the alert types will include e-mail, pop-up, and paging.

#### 3.2.1.5 Traffic Simulation Software

The TMC software will be compatible with various traffic simulation software programs, including importing/exporting data, and will provide time-space diagrams.

#### 3.2.1.6 Database

The TMC software will support a data archiving capability to allow the retrieval and sharing of data that may be used for planning, designing, and performance measures. The data to be collected and archived will include, but not be limited to, traffic volume, speed, occupancy, and classification.

#### 3.2.1.7 Optional Requirement: Center-to-Center Communication

The TMC software will support NTCIP center-to-center (C2C) communications to exchange command/control and data between facilities. The C2C feature will permit information exchange among different control centers, including other traffic control and emergency management facilities.

#### 3.2.1.8 Optional Requirement: Integration with the SunGuide$^{SM}$ Software System

The FDOT's SunGuide$^{SM}$ Software System is being developed for use in Florida. It is primarily designed for installation in regional TMCs, or RTMCs, in order to manage freeway traffic. The issue of integration between arterial traffic management software and the SunGuide software has been discussed by some of the county agencies in Florida.[13]

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[12] ArcView and ArcInfo are registered trademarks of Environmental Systems Research Institute, Inc.

[13] SunGuide is a service mark of the Florida Department of Transportation. More information regarding the SunGuide Software System is available online at http://stmcsls.datasys.swri.edu/.

There are four general options for the integration of traffic signal control systems with SunGuide freeway management centers:

- **Option 1 – Don't modify the SunGuide software.**

  Don't modify the SunGuide software at all. Install a remote workstation for the traffic control system at the RTMC and a remote workstation with the SunGuide software at the local traffic control center.

- **Option 2 – Add a C2C interface and traffic control graphical user interface (GUI) module to the SunGuide software.**

  Add a C2C traffic signal management interface to the SunGuide software, modify the SunGuide software GUI to allow the display of traffic signal status, and permit the control of traffic signals through activation of local response plans. Local traffic control systems can be modified in a similar manner, if desired, to display freeway data and device status on the local traffic control system's GUI. Integration of the C2C module with various subsystems would allow implementation of all these capabilities.

- **Option 3 – Add full traffic signal control module to the SunGuide software.**

  Modify the SunGuide software to fully support full-featured traffic signal management, including the ability to communicate directly with traffic signals and the signal data editor, and to select the traffic responsive timing, etc. This would enable a local jurisdiction to choose the SunGuide software for arterial management, and would provide the RTMC with all the functionality needed to coordinate effectively with arterial traffic management. Integration with a C2C interface would not be necessary, since all arterial/freeway coordination would be done internally. It would also provide a local agency using this enhanced version of the SunGuide software with all the functionality needed to coordinate operations with freeway traffic management.

- **Option 4 – Interface a third-party traffic control system directly to the SunGuide software (i.e., no C2C functionality).**

  Rather than writing a new arterial traffic control module from scratch for the SunGuide software, integrate an existing arterial traffic control system into the SunGuide software architecture. The traffic control system would interface directly with the SunGuide software data bus, rather than through a C2C connection. The SunGuide software GUI would be modified to display traffic control system status, but the traffic control system's existing GUI would still be used for most traffic control-specific functions.

# 4. Closed-Circuit Television Systems

A CCTV system is an element of an ATMS that allows the detection and monitoring of traffic incidents. This system also provides a means to monitor traffic conditions and events. With this surveillance, when an incident occurs, a quick assessment and appropriate response can be made so that the incident has a minimum effect on traffic flow. The main purpose behind implementing the CCTV system is to maximize the efficiency of existing roadways.

A CCTV system field installation will include a camera contained in a weatherproof enclosure, a positioning device for PTZ functions, a camera pole with cabinet, and cable to transfer the video from the CCTV cabinet to the FOC backbone. A lowering device may be used so a field technician would have the ability to unlatch the camera assembly from its mount at the top of the pole and lower the camera for maintenance without the need to use a bucket truck.

Other components at the site would include a managed field Ethernet switch (MFES) and digital video encoder, along with power supplies and transient surge suppression devices to protect the equipment. At the TMC, a digital video decoder would convert the incoming data stream into analog video for display on workstation monitors and the video wall.

The effectiveness of the CCTV system depends on the design and installation of the camera and pole. The design needs to identify the appropriate location and height of the camera pole so the camera will be able to clearly view the traffic on the main street and the cross street. It is also important to ensure that a high-performance camera is used to obtain the maximum benefit from the installed ATMS.

*Section 4.1* discusses the camera requirements, while the camera pole and pole height are described in *Section 4.2*. The CCTV cabinet issues are discussed in *Section 4.3*, and *Section 4.4* provides an overview of the CCTV locations.

## *4.1 Closed-Circuit Television Camera Requirements*

Choosing the right CCTV camera will depend on the configuration of the image sensor, lens, and positioner specified. Even though this issue will be more aptly addressed in the Bay County ATMS Phase II project's technical specifications package, this ConOps identifies basic camera configuration concepts for the Bay County Traffic Engineering Division to consider.

To achieve the maximum benefit from the CCTV system, it is important to have a high-resolution camera with PTZ capabilities. PBS&J recommends the use of a nitrogen-pressurized, dome type camera with 360-degree continuous pan and 90-degree tilt positioner capabilities. The camera must provide both color and black-and-white (B&W) images with automatic switchover from color to B&W under low light conditions. Some of the other standard camera features will include auto focus and auto iris. The camera should be Internet Protocol (IP)-addressable and the CCTV system should be NTCIP compliant.

## 4.2 Pole Material and Pole Height Issues

Unless otherwise stated, PBS&J recommends the use of a pole that is 35 to 40 feet in height so the camera can obtain a better view of the main street and cross street at the intersection. An exception will be the intersection of St. Andrews Road and Baldwin Road, which is close to the airport. Federal Aviation Administration (FAA) regulations will limit the pole height that can be used at this location. PBS&J project staff will determine the height of this camera pole after conducting further research on the FAA regulations and restrictions.

The pole material to be used could be either steel or spun concrete. PBS&J and the Bay County Traffic Engineering Division will further discuss this issue to decide on the pole material to be used for the project.

The Bay County Traffic Engineering Division and PBS&J also will discuss the need for camera lowering devices for some or all CCTV locations. These lowering devices allow individual pole-mounted cameras to be unlatched from the top of the pole and lowered to ground level. Steel cables are used to lower the cameras and their housings. Lowering devices allow safe and easy installation, maintenance, and replacement of components at ground level, tasks which would otherwise be completed using a bucket truck. Using a lowering device also eliminates problems that may arise when using a bucket truck, such as ITS design constraints and maintenance of traffic (MOT) issues. The lowering devices can help reduce the cost of maintenance and would not require MOT. Even though the initial cost of these devices is high, an FDOT study[14] in 2003 showed that the long-term maintenance cost for CCTV systems with lowering devices is lower than systems maintained using bucket trucks.

[14] *White Paper – Design Criteria: Pole Heights and Locations for Video Surveillance Systems* (November 2003). FDOT Contract No. C-7772. Available online at http://floridaits.com/Standards.htm.

## *4.3 Closed-Circuit Television Cabinet Installation*

The PBS&J project team conducted site visits to identify the locations that require the installation of new CCTV control cabinets. Some locations may not require new cabinets, but could use existing traffic signal cabinets if the existing units are close enough to the CCTV pole and if the traffic signal cabinet has been designed to accommodate the ITS equipment that must be placed inside.

Six CCTV locations were originally short-listed for possible collocation of traffic signal equipment and CCTV equipment. These locations had the proposed CCTV location and the traffic signal cabinet on the same side of the intersection and close to each other. These six locations are:

1) State Road 77 and U.S. Highway 98 Business
2) United States Highway 98 and 23rd Street
3) Frankford and 23rd Street;
4) State Road 389 and U.S. Highway 231
5) 11th Street and East Avenue
6) 11th Street and Harrison Avenue

Of these six locations, 11th Street and East Avenue (No. 5) is the only intersection recommended for a new traffic signal cabinet. This cabinet needs to be designed for housing both CCTV and traffic signal equipment.

Four locations (Nos. 1 through 4) were not selected for collocation of CCTV and traffic signal equipment because the cabinets there lacked sufficient room to accommodate the Ethernet (edge) switch, digital video encoder, and color monitor with the power and data cabling for the equipment.

PBS&J recommends the other two intersections (11th Street and East Avenue [No. 5] and 11th Street and Harrison Avenue [No. 6]) use the traffic signal cabinet for the CCTV equipment. The PBS&J project team will re-evaluate these locations before production of final plans.

The other 30 CCTV locations require new CCTV cabinets. The new cabinet will be a Type IV pole-mounted unit. The cabinet will be a standard Type 336S and will measure 46 inches long by 24 inches wide by 22 inches in height. These cabinets will include a surge suppression device for the data, video, and power supply.

The new and existing cabinets will include a digital video encoder, Ethernet switch, power supply for the camera, and a high-performance video monitor for maintenance purposes.

## 4.4 Closed-Circuit Television Locations

Thirty-two CCTV cameras are proposed for Phase II. Cameras will be mounted near arterial intersections to provide video images of both main and cross streets. The cameras will be placed at strategic locations where they will be most effective. Intersections on highly traveled corridors are ideal locations for CCTV cameras. Cameras will be located as close as a half-mile apart in areas that experience recurrent backups, traffic congestion, or have high accident rates. For this project, the 32 CCTV cameras will be located along the following corridors in and around Panama City. Figure 4.1 identifies the CCTV installation locations.

### 4.4.1 State Road 77 / Cove Boulevard

State Road 77 is the major north-south corridor motorists use between Panama City and Lynn Haven. It passes through downtown Panama City and is a major hurricane evacuation route. For this reason, eight CCTV cameras will be located along this heavily traveled corridor from the intersection of SR 390 (14$^{th}$ Street) and SR 77 in Lynn Haven south to U.S. Highway 98 Business (6$^{th}$ Street) and Cove Boulevard east of downtown Panama City.

### 4.4.2 11$^{th}$ Street (County Road 28)

A mix of residential communities, schools, and businesses are served by the 11$^{th}$ Street east-west arterial. It also borders the northern portion of downtown Panama City. There are four proposed CCTV camera locations along 11$^{th}$ Street beginning at Frankford Avenue east to School Avenue, excluding the CCTV cameras at Harrison Avenue and SR 77.

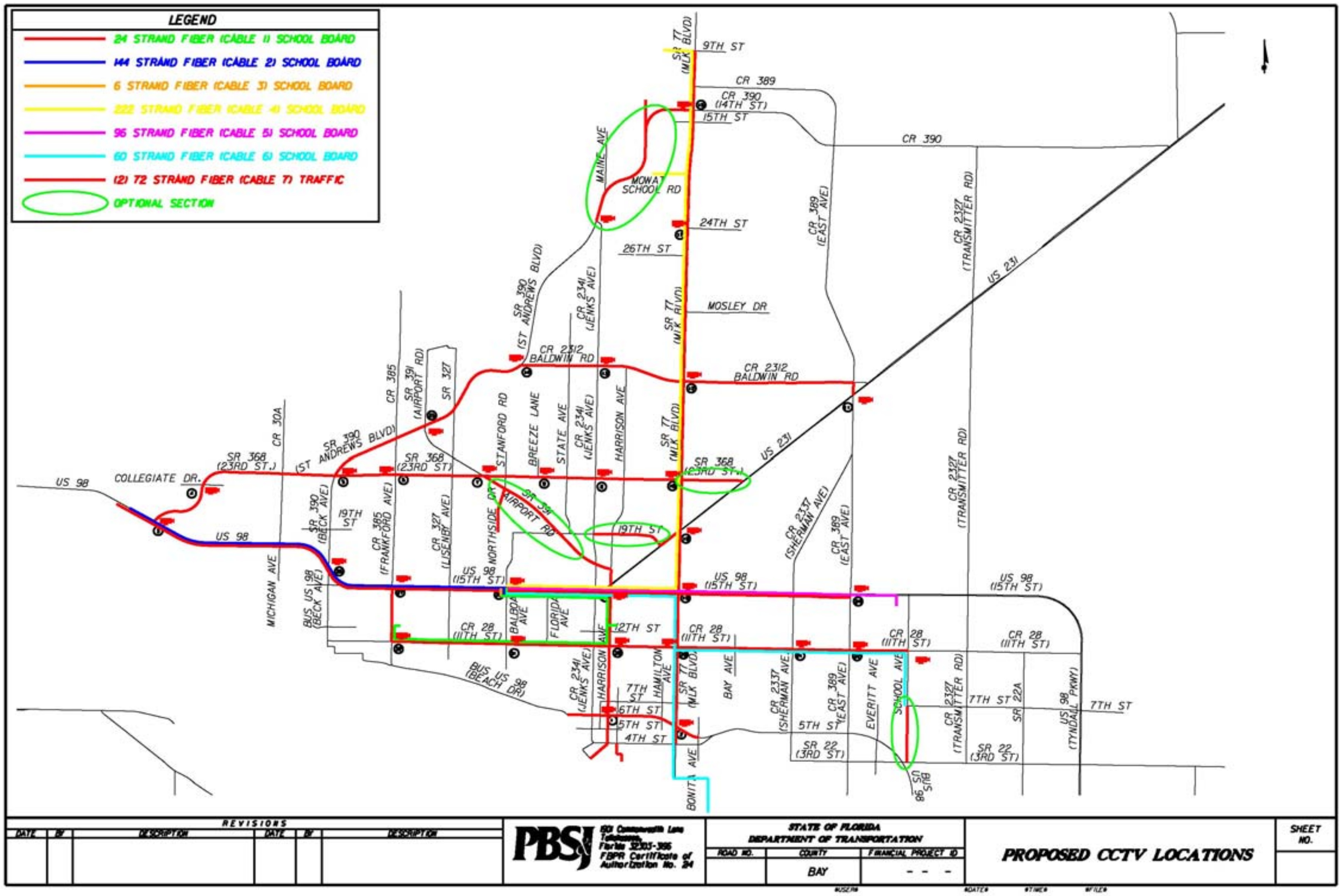
### 4.4.3 15$^{th}$ Street (United States Highway 98 / State Road 30)

The major east-west corridor through Panama City is 15$^{th}$ Street (U.S. Highway 98/SR 30). Not only does this corridor experience urban traffic congestion, but it is also the only direct route between Panama City and the Gulf beaches that are a main attraction for both tourists and residents. Maintaining a smooth and efficient traffic flow, especially near the Hathaway Bridge, is imperative. Six CCTV camera locations will be established along this corridor from 23$^{rd}$ Street east to SR 389 (East Avenue), not including the CCTV at SR 77.

### 4.4.4 23$^{rd}$ Street (State Road 368 / Alternate State Road 30)

Residents and tourists use 23$^{rd}$ Street (SR 368/Alternate SR 30) to reach the Panama City Mall and other shopping areas, hotels, and restaurants. Since this roadway is the major shopping and dining corridor, traffic backups are common. Maintaining traffic flow along this corridor is especially important because of the economic impact on local businesses. There are six proposed CCTV locations along the segment from the intersection at Collegiate Drive east to the intersection at Jenks Avenue.

**Figure 4.1 – CCTV Location Map**



### *4.4.5 State Road 390 (St. Andrews Boulevard) / State Road 391 (Baldwin Road)*

Motorists who want to avoid downtown traffic use St. Andrews Boulevard (SR 390) and Baldwin Road. St. Andrews Boulevard is the primary route to the Panama City-Bay County International Airport, and extends from SR 77 in Lynn Haven southwest along the airport perimeter to 23rd Street (SR 368/Alternate SR 30). This road has three CCTV proposed locations at the intersections with Jenks Avenue, Baldwin Road, and Airport Road. The camera at Baldwin Road will be at the end of Runway 14 and will require a height analysis to verify that it does not interfere with flight paths. Baldwin Road also has one proposed CCTV location at the intersection with Jenks Avenue.

### *4.4.6 United States Highway 231 (State Road 75) / Harrison Avenue*

The main road into downtown Panama City is U.S. Highway 231 (SR 75). It is also a major hurricane evacuation route. Motorists use this corridor to travel southwest into the city. South of 15th Street, U.S. Highway 231 is also known as Harrison Avenue, a major north-south corridor with several busy intersections where recurrent backups are common. There are two proposed CCTV camera locations along Harrison Avenue beginning at East Avenue near Hiland Park through downtown to 6th Street. This does not include the CCTV cameras at SR 77, 15th Street, and 11th Street.

# 5. Traffic Signal Cabinet Issues

Eighty-two traffic signals are located within the Phase II project limits. A field survey in December 2004 examined 79 cabinets as documented in the *Bay County ATMS Phase II Project Site Visit Report* dated February 15, 2005.[15] The *Site Visit Report* recommended that 57 cabinets be retained and 24 cabinets be replaced. A decision on the one remaining cabinet will be made following another field survey. Figure 5.1 identifies the locations of the traffic signal cabinets that need to be upgraded.

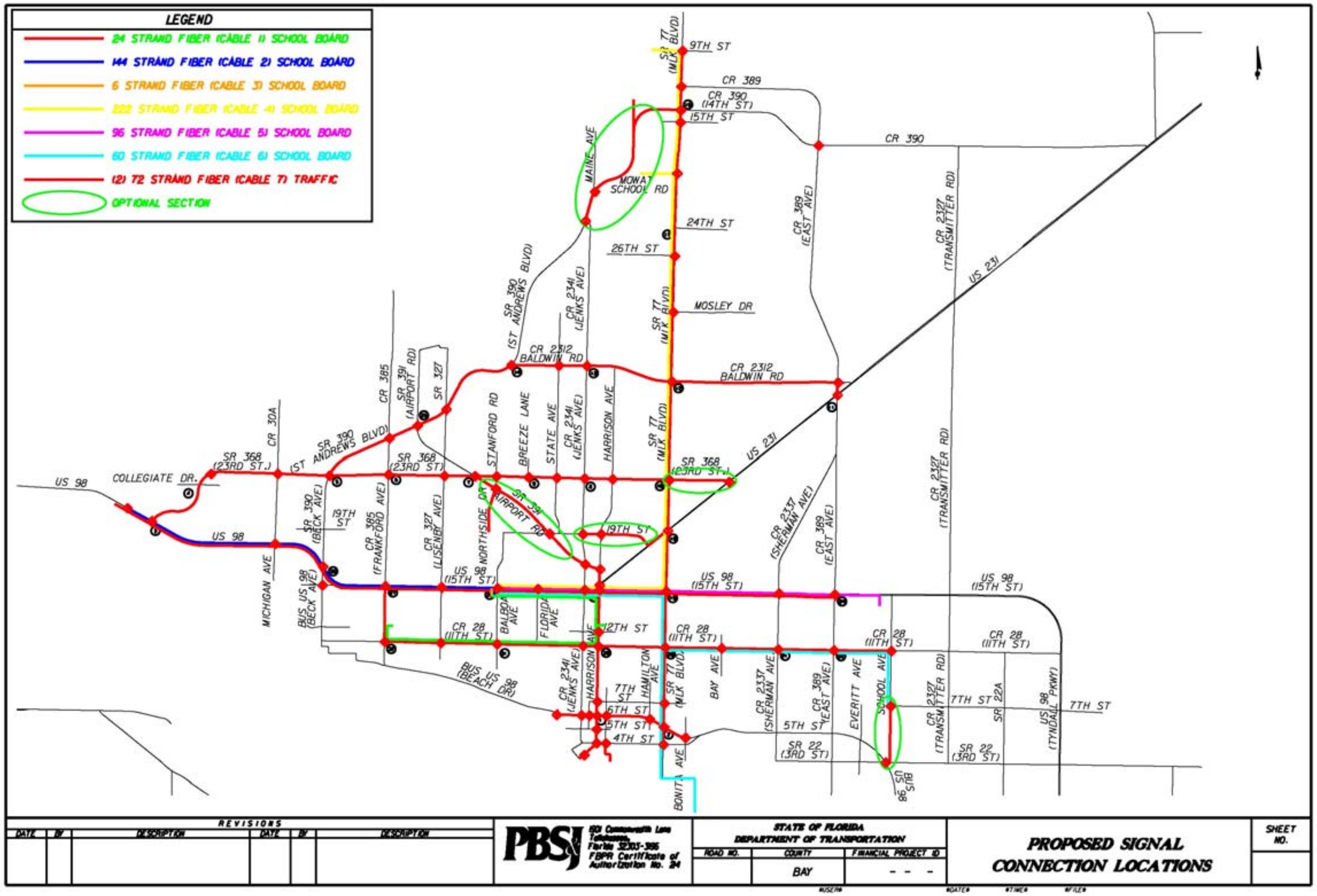
## *5.1 The National Electrical Manufacturers Association Standard versus 170 / 2070 Standard Controllers*

There are two basic standards for traffic signal controllers: the NEMA standard and the 170/2070 controller standards. The NEMA specifies standards for cabinets, controller hardware, and controller software. However, the standards allow manufacturers to incorporate proprietary features in their controller hardware and software that sometimes limit interchangeability. The key to these standards is requiring interchangeability by defining standardized inputs and database objects. It allows the manufacturers to size the physical housing and the layout of internal components. The TS 1 standard was introduced in 1989 and the current TS 2 standard was introduced in 1992. The California Department of Transportation (Caltrans) developed the 170 standard and the 2070 is an update of that standard. The 2070 specifies standards for the cabinet and controller hardware. These standards specified "generic" nonproprietary, interchangeable components. Although there is a Caltrans software specification, most 2070 software is proprietary. However, these proprietary software programs are fully functional with the 2070 cabinets and controllers.

Bay County and Panama City have made a sizeable investment in new NEMA cabinets. Since 1996, 54 of the 79 cabinets surveyed had been installed. Because of this recent investment in new NEMA cabinets and the technicians' familiarity with NEMA controllers, this project's stakeholders strongly desire to retain the NEMA standard.

[15] *Intelligent Transportation Systems: Bay County Advanced Traffic Management System Phase II Project – Site Visit Report* (February 2005). FDOT Contract No. C-7772. Available online at http://floridaits.com/ATMS.htm.

**Figure 5.1 – Cabinet Location Map**



## 5.2 Controllers

PBS&J recommends replacing the 82 TS 1 controllers with TS 2 Type 1 and Type 2 controllers. TS 2 Type 1 controllers will be used in the 24 TS 2 cabinets. The TS 2 Type 1 controllers are specifically designed for TS 2 cabinets and are not backward compatible with TS 1 cabinets since they use a bus connector. The TS 2 Type 2 controllers will be used in the 57 existing TS 1 cabinets. The TS 2 Type 2 controllers have Military Specification (MS) type connectors labeled A, B, and C that are directly compatible with TS 1 cabinets. As with the cabinet, a decision on the one remaining controller will be made following another field survey.

## 5.3 Cabinets

There are two types of NEMA cabinets: TS 1 and TS 2. The TS 1 cabinet is the older of the two cabinets and was developed in 1989 along with the TS 1 controller. The TS 2 cabinet is the current standard NEMA cabinet and was developed in conjunction with the TS 2 Type 1 controller.

### 5.3.1 Existing TS 1 Cabinets versus TS 2 Cabinets

The 54 cabinets replaced since 1996 are in good condition. Since these are relatively new cabinets, the decision has to be made whether the benefits of TS 2 cabinets outweigh the costs of retaining the TS 1 cabinets. The major differences between TS 1 and TS 2 cabinets are in the number of detectors, detector diagnostics, and conflict channels.

The TS 1 cabinets are wired for a maximum of 16 detectors compared with 64 for TS 2 cabinets. This TS 2 advantage is not a factor for the great majority of Bay County and Panama City intersections. The TS 2 cabinets also have automatic detector diagnostics. This feature is useful, but not essential considering the age of the existing cabinets. The TS 2 cabinets also have 16 conflict channels versus 12 for TS 1 cabinets. The impact of this difference is discussed in *Section 4.5* but, again, the difference is not essential considering the age of the existing cabinets.

Thus, PBS&J recommends retaining the 57 existing TS 1 cabinets as documented in the *Bay County ATMS Phase II Project Site Visit Report* previously referenced.

### 5.3.2 Proposed Replacement Cabinets

For the 24 cabinets that require replacement, PBS&J recommends TS 2 cabinets. The TS 2 cabinets are the current NEMA standard cabinets and will provide the advantages detailed in the previous section. Replacement with TS 2 cabinets will provide Bay County and Panama City with the full benefits of the current NEMA standard at 29 percent of the intersections, while minimizing the project's cost. PBS&J envisions that following the completion of the Bay County ATMS project, Bay County and Panama City will replace TS 1 cabinets with TS 2 units as they are damaged or reach the end of their useful lives.

## 5.4 Other Equipment

PBS&J recommends replacing the existing conflict monitors in the 81 cabinets with malfunction management units (MMUs). Malfunction management units are designed for use with the TS 2 standard and MMUs installed in the TS 2 cabinets will be fully functional. The MMUs installed in the TS 1 cabinets will operate as conflict monitors because the cabinets only have 12 channels versus 16 channels in the TS 2 cabinets. Again, this will provide the full benefit of the current NEMA standard at 29 percent of the Bay County and Panama City intersections. This is an investment in the future because following the completion of the Bay County ATMS project, the MMUs in the TS 1 cabinets will achieve full MMU functionality as their TS 1 cabinets are replaced with TS 2 cabinets.

# 6. Hathaway Bridge Intelligent Transportation System Integration

The Hathaway Bridge over St. Andrews Bay is the only transportation link between the high traffic demand areas of Panama City Beach and the urbanized area of Panama City. In 1998, the FDOT completed a project for the deployment of an incident verification and motorist information system on the approaches of the Hathaway Bridge.[16]

As part of the system, eight CCTV cameras were installed at the following locations:

- CCTV No. 1 – east end of the westbound bridge
- CCTV No. 2 – mid-span of the westbound bridge
- CCTV No. 3 – west end of the westbound bridge
- CCTV No. 4 – west end of the eastbound bridge
- CCTV No. 5 – east end of the eastbound bridge
- CCTV No. 6 – approximately 1,000 feet east of Soloman's Drive
- CCTV No. 7 – approximately 1,000 feet east of Thomas Drive
- CCTV No. 9 – intersection of Front Beach Boulevard and Connector Drive[17]

All of the CCTVs utilize point-to-point cabling and are not set up for Ethernet. All CCTVs, except the one at Front Beach Boulevard and Connector Drive, have lowering devices that allow full access to the camera system at ground level.

There are three DMS units included in this system, which are located at:

- Thomas Drive north of McElvey Road
- United States Highway 98, 350 feet east of Cauley Road
- Front Beach Boulevard, 1,000 feet west of the intersection with Connector Drive

The signs allow drivers to make travel decisions based on real-time information displays. The Hathaway Bridge DMS units are used to address recurring congestion, incidents, and other traffic concerns. The DMS units are especially helpful in directing vehicles during hurricane evacuations.

[16] Information obtained from the submittal data for Project No. OZ-12135 – Hathaway Bridge Intelligent Traffic Systems.

[17] The location for CCTV No. 8 is not referenced in this document. The locations identified were referenced as discussed with Metric Engineering.

One RWIS station is colocated with CCTV No. 2. The RWIS is used to identify hazardous driving conditions due to high winds, wet pavement, low visibility due to fog, and other weather conditions. With the closure of the FHP building, the control equipment has been relocated to Metric Engineering's project construction office.[18]

All of these components are served by 24-strand fiber. The fiber extends approximately 1,200 feet east of the bridge along the north side of U.S. Highway 98 and to the former FHP building on the east side of the bridge.

## 6.1 Hathaway Bridge Intelligent Transportation System Devices in Phase II

Once the interim TMC is ready, the Hathaway Bridge's ITS monitoring and control devices, along with all associated equipment, will be moved from Metric Engineering's field office to the interim TMC. The Hathaway Bridge's 24-strand FOC ends approximately 180 feet west of the U.S. Highway 98 intersection with Moody Avenue. Phase I's two 72-strand cables overlap the Hathaway Bridge's cable and terminates approximately 1,630 feet west of Moody Avenue. The Hathaway Bridge FOC will be spliced into one of the Phase I FOCs along this section of cable. The Hathaway Bridge's CCTVs are not Ethernet capable and will require additional equipment to perform that function.

[18] More information regarding Metric Engineering, Inc., is available online at http://www.metriceng.com/.

# 7. Vehicle Detection Systems

## 7.1 Introduction

Detecting traffic movement and producing such traffic data as vehicle presence, speed, volume, and occupancy are important elements in determining current and future traffic management needs. Traffic data is collected through detector systems installed either under the roadway pavement or at the roadside. Bay County may consider a do-nothing alternative that would keep in place the inductive loop detectors, which are the current method of vehicle detection. If funds are available, Bay County may want to consider installing new roadside detector systems, which are becoming increasingly prominent along today's roadways. Bay County also has microwave detection systems placed at some intersections, along with a video detection system at the intersection of Ohio Avenue and 9th Street. The following subsections provide a brief overview of each detection device used in Bay County.

## 7.2 Inductive Loop Detectors

Inductive loop detectors consist of loops of wire embedded in the pavement and connected to a control box, forming an inductive element. Vehicles travel over the loop, causing a reduction in the inductance. This reduction is detected and a signal is sent to the control box, which supplies vehicle data. This system is the most widely used in the United States, and is very reliable and accurate in counting vehicles.

Inductive loop detectors are currently located at intersections within the project limits. The system must, however, be reinstalled each time pavement is repaired. Installation is extremely important because the reliability of the loop depends on it.

## 7.3 Microwave Vehicle Detection and Video Image Detection

Microwave vehicle detection systems (MVDSs) and video image detection (VID) systems are nonintrusive vehicle detection and data collection alternatives to underground inductive loop detectors.

Microwave vehicle detection systems are installed either over a single travel lane (i.e., overhead mount) or on the roadside (i.e., side-fire mount). The system measures traffic data using a microwave radar beam. Microwave energy is beamed on an area of roadway from an antenna. The effect of the vehicle's movement on the beam is detected and produces the necessary data. This data is provided to the TMC's computer through the Electronic Industries Alliance (EIA) serial communications port, a device server, and a MFES. The MVDS is capable of producing data for a minimum of eight travel lanes. This system performs well in inclement weather. Its components are small, lightweight, and easier to install than the loop detectors.

The VID system uses CCTV cameras to collect visual images along portions of a roadway. Images are transmitted to the system's machine vision processor (MVP), which in turn produces the traffic data. The MVP is capable of producing data for up to eight lanes of traffic in the camera's field of view. The VID uploads the traffic data to the TMC computer. Video image detection systems can offer a range of traffic data and functions, including vehicle classification and incident detection.

# 8. Organization Structure of the Bay County Traffic Engineering Division

The Bay County PWD includes a division for traffic engineering and traffic operations. The division manager/county traffic engineer's duties include: budgeting, administration, grants, signal timing, signalized intersection design, citizen complaints, speed hump projects, traffic studies, development reviews, board meetings, public presentations, advise on street design issues, street lighting, pavement marking contractor projects, and the coordination of Navy projects with the Navy project manager. Figure 8.1 provides the Bay County Traffic Engineering Division's organizational chart.

Under the division manager is a superintendent who is responsible for all field operations. Under the superintendent are three sections: traffic studies and pavement markings; traffic signing; and traffic signals. The traffic studies and pavement markings section includes one traffic technician staff member and a supervisor who collect turning movement and tube counts; process accident records; perform accident studies using the Accident Information Management Software (AIMS)[19]; collect global position system (GPS) locations for all field devices; and perform traffic studies. This section also reviews pavement markings and provides maintenance support for markings. All pavement marking work is performed by an outside contractor.

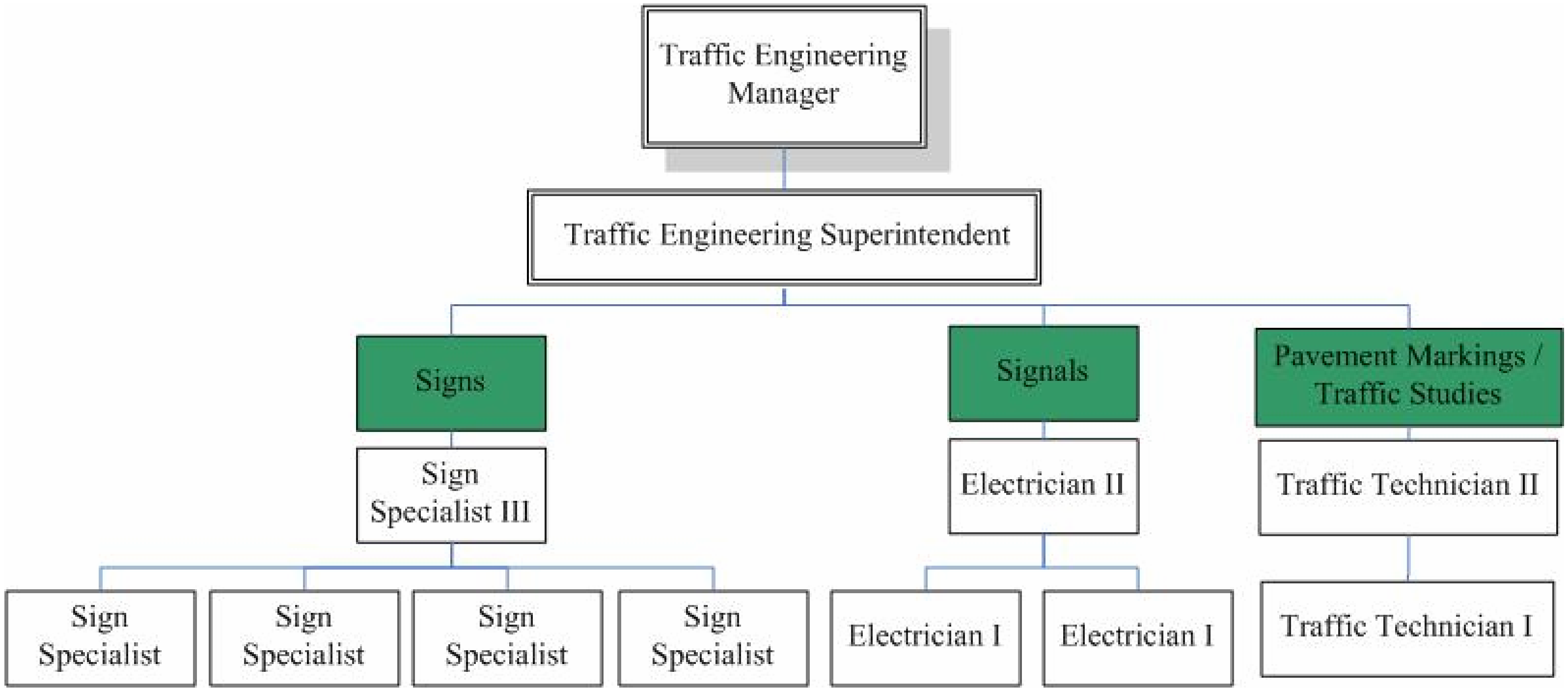
The signing section consists of a supervisor and four technicians. The supervisor answers the telephones at the shop and makes all the signs, as well as supervises the crews. Each technician works as a one-man crew in an assigned area. They are responsible for installation, cleaning, maintaining, and repairing signs.

An Electrician II supervises the traffic signal section. He has two Electrician I positions. They are responsible for all signal maintenance, operations, and construction. This staff works four 10-hour days, alternating days off so there is staff on Monday through Friday. The three employees share overtime and standby calls. All repair work is tested to the board level and then sent back to the manufacturer for component level repair. Bay County does not perform any bench repair. They do have a conflict monitor tester that is used to check all conflict monitors at least once per year.

Bay County has two aerial trucks, one bucket truck with a 45-foot working height, and one basket platform. They also have a pole trailer.

[19] AIMS is a three-dimensional GIS accident software provided by JMW Engineering, Inc. More information is available online at http://www.jmwengineering.com/.

**Figure 8.1 – Bay County Traffic Engineering Division's Organizational Chart**



With the Phase I project, they will get a FOC splicing trailer; an optical time domain reflector (OTDR); a splicer; and related small tools for fiber testing and splicing.

The *Feasibility Study* recommended the addition of one traffic signal technician for the county and an engineer for the signal system to be shared with the City of Panama City. The engineer would be primarily responsible for developing traffic signal timing plans.

## 8.1 Transportation Management Center Operations

The TMC will be located in a vacant office in the north wing of the Bay County PWD building. Some minor modifications to that room will be necessary. These modifications will consist of adding electrical and network outlets, and console furniture. Since this room is too small to host demonstrations or meetings, consideration should be given to mounting a large flat screen display in the adjacent conference room on the wall. Since Bay County's Information Technology (IT) Division is part of the PWD, the county will utilize that staff to maintain the computer equipment. The servers, FOC terminations, and any other communication hardware will reside in the IT server room in the southwest corner of the building.

To perform the day-to-day activities at the interim TMC, the TMC will be staffed with five personnel. The roles and responsibilities of the TMC staff are highlighted below:

- The TMC activities will be supervised by the *TMC Manager*. The Manager will ensure the smooth functioning of the TMC and provide managerial support for staff.

- The *TMC Operator* will monitor traffic conditions through the video wall and computer display screen. His duties will include informing the local police and emergency services of any accidents.

- The TMC will include two *Traffic Technicians* who will be responsible for maintaining a log for fiber splicing; locating fiber; and surveillance system and TMC equipment maintenance. Their duties will include coordinating with required contractors or manufacturers to replace or repair equipment that is not functioning properly. They will coordinate FDOT fiber locations at particular roadway segments and fiber splicing operations with other agencies as required.

- The Bay County Traffic Engineering Division will also include a *Traffic Signal Timing Engineer* to maintain and update the traffic signal timing plan for Bay County.

The TMC will be staffed by personnel in staggering shifts so that full coverage is provided throughout the day.

## 8.2 Institutional Issues

In order to make the Bay County ATMS project a success, some institutional issues will need to be addressed. These issues will include contractual, financial, and legal responsibilities between agencies to ensure the public gets the best value for its investment.

Presently, Bay County maintains all traffic signals in the county except those on Tyndall Air Force Base (AFB) and in Panama City. The county has agreements with the towns of Lynn Haven, Panama City Beach, Cedar Grove, Springfield, Parker, and Calloway for operations and maintenance (O&M), and the work is performed on a time and materials basis. Similarly, Bay County and Panama City have agreements with the FDOT for maintaining traffic signals on state-maintained roads.

The construction of a countywide ATMS will cross jurisdictional boundaries. The communication infrastructure will cross jurisdictional boundaries. Travel patterns and conditions do not change radically as one crosses the city limits. It is more efficient to have one system to maintain compatible equipment and continuity across jurisdictional boundaries. One countywide system will manage the traffic signals in the county more efficiently than two systems divided along jurisdictional boundaries. The initial network of 82 traffic signals makes it inefficient to maintain two TMCs and the accompanying staff. It is proposed that there be one countywide TMC maintained by the county. Therefore, the county staff will need to be able to access city cabinets to trouble-shoot and maintain the communication equipment. It will be considerably more efficient for one agency to maintain this equipment than to divide these duties and to require staff from both agencies to respond.

The new signal system will likely have timing plans and control sections that extend across jurisdictional boundaries. Again, it will be more efficient for one agency to maintain that operation. This arrangement does not require Panama City to relinquish all responsibility and control of their traffic signals. Panama City can and should still maintain their equipment, with Bay County maintaining the communication equipment and system operation.

In order for Bay County to assume certain maintenance responsibilities for Panama City traffic signals, there needs to be an interagency agreement.

The construction, engineering, and inspection (CEI) firm for the Thomas Drive widening project presently maintains the Hathaway Bridge ITS components. The equipment resides in the CEI's office. Upon completion of the widening project, the equipment will have to be moved so the temporary CEI office can close. At that time, the system will be maintained by the FDOT. Presently, there is no interagency agreement for Bay County to assume operations or maintenance responsibilities for the system.

It will be necessary for the participating agencies to budget the O&M costs for the central equipment and FOC plant. This will include the above described staffing as well as materials.

# 9. Conclusion

Phase II of the Bay County ATMS project will include the construction and integration of the Bay County TMC; upgrading the existing traffic signal cabinets and controllers operated by Bay County and Panama City along the FOC installation route; and the deployment of a CCTV system. It will also incorporate the Hathaway Bridge ITS devices.

An interim TMC will be located in the Bay County TMC. The TMC will have a video wall, plus monitoring and control equipment for CCTV, DMS, and RWIS. The TMC software will allow the operator to monitor traffic through a CCTV system and control traffic signals. Traffic data will be supplied by loop detectors, video detection systems, and microwave detection systems at intersections to detect traffic and actuate signals. The software will also display incident management response plans through DMS. The TMC software will allow operators to monitor current traffic conditions, which the system will display on the video wall. The TMC software will also be integrated with the Hathaway Bridge project's ITS components. The TMC software will provide center-to-field device control for field devices. It will support the import and export of data to and from the traffic simulation/modeling software; support a GIS interface to allow import and export of map features; and support alarm events. The TMC operator will have the ability to prioritize alarms by type of alert. In addition, the TMC software will be compatible with various traffic simulation software programs and will support data archiving capability.

During Phase II, 32 CCTV cameras will be installed near arterial intersections along major corridors within the project area. PBS&J recommends that two intersections, the 11$^{th}$ Street intersection at East Avenue and the 11$^{th}$ Street intersection at Harrison Avenue, use the traffic signal cabinets to house the CCTV equipment. PBS&J recommends the use of dome type cameras with 360-degree continuous pan and 90-degree tilt positioner capabilities. The cameras must provide both color and B&W images, and be equipped with auto focus and auto iris functions.

The 57 existing TS 1 cabinets will be retained, while 24 cabinets will be replaced with TS 2 cabinets. The 82 TS 1 controllers will be replaced with TS 2 Type 1 and 2 controllers. Existing conflict monitors will be replaced with MMUs. Existing Hathaway Bridge ITS components including CCTV cameras, DMS units, and RWIS stations will be integrated into the Bay County ATMS by the TMC software that will be procured.

Following approval of this document, work will begin on 30 percent plans. These plans will include preliminary plan sheets for the interim TMC, CCTV locations, and traffic signal cabinets. It will also include preliminary splice diagrams and standard drawings for ITS devices.