SMART REGION

CITY OF FOLSOM

TECHNOLOGY IMPLEMENTATION PLAN

FINAL

February 2019

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List of Abbreviations

ATMS – Advanced Transportation Management System
ATP – Active Transportation Program
ATSPM – Automated Traffic Signal Performance Measures
CCTV – Closed Circuit Television
CIP – Capital Improvement Program
CMAQ – Congested Mitigation and Air Quality Improvement
CMS – Changeable Message Signs
CV/AV – Connected Vehicle/Automated Vehicle
GIS – Geographical Information System
IoT – Internet of Things
ITIP – Interregional Transportation Improvement Plan
ITS – Intelligent Transportation Systems
MPO – Metropolitan Planning Organization
MTP – Metropolitan Transportation Plan
O&M – Operations and Maintenance
PTZ – Pan-tilt-zoom
RSTP – Regional Surface Transportation Program
RTIP – Regional Transportation Improvement Plan
SACOG – Sacramento Area Council of Government
SCS – Sustainable Communities Strategy
SHA – State Highway Account
SOV – Single Occupancy Vehicle
STARNET – Sacramento Transportation Area Network
STIP – State Transportation Improvement Plan
TMC – Traffic Management Center
TOC – Traffic Operations Center
VMT – Vehicle Miles Travelled

SMART REGION SACRAMENTO

City of Folsom TECHNOLOGY IMPLEMENTATION PLAN EXECUTIVE SUMMARY

February 2019

Transportation management is growing in terms of technology, software, and applications. The future of transportation includes connected vehicles, autonomous vehicles, decision-making based on performance metrics, and a committed focus on more effective operations and management of systems rather than just capital improvements. There is no way to build the way out of congestion, the only way to effectively improve mobility is to manage it better.

The City of Folsom is one of eight agencies that is contributing to the Sacramento Area Council of Governments' (SACOG's) Smart Region Sacramento: Intelligent Transportation System (ITS) Architecture and Future Technology Project (referred to as Smart Region Sacramento). This Technology Implementation Plan provides the City of Folsom with the framework necessary to proactively and positively affect how residents and all travelers move within and access the City transportation network. This framework and its resulting tools, if prioritized and managed well by the City, will assist with every aspect of City public service: mobility, incident response, efficient maintenance, and cost savings across the City's bottom line. Because technology investments are low-cost compared to capacity-related projects and offer potentially significant benefits to the broad transportation system and its users, prioritizing technology investments supports the vision of an integrated and reliable transportation system.

Goals and Objectives

The City of Folsom participated in the development of this Technology Implementation Plan that follows the Smart Region mission statement intended to clearly define the path toward technology investments and resources moving forward from 2019.

SMART REGION MISSION STATEMENT: To improve system performance, safety, sustainability, and reliability by ensuring efficient investments in regional smart transportation projects.

Previously identified goals and objectives from the original 2015 City of Folsom ITS Master Plan were brought into the development of this Smart Region Technology Implementation Plan. City goals were paired with Smart Region objectives to provide a direction and motivation for operating, maintaining, and planning for technology initiatives that support not only the City's vision but the Region's vision for smarter mobility.

The City of Folsom Smart Mobility Goals include:

- Document network conditions
- Establish technology integration policies
- Develop technology standards
- Identify prioritized project list
- Develop collaboration plan
- Develop Traffic Operations Center concepts
- Define public access portal
- Improve data open access
- Automate traffic operations
- Expand transit operations

The Smart Region Objectives include:

- Accommodate Different Communities Throughout the Region (Urban, Suburban, Rural, and Underserved)
- Adapt the Region to New Technology
- Achieve Consistency and Reliability for all Modes
- Increase Safety
- Improve Traveler Information Dissemination
- Improve Emergency/Disaster Preparedness

System Needs

The City is challenged with significant gaps that are inhibiting the system from addressing operational and management goals. System needs are identified by Infrastructure/Data (D), Operational (O), and Institutional (I) categories:

- D1: Baseline communications infrastructure
- D2: Robust coverage to acquire real-time conditions
- D3: Support active transportation operations
- D4: Reliable communications to prevent system downtime
- D5: Maintainable infrastructure and assets
- D6: Adequate bandwidth in communications for data sharing
- D7: Central system management of tools and data to support operations
- D8: High-resolution traffic data for real-time operational decision making
- D9: Sharing of camera images to support pre-trip, en-route, and incident management purposes
- D10: Reduce impact of light rail preemption on traffic mobility
- D11: Share data between agencies that share a corridor
- D12: Encourage travel mode shift
- D13: Real-time traveler information
- O1: Trained staff to support operations
- O2: Improve traffic operations
- O3: Sufficient environment for TOC operations
- I1: Funding strategy

SMART REGION SACRAMENTO

City of Folsom TECHNOLOGY IMPLEMENTATION PLAN EXECUTIVE SUMMARY

February 2019

Determining the Path Forward

Traffic operations and management technology is constantly advancing and evolving, which makes it an important consideration during the formulation of implementation strategies. It is crucial that the implementation process takes full advantage of the existing ITS technologies available while also formulating strategies that align with where technological advancements may be heading. The following are current technology trends that were evaluated for applicability in addressing needs and gaps:

- *Big data* – more data collected from roads, vehicles, and other sources
- *Transportation network carriers* – rideshare services
- *Connected vehicles* – field infrastructure and policies for data sharing
- *Autonomous vehicles* – vehicle fleets, availability, additional data
- *Smart wayfinding and citizen engagement platforms* – smart kiosks
- *Adaptive traffic signal control* – signals that can retime themselves
- *Traffic signal performance metrics* – software that finetunes how traffic signal timing serves the traveling public
- *Vehicle-to-everything communications* – data exchange
- *Internet of things* – connected devices that communicate in new ways
- *Electrification* – electric vehicles and charging stations
- *Multi-modal considerations* – on-board and fleet transit technologies

Determining the priority of which strategies are applicable to the City of Folsom requires a careful evaluation of not only the existing conditions of the region (the infrastructure available, the data available, and the propensity for agencies to adopt certain technologies over others) but also the available technology trends that lend themselves toward potentially being solutions to the needs of the City of Folsom.

Operations & Maintenance

The major elements of the future network include:

- 47 miles of fiber optic communications
- 82 traffic monitoring cameras
- 15 traffic information signs
- 79 upgraded traffic signal controllers
- 82 traffic detection devices

To effectively operate and maintain the various project elements and projects identified in this Implementation Plan, the City of Folsom must be adequately staffed and prepared to sustain the system after it is deployed. Operations and maintenance procedures are essential to define the appropriate staffing levels, training, operational processes, and maintenance plans necessary to sustain an effective system. This Plan includes guidance for staffing resources necessary to support operations and maintenance activities recommended to maximize investment in assets.

Deployment Strategies

Strategies were developed and prioritized based on the City's conveyed needs and will aid in the phasing of future technology deployments and investments in the future of a Smart Region. Project corridors recommended to be outfitted with technology generally include enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment, deployment of vehicle video detection, installation of traffic monitoring cameras, installation of changeable message signs, upgrade of intersection fiber equipment, installation of connected vehicle radio units, deployment of advanced traffic signal performance metrics, deployment of transit signal priority, and traffic signal controller upgrades. Other strategies were developed to improve processes, outline standard operating procedures, or prepare for a future of connected and autonomous vehicles.

Exhibit ES-1 – *Ultimate Communications Implementation*

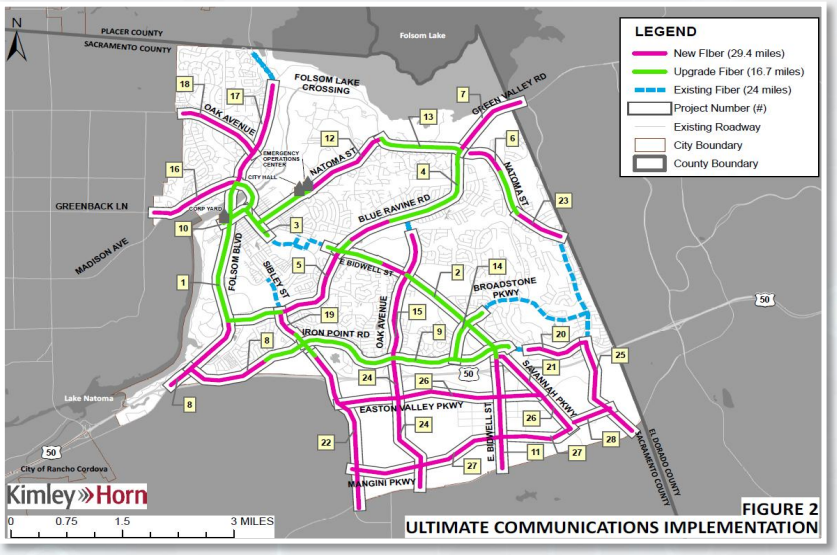


FIGURE 2
ULTIMATE COMMUNICATIONS IMPLEMENTATION

Exhibit ES-2 – *Ultimate Traffic Signals, Cameras, and Message Signs*

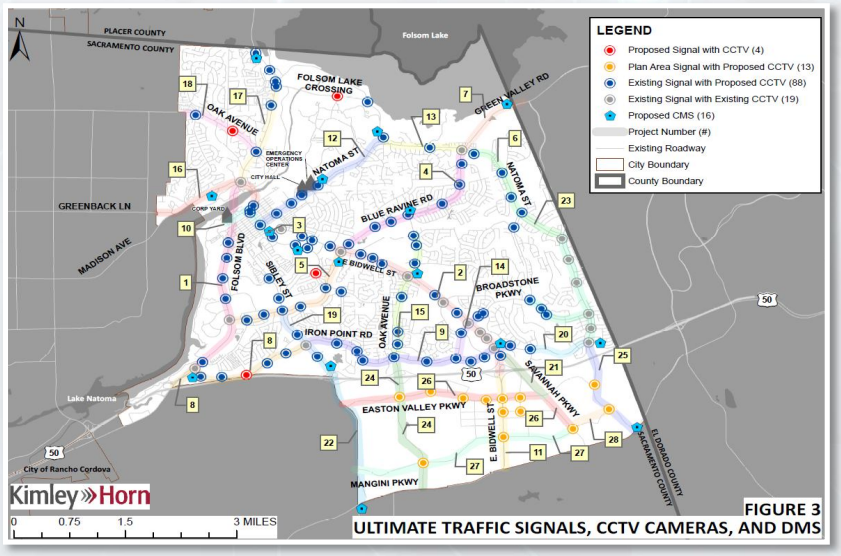


FIGURE 3
ULTIMATE TRAFFIC SIGNALS, CCTV CAMERAS, AND DMS

INTRODUCTION

The City of Folsom is one of eight agencies that is contributing to the Sacramento Area Council of Governments' (SACOG's) Smart Region Sacramento: ITS Architecture and Future Technology Project (referred to as Smart Region Sacramento). The eight partner agencies participating in this regional program are:

- City of Sacramento
- City of Citrus Heights
- City of Elk Grove
- City of Rancho Cordova
- **City of Folsom**
- Sacramento County
- El Dorado County
- Caltrans District 3

MISSION STATEMENT

To improve system performance, safety, sustainability, and reliability by ensuring efficient investments in regional smart transportation projects.

Development of the Smart Region plan follows a methodical Systems Engineering approach illustrated in **Figure 1**.

The initial discovery phase included a comprehensive review of adopted regional and local plans, existing transportation infrastructure, existing assets, and a definition of program needs. Gaps were identified within individual agencies based on the existing conditions and input received from agency stakeholders at one-on-one meetings and the Concept of Operations group workshop. These initial phases established a benchmark for what the City currently has and defined the needs and deficiencies for the transportation system. This document culminates with a roadmap in the form of a list of implementable projects that close the gaps and fulfill the needs of the City.

On a separate and related path, the regional Concept of Operations was developed to document the parameters in which the system will function, define stakeholder roles and responsibilities, and outline data usage expectations.

The City of Folsom participated in developing this plan and provided input to all stages of the Smart Region Sacramento program development. Information and details presented in this Technology Implementation Plan incorporate and build on the current infrastructure deployment projects and objectives to update the City's overall strategy going forward.

Additional background information was gathered from the City to enhance the previous work. This included the following:

- **One-on-one and group meetings** – At the one-on-one stakeholder meeting held in March 2018, the City's 2015 ITS Master Plan vision, goals, objectives, needs, and implementation projects were reviewed and discussed. The City expressed that the previous master plan was still relevant to the City's transportation needs but they desire to incorporate recent emerging technologies like automated performance measures which will provide more traffic operations capabilities.

- **Documents/Plans** – The primary reference for the Implementation Plan is the City's previous Intelligent Transportation Systems Master Plan (January 2015), in addition to documentation on CCTV camera locations, GIS maps, network communications diagram, traffic signal locations and inventory information (cabinet, controller, communications) provided by the City. Regional documents that represent multiple jurisdictions were also collected, an example of which is the Caltrans US 50 ICM Regional Concept of Transportation Operations (RCTO).

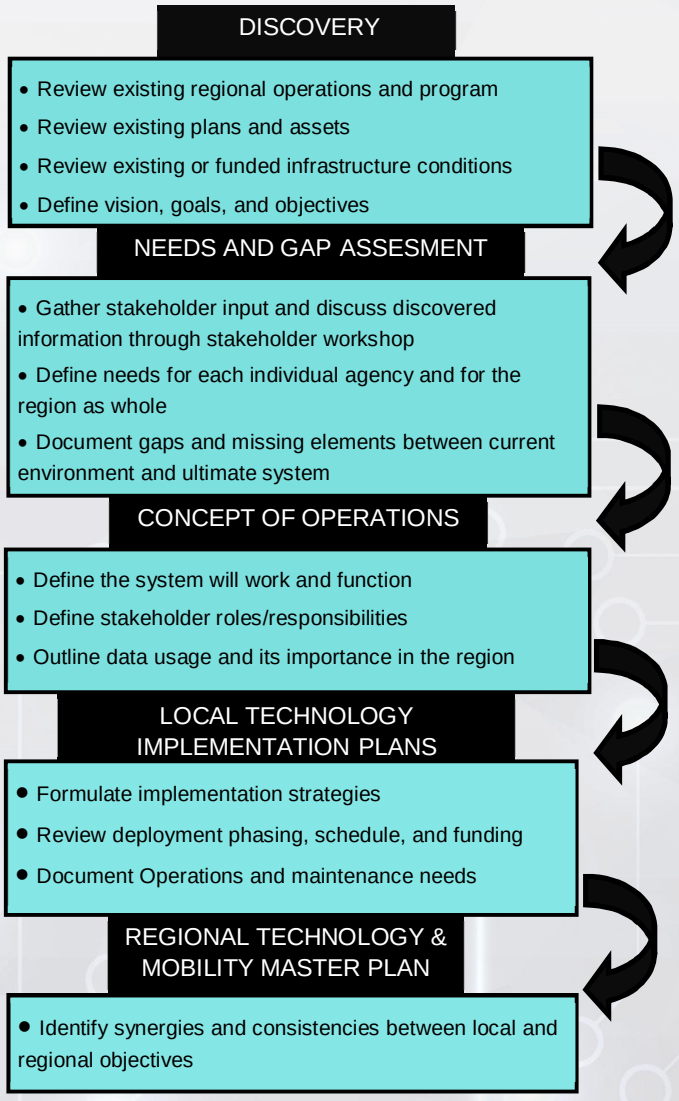


Figure 1 – Smart Region Sacramento Development Process

Document Organization

This document includes the following primary sections:

- **Program Goals, and Objectives** – Summarizes the guiding principles for developing the Plan.
- **Existing Conditions** – Summarizes existing field devices, system performance, and operations and maintenance performance.
- **Needs and Gaps Assessment** – Discusses and tabulates the City of Folsom's Needs and Gaps Assessment.
- **Determining the Path Forward** – Provides a link between needs and gaps assessment and how implementation projects were developed.
- **Implementation Project Development** – Describes the methodology for grouping strategy elements into implementable projects for delivery.
- **Deployment Prioritization** – Provides information on how projects are prioritized based on 10 criteria.
- **Funding** – Describes regional, state, and federal funding opportunities for ITS Projects.
- **Operations and Maintenance** – Describes strategies for staffing and ongoing maintenance.
- **Performance Metrics** – Describes evaluation and performance standards that will be used to evaluate transportation system performance, traffic signal operations, safety, and maintenance.
- **Next Steps** – Describes how to use the results of the Technology Implementation Plan to develop and deliver projects.

PROGRAM GOALS AND OBJECTIVES

As a part of the City of Folsom's 2015 Intelligent Transportation System (ITS) Master Plan, the City developed the following statement to represent the focus and direction of the ITS program:

> *To efficiently expand the existing communications network in a manner consistent with the City's General Plan to develop a robust and flexible system that provides redundancy, sets a standard for future expansion, reduces recurring monthly costs, and interfaces with internal and external partners to equip traffic engineers with the tools and system to effectively monitor and manage traffic flow, proactively optimize system operations, fully utilize the communications network, collaborate on incident response, and disseminate timely and meaningful transportation information to the public.*

To elaborate on the vision statement and address the City's gaps and needs, the City identified a set of goals and objectives to segment the vision into more specific, measurable, and manageable statements. The previously identified goals and objectives are described in **Table 1**.

Table 1 – City of Folsom 2015 Master Plan Update Goals and Objectives

Goal	Objectives
A. Document communications network conditions, gaps, and opportunities	▪ Identify existing physical network and known issues ▪ Identify and evaluate ITS system gaps ▪ Present opportunities for gap closures and system expansion. ▪ Identify prioritization guidelines for addressing gaps.
B. Establish ITS policies for integration in the *General Plan Update*	▪ Develop specific plan policies to encourage the longevity of the ITS program
C. Develop device standards and prioritize component installation and replacement	▪ Inventory existing hardware and shortcomings ▪ Create device standards including equipment type, placement, and specifications ▪ Prioritize new traffic signal installations ▪ Develop device standards that are consistent with regional ITS infrastructure
D. Identify potential project candidates for future growth of ITS network	▪ Develop project limits, project elements, and planning level costs for possible ITS equipment deployments ▪ Identify potential funding sources, including grants and developer's fees, for the installation of ITS elements
E. Develop an informal plan for collaboration with neighboring and regional jurisdictions' systems, policies, and protocols	▪ Engage neighboring stakeholders to initiate local and regional collaboration ▪ Regularly participate in monthly SACOG ITS Partnership Meetings
F. Develop preliminary concepts for a Traffic Operations Center (TOC) that encourages interdepartmental collaboration and coordination	▪ Solicit and compile departments' priorities and requirements ▪ Identify conducive space within City Hall ▪ Consider a concept of operations to define department interaction and TOC complexion ▪ Develop access policies for data sharing with various City departments and external stakeholders
G. Develop system access opportunities to provide public with timely and meaningful traveler information	▪ Research effectiveness of regional agency traveler information mediums ▪ Document industry-wide trends and emerging user tendencies ▪ Identify type of information and dissemination options

The City has implemented a number of projects recommended in the 2015 ITS Master Plan to address the goals and objectives above, but the City acknowledges that these objectives are still relevant to the current system needs. As a part of this implementation plan development, the City of Folsom defined the following goals and objects, listed in **Table 2** below, to add to the ones listed above.

Table 2 – City of Folsom 2018 Smart Region Goals and Objectives

Goal	Objectives
H. Improve Access to Traffic Data	▪ Collect real-time traffic data ▪ Implement detection to collect volumes and flow ▪ Identify pass-through traffic on local streets
I. Automate and optimize traffic operations to maintain lower staffing levels	▪ Deploy adaptive signal control to reduce need for signal timing development ▪ Create an automated performance measures system for evaluating existing operations
J. Expand transit connections and operations	▪ Implement advanced transit preemption to improve both light rail and roadway corridor operations ▪ Evaluate microtransit and autonomous transit opportunities for connections to light rail

The Smart Region Plan has six key regional objectives that emerged as most critical throughout the project process, particularly during the strategy implementation phase. These six key objectives were crucial in guiding the strategy development process. The Smart Region objectives are:

- Accommodate Different Communities Throughout the Region (Urban, Suburban, Rural, Underserved)
- Adapt the Region to New Technology
- Achieve Consistency and Reliability for all Modes
- Increase Safety
- Improve Traveler Information Dissemination
- Improve Emergency/Disaster Preparedness

These primary regional objectives are important considerations throughout Smart Region development and implementation because they provide guidelines for identifying projects and creating performance measures to evaluate program efficacy. In addition, these objectives are helpful in determining strategy prioritization and deployment phasing priorities, which are be discussed in more detail later in this document.

EXISTING CONDITIONS

Traffic Signals

Within the City of Folsom, there are currently 98 traffic signals: 77 interconnected traffic signals and 21 non-interconnected traffic signals. Of the 77 interconnected signals, only 65 signals can be remotely accessed by City staff via central system software. The remaining interconnected signals have local communications for signal timing coordination. Traffic signals are interconnected on major arterials, such as Folsom Boulevard and East Bidwell Street, while non-interconnected signals are scattered and isolated throughout the City. In addition to traffic signals, there are seven (7) fiber hubs located along Folsom Boulevard, East Bidwell Street, and Iron Point Road. At the time of this report, nine 97) traffic signals are to be constructed in 2019: three (3) on E. Bidwell Street and six (6) on Empire Ranch Road. These new signals will be interconnected using single-mode fiber optic communications.

The City has deployed time-of-day based traffic signal timing coordination along the following six (6) corridors:

1. East Bidwell Street from Montrose Drive to Placerville Road (14 signals)
2. Folsom Boulevard from Iron Point Road to Oak Avenue Parkway (8 signals)
3. Folsom-Auburn Road from Folsom Lake Crossing to Pinebrook Drive (4 signals)
4. Prairie City Road from Willard Drive to the Office Park Driveways (3 signals)
5. Blue Ravine Road from East Bidwell Street to Folsom Square (2 signals)
6. Riley Street from Scott Street to Natoma Street (4 signals)

The City currently utilizes two (2) different controller vendors and central systems. Most of the City's traffic signals are controlled using Multisonic controllers with OSAM (on-street arterial master) software. In 2014, the City procured and implemented an Econolite Centracs central system and deployed Econolite Cobalt controllers at 10 traffic signals along Iron Point Road. The City is in the process of migrating all interconnected signals to the Centracs system. The City's existing traffic signal network is presented in **Exhibit 1** of **Appendix A**.

Communications Network

The City's existing communications network consists of a combination of fiber optic, copper, leased line, and wireless communications media that are utilized for traffic signal interconnections and other traffic communication purposes like accessing closed circuit television (CCTV) cameras.

See **Exhibit 1** of **Appendix A** for the locations of existing communications deployments.

Both single- and multi-mode fiber optic cables are currently deployed and are either 6- or 24-strand cables. The majority of fiber optic infrastructure is located along Folsom Boulevard, Folsom-Auburn Road, Natomas Street, Blue Ravine Road, East Bidwell Street, Broadstone Parkway, and Iron Point Road. The City is looking to convert all traffic related communications to a single-mode fiber optic network. The existing copper segments consist of 6-, 12-, or 24-strand cables. The City has expressed a desire to phase out all existing copper lines and migrate to a Citywide fiber optic network. The existing copper lines are primarily located along Iron Point Road, Greenback Lane, and a small portion along East Bidwell Street.

Leased-line and wireless communications are currently utilized to bridge gaps where there is no City owned copper or fiber optic communication. The leased-lines are used between communication hubs on Folsom Boulevard near Parkshore Drive, on Folsom-Auburn Road near Folsom Lake Crossing, on Blue Ravine Road near Oak Avenue Parkway, and on East Bidwell Street near Scholar Way. The existing wireless communication, provided by NComm, is utilized to provide communication between Natoma Street and Broadstone Parkway, as well as between Oak Avenue Parkway and East Bidwell Street.

Closed Circuit Television (CCTV) Cameras

The City has 10 pan-tilt-zoom (PTZ) CCTV cameras (manufactured by Axis Communications), located primarily along East Bidwell Street and Folsom Boulevard. PTZ CCTV cameras will be installed at nine

(9) of the traffic signal installations or modifications to be completed this year. The existing camera locations (including the nine to be installed in 2019) are shown in **Exhibit 2** of **Appendix A**.

These cameras facilitate the City's data collection at key locations throughout Folsom. The cameras are connected via an existing communications network made up of fiber optic, copper, leased-lines and a wireless network. The city does not share CCTV imagery with other agencies, at the moment, but it is an identified gap and is addressed in the implementation projects.

Video Detection Cameras

Prior to 2018, the City has one (1) video detection camera (manufactured by FLIR) deployed at the intersection of Sibley Street and Levy Drive for the westbound approach only. The City is in the process or recently installing video detection cameras at nine (9) intersections along E. Bidwell Street between Oak Avenue Parkway and Placerville Road, and six (6) intersections on Empire Ranch Road. The City desires to replace all legacy vehicle detection with video detection.

Traffic Management/Operations Center

The City does not have a traffic management center (TMC), though traffic signals are currently managed using an informal workstation at the existing Corporation Yard. As part of the 2015 ITS Master Plan update, three (3) alternatives were developed for implementing a TMC at City Hall; however, the City has not yet selected a preferred alternative for the full TMC buildout. However, this past fall, the City completed the installation of a new workstation at City Hall (at a Associate Civil Engineer's desk) with access to the Centracs system.

System Performance

The City has communications to a majority of its existing traffic signals and CCTV cameras; however, many corridors are currently connected via a mix of communications media which present limitations with regards to bandwidth, flexibility, and data reliability. Additionally, the City uses a combination of three signal controller types and central systems, leading to inefficient operations and increased maintenance activities since equipment isn't directly interchangeable.

Arterial traffic management is a major component of the performance of the City's overall transportation system. Natoma Street, E. Bidwell Street, Folsom Boulevard, Iron Point Road, and Blue Ravine Road are key arterials which have experienced traffic growth in recent years due to steady increases in development and population (i.e., population of Folsom has grown 40% in the past 15 years). While there is some ITS infrastructure in place to allow for active system management, the system is not robust enough to allow the City to effectively manage traffic. Due to limited available tools (e.g., Engineering staff does not have access to the existing central systems), traffic management is generally reactive and dependent on traditional methods like comprehensive traffic studies to address issues.

NEEDS AND GAPS ASSESSMENT

The City of Folsom's Needs and Gaps Assessment process was conducted using a combination of methods. Existing documents and plans related to transportation and technology relevant to the City and the region were thoroughly reviewed. These needs and gaps form the foundation for identifying project solutions.

The needs and gaps were identified and categorized by the following distinctions:

- **Infrastructure/Data (D)** – field infrastructure, communications equipment, data, systems/software
- **Operations (O)** – operational enhancement projects and processes, staffing
- **Institutional (I)** – policies, agreements, funding/programming mechanisms, reporting/documenting, training

The following **Table 3** summarizes the City of Folsom's Needs and Gaps Assessment.

Table 3 – City of Folsom Needs and Gaps Summary

ID #	Need	Gap
	Infrastructure/Data (D)	
D1	Baseline communications infrastructure	Cannot communicate with all field devices and traffic signals, which limits the City's operations staff from remotely monitoring and managing from a central location.
D2	Robust coverage to acquire real-time conditions	Lack of device coverage and range of devices to collect different types of data.
D3	Support active transportation operations	Lack of bicycle and pedestrian detection create unnecessary delay due to inefficient signal timing.
D4	Reliable communications to prevent system downtime	Lack of redundant communications results in system downtime if communications are lost. System is currently only connected to City Corporation Yard, which limits ability to manage network.
D5	Maintainable infrastructure and assets	The majority of the City's traffic signals are end-of-life/legacy equipment with outdated functional capabilities. Additionally, the city has three types of traffic controllers which increases incompatibility issues and maintenance activities.
D6	Adequate bandwidth in communications to support data sharing	The City's existing system is composed of a variety of communication media (copper, single-mode fiber, multi-mode fiber, wireless, leased); utilizes both fiber-optic and copper communications; lack of bandwidth to support data sharing.
D7	Central system management of tools and data to support operations	Central system lacks functionality required by agency operations and/or regional operations.
D8	High-resolution traffic data for real-time operational decision making	Lack of performance measurement and analysis capabilities. Out-of-date signal controllers unable to support ATSPM software development and collect high-resolution traffic data. Lack of ATSPM software for data analytics.
D9	Sharing of camera images to support pre-trip, en-route, and incident management purposes	No infrastructure in place for sharing video feeds with the public, public safety agencies, and partner agencies.

ID #	Need	Gap
D10	Reduce impact of light rail preemption on traffic mobility	Light rail preemption throws Folsom Boulevard signals out of coordination and reduces traffic throughput. Lack of robust preemption tools prevents effective and reliable operations the corridor.
D11	Share data between agencies that share a corridor	Lack of real-time or planned knowledge of corridor restrictions to operate efficiently across jurisdictions. Lack of regional data sharing policies and guidelines to establish data sharing protocol.
D12	Encourage travel mode shift	Limited information is available or disseminated to support mode shift.
D13	Real-time traveler information	Limited real-time traveler information available to public and limited methods to disseminate information. Limited CMS equipment for communication of traveler information.
	Operations (O)	
O1	Trained staff to support operations	Lack of staffing to support traffic operations functions to proactively manage transportation network.
O2	Improve traffic operations	Automate some functions to streamline operations. Lack of data collection capabilities limits ability to quickly and actively identify operational issues and proactively respond.
O3	Sufficient environment for TOC operations	Poor ergonomics and layout (or lack) of TOC to serve operational functions. Lack of functional workstation layout at TOC.
	Institutional (I)	
I1	Funding strategy	Lack of reliable funding mechanism to support Smart City or Smart Region initiatives on a regional or agency-by-agency basis. Lack of regional technology procurement contract and regional technology and systems funding program.

DETERMINING THE PATH FORWARD

There are many directions that SACOG and the region could move toward in implementing solutions to address the needs and gaps. While some gaps point to specific types of strategies that will directly and completely address that gap, other gaps are more difficult to solve and will require a combination of infrastructure, operations, and institutional processes to be implemented to completely address the gap.

Traffic operations and management technology is constantly advancing and evolving, which makes it an important consideration during the formulation of implementation strategies. It is crucial that the implementation process takes full advantage of the existing ITS technologies available while also formulating strategies that align with where technological advancements may be heading. The following are current technology trends that were evaluated for applicability in addressing needs and gaps as defined for the Smart Region Program:

- **Big Data** is becoming readily available as more data is acquired from connected field infrastructure on a near-real-time-basis as well as additional data-rich information from new sources such as probe vehicles, fleet vehicles, and connected vehicles becomes more mainstream. Big Data is about predictive analytics; or more simply, improving our ability to predict and anticipate outcomes. Historically, transportation data has been difficult and costly to obtain but as it becomes increasingly available through location tracking, phone apps, and many other sources this is quickly changing.

Big Data is already changing the way we plan, analyze, and operate our transportation, and big data will play a large role in affecting the evolution of STARNET.

- **Transportation Network Carriers (TNCs)** – TNCs pair passengers with drivers who provide on-demand service, most often via websites or mobile apps. Services such as Uber and Lyft are examples of the sharing economy. Increasingly, transit providers, including Sacramento Regional Transit (RT), are beginning to provide on-demand transportation services to augment their systems. These services have the potential to address the long-standing challenge of first-mile, last-mile service to expand the reach of existing bus and light rail service.
- **Connected Vehicle (CV)** readiness, both in terms of infrastructure and institutions, was identified as a need and yet full connected vehicle CV deployment is gradually becoming a reality in the industry. As a result, it is important that the partner agencies are equipped with the infrastructure and projects needed to adapt to those changes and needs. It is important to recognize the changing landscape of technology options with connected vehicles because the federal guidelines have not been finalized. Agency adoption of providing data to or collecting data from a connected vehicle will need to have benefits outlined and likely deployed on a scalable basis until more formal guidelines for adoption and expectations are defined.
- **Autonomous Vehicle (AV)** readiness, in terms of institutions and policies, was identified as a need as AVs are being tested on more and more roadways throughout the Country. Although functioning autonomously, there may be a variety of useful data that could be provided to the vehicle, collected by the vehicle, or shared between AVs that could require an agency role and responsibility.
- **Smart Wayfinding and Citizen Engagement Platforms –** Smart kiosks offer new, interactive ways for municipalities, business improvement districts, and marketing organizations to communicate with the public. Citizens and visitors use touchscreen displays to access a wide variety of information ranging from smart wayfinding and transit planning to locating nearby businesses and entertainment. Cities have the ability to broadcast important service announcements and relay emergency alerts enhancing public safety.
- **Adaptive Traffic Signal Control** enables traffic signals to proactively adjust signal timing parameters to accommodate unplanned variances in traffic demand. There are several adaptive systems in the market, each of which tends to accommodate specific corridor needs (e.g., maximize throughput, minimize side-street delay).
- **Automated Traffic Signal Performance Measures (ATSPM)** is a software module add-on to many traffic signal software applications that processes and analyzes traffic signal data to display and report performance metrics of an individual traffic signal, corridor, and/or across the traffic signal network. This feature enables agencies to proactively identify trouble areas, report on corridor performance, and facilitate efficient traffic management.
- **Vehicle-to-Everything (V2X) Communications** is becoming a highly-desirable system feature that establishes an exchange of data between vehicles and field infrastructure. One example includes Signal Phase and Timing data that enables subscribed vehicles to display when a downstream traffic signal will change. Another example is collecting vehicle location information for collision avoidance or for origin-destination analysis.
- **Internet of Things (IoT)** – Often referred to as “connected devices”, items are embedded with technology such that objects can exchange and collect data. From a streetlight bulb that notifies

that it needs changing to roadway sensors that monitor traffic speeds, the opportunities to collect and use data to improve the maintenance and operations of the transportation system are rapidly expanding.

- **Electrification** – The transportation sector is responsible for approximately 36 percent of California's Green House Gas (GHG) emissions (50 percent when you include refineries) and more than 80 percent of NOx and particulate emissions. In conjunction with the continued addition of renewable energy sources as the basis for electrification, the positive impact of air quality will be significant. As the location of charging stations continues to expand, electric vehicles will also become increasingly easy to own and operate.
- **Multi-Modal Considerations –** Municipalities and transit providers are also faced with the challenge of embracing technological advancements. These technologies are aimed at improving bicycle and pedestrian safety and mobility, as well as maximizing the efficiency and convenience of transit service. Technological advancements that provide more meaningful real-time and situational awareness information for multi-modal users include detection techniques, minimizing conflicts at traffic signals, fleet management, mobile traveler information, and Automatic Vehicle Location (AVL), among other methods. Multi-modal transportation users are diverse in their ability to provide information as well as receive it, and service providers are already applying technology in equipment as well as systems to provide a greater experience for the user.

Determining the priority of which strategies are applicable to the SACOG region requires a careful evaluation of not only the existing conditions of the region (the infrastructure available, the data available, and the propensity for agencies to adopt certain technologies over others) but also the available technology trends that lend themselves toward potentially being solutions to the needs of the SACOG region.

IMPLEMENTATION PROJECT DEVELOPMENT

The previous information gathering efforts and the needs and gaps assessment influence the development of the City of Folsom's implementation projects. The needs and gaps illustrate the foundation for project opportunities to enhance the overall transportation system. The foundation of knowledge and understanding of previously built projects ensures that the implementation projects are realistic and relevant to the City's conditions.

To support development and expansion of the transportation network, several deployment parameters were considered in conjunction with previously discovered information to formulate overarching implementation criteria. These include:

- Key Emerging Technologies – Provisions for CV/AV technology, multi-modal considerations (including transit), as well as other important initiatives in the region that are advancing innovative technology deployment.
- Emergency/Disaster Preparedness – Strategies facilitate the ability to improve the effectiveness of emergency and disaster response.

- Data Availability – The type and quality of available data, how data set can be improved and/or expanded, and how data can be effectively leveraged once it has been analyzed.
- Project Dependencies – Certain project elements must be constructed before other elements can be advanced.
- Overlap with Other projects – Other projects within the same project area offer efficiencies for construction.
- Safety – Strategy contributes to improved safety.
- Context of Individual Agency – Specifically customized for applicability to each agency.

As there was an ITS Master Plan developed for the City of Folsom in 2015, this was primarily incorporated into the Technology Implementation Plan in the form of corresponding projects. The recent Master Plan Update has had only slight changes in the last three years that were all addressed regarding the SACOG existing conditions memo for the City. These projects address communication gaps and projects that the City hopes to implement in the next few years.

Strategy Development

Overarching project strategies have been developed to identify a broad set of technology solutions that will address infrastructure/data, operations, and institutional stakeholder needs and system gaps; and to satisfy this deployment criteria. The strategy summary format is provided below and is detailed for each strategy in **Appendix B – Strategy Summary Sheets**:

- **ID #** – This is the identification number of the strategy.
- **Title** – This is the title of the strategy.
- **Description** – This is a succinct description of the strategy for context.
- **Relation to Needs** – This is a mapping of strategies to the original needs, recognizing that one strategy may serve multiple needs.
- **Scope/Limits** – This is a succinct summary of what is included in the strategy and/or locations (if applicable) of where the strategy would be deployed.
- **Considerations** – This is a bullet listing of other strategy ID #'s and Titles that are relevant for the City to reference during implementation or that could be packaged together to be implemented as part of a larger project in a particular timeframe.
- **Prerequisite Dependencies** – This is a bullet list summary of the high-level steps required to implement the strategy.

When all of these strategies are constructed, the City will have established an overall communications network and field equipment that enables staff to effectively monitor and manage traffic congestion. Infrastructure strategies, inclusive of communications media, CMS, CCTV cameras, detection, and traffic signal controllers, are visually presented in **Figures 2** and **3**, which shows the ultimate communication and ITS device deployment in the City, respectively.

DEPLOYMENT PRIORITIZATION

After developing the various strategies, strategy element segments and locations are grouped into specific deployment projects that will be prioritized for implementation. This results in a unique list of implementable projects tabulated in **Appendix D**. In general, strategy elements pertaining to ITS infrastructure improvements have been grouped based on a corridor or geographical location. Projects related to operational and institutional strategies will likely be deployed on a standalone basis.

Prioritization

Projects are prioritized based on a set of 10 local and regional criteria and emphasize providing an infrastructure foundation, systems and data integration to enhance functionality, and innovative advanced technology solutions when other critical elements are in place. Each criterion was weighted to represent some criteria being more important than others. The 10 local objectives and their weighting value are shown below:

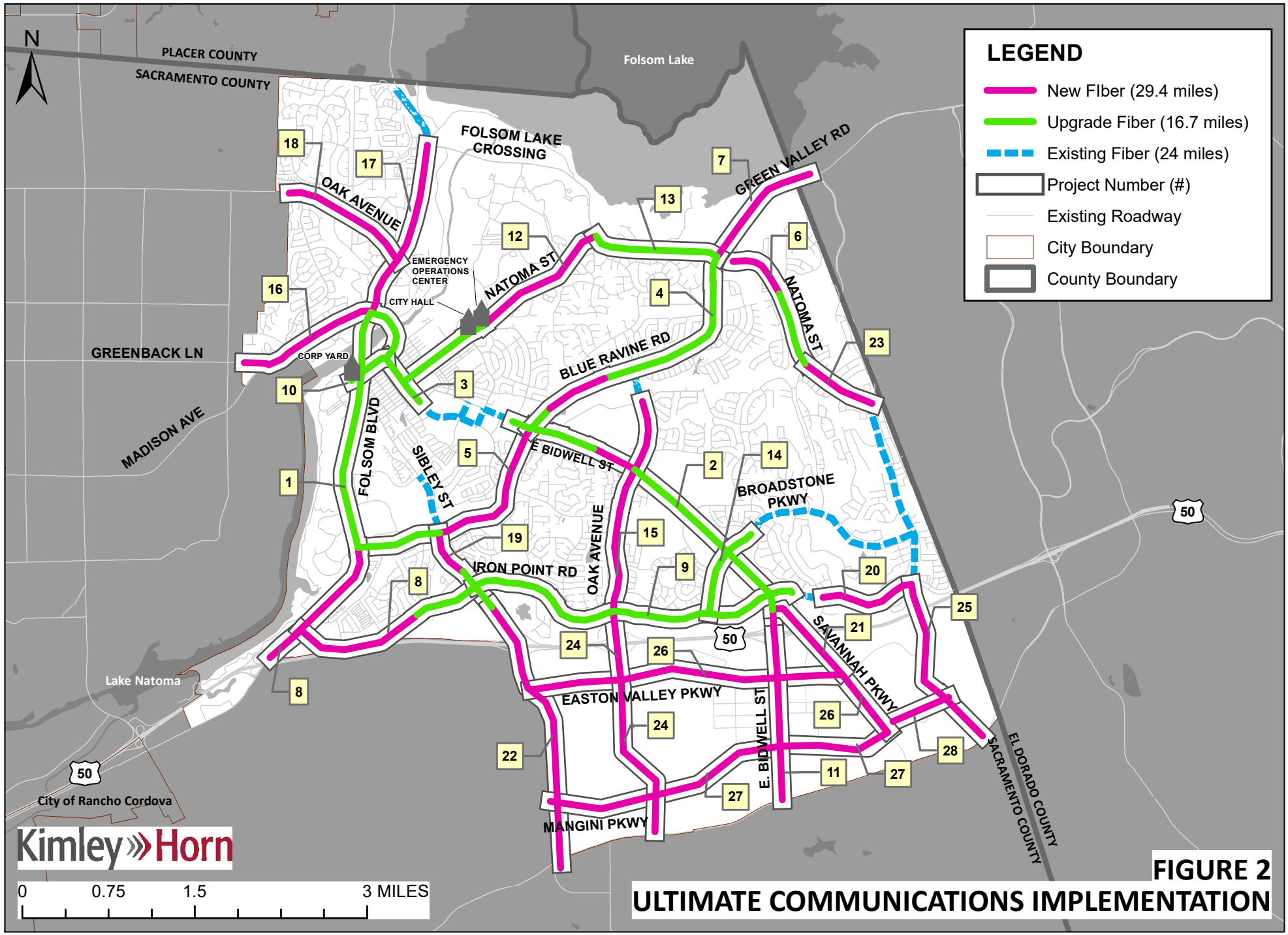


FIGURE 2
ULTIMATE COMMUNICATIONS IMPLEMENTATION

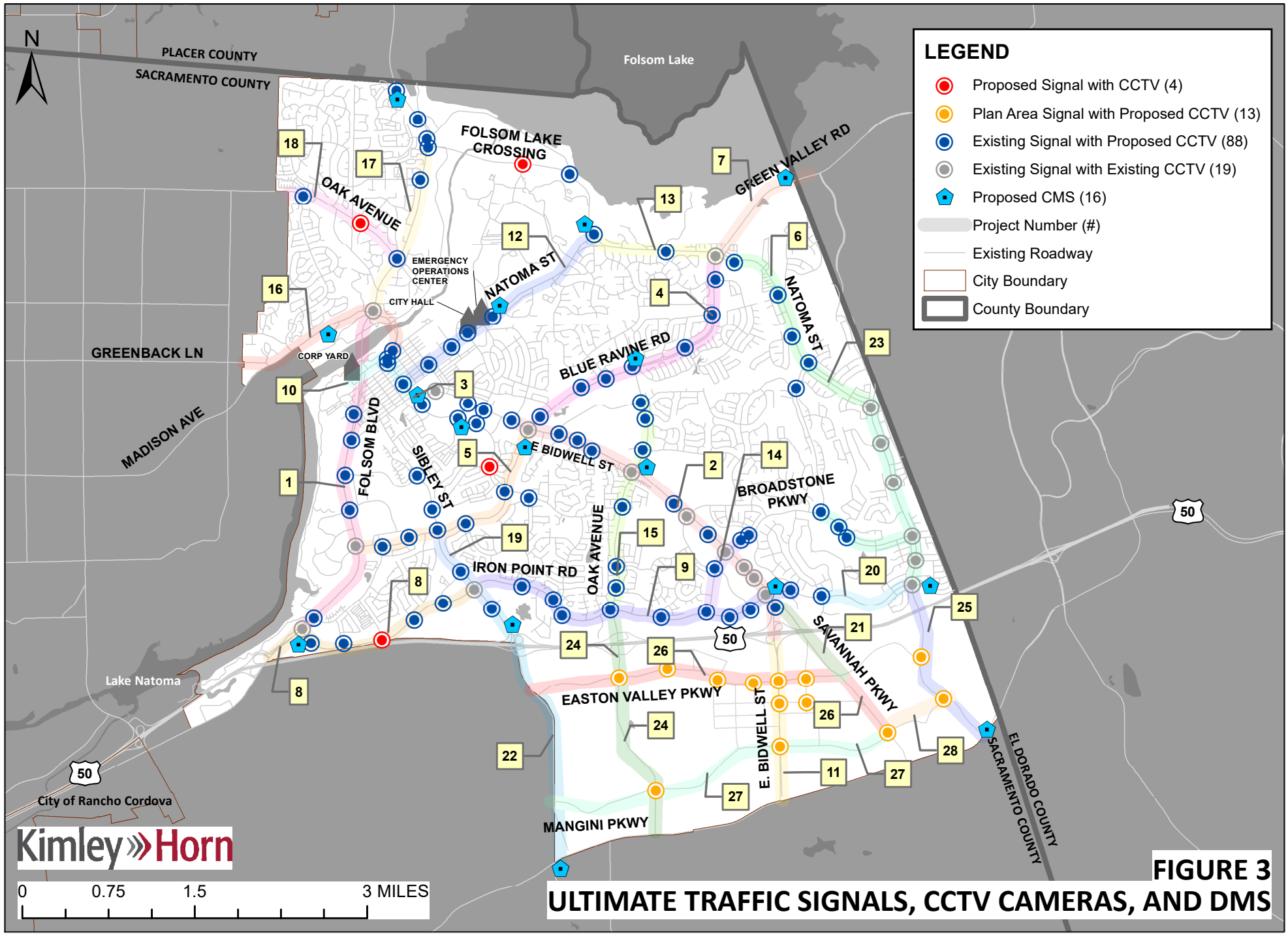


FIGURE 3
ULTIMATE TRAFFIC SIGNALS, CCTV CAMERAS, AND DMS

1. **Extent that project achieves local objectives (14)** – project emphasizes addressing local needs
2. **Adaptable to new technology (13)** – can handle new technology without needing to be replaced
3. **Safety (13)**
4. **Addresses multijurisdictional networking (10)** – contributes to a multijurisdictional solution
5. **Improves reliability and consistency of driver trips (10)** – traveler information to drivers helps them make informed and real-time decisions
6. **Improves traveler information and dissemination (10)** – provides more and better information about roadway conditions and multimodal options
7. **Contributes to operational and institutional efficiency (10)** – enables staff to more efficiently manage the transportation network
8. **Enhances major corridors (10)** – corridors that serve more people than other corridors
9. **Emergency/disaster preparedness (5)** – better information to public and more robust system
10. **Other projects rely on this project (5)** – this project must be done before other projects can begin

Each project was given a subjective score of zero (0) to four (4) for each criterion based on its relevancy to the criteria. Project scores were totaled and ranked to identify the highest priority projects.

This Plan is intentionally structured to be agile and flexible in its implementation to enable the City to quickly identify a candidate project with a concise set of actions and next steps as funding becomes available and opportunities arise, or to reprioritize projects based on specific areas of emphasis.

Cost Estimations

Planning level cost estimations were prepared to reflect an order-of-magnitude cost for each project. A summary of specific costs and considerations related to implementing Smart Region elements is provided for each strategy where a cost can be reasonably estimated. **Appendix C – Cost Assumptions** summarizes the cost assumptions that were used to provide planning level cost estimations for each project, if applicable. These assumptions include a detailed breakdown of capital component costs and acknowledges the project development, design, construction, integration, and operations and maintenance costs associated with each project. The cost information is a planning-level estimate to deploy each project, based on available current (2018) pricing information for similar technology projects in the region.

Throughout development of projects, a distinction was made between projects that carry a cost and those that carry little to no cost. Projects that have costs may require initial capital investments and subsequent ongoing operations and maintenance (O&M) costs. Examples of these projects would be the deployment of new field infrastructure or upgrades to existing Traffic Operations System elements. No cost projects tend to fall into the institutional category and can be deployed with little to no cost and no future O&M costs. Examples of these projects would be the creation of a set of security guidelines, an interjurisdictional agreement, changes to a policy, or completing performance measurement analysis.

List of Prioritized Projects

A summary of prioritized projects is presented in **Table 4**.

Table 4 – Project Summary

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
1	Folsom Boulevard - Greenback Lane to Iron Point Road	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; deployment of transit signal priority; and traffic signal cabinet and controller upgrade.	$ 2,689,100
2	E. Bidwell Street - Coloma Street to Highway 50	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; installation of communication hub; and traffic signal cabinet upgrade.	$ 2,963,800
3	Riley Street Street - Leidesdorff Street to Glenn Drive	Project includes enhanced communication infrastructure through replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; deployment of transit signal priority; and traffic signal cabinet and controller upgrade.	$ 895,300
4	Blue Ravine Road - E. Natoma Street to E. Bidwell Street	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; installation of communication hub; and traffic signal cabinet and controller upgrade.	$ 2,442,000
5	Blue Ravine Road - E. Bidwell Street to Folsom Boulevard	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; and traffic signal cabinet and controller upgrade.	$2,171,300
6	E. Natoma Street - Blue Ravine Road to Golf Links Road	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; upgrade of intersection fiber	$ 1,214,500

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
		equipment; installation of DSRC radio units; deployment of ATSPM; installation of communication hub; and traffic signal cabinet and controller upgrade.	
7	Green Valley Road - E. Natoma Street to Sophia Parkway	Project includes enhanced communication infrastructure through installation of new interconnect; and installation of CMS.	$ 1,095,700
8	Iron Point Road - Premium Outlets Driveway to Prairie City Road Folsom Boulevard - Iron Point Road to County Line	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; and traffic signal cabinet and controller upgrade.	$ 2,326,000
9	Iron Point Road - Prairie City Road to Serpa Way	Project includes enhanced communication infrastructure through replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of DSRC radio units; deployment of ATSPM, and traffic signal cabinet and controller upgrade.	$ 2,151,300
10	Leidesdorff Street -Riley Street to Burnett Street	Project includes enhanced communication infrastructure through replacement of legacy equipment.	$ 71,300
11	E. Bidwell Street - Highway 50 to Plan Area City Limit Line	Project includes enhanced communication infrastructure through installation of new interconnect.	$ 1,278,300
12	Natoma Street and E. Natoma Street - Riley Street to Folsom Lake Crossing	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; and traffic signal cabinet and controller upgrade.	$ 1,993,200
13	E. Natoma Street - Folsom Lake Crossing to Blue Ravine Road	Project includes enhanced communication infrastructure through installation of new interconnect; deployment of vehicle video detection; installation of CMS; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; deployment of ATSPM; and traffic signal cabinet and controller upgrade.	$ 1,161,600
14	Broadstone Parkway - Cavitt Drive to Iron Point Road	Project includes enhanced communication infrastructure through replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal cabinet and controller upgrade.	$ 631,400

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
15	Oak Avenue Parkway - Creekside Drive to Iron Point Road	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal cabinet and controller upgrade.	$ 2,165,700
16	Greenback Lane - Riley Street to Main Avenue	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CMS; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal cabinet and controller upgrade.	$ 1,720,500
17	Folsom-Auburn Road - Folsom Lake Crossing to Greenback Lane	Project includes enhanced communication infrastructure through installation of new interconnect; deployment of vehicle video detection; installation of CMS; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal cabinet and controller upgrade.	$ 2,366,900
18	Oak Avenue Parkway - Folsom-Auburn Road to East City Limit	Project includes enhanced communication infrastructure through installation of new interconnect; deployment of vehicle video detection; installation of CMS; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal cabinet and controller upgrade.	$ 1,430,800
19	Prairie City Road - Blue Ravine Road to American Aggregate Road	Project includes enhanced communication infrastructure through installation of new interconnect and replacement of legacy equipment; deployment of vehicle video detection; installation of CMS; installation of CCTV cameras; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal cabinet and controller upgrade.	$ 803,800
20	Iron Point Road - Serpa Way to Empire Ranch Road	Project includes enhanced communication infrastructure through installation of new interconnect; deployment of vehicle video detection; installation of CMS; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal controller upgrade.	$ 788,000
21	Placerville Road - East Bidwell Street to Highway 50	Project includes enhanced communication infrastructure through installation of new interconnect; deployment of vehicle video detection; upgrade of intersection fiber equipment; installation of DSRC radio units; and traffic signal controller upgrade.	$ 315,700
22	Prairie City Road - American Aggregate Road to Manjini Parkway	Project includes enhanced communication infrastructure through installation of new interconnect and CMS.	$ 2,449,100

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
23	E. Natoma Street – Golf Links Drive to Empire Ranch Road	Project includes enhanced communication infrastructure through installation of new interconnect.	$ 612,900
24	Oak Avenue Parkway - Iron Point Road to Plan Area City Limit	Project includes enhanced communication infrastructure through installation of new interconnect.	$ 1,838,700
25	Empire Ranch Road - Iron Point Road to Plan Area City Limit	Project includes enhanced communication infrastructure through installation of new interconnect, installation of CCTV cameras, and installation of CMS.	$ 1,376,000
26	"Easton Valley Parkway - Prairie City Road to Savannah Parkway Savannah Parkway - Placerville Road to Manjini Parkway"	Project includes enhanced communication infrastructure through installation of new interconnect.	$ 2,627,000
27	Manjini Parkway - Prairie City Road to Savannah Parkway	Project includes enhanced communication infrastructure through installation of new interconnect.	$ 2,758,000
28	Manjini Parkway - Savannah Parkway to Empire Ranch Road	Project includes enhanced communication infrastructure through installation of new interconnect.	$ 551,600
		Unprioritized Projects	
N/A	Develop Center-to-Center Network for Sharing CCTV Imagery	Region will set up a network to share CCTV camera imagery	See Regional Document
	Adaptive Traffic Control for the Signalized Intersections Along Key Corridors	Deploy adaptive traffic control on key corridors	$ 1,361,000
	Traffic Operations Center (Local) TOC Site Evaluation TOC Standard Operating Procedures and Functional Requirements	Upgrade agency TOC	$ 130,000
	Support of Regional Technology Procurement Contract Development	Provide support during establishment of reginal technology procurement contract	See Regional Document

Priority No.	Project Corridor	Project Description	Planning Level Cost Estimate
	CV/AV Roadside Technology Evaluation	Staffing to evaluate need for CV/AV technology	$ 38,880

FUNDING

Implementation of many of the projects identified by this Plan are contingent upon acquiring additional funding. The following are potential funding opportunities for ITS infrastructure and systems that are described in additional detail below.

- Local Funding Programs
- SACOG Funding Programs
- State Funding Programs
- Federal Funding Programs
- Grants/Pilot Programs
- Other Funding Types

Local Funding Programs

The City of Folsom has a Capital Improvement Program (CIP) established on an annual basis. Each CIP outlines suggested transportation improvements and includes a corresponding budget. The 2018-2019 CIP involves signal and striping modifications, streetlight/pole improvements, traffic safety improvements, traffic signal upgrades, etc. Not all projects outlined in the CIP are related to ITS improvements, but the local CIP indicates budget available for transportation-specific projects.

SACOG Funding Programs

SACOG offers a variety of different annual funding programs for public agencies within the region. The funding programs relevant to ITS projects are shown in **Table 5**.

Table 5 – SACOG Funding Programs

Program	Funding Amount	Criteria	Performance Outcomes Measured for Selection
Regional Program	$92,586,000 Amount given and to how many projects will vary depending on applicants	• Eligible for CMAQ, RSTP or STIP funds • Listed in recent MTP/SCS or fit within a lump-sum project category • Must match 11.47% of award with non-federal funds • Begin construction or operation before April 2025	• Reduce regional VMT per capita • Reduce regional congestion VMT per capita • Increase multi-modal or alternative travel choices • Provide long term benefits, sustaining both rural and urban economies • Improve movement of goods, in and through the region • Improve safety and security • Maintain and improve upon the existing transportation system

Program	Funding Amount	Criteria	Performance Outcomes Measured for Selection
Green Region	$11,760,000 Amount given and to how many projects will vary depending on applicants	• Eligible for CMAQ, RSTP or STIP funds • Must match 11.47% of award with non-federal funds • Begin construction or operation before April 2021 • Request for construction funding demonstrates that environmental, engineering and right-of-way will be ready by the time funds are requested • Agency is capable of on-going O&M costs	• Reduce regional VMT per capita • Increase multi-modal or alternative travel choices • Advances the use of electric and other zero-emission vehicles • Project exists within at least one of the Green Region Plan program areas
TDM Innovations Grant	$750,000 Awards of $25,000-$150,000 per project	• El Dorado, Placer, Sacramento, Yuba, Yolo and Sutter Counties • Must match 11.47% of award with non-federal funds • Program must be active within 2 years of an agreement being signed • Include a detailed project budget and how funding will be used • Must demonstrate link between project and grant program's goal to reduce SOV trip and miles • Demonstrate how the project will serve underserved or insecure communities • Demonstrate creativity and appeal to a broad audience	• Innovative and Uniqueness of Project (40pts) • Potential for project to reduce motor vehicle trips and miles (15pts) • Target/Market Audience Development (15pts) • Description of plan to measure VMT reductions, data collection/analysis and project modification/adaptability (25pts) • Budget & project cost/participant (5pts)
Regional Active Transportation Program	$11,664,000 ($439,560 Statewide) Amount given and to how many projects will vary depending on applicants	• Projects must first complete in Statewide ATP program before being eligible for smaller MPO programs • Must match 11.47% of award with non-federal funds	• Disadvantaged communities • Potential to increase users (biking/walking) • Public participation and planning • Potential to reduce crashes (fatalities and injuries)

Program	Funding Amount	Criteria	Performance Outcomes Measured for Selection
Metropolitan Transportation Improvement Program	Varies based on available federal and state funds	• Projects must be included in the Metropolitan Transportation Plan (MTP) • Application opportunity every odd year	• Prioritized alongside other submitted projects. Funds are allocated based off prioritization.

State Funding Programs

The State Highway Account is essentially a bank account that funds a variety of California programs for transportation and traveler mobility purposes. The SHA receives its funds from the State Base Excise Tax and the Federal Highway Trust Fund. The programs that are relevant to Smart Region projects are described in **Table 6**.

Table 6 – State Transportation Funding Opportunities

Program	Important Dates	Funding Information	Criteria
State/ Regional/ Interregional Transportation Improvement Program (STIP/RTIP/ ITIP)	• Multi-year CIP • Cycle begins in odd-numbered years with the release of fund estimate in July. • December 15th of odd-numbered years the ITIP/RTIP/STIP is submitted • Next opportunity for this funding will be July, 2019	• Local agencies work with their MPO to get their projects included in the RTIP for nomination	• Must include a Project Study Report (PSR) or an equivalent for non-State Highway projects • Caltrans/Regional Consultations for projects to be included in the STIP/RTIP/ITIP • Evaluated on how the project aligns with furthering regional objectives, particularly for Sustainable Communities Strategies • STIP Guidelines
California Transportation Commission Active Transportation Program (CTC ATP)	• Distributed annually	• 40% of funds go to MPO's in urban areas • 10% of funds go to small urban or rural communities and awarded by the Commission on a competitive basis • The remaining 50% is competitively distributed on a statewide basis	• Selected through a competitive process and meet one or more ATP program goals. • Minimum funding request is $250,000 • ATP Guidelines

Federal Grant/Pilot Funding Programs

Many federal programs distribute money directly to the State, which distributes the funds based on local policies or award programs. One example of this type of funding is described above in the State Highway Account which receives a portion of its funding from federal programs. Other programs are described below.

Surface Transportation Block Grant Program (STBG):
The STBG is an approved funding program through at least 2020. Infrastructure-based ITS capital improvements, including the installation of vehicle-to-infrastructure communication equipment, are eligible for the grant. In addition, operational improvements (including capital and operations costs) for traffic operations facilities, environmental measures, and some parking strategies are eligible. The project must be identified in a Statewide Transportation Improvement Program (STIP) and be aligned by long range Metropolitan Transportation Plans. Federal share is generally 80% although there are stipulations that allow for a full 100% share or as low as 50% federal share and is determined by project type per 23 U.S.C. 120.

Better Utilizing Investments to Leverage Development (BUILD) Grants:
The BUILD program has replaced the Transportation Investment Generating Economic Recover (TIGER) grant program and grants are awarded on a competitive basis for projects with significant regional or local impacts. These grants are designed to benefit surface transportation systems while providing further support to rural communities. A greater share of BUILD grants will be awarded to projects located in rural areas. $1.5 billion dollars has been made available for BUILD grants through September 2020. BUILD funds may cover up to 80% of project costs in urban areas and 100% of project costs in rural areas. During the 2018 cycle, the maximum project award is $25 million and a single state cannot receive more than $150 million. The application deadline for BUILD grants is late July of each year.

The Nationally Significant Freight and Highway Projects (INFRA) Program: The INFRA Grants program provides dedicated, discretionary funding for projects that address critical issues facing our nation's highways and bridges. In 2018 approximately $1.5 billion in INFRA Grants will be awarded to projects across the country.

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD):
ATCMTD is a competitive grant program that funds projects related to many ITS objectives. The grant serves to fund installation of transportation technologies that can improve efficiency, safety, and system performance. A state, local, transit, or Municipal Planning Area (MPA) agency is eligible to apply. In addition, a multijurisdictional group can apply with a signed agreement. A maximum of $60 million is available each fiscal year through 2020. A 50% minimum local match is required. Single project awards will not exceed $12 million and there will be between 5 and 10 grants awarded. Applications are invited during the Spring of each year.

Other Funding Types

Other funding opportunities that the City could utilize to help support their ITS Program include:

Safety/Emergency Projects/Initiatives:
Partnering with other departments or emergency/safety agencies to include ITS components or to identify additional data that can be obtained from emergency/safety service systems could be mechanisms used to expand the ITS program or data that is available. An example might be a project to upgrade the radio network of the Police Department, or dynamic emergency vehicle routing.

Establishing Open Funding Streams:
Some states and MPOs have developed alternative methods for financing congestion reduction efforts, including ITS projects. Supplemental traditional funding sources could include: tolling, local/regional sales tax measures, or other fees; and developing partnerships with private industry.

Public/Private Partnerships (P3s):
P3s can provide alternative funding sources for transportation projects when a public agency enters into a partnership/agreement with a third party private company. Essentially, the public agency brings in a private-sector firm who provides development, operation, and financing mechanisms for the transportation project. P3s have become more popular as public resources become more limited and the demand for improved transportation systems continues to increase. There are benefits and limitations to engaging in a public/private partnership, so it is important to weigh those factors prior to P3 implementation.

OPERATIONS AND MAINTENANCE

To effectively operate and maintain the various project elements and projects identified in this Implementation Plan, the City of Folsom must be adequately staffed and prepared to sustain the system after it is deployed. Operations and maintenance procedures are essential to define the appropriate staffing levels, training, operational processes, and maintenance plans necessary to sustain an effective system.

Staffing

Staffing serves the operations side of the Implementation Plan. The successful implementation of operations strategies is largely dependent on providing appropriate staffing relative to the increase in operational capabilities.

The City of Folsom has experienced a steady population growth over the last couple decades. The population was recorded as just over 78,000 people in 2017 which is a 1.1% increase from 2016. The population in Folsom in 2000 was just under 56,000 people, which indicates an approximate 50% growth rate over the last 17 years. The City leaders, especially those in the transportation field, are aware of the growth and are attempting to prepare for accommodating the growing population. While growth in the City is a positive, the City must make sure that it is planning for the projected growth as it

takes on more projects, expands its infrastructure and services, and offers more to residents and visitors.

The City of Folsom transportation department currently has six (6) employees.

- One (1) Engineering Operations Manager
- One (1) Associate Traffic Engineer
- Four (4) maintenance staff members.

The City plans to establish a TOC but does not intend to assign dedicated staff for the TOC. However, it is acknowledged that the City will need one or more staff members whose primary responsibilities are operating and managing the ITS network. Currently, operations and management is one of the many duties and responsibilities of the Engineering Operations Manager and Associate Traffic Engineer. The City also has expressed the desire for a dedicated IT person to maintain the ITS communication network.

Staffing the Smart Region Program

The City of Folsom should follow a well-crafted staffing plan that addresses five key objectives:

1. Ensure appropriate staffing levels based on increasing and aging assets;
2. Ensure the organization employs staff with the requisite knowledge, skills, ability, and other characteristics in the appropriate positions when needed;
3. Ensure that the organization adapts to changes internally and externally;
4. Provide a systematic approach for human resource management; and
5. Provide a shared vision of human resource functions.

Table 7 provides recommended ratios for the number of devices or signals to warrant one staff person for small, medium, and large jurisdictions based on the total number of devices or signals the jurisdiction is expected to operate and maintain. Operations staff are responsible for daily monitoring and use of transportation management assets. Engineers are responsible for conducting analysis of system performance and developing solutions. Maintenance staff are responsible for preventative and routine servicing of field assets.

Table 7 – Staffing Ratios for Operations and Maintenance

Equipment Total Values	Number Of:	Small	Medium	Large
Total	Signals	< 50	50 – 200	> 200
Total	Devices	< 100	100 – 300	> 300
Recommended Staffing Ratios	**Number Of:**	**Small**	**Medium**	**Large**
Operations	Devices	25 : 1	50 : 1	75 : 1
Engineer	Devices	100 : 1	100 : 1	100 : 1
Maintenance/Technicians	Signals	40 : 1	40 : 1	40 : 1
Maintenance/Technicians	Devices	100 : 1	100 : 1	100 : 1

** Using ITE recommendations for staffing ratios per device from Traffic Control Systems Operations – Installation, Management and Maintenance which recognizes the difference between large, medium, and small agency size ratios. Values were verified to be consistent with other more recent sources such as Traffic Signal Operations and Maintenance Staffing Guidelines (FHWA-HOP-09-006) and other agency publications around the country.*

With 104 signals traffic signals and 31 devices, the City of Folsom is considered a medium-sized agency. **Table 8** provides a summary of the existing and future number of devices and staff recommendations to support the desired infrastructure and functionality envisioned through this Plan. As shown, recommended staff under full build out conditions includes up to 3 ITS/traffic operations staff, 2 engineering staff, 3 signal maintenance staff and 2 device maintenance staff.

Table 8 – Staffing Recommendations for SACOG Agency Stakeholders

City of Folsom	Devices*	Operations Staff - Devices (50:1)	Engineering Staff – Devices (100:1)	Traffic Signals	Maintenance Staff – Signals (40:1)	Maintenance Staff – Devices (100:1)
Existing Conditions	31	1	1	104	3	1
Full Buildout	216	3	2	124	3	2

**ITS equipment includes: traffic signals, vehicle detection devices, emergency vehicle preemption devices, CCTV cameras, CMS, miles of fiber and wireless radios.*

Staffing Considerations

While the City of Folsom currently appears to be adequately staffed with regards to engineering and signal staff, the City does not meet operations staffing. Adding additional ITS infrastructure and functionalities that are desired by the City and identified within this Plan will require an increase in resources to account for staffing needs for the Smart Region program. To address this challenge, it is recommended that a process be put in place as part of the capital project programming process for traffic signals and other ITS communications projects that requires consideration of the staffing resources needed to operate and maintain the new infrastructure in addition to existing infrastructure.

There are regional staffing structures for operations and maintenance that are being recommended to SACOG to help support individual local agencies and their ability to support Smart Region initiatives. These regional structures may alleviate some of the need for additional staffing at the City level, although it is recommended that each individual agency evaluate their own staffing needs once additional equipment and infrastructure is implemented.

When planning for additional or adjusted staffing to account for Smart Region improvements, the City should consider the following:

- **Heightened Skill Set** – Central management systems are undergoing fundamental changes, including the introduction of more sophisticated technologies, a shift to integrated operations (multiagency, multimodal), and improvements to customer service capabilities. The increased demand for services and changes to central management system operations affects staffing skill sets. Increasing demand requires more employees and the necessary knowledge, skills, and abilities to handle the demand. In many cases, personnel required to manage multijurisdictional systems have an Information Technology background and skill set that includes network management, software development, database administration, and application troubleshooting. Although engineering skill sets, or a professional license may be warranted for specific activities such as signal timing plan development, an engineer may not always be necessary to fulfill other agency functions. Each agency should consider a combination of personnel skill sets as they relate to the individual agency requirements to fulfill operational functions.
- **Redundant Support Structure** – It will be important to foster and maintain staff skills and redundancy through greater training and cross-training so that there is more than one person with the knowledge and skill set required to operate and maintain ITS equipment and systems.
- **Central System Management Architecture** – Another major factor that has a significant impact on staff planning is whether the central management system operations function out of a traditional TMC with workstations and a video wall, or if the central management system is operated on a virtual basis with a few City offices having permissions level access to certain parts of the system.

Maintenance Plan

Planning for ITS operations and maintenance costs is a critical component when developing an implementation project. Operation and maintenance of ITS technologies and systems extends beyond simply keeping the equipment working. The City will need to maintain ITS devices and systems and will require appropriate training to serve in that role. Reacting to emergency failure conditions, maintaining accurate maintenance logs, and conducting preventative maintenance programs all require fully-trained staff. Maintenance of ITS devices will require an allocation of funds within the City budget. A maintenance management system can also be used to track failures and decrease the time needed to repair the failures.

The maintenance plan identifies the criteria for replacement and preventative maintenance and the need for ongoing support for ITS devices and systems. The number of devices and systems that need to be maintained throughout the City will increase in the near-term based on the programmed ITS infrastructure projects. These devices and systems need to be appropriately maintained and effectively operated to provide accurate, reliable, and timely information.

The following three maintenance types are included in this section to recommend maintenance activities based on general guidelines for each type of device, rather than required activities, to allow

the City to identify areas where maintenance activities could be introduced based on resource availability:

- **Preventative Maintenance** – What to do to prevent failure – This encompasses a set of checks and procedures performed at scheduled intervals including inspection, record keeping, cleaning, and replacement.
- **Responsive Maintenance** – What to do when something fails – This is the initial reply by field maintenance staff to an ITS subsystem or malfunctioning device. Response maintenance includes minor maintenance activities, major maintenance activities, and major rehabilitation/upgrade activities.
- **End-of-Life Replacements and Upgrades** – What to do when something cannot be fixed – This can be required if the device has experienced frequent malfunctions, failures, or has reached end-of-life and it is more cost-effective to replace the technology rather than continue to maintain it.

Roles and responsibilities, maintenance guidelines, and requirements of the staff should be developed to define preventative maintenance, responsive maintenance, and replacement of ITS devices and systems.

Preventative Maintenance

Preventative maintenance is performed to ensure the reliability and longevity of the mechanical and electrical operations of the system and will reduce equipment failures, response maintenance, road user costs, and liability exposure. Preventative maintenance involves repetitive upkeep to allow devices and systems to operate efficiently and effectively to maximize the operating lifespan of ITS devices. Preventative maintenance includes minor and major maintenance needs, making the frequency of maintenance an important consideration.

The preventative maintenance activities and frequency varies by device, device components, and system, which are outlined in **Table 9**. The City can refer to this table when incorporating new signals, new ITS infrastructure, or new staff. The City should review and revise the preventative maintenance procedures on an annual basis to ensure new issues are being addressed and equipment is being properly maintained.

Table 9 – Preventative Maintenance Recommendations

Intersection PM Checklist	Recommended Interval
Interior Cabinet Check	
Clean Cabinet Interior Check controller lamp and door switch Check filter Check door fit and gasket Check locks and hinges Check/verify for cabinet timing and log sheet Check field block terminal connections Signal controller battery backup check	Every six-months (current City interval)
Check conflict monitor indications Check all detectors	Every six-months (current City interval)
Exterior Cabinet Field Check	
Check condition of cabinet exterior Check all signal indications Check all pedestrian indications Check pole conditions and hand hole covers	Annual
Check all signal head back plates and visors Check alignment of signals and pedestrian heads Check condition of pull boxes and lids	Quarterly
Intersection Field Check	
Visual check of all traffic signs at intersection Visual check of intersection luminaries	Monthly
Visual check of all traffic loops	Quarterly
Visual check of other traffic system related cabinets	Annual
Typical CCTV Checklist Items	
Visual check of assembly CCTV receiver Video transmitter Fiber distribution unit Cabinet equipment Pole or exterior condition	Annual
Typical Message Sign Check List Items	
Field intersection Sign panel Pull boxes Cabinet exterior Cabinet interior Re-lamping	Every six-months

Responsive Maintenance

ITS devices and systems have specific maintenance requirements per the manufacturer's maintenance manual of each device. There are three types of maintenance that ITS devices require to fulfill their intended design for operations and lifecycle:

- **Minor Maintenance** – Minor maintenance includes tasks which can be carried out without large scale testing or the use of heavy equipment. It includes visual inspections and checking of many items, elementary testing, cleaning, lubricating, rebooting/resetting, and minor repairs that can be carried out with hand tools or portable instruments.
- **Major Maintenance** – As well as all items normally done under minor maintenance, major maintenance also includes extensive testing, overhauling and replacement of components, which may require a scheduled power outage and the use of bucket trucks or other heavy equipment.
- **Major Rehabilitation** – Major rehabilitation or complete replacement is contemplated for devices that experience frequent or recurring malfunctions or failures.

Table 10 identifies a rule-of-thumb frequency of minor and major maintenance and major rehabilitation for a range of ITS devices that the City will be implementing. These guidelines should be reviewed and updated annually to reflect actual needs in the City of Folsom.

Table 10 – ITS Device and Network Communications Maintenance Guidelines

Equipment	Minor Maintenance	Major Maintenance	Major Rehabilitation
Traffic Signal Systems			
Cabinets	26 weeks	2-5 years	10 years
Signal Heads	26 weeks	2-5 years	10 years
Electronics	13 weeks	N/A	N/A
Traffic Signal Controller	26 weeks	2-5 years	10-15 years
Poles	26 weeks	5 years	15 years
CCTV Camera Systems			
PTZ Units	26 weeks	1 years	3 years
Changeable Message Signs			
Sign Case	-	26 weeks	1.5 years
Protective Devices	26 weeks	1 year	2 years
Pixels, Modules and Drivers	-	26 weeks	3 years
Controllers	-	26 weeks	3 years
Vehicle Detection Systems			
Cabinets	-	26 weeks	10 years
Power Supply	26 weeks	5 years	10 years
Emergency Vehicle Preemption (EVP) / Transit Signal Priority (TSP)	26 weeks	2-5 years	10 years
Loop Detection (per approach)	26 weeks	1 year	5 years
Video Detection (per intersection)	26 weeks	1 year	5 years
Travel Time Readers (per location)	26 weeks	1 year	5 years
Pedestrian Detection (per intersection)	26 weeks	1 year	5 years
Grounding	-	2-5 years	10 years
Controllers	-	26 weeks	3 years
Telecommunication Systems			
Fiber Optic Cable Plant	1 year	5 years	25 years
Communication Switches (field)	26 weeks	1 year	3 years
Wireless Radio Spread Spectrum	26 weeks	4 years	10 years

Equipment	Minor Maintenance	Major Maintenance	Major Rehabilitation
TMC Equipment			
Servers	26 weeks	1 year	2 years
Communication Switches (TMC/Hub)	26 weeks	1 year	3 years
Rack Equipment	-	1 year	2 years
Workstations	26 weeks	2 years	2 years
Workstation Displays	26 weeks	1 year	3 years
Uninterruptable Power Supply	1 year	5 years	10 years

Data source: Recommended Practice for Operations and Management of ITS (ITE Publication); and International Municipal Signal Association (IMSA) Preventative Maintenance of Traffic Signal Equipment Program.

Development or integration of a maintenance tracking system would be beneficial to keep an inventory of maintenance activities that have occurred on each device. The City's responsive maintenance tracking should consist of the following maintenance activities:

- Failure detection;
- Work order creation;
- Dispatched resources;
- Response activities;
- Diagnosis;
- Interim repairs; and
- Work order close out.

This tracking will allow the City to identify devices that are not reliable or accurate or have had frequent malfunctions. The tracking will also allow the City to identify appropriate cases for technology replacements where maintenance of an existing technology may be costlier than upgrading to a newer technology. Developing periodic reports and then reviewing those reports are critical to being able to identify frequently failing devices for replacement.

End-of-Life Replacements and Upgrades

End-of-life replacement strategies and upgrades are an important aspect of technology projects because equipment and infrastructure needs to be maintained and/or replaced in a routine manner. Equipment replacement is required if a device has exceeded its life expectancy, either through a sunsetting of manufacturer servicing or a failure in legacy equipment. Equipment upgrades are required when additional functionality is needed that cannot be provided by legacy equipment. This section provides information about what the City of Folsom's replacement needs are, recommended equipment lifecycle timeframes, and mechanisms available for procurement and maintenance.

Agency Replacement Needs

The City of Folsom should establish an inventory of modernized, supplemental traffic and ITS equipment for replacement of devices in the field as they reach end-of-life or become broken. A typical method for establishing an inventory is to keep 10% of existing field devices for each type. A proper inventory of devices and spare parts that can be accessed to conduct routine and emergency

maintenance also needs to be built into the City's budget cycle. As an example, for every 100 cameras deployed across the transportation network, the City should have at a minimum ten (10) cameras in inventory to be able to be responsive and make repairs/replacements when needed.

Lifecycle Replacement

To adequately prepare for necessary infrastructure updates in the future, the City should consider the estimated lifespan of its infrastructure. Lifecycle replacement mechanisms will need to be developed to stay up-to-date on equipment replacement needs and emerging technology availability. **Table 11** should be used as a reference tool for the City of Folsom so that equipment remains current and performs at an optimal level.

Table 11 – Anticipated Technology Lifecycle Timeframes

Equipment	Anticipated Lifecycle Timeframe (Years)
Traffic Signal Systems	
Cabinets	20
Signal Heads	20
Electronics	10
Traffic Signal Controller	15
Poles	50
CCTV Camera Systems	
PTZ Units	10
Changeable Message Signs	
Sign Case	10
Protective Devices	10
Pixels, Modules and Drivers	6
Controllers	6
Vehicle Detection Systems	
Cabinets	20
Power Supply	20
Emergency Vehicle Preemption (EVP) / Transit Signal Priority (TSP)	10-15
Loop Detection (per approach)	5-15
Video Detection (per intersection)	10
Pedestrian Detection (per intersection)	10
Grounding	25
Controllers	7
Telecommunication Systems	
Fiber Optic Cable Plant	25
Communication Switches (field)	5-8
Wireless Radio Spread Spectrum	20
TMC Equipment	
Servers	5
Communication Switches (TMC/Hub)	5-8
Rack Equipment	5
Workstations	5
Workstation Displays	5
Uninterruptable Power Supply	20

Agency Replacement Strategy

As noted in the existing conditions, the majority of existing controllers are legacy controllers that are not compatible with the Econolite Centracs system that the City is converting to. As such, the City should plan to upgrade controllers each year. It is recommended that the City target a standardization of controllers within the next five years. Since, the City has over 80 traffic signals that need to be converted to Econolite controllers, at least 16 controllers should be replaced in each year until the conversion is complete. These replacements could be completed in conjunction with the implementation projects recommended as a part of this plan, but others will need to be replaced through a separate project.

Of the City's existing 10 CCTV cameras, half are less than 3-years old and will not have to be replaced soon. However, the other half are approaching 6 and 7-years since deployment, so the City should program replacement funds for these cameras in the next several years as they reach the anticipated lifecycle of 10-years.

For other traffic signal equipment, opportunities for replacement and upgrades should be evaluated in conjunction with the recommended corridor enhancement projects recommended as a part of this plan.

PERFORMANCE METRICS

Performance metrics are used to evaluate and demonstrate the effectiveness of the City of Folsom's implementation projects in addressing local and regional goals and objectives. Recommended data types, data sources, and calculations to evaluate performance of projects are provided in **Table 12** for each of the overall project objectives. As projects are delivered, the City of Folsom can use these metrics as a guideline to evaluate projects.

Table 12 – Performance Metrics to Perform Project Evaluations

Objective	Performance Metric	Data Type	Source	Calculation
Improve Access to Traffic Data	Increase Capacity of Communications Network	Fiber/Wireless/Bandwidth Usage	TMC System	Measure communications network capacity before and after ITS device deployment
	Reduced Downtime	System Errors/Failure	System Operations	Compare Downtime Incident Occurrences before and after project implementation
	Reduced Public Complaints	Public Feedback and Complaints	TMC and other Operator Records Online Surveys and Focus Groups	Compare the amount and responses of public complaints/input related to inconsistency/ unreliability from before and after implementation project

Objective	Performance Metric	Data Type	Source	Calculation
Automate and optimize traffic operations to maintain lower staffing levels	Reduced Travel Time and Delay	Travel Time,	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation along coordinated corridors
	Intersection Operations: Reduced Queues, Stops, % Arrivals on Greens, Emissions, and Saturation Levels	Turning Movement Counts, and ADT Volumes	Agency TMC	Compare traffic signal operations before and after project implementation, calculate percentage change.
	Reduce Response Time to Device Failures	Response Time	TMC and Dispatch Records	Measure reduction in response times before and after project implementation
	Reduced Public Complaints	Public Feedback and Complaints	TMC and other Operator Records Online Surveys and Focus Groups	Compare the amount and responses of public complaints/input related to inconsistency/ unreliability from before and after implementation project
Expand transit connections and operations	Reduced Travel Time and Delay	Travel Time	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation along transit corridors
	Increased Transit Ridership	Sales/Revenue	Transit TMC and Transit Provider Records	Count ridership levels before and after project implementation, calculate percentage change
Accommodate **smart** transportation **strategies** for urban, suburban, and rural communities	Reduced Travel Time	Travel Time	Agency TMC	Travel time in minutes between Point A and Point B prior to and after project implementation
	Increased Transit Ridership	Sales/Revenue	Transit TMC and Transit Provider Records	Count ridership levels before and after project implementation, calculate percentage change
	Incident detection by CCTV cameras	CCTV Images	Agency TMC	Count incidents that are detected via CCTV camera before being identified by public
	Accurate Travel Time Estimates (particularly focused on rural and suburban communities w/ commuting needs)	Travel Times	Agency TMC	Compare travel times estimated and actual travel times to verify accuracy for those commuting into urban centers from rural or suburban communities

Objective	Performance Metric	Data Type	Source	Calculation
Prepare for **smart** region **infrastructure** adapting to new technology	Number of hours (in 6-month intervals) of continued education or training completed by staff	Training Hours	CE courses, Vendor Training Seminars, etc.	Count hours staff spent attending new technology trainings or pursuing certifications
	System Readiness for CV/AV Technology Integration	CV/AV Technology (Device and Data)	TMC System	When applicable, monitor CV/AV technology integration and compare qualitatively or quantitatively with other region's technology integration experiences
	Number of Smart Region Trial Projects	Project Deployments	Agency TMC	Count the number of project deployments and compare qualitatively or quantitatively with other region's technology integration experiences
	Increase Capacity of Communications Network	Fiber/Wireless/Bandwidth Usage	TMC System	Measure communications network capacity before and after ITS device deployment
Reduce user frustration by providing **consistency and reliability**	Reduced Downtime	System Errors/Failure	System Operations	Compare Downtime Incident Occurrences before and after project implementation
	Reduced Public Complaints	Public Feedback and Complaints	TMC and other Operator Records Online Surveys and Focus Groups	Compare the amount and responses of public complaints/input related to inconsistency/ unreliability from before and after implementation project
	Reduce Response Time to Device Failures	Response Time	TOC and Dispatch Records	Measure reduction in response times before and after project implementation
	Increase percent of field device that are operational	Operational Devices	Asset Management System	Calculate percent of devices that are operational based on total devices in the inventory. Compare that figure to the same percentage ratio prior to implementation project
Proactively improve transportation system **safety**	Reduced vehicle-to-vehicle crashes	Crash Records	Crash Record System	Calculate percentage change of crashes before and after implementation
	Reduced vehicle-to-bicycle crashes	Crash Records	Crash Record System	Calculate percentage change of crashes before and after implementation

Objective	Performance Metric	Data Type	Source	Calculation
	Reduced vehicle-to-pedestrian crashes	Crash Records	Crash Record System	Calculate percentage change of crashes before and after implementation
	Reduced Safety Incidents Involving Transit Operations	Transit Incident Records	Transit TMC and Transit Provider Records	Count amount of safety incidents involving transit operations after project implementation and compare to before implementation
Improve **traveler information** and dissemination to public and within region	Reduced vehicle traffic (congestion) due to CMS Message	Traffic Volume	Agency TMC	Difference between Pre/Post CMS Traffic Volumes on Corridor and Alternate Corridor
	Increased Social Media Presence via Agency Managed Apps/Websites	Social Media Posts and Push Notifications (Facebook, twitter)	PR/PIO Records	Track social media outputs, compare to posts prior to implementation strategies
	Increased Partnerships between Third Party Data Companies and Public Agencies	Partnerships	Institutional Policies/Documents	Count the number of private party /public agency data sharing agreements that have occurred since implementing strategies
	Increased 511 Inputs (on all available platforms)	Website Updates, Radio Updates, and Push Notifications	511 System/Records	Count traveler information inputs that are sent out through 511 systems and compare it to counts prior to implementation
	Increased 511 Usage/Subscriptions	App Download/Website Usage	App/Website Management	Count of 511 website views
Emergency / Disaster preparedness	Improved Emergency Response Time	Travel Time	Agency TMC	Time between initial notification to first responder arrival
	Improved Incident Clearing Times	Incident Response and Clearing Times	Agency TMC	Compare time it takes to respond to and clear an incident before and after project implementation

NEXT STEPS

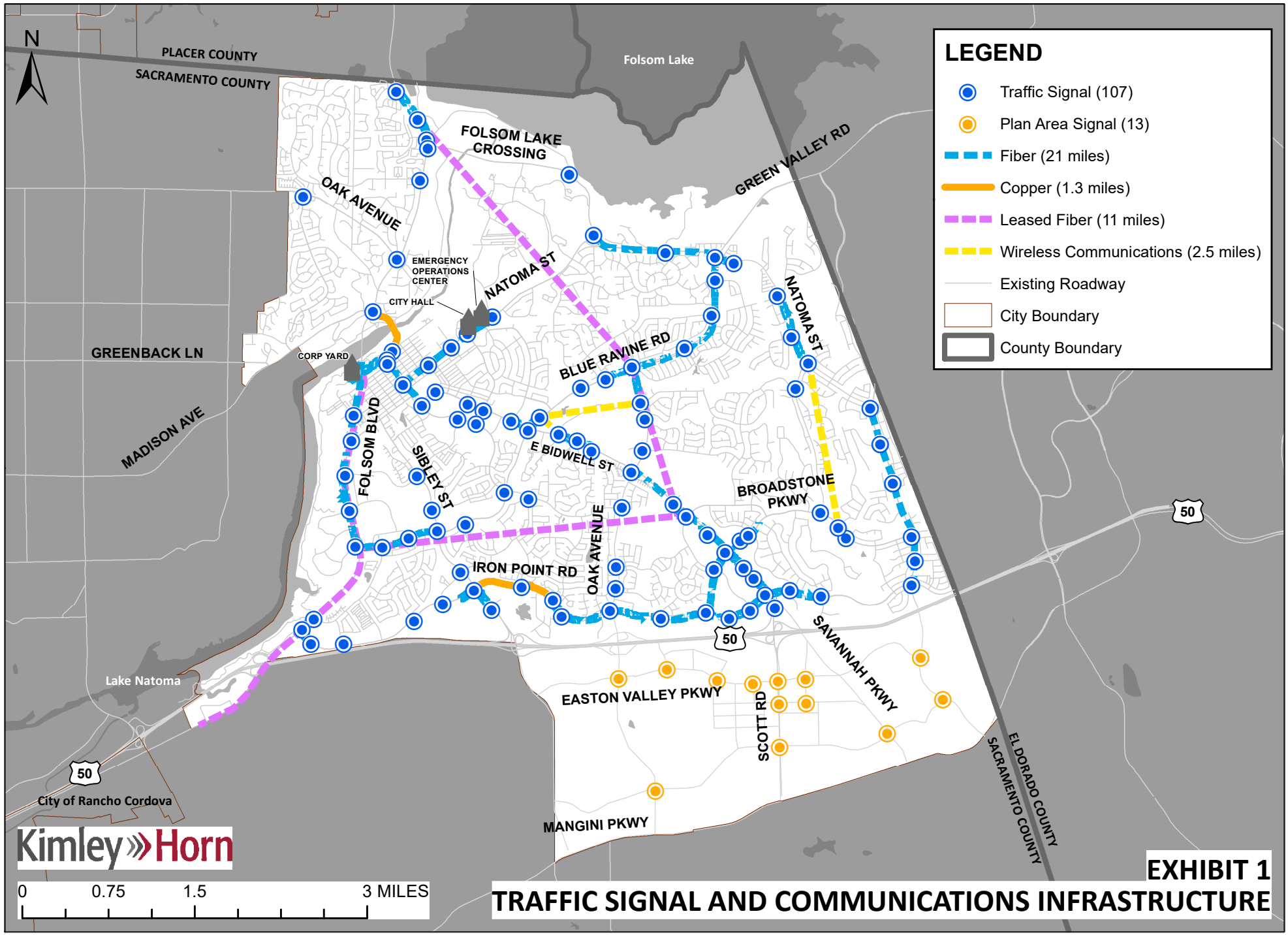
The outcome of this Technology Implementation Plan is a roadmap of prioritized projects that the City of Folsom can follow to systematically implement technology projects that achieve local and regional objectives through expansion of infrastructure, integration of systems and subsystems, and deployment and readiness for emerging technologies. The appendices of this Plan contain supporting information on project priority development, costs, project details, and other information that are essential to moving projects into development and deployment.

The City of Folsom's Technology Implementation Plan is a dynamic and flexible set of projects that contribute to SACOG's broader Smart Region Plan. The projects set forth are a mix of infrastructure, operations and institutional projects that are adaptable to changing needs and evolving technologies. This plan and the associated tools should remain a living set of resources that staff can update as projects are implemented or expanded, agency priorities change, or other changes occur that impact the region or the City of Folsom. The projects identified in this plan can and should be modified, or priorities adjusted, to accommodate changing priorities, emerging technology opportunities, other construction and development projects, or other initiatives that influence the guidance and recommendations provided in this Plan. In addition, it is particularly important to maintain a process to update the Plan because of the deployment phasing methodology used.

Plan Components to Update

- **Deployment Phasing** – It will be particularly important to update the Plan to reflect projects that have been completed. Priorities across projects may also change and should be reflected in the document. As time goes by and projects change in priority, updating the project list will provide an opportunity to evaluate if new projects are available based on emerging technology, increased staffing levels, and so on.
- **Funding Opportunities** – Funding opportunities are always changing. Existing programs or grants may expire, while new ones may emerge. It is imperative that funding opportunities are kept current to maximize the opportunity to utilize new funding sources. In addition, it will continue to be important to leverage emerging opportunities for third party or private sector support.
- **Equipment Replacement Strategies** – The success of this Plan is largely based on ensuring that all equipment continues to work effectively and efficiently. Legacy equipment should be continuously updated or replaced to accommodate emerging technology and enhanced system functionality.
- **Operations and Maintenance** – Adequate staffing levels allow for optimal functionality. As the plan grows and progresses, staffing levels must continue to reflect the need for sustaining a functioning system.

APPENDIX A – EXISTING CONDITIONS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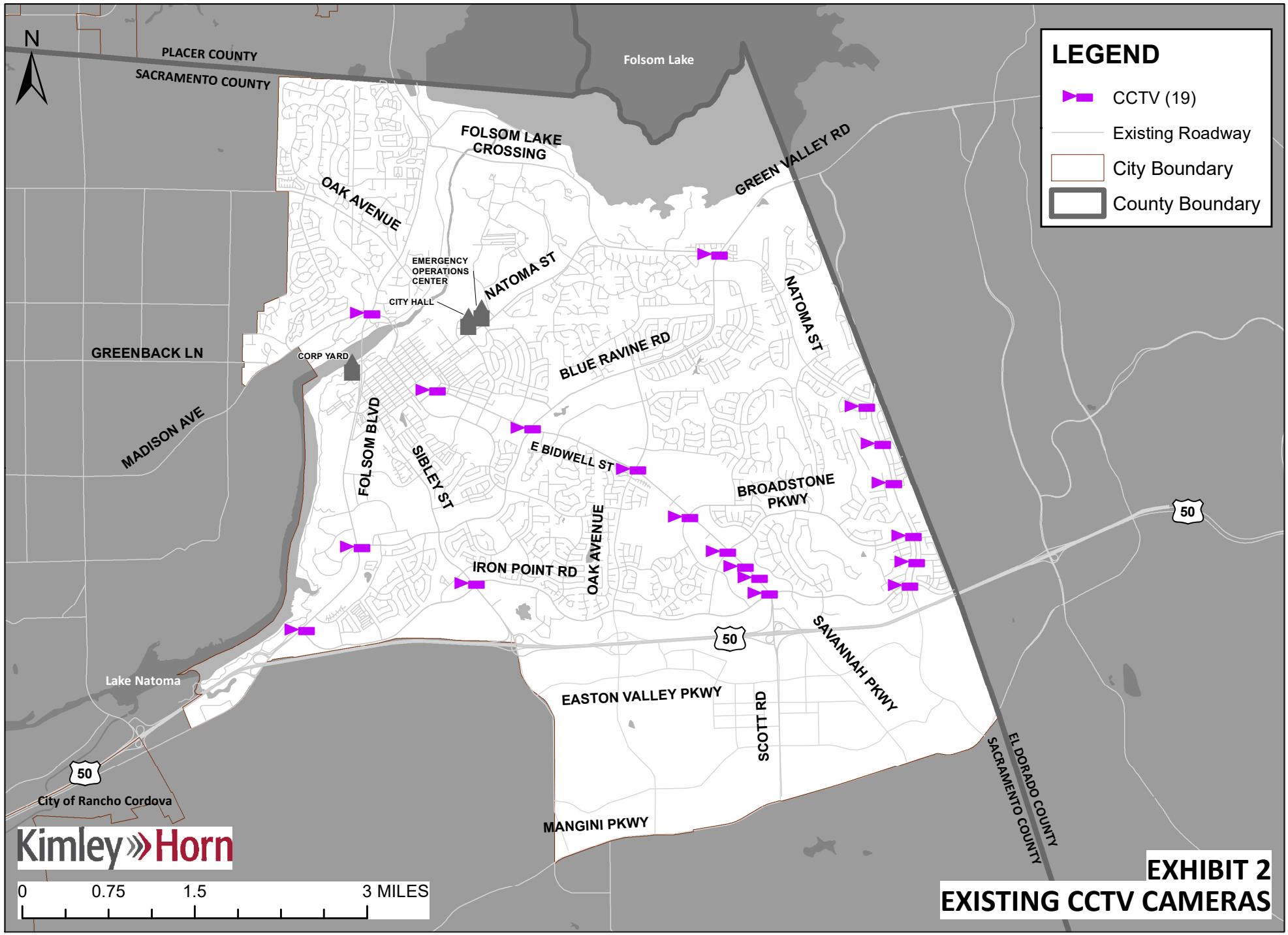
PLACER COUNTY
SACRAMENTO COUNTY
Folsom Lake
FOLSOM LAKE CROSSING
GREEN VALLEY RD
OAK AVENUE
EMERGENCY OPERATIONS CENTER
NATOMA ST
CITY HALL
CORP YARD
GREENBACK LN
BLUE RAVINE RD
NATOMA ST
MADISON AVE
FOLSOM BLVD
SIBLEY ST
E BIDWELL ST
BROADSTONE PKWY
50
IRON POINT RD
OAK AVENUE
50
SAVANNAH PKWY
Lake Natoma
EASTON VALLEY PKWY
SCOTT RD
EL DORADO COUNTY
SACRAMENTO COUNTY
50
City of Rancho Cordova
MANGINI PKWY
LEGEND
Traffic Signal (107)
Plan Area Signal (13)
Fiber (21 miles)
Copper (1.3 miles)
Leased Fiber (11 miles)
Wireless Communications (2.5 miles)
Existing Roadway
City Boundary
County Boundary
Kimley»Horn
0
0.75
1.5
3 MILES
EXHIBIT 1
TRAFFIC SIGNAL AND COMMUNICATIONS INFRASTRUCTURE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PLACER COUNTY
SACRAMENTO COUNTY
Folsom Lake
FOLSOM LAKE CROSSING
GREEN VALLEY RD
OAK AVENUE
EMERGENCY OPERATIONS CENTER
CITY HALL
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NATOMA ST
MADISON AVE
FOLSOM BLVD
SIBLEY ST
E BIDWELL ST
BROADSTONE PKWY
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IRON POINT RD
OAK AVENUE
50
SAVANNAH PKWY
Lake Natoma
EASTON VALLEY PKWY
SCOTT RD
50
City of Rancho Cordova
MANGINI PKWY
EL DORADO COUNTY
SACRAMENTO COUNTY
LEGEND
CCTV (19)
Existing Roadway
City Boundary
County Boundary
Kimley»Horn
0
0.75
1.5
3 MILES
EXHIBIT 2
EXISTING CCTV CAMERAS

APPENDIX B – DETAILED PROJECT SHEETS

Strategy ID # – This is the identification number by strategy.

Title – This is the title of strategy.

Description – This is a succinct description of the strategy for context.

Relation to Needs – This is a mapping of strategies to the original needs, recognizing that one strategy may serve a variety of needs.

Scope/Limits – This is a succinct summary of what is included in the strategy and/or locations (if applicable) of where the strategy would apply.

Considerations – This is a bullet listing of other strategy #'s and titles that are relevant for the City to reference during implementation or could be packaged together to be implemented in a larger strategy in a particular timeframe.

Prerequisite Dependencies – This is a summary bullet list of high-level steps to implement the strategy.

Strategy ID #1

Improve Existing Communications Capabilities on Key-Corridors

Strategy Description – Eliminate communications gaps and expand communications network along key traffic corridors. Utilize copper/fiber or wireless technologies to achieve more robust communications coverage. Connect communications to devices and traffic signals along the key corridors for remote monitoring and control. This includes upgrading communications from legacy copper or T1 leased lines to more robust agency-owned infrastructure such as fiber.

Relation to Needs – Improving existing communications capabilities addresses the following needs.

- Baseline communications infrastructure (Need D1)
- Reliable communications to prevent downtime (Need D4)
- Adequate bandwidth in communications to support data sharing (Need D6)
- Share data between agencies that share a corridor (Need D11)

Scope/Limits – As discussed in the 2015 ITS Master Plan, the following communication improvements will be implemented for the City of Folsom.

- Communication gap closure and upgrade
  - Upgrade traffic signal controllers to provide more robust traffic signal systems with a variety of enhanced features and capabilities.
  - Upgrade intersection fiber optic cabling to provide a reliable and thorough traffic signal network.
- Communication hubs
  - Install new communication hubs to allow for the consolidation of communication to bring it back to the TOC.

Below is a list of primary corridors in Folsom that are involved with this project.

- E. Natoma Street
- E. Bidwell Street
- Blue Ravine Road
- Folsom Boulevard
- Iron Point Road
- Prairie City Road
- Empire Ranch Road
- Manjini Parkway
- Savannah Parkway

Considerations – The following is a list of other strategies within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #4
- ID #5
- ID #6
- ID #8
- ID #9
- ID #10

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Deploy projects that connect to the central system
- Existing infrastructure supporting subsequent projects should be functional

Strategy ID #2

Improve Existing Communications Capabilities on Secondary Corridors

Strategy Description – Eliminate communications gaps that exist along secondary traffic movement corridors. Utilize copper/fiber or wireless technologies to achieve more robust communications coverage. Connect communications to devices and traffic signals along the key corridors. This includes upgrading communications from legacy copper or T1 leased lines to more robust agency-owned infrastructure such as fiber.

Relation to Needs – Improving existing communications capabilities addresses the following needs.

- Baseline communications infrastructure (Need D1)
- Reliable communications to prevent downtime (Need D4)
- Adequate bandwidth in communications to support data sharing (Need D6)

Scope/Limits –

- Communication gap closure and upgrade
  - Upgrade traffic signal controllers to provide more robust traffic signal systems with a variety of enhanced features and capabilities.
  - Upgrade intersection fiber optic cabling to provide a reliable and thorough traffic signal network.
- Communication hubs
  - Install new communication hubs to allow for the consolidation of communication to bring it back to the TOC.

Below is a list of secondary corridors in Folsom that are involved with this project.

- Folsom-Auburn Road
- Greenback Lane
- Oak Ave Parkway
- Green Valley Road
- Easton Valley Parkway
- Placerville Road
- Broadstone Parkway

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #4
- ID #5

Prerequisite Dependencies– The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Deploy projects that connect to the central system
- Existing infrastructure supporting subsequent projects should be functional
- Improve communications on primary corridors prior to beginning secondary corridors

Strategy ID #3

Replace End-Of-Life/Legacy Equipment with Modernized and Updated Equipment

Strategy Description – Establish an inventory of modern equipment that can be used to replace field devices upon their failure or end-of-life. Keeping a modern inventory will ensure that replacements are up-to-date and that in the event of an existing device reaching end-of-life, the device can be quickly replaced with stock equipment.

Relation to Needs – Modernizing and upgrading field devices addresses the following needs:

- Maintainable infrastructure and assets (Need D5)
- Improve traffic operations (Need O2)

Scope/Limits – Inventory of supplemental, modernized field devices includes but is not limited to Closed Circuit Television Cameras, Video Cameras, and Changeable Message Signs. A sufficient number of each device category will be kept in the inventory and will be refilled as the inventory gets low. The recommended number of devices to maintain is 10 percent of the total number of each device. Therefore, with the existing and proposed devices, it would be suggested that the City maintains four (4) CCTV Cameras, two (2) Changeable Message Signs, and ten (10) Video Cameras.

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #2
- ID #5

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Deploy projects that connect to the central system

Strategy ID #4

Deploy New Vehicle Detection Devices: Video and CCTV Camera

Strategy Description – Deploy new video detection equipment at all signalized intersection locations. Video detection equipment will require devices to be mounted on all mast arms or overhanging on one pole location to be able to view all legs of the intersection, depending on the type of technology procured. Video detection will be able to detect vehicles, bicycles, and pedestrians in zones set up by the traffic operations center to support signal timing plan implementation. Also, depending on the type of technology procured, video detection may be able to collect real-time turning movement counts to support more real-time signal timing adjustments required. Additional detection can support more traffic-responsive signal timing to detect the main street and side streets more effectively.

Deploy new CCTV camera equipment at signalized intersection locations that do not have current video capabilities available. CCTV camera equipment will require devices to be mounted on one pole location to be able to view all legs of the intersection and, as feasible as possible, to view the next intersection location. CCTV camera video will provide real-time streaming video to allow traffic operations centers to view road network conditions and to share information about real-time conditions with partner departments, such as public safety, that may need to respond to an incident or event. The new CCTV cameras will need to be integrated into the agency's central management system for viewing and control.

Relation to Needs – The installation of a range of vehicle detection devices addresses the following needs.

- Robust coverage to acquire real-time conditions (Need D2)
- Support active transportation operations (Need D3)
- Sharing of camera images to support pre-trip, en-route, and incident management purposes (Need D9)
- Improve traffic operations (Need O2)

Scope/Limits – Vehicle detection devices will be installed in the form of CCTV cameras and Video Detection cameras.

PTZ CCTV Cameras and video detection cameras will be installed at all intersections throughout the City.

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #2

- ID #3

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Establish a baseline communications network
- Deploy projects that connect to the central system
- Close communication gaps
- Determine whether real-time detection is appropriate

Strategy ID #5

Deploy New CMS Equipment

Strategy Description – Deploy new CMS equipment at key locations within the City's jurisdiction at new locations. CMS equipment will require devices to be mounted cantilever, on a pole, or over the travel lane. CMS provides the traveling public with an en-route message that is pertinent to their travel. The CMS will need to be integrated into the City's central management system to post messages.

Relation to Needs – The installation of a new CMS equipment addresses the need to provide real-time traveler information (Need D13)

Scope/Limits – As outlined in the 2015 Folsom ITS Master Plan, the following list includes the CMS's that will be installed at key strategic decision locations to relay traveler information, which may include incident and special event information.

- Northbound Folsom Boulevard just before Iron Point Road
- Northbound Prairie City Road just after US-50
- Northbound Bidwell Street just after Iron Point Road
- Eastbound Greenback Lane just before American River Canyon Drive
- Southbound Folsom Auburn Road just before Folsom Lake Crossing
- Westbound Green Valley Road just past Sophia Parkway
- Westbound Iron Point Road just before Empire Ranch Road
- Northbound Bidwell Street just before Oak Avenue Parkway
- Eastbound Blue Ravine Road just before Oak Avenue Parkway
- Northbound Blue Ravine Road just before Bidwell Street
- Northbound Glenn Drive just before Riley Street
- Westbound Riley Street just before Bidwell Street
- Westbound Natoma Street near the EOC
- Southbound Folsom Lake Crossing just before Natoma Street
- Northbound Empire Ranch Road just entering the Plan Area
- Northbound Prairie City Road just entering the Plan Area

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #2

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Establish a baseline communications network
- Deploy projects that connect to the central system
- Close communication gaps

Strategy ID #6

ATSPM Software Deployment

Strategy Description – Establish an ATSPM software that the City can use to analyze high-resolution traffic condition data for the purpose of better signal timing and coordination. Establish a central agency that owns the software and servers that other agency ATMS systems will connect to in order to provide ATSPM data. As part of this project, establish a SACOG or third-party contract to analyze performance metrics related to ATSPM data to provide support to all agencies with reliable metrics to support their individual agency operations. Included in the software procurement and integration will need to be training on the use of ATSPM.

Relation to Needs – Deploying ATSPM software addresses the need for high-resolution traffic data for real-time operation decision making (Need D8).

Scope/Limits – ATSPM cabinets will be installed at each of the signals along the primary corridors. The primary corridors, previously listed in Project #1, are listed again below. There are 68 existing signals on the primary corridors in Folsom.

- E. Natoma Street
- E. Bidwell Street
- Blue Ravine Road
- Folsom Boulevard
- Iron Point Road
- Prairie City Road
- Empire Ranch Road
- Manjini Parkway (Future Plan Area Roadway)
- Savannah Parkway (Future Plan Area Roadway)

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #2
- ID #4

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Establish a baseline communications network
- Deploy modernized traffic signal equipment
- Deploy adequate detection

Strategy ID #7

Share CCTV Camera Video with Individual Agencies

Strategy Description – Utilizing a robust communications center-to-center network between agencies, CCTV camera streaming video images should be shared between agencies. Shared control of CCTV cameras may not be desirable nor feasible, but could be allowed through this center-to-center asset viewing capability.

Relation to Needs – The development of a center-to-center sharing network addresses the following needs.

- Sharing of camera images to support pre-trip, en-route, and incident management (Need D9)
- Share data between agencies that share a corridor (Need D11)
- Real-time traveler information (Need D13)

Scope/Limits – A network will be set up on a regional basis to share CCTV camera imagery between agencies.

Considerations – See regional document for further details.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Establish a baseline communications network
- Close communication gaps
- Establish communication connection with partner agency
- Deploy modernized CCTV cameras at identified locations
- Establish an inventory of supplemental CCTV cameras

Strategy ID #8

Implement Transit Signal Priority

Strategy Description – Implement transit signal priority along key transit routes where signal timing has made mobility and efficiency for the transit service challenging. This involves infrastructure installed at the signalized intersection as well as integration into the existing signal controller for priority requests of the signal timing plan.

Relation to Needs – Implementing transit signal priority addresses the following needs:

- Reduce impact of light rail preemption on traffic mobility (Need D10)
- Encourage travel mode shift (Need D12)
- Improve traffic operations (Need O2)

Scope/Limits – The Gold Line, part of the Sacramento Regional Transit light rail system, passes through ten (10) signalized intersections in the City of Folsom. These signals are on Folsom Boulevard between Iron Point Road and Greenback Lane. Signal modification will be implemented at each of these ten locations.

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #2
- ID #4

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish a baseline communication network
- Coordinate signals along light rail
- Deploy modernized traffic signal equipment at each involved intersection

Strategy ID #9

Adaptive Traffic Control

Strategy Description – Deploy adaptive traffic control on select key corridors that experience variable peak periods. Adaptive traffic control includes additional detection at signalized intersections, installation of adaptive software for signal controller use, and integration into the agency's ATMS system. It is recommended to complete a before and after evaluation of adaptive signal control effectiveness.

Relation to Needs – Implementing adaptive traffic control addresses the need for better traffic operation functions (Need O2).

Scope/Limits – Key corridors, as identified in Project #1 and #6, are as follows. Adaptive traffic control will be evaluated at the 68 signals along the identified key corridors in Folsom.

- E. Natoma Street
- E. Bidwell Street
- Blue Ravine Road
- Folsom Boulevard
- Iron Point Road
- Prairie City Road
- Empire Ranch Road
- Manjini Parkway
- Savannah Parkway

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #4
- ID #6

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish traffic operations center
- Establish a baseline communications network
- Deploy modernized traffic signal equipment

Strategy ID #10

Establish and Staff Agency TOC

Strategy Description – Establish new agency TOC including such components as a video wall, extra screens for view only, network equipment, workstation layouts, workstation equipment, file storage, communication wiring, network room rack space, cooling and fire suppression systems, and other characteristics of a TOC that require consideration. New staff may need to be accommodated and access to systems warrants a specific design and allocation of space within an existing facility or office space. Establish staffing levels to support the operations and maintenance of the transportation network and Smart Region initiatives. Offered in the plan are ratios of devices to the number of staff required to operate or maintain those devices. The agency should consider potential IT or Traffic Engineering staff that would need to be involved in the implementation of Smart Region initiatives such as data access/sharing and project management of infrastructure implementations. Additional data analysis staff may be required.

Relation to Needs – Establishing and staffing a TOC for the agency will address the following needs:

- Central system management of tools and data to support operations (D7)
- Trained staff to support operations (Need O1)
- Sufficient environment for TOC operations (Need O3).

Scope/Limits – The TOC developed for the City of Folsom will have two workstation locations, a large LCD screen, and a conference room, which is the standard setup for a local TOC. Sites will be evaluated by senior level and production staff to determine a location for the TOC. This implementation will also include developing standard operating procedures and functional requirements.

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1

Prerequisite Dependencies– The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Identify staff to perform a site evaluation for a local TOC
- Employ staff to work at the local TOC

Strategy ID #11

Establish Regional Technology Procurement Contract

Strategy Description – Establish a regional technology procurement contract that will be managed by a single agency and can be utilized by local agencies to procure technology for transportation use such as detection, CCTV cameras, CMS, software, or other technologies. This project will alleviate the requirement for all agencies to individually establish procurement specifications for this equipment. This contract is envisioned as a qualified vendor list that offers the agencies multiple vendor options for each type of device, not that a single vendor would be chosen for each type of device. This will expedite the procurement and acquisition of technologies in the region. No dedicated budgeting is anticipated for this contract as it is focused on contractual use by individual agencies.

Relation to Needs – Establishing a regional technology procurement contract will address the need of a funding project for the Smart Region implementation plans (Need I1).

Scope/Limits – Folsom should support the development of a regional technology procurement contract.

Considerations – See regional document for further details.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Identify a staff member to coordinate with regional staff and other agency staff to develop the technology procurement contract

Strategy ID #12

CV/AV Technology Readiness

Strategy Description – Deploy CV equipment (DSRC radios or equivalent) at signalized locations or other key locations through the use of agency-owned infrastructure. This project would initiate a pilot program (with option to extend) of key corridors that supports agency-owned CV technology and would require procuring CV equipment that would need to be installed at signalized intersections along priority corridors by the agency. Expansions to this pilot program would be assumed after the pilot project completion. This project does not include the push of specific CV data to vehicles using the system, but rather making the CV infrastructure available for agencies or the region to utilize when CV software and data are more robust and available. Deploy AV pilot for fleet of vehicles to be managed and operated by the agency. This could include transit vehicles or maintenance vehicles, depending on the agency priority. Vehicles would be procured by the agency or a contract with a private provider would be established to provide the vehicles for the AV fleet. The AV fleet program would be closely monitored and managed by the agency and performance evaluations completed to determine its viability for expansion. Capital, operations, and maintenance costs will need to be factored in and identification of the fleet type, number of vehicles, and scope for the pilot program would need to be established.

Relation to Needs – Deploying CV/AV technology addresses the need for the City to be CV/AV ready (Need #).

Scope/Limits – To better prepare for CV/AV technology, Folsom will evaluate its CV roadside technology and ultimately will deploy CV roadside technology at signalized intersections. This technology will be implemented at all 98 signals in the City.

Considerations – The following is a list of other projects within Folsom's Technology Implementation Plan that should be considered along with this project.

- ID #1
- ID #2
- ID #4
- ID #8

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this project.

- Establish a baseline communication network
- Deploy modernized traffic signal and ITS device equipment at all signalized intersections

Strategy ID #13

Back Up TOC Capabilities

Description – Establish VPN or other remote access to be able to control field infrastructure through ATMS system from a minimum of two physically separate locations. It is recommended that one of the locations is not a laptop or tablet, as there may be instances where that device is physically located in the TOC and thus creates a single-failure-point for the ATMS system. Redundant servers in a separate facility is an ideal condition.

Relation to Needs –

- N4: Reliable communications and systems to prevent downtime

Scope/Limits – At a location that has communications connectivity, locate a server and firewall that can remotely access the main TMC servers to provide live backup and act as a secondary TMC location in case access to the main facility is compromised

Considerations –

- Establish Agency Network Security Policies and Standards
- Communications Sharing to Support Local Agencies
- Improve Existing Communications Capabilities on Key-Corridors

Prerequisite Dependencies –

- Identify a location that has existing communications and can serve traffic management functions
- Consider opportunities to partner with another agency, such as City of Sacramento, to identify the location - there may be opportunities to share fiber to provide the necessary connectivity
- Engage Caltrans IT to procure a server and firewall equipment to be installed at the back up location
- Coordinate with IT to have the server perform live backups of the main TMC system and provide VPN access to the main server from the backup facility
- If necessary, develop an IGA with partner agency for the facility sharing and establish an agreement for roles and responsibilities related to performing back up operations and define thresholds for activation
- Include new equipment into asset management system and maintenance budget/procedures

Strategy ID #14

Establish CAD System and TOC Connections for Automated Alerts/Notifications

Description – Establish filtered CAD system access from agency TOCs to be able to see when incidents are restricting lanes and warrant traffic management measures. This strategy will involve communications between the public safety network and the agency TOC. The CAD system will need to be filtered to anonymous data for lane restriction and location information only, and separate monitors and server will be required at the agency TOC because CAD will not be integrated into the agency's ATMS system for viewing.

Relation to Needs – Better incident coordination across jurisdictions and with public safety (Need #24)

Scope/Limits – Integrate Sacramento County Sheriff CAD system with City's ATMS system and TOC. This scope of work includes software integration to update Sacramento County Sheriff CAD system and City's ATMS system to allow data push from sheriff CAD system to ATMS system, and view the data in ATMS interface. The scope includes purchase, installation, configuration and integration of servers and software required at City's TOC.

Considerations – This strategy is not codependent on any other strategy identified for the City and can stand alone in implementation.

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Server located at TOC

Strategy ID #15

Establish Agency Network Security Policies and Standards

Description – Network security training will be a requirement for personnel involved in using, accessing, or securing the agency's ATMS system or technologies. This will involve an agency requirement for IT to update security training on a regular basis. This will also involve in procurement specifications that the vendor/firm providing new technology provide training on the new functionality and security standards involved in that new technology. The agency's IT department will need to stay involved in keeping these policies and procedures up to date with current security requirements on the agency enterprise system.

Relation to Needs – Implementing network security policies and standards will address the following need.

- Reliable network security (Need I1)

Scope – The Traffic Department will work with City IT staff to procure a new firewall system and establish standard network security policies for operations and maintenance of traffic assets and the collection, storage, and dissemination of data.

Considerations – This strategy is not codependent on any other strategy identified for the City and can stand alone in implementation.

Strategy ID #16

Improve Traffic Signal Timing Along Key Transit Corridors

Description – Complete signal optimization plans along key transit routes that need updating to consider transit mobility needs as well as transit signal priority, if existing. Signal timing plans need to be developed based on current traffic turning movement counts, developed modeling outputs, and uploaded into the signal controllers. Before and after evaluation of the corridor is recommended as many times tweaks are required of signal timing plans prior to completion of a signal timing plan effort. Use performance metrics to analyze throughput and coordinate light rail and heavy rail preemption where necessary with traffic signal operations.

Relation to Needs – Optimizing traffic signal timing along transit corridors will address the following needs.

- Reduce impact of light rail preemption on traffic mobility (Need D12)

Scope/Limits – The City of Sacramento will develop signal optimization plans for corridors that run adjacent to or intersect Sacramento RT light rail transit corridors. Once signals optimization plans are developed at these locations, the City will prioritize bus transit corridors for retiming based on recommendations from Sacramento RT. Complete signal optimization will be implemented on these corridors based on signal infrastructure capabilities such as detection and communications.

Considerations – The following are other strategies that should also be considered in conjunction with this strategy.

- ID #2 – Modernize Signal Controllers and Cabinets
- ID #16 – Implement Transit Signal Priority

- **Prerequisite Dependencies** – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

  - Establish a functional baseline communications network

Strategy ID #17

Real-Time Data Connection between Transit and Transportation Agencies

Description – Establish connection between transit and transportation agencies for sharing data related to transit services. The purpose is for transportation agencies to organize traffic operations to accommodate transit services through collected data, such as vehicle location and on-time schedule performance that can better support the coordination of transit mobility and traffic mobility. This strategy specifically addresses transit signal priority needs and light rail transit needs for better mobility.

Relation to Needs – – This is a mapping of strategies to the original needs, recognizing that one strategy may serve multiple needs.

- Share data between agencies that share a corridor (Need 10)
- Encourage travel mode shift (Need D11)
- Real-time traveler information (Need D12)
- Improve traffic operations (Need O3)
- Improve notification and alerts to travelers (Need O9)

Scope/Limits – Develop inter-agency agreements to share real-time data collected through video detection and CCTV cameras.

Considerations – The following are other strategies that should also be considered in conjunction with this strategy.

- ID #2 – Deploy New Video Detection and CCTV Equipment
- ID #4 – Third Party Real-Time Data
- ID #5 – Perform ATMS Data Back Up
- ID #7 – Establish Central Regional Video Management System
- ID #10 – Share CCTV with Individual Agencies
- ID #11 – Share CCTV with Agency Public Traveler Information Platforms

Prerequisite Dependencies – This is a bullet list summary of the high-level steps required to implement the strategy.

- Establish CCTV Sharing Agreements between the individual agencies.
- Deploy modernized CCTV cameras at identified locations
- Establish an inventory of supplemental CCTV cameras

Strategy ID #18

Train Staff on Network Security

Description – Network security training will be a requirement for personnel involved in using, accessing, or securing the agency's ATMS system or technologies. This will involve an agency requirement for IT to update security training on a regular basis. This will also involve in procurement specifications that the vendor/firm providing new technology provide training on the new functionality and security standards involved in that new technology. The agency's IT department will need to stay involved in keeping these policies and procedures up to date with current security requirements on the agency enterprise system.

Relation to Needs – – This is a mapping of strategies to the original needs, recognizing that one strategy may serve multiple needs.

- Reliable network security (Need I1)

Scope/Limits – City of Folsom will need to consider placing staff through technology training tracks and/or encourage staff to pursue certifications.

Considerations – The following are other strategies that should also be considered in conjunction with this strategy.

- ID #5– Perform ATMS Data Back Up
- ID #23 – Establish Agency Network Security Procedures and Standards

Prerequisite Dependencies – This is a bullet list summary of the high-level steps required to implement the strategy.

- Agency must have a defined set of security procedures and standards in order to train staff

Strategy ID #19

Upgrade Agency ATMS

Description – Upgrade agency ATMS to incorporate new functionality as required by Smart Region initiatives and incorporate a variety of data deemed important by agencies to receive automated alert notifications. Additional data to incorporate into an agency ATMS upgrade include CCTV video streaming, weather notifications from weather devices, emergency notifications, and equipment maintenance status and alerts. Additional modules may be needed to support travel time devices, connected vehicle devices, or other types of devices not currently in use by the agency.

Relation to Needs –

- Adequate bandwidth in communications to support data sharing (Need #6)
- Timely emergency notifications (including weather) (Need #24)
- Share data between agencies that share a corridor (Need #11)
- Access to central systems 24x7 (Need #19)

Scope/Limits – Procurement of upgraded ATMS to incorporate new functionality including integration of multiple existing CCTV video streaming systems onto a centralized transportation management system.

Considerations – Other strategies that will require consideration with regard to this strategy are:

- ID #7 – Perform ATMS Data Back Up
- ID #8 – Back Up TOC Function Capabilities
- ID #15 – Analytics Software for Real-Time Operations Decision Making

Prerequisite Dependencies – The following is a high-level list of prerequisite actions that will need to be taken prior to implementing this strategy.

- Establish a functional baseline communications network
- Deploy modernized and compatible CCTV cameras at identified locations

APPENDIX C - COST ASSUMPTIONS

Table 1: Cost Summary

Project No.	Project Description	Video Detection	Transit Signal Priority	Controller Cabinet Upgrade	Controller Upgrade	Intersection Fiber Equipment Upgrade	CCTV	CMS	Communication (Miles)			Communication Hub	ATSPM	Connected Vehicle Technology	Planning Level Cost
									New	In empty	Replace				
Infrastructure Projects - Improve Existing Communications Capabilities															
Communication Gap Closures, Communications Equipment Upgrade, Upgrade to Fiber															
1	Folsom Boulevard - Greenback Lane to Iron Point Road	8	8	8	8	8	5	1	0.8		2.3		8	8	$ 2,689,100.00
2	E. Bidwell Street - Coloma Street to Highway 50	8		16			9	2	0.7		2.4	2	17	17	$ 2,963,800.00
3	Riley Street - Leidesdorff Street to Glenn Drive	5		5	5	5	5	1			0.5			5	$ 895,300.00
4	Blue Ravine Road - E. Natoma Street to E. Bidwell Street	8		8	8	8	7	1	0.8		1.7	1	8	8	$ 2,442,000.00
5	Blue Ravine Road - E. Bidwell Street to Folsom Boulevard	5		5	4	4	5	1	1.4		0.7		5	5	$ 2,171,300.00
6	E. Natoma Street - Blue Ravine Road to Golf Links Drive	4		3	1	1	4		0.7		0.7			4	$ 1,214,500.00
7	Green Valley Road - E. Natoma Street to Sophia Parkway							1	1.2						$ 1,095,700.00
8	Iron Point Road - Premium Outlets Driveway to Prairie City Road Folsom Boulevard - Iron Point Road to County Line	6		6	4	4	5	1	1.5		0.7		6	6	$ 2,326,000.00
9	Iron Point Road - Prairie City Road to Serpa Way	9		9	9	9	9				3.2		9	9	$ 2,151,300.00
10	Leidesdorff Street -Riley Street to Burnett Street						0				0.3			0	$ 71,300.00
11	E. Bidwell Street - Highway 50 to Plan Area City Limit Line								1.5						$ 1,278,300.00
12	Natoma Street and E. Natoma Street - Riley Street to Folsom Lake Crossing	5		5	5	5	5	1	1.1		1.1		5	5	$ 1,993,200.00
13	E. Natoma Street - Folsom Lake Crossing to Blue Ravine Road	1		1	1	1	1	1	1.1				1	1	$ 1,161,600.00
14	Broadstone Parkway - Cavitt Drive to Iron Point Road	3		3	3	3	3				0.8			3	$ 631,400.00
15	Oak Avenue Parkway - Creekside Drive to Iron Point Road	6		6	6	6	6		1.3		0.6			6	$ 2,165,700.00
16	Greenback Lane - Riley Street to Main Avenue	1		1	1	1	1	1	1.6		0.5			1	$ 1,720,500.00
17	Folsom-Auburn Road - Folsom Lake Crossing to Greenback Lane	6		6	6	6	6	1	1.6				6	6	$ 2,366,900.00
18	Oak Avenue Parkway - Folsom-Auburn Road to East City Limit	2		2	2	2	2		1.3					2	$ 1,430,800.00
19	Prairie City Road - Blue Ravine Road to American Aggregate Road	2		2			2	1	0.5		0.4			2	$ 803,800.00
20	Iron Point Road - Serpa Way to Empire Ranch Road						0		0.9					0	$ 788,000.00
21	Placerville Road - East Bidwell Street to Highway 50						1		0.3					0	$ 315,700.00
22	Prairie City Road - American Aggregate Road to White Road Road						0	2	2.6			1		0	$ 2,449,100.00
23	E. Natoma Street - Golf Links Drive to Empire Ranch Road								0.7						$ 612,900.00
24	Oak Avenue Parkway - Iron Point Road to Plan Area City Limit								2.1						$ 1,838,700.00
25	Empire Ranch Road - Iron Point Road to Plan Area City Limit						1	1	1.5						$ 1,376,300.00
26	Easton Valley Parkway - Prairie City Road to Savannah Parkway Savannah Parkway - Placerville Road to Manjini Parkway								3.0						$ 2,626,700.00
27	Manjini Parkway - Prairie City Road to Savannah Parkway								3.2						$ 2,758,000.00
28	Manjini Parkway - Savannah Parkway to Empire Ranch Road								0.6						$ 551,600.00
Non-Infrastructure Projects															
29	Develop Center-to-Center Network for Sharing CCTV Imagery														See Regional Document
30	Adaptive Traffic Control for the Signalized Intersections Along Key Corridors														$ 1,360,800.00
31	Traffic Operations Center (Local)														$ 54,000.00
32	TOC Site Evaluation														$ 41,760.00
33	TOC Standard Operating Procedures and Functional Requirements														$ 34,200.00
34	Support of Regional Technology Procurement Contract Development														See Regional Document
35	CV/AV Roadside Technology Evaluation														$ 38,880.00

APPENDIX D - PRIORITIZATION SUMMARY

Project No.	Project Corridor	Address multijurisdictional networking	Adapt to new technology	Improve reliability and consistency of driver trips	Safety	Improve traveler information and dissemination	Emergency / disaster preparedness	Contribute to operational and institutional efficiency	Enhances major corridors	Extent that project achieves local objectives	Other projects rely on this project	Total Strategy Score Compared to Objectives
1	Folsom Boulevard - Greenback Lane to Iron Point Road	4	4	3	1	4	1	4	4	4	4	84
2	E. Bidwell Street - Montrose Drive to Highway 50	4	3	3	1	4	1	3	4	4	4	78
3	Riley Street - Folsom-Auburn to E. Bidwell Street	4	3	3	1	4	1	3	4	4	4	78
4	Blue Ravine Road - E. Natoma Street to E. Bidwell Street	4	3	3	1	3	1	3	4	4	4	76
5	Blue Ravine Road - E. Bidwell Street to Folsom Boulevard	4	3	3	1	3	1	3	4	4	4	76
6	E. Natoma Street - Blue Ravine Road to Golf Links	2	3	3	1	4	1	3	4	4	4	73
7	Green Valley Road - E. Natoma Street to Sophia Parkway	4	3	3	1	4	1	2	2	3	2	65
8	Iron Point Road - Folsom Bouleverd to Prairie City Road	4	3	3	1	2	1	4	2	3	2	65
9	Iron Point Road - Prairie City Road to Serpa Way	4	3	3	1	2	1	4	2	3	2	65
10	Leidesdorff Street -Riley Street to Burnett Street	2	3	2	1	4	1	2	2	4	4	63
11	Scott Road - Highway 50 to Plan Area City Limit Line	4	2	2	1	2	1	4	4	2	1	59
12	Natoma Street and E. Natoma Street - Riley Street to Folsom Lake Crossing	2	3	2	1	2	1	3	3	3	3	59
13	E. Natoma Street - Folsom Lake Crossing to Blue Ravine Road	3	3	3	1	2	1	1	2	4	2	58
14	Broadstone Parkway - Cavit Drive to Iron Point Road	3	3	3	1	2	1	2	2	3	2	57
15	Oak Avenue Parkway - Creekside Drive to Iron Point Road	3	3	3	1	2	1	2	2	3	2	57
16	Greenback Lane - Riley Street to Main Avenue	3	3	3	1	2	1	2	2	3	2	57
17	Folsom-Auburn Road - Folsom Lake Crossing to Greenback Lane	3	3	3	1	2	1	2	2	3	2	57
18	Oak Avenue Parkway - Folsom-Auburn Road to East City Limit	3	3	3	1	2	1	2	2	3	2	57
19	Prairie City Road - Blue Ravine Road to American Aggregate Road	3	3	3	1	2	1	2	2	3	2	57
20	Iron Point Road - Serpa Way to Empire Ranch Road	3	3	3	1	2	1	2	2	3	2	57
21	Placerville Road - East Bidwell Street to Highway 50	3	3	3	1	2	1	2	2	3	2	57
22	Prairie City Road - American Aggregate Road to Street 'A'	3	3	3	1	2	1	2	2	3	2	57
23	E. Natoma Street - Golf Links to Empire Ranch	2	3	1	1	1	1	1	4	4	1	52
24	Oak Avenue Parkway - Iron Point Road to Plan Area City Limit	3	2	3	1	2	1	2	2	2	1	49
25	Empire Ranch Road - Iron Point Road to Plan Area City Limit	2	2	2	1	3	1	2	2	2	1	47
26	Easton Valley Parkway - Prairie City Road to Street 'B' Savannah Parkway - Placerville Road to Manjini Parkway	2	2	2	1	2	1	2	2	2	1	44
27	Manjini Parkway - Prairie City Road to Savannah Parkway	2	2	2	1	2	1	2	2	2	1	44
28	Manjini Parkway - Savannah Parkway to Empire Ranch Road	2	2	2	1	2	1	2	2	2	1	44