ITS

STRATEGIC PLAN

for the City of Yuma

In partership with

ADOT

1. **ITS Strategic Plan**
2. **Traffic Operations Center (TOC) Concept of Operations**
3. **ITS Infrastructure Implementation Plan**

Prepared by
Kimley»Horn

2020 ITS STRATEGIC PLAN

for the CITY OF Yuma

In coordination with

ADOT

YMPO — Yuma, San Luis, Cocopah, Wellton, Somerton, Yuma County, ADOT

YUMA COUNTY ARIZONA

CITY OF SOMERTON ARIZONA 1898

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October 2020

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1. Introduction to the ITS Strategic Plan

The City of Yuma is undergoing the development of a City Intelligent Transportation System (ITS) Strategic Plan. This ITS Strategic Plan will help guide the City's investments in ITS to support traffic management, traveler information, incident management, interagency communications, and coordination with regional stakeholders. The plan will provide a phased approach to implement and integrate existing and new ITS infrastructure, systems, and strategies.

This plan explores and propose a framework for the near- and long-term operations and management of transportation investments in the City. The framework also highlights opportunities where other local, county, regional, and state agencies in the Yuma region may partner or contribute to processes, strategies, or projects that could elevate local and regional traffic operations.

This ITS Strategic Plan is the first phase of a multi-phased effort to define, plan for, and potentially implement advanced traffic management systems and strategies in the City. The ITS Strategic Plan identifies a holistic program of strategies to enable and implement a comprehensive ITS program in Yuma, including infrastructure and systems, policies, programs, staff, and partnerships. To support the City in strategically and efficiently implementing the various strategies, a set of additional, more detailed documents will be developed that identify specific implementation-level details, such as detailed cost estimates or conceptual plans. These more detailed documents will support the City in pursuing funding for implementation, including federal grant funding opportunities that might be available.

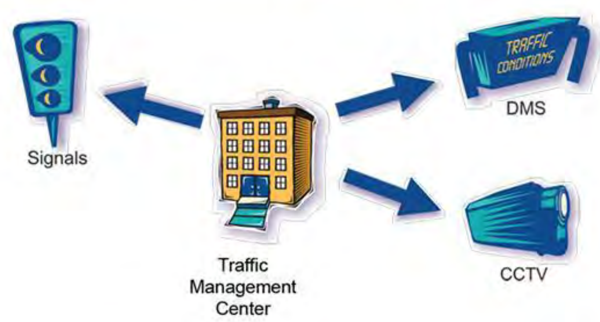
The key project phases of the Yuma ITS Strategic Plan include:

- **Vision and Goals** – Identifies the City vision, goals, and priorities related to traffic operations and management, with a focus on opportunities for transportation technologies and systems.
- **Inventory and Needs** – Identifies and documents existing ITS devices and systems within the region. The document determines gaps in the infrastructure and identifies traffic operations and management needs in the City including some that persist across the region.
- **Integration Recommendations** – Provides general infrastructure integration strategies and high-level phasing. Strategies will include such items as:
    - Projects that need funding to support their implementation, such as device deployment or upgrades to existing equipment.
    - Resources needed to establish a City traffic operations center (TOC) and equipment to maintain the functionality and be able to grow long-term.
    - Opportunities to improve coordination with other agencies in the region along major freeway and arterial corridors for potential regional arterial operations.

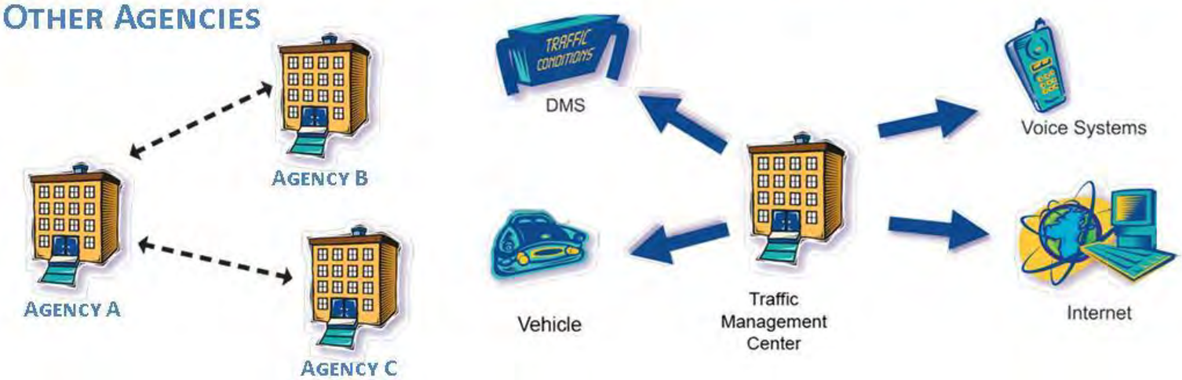
2. Introduction to ITS

ITS is a term that encompasses the infrastructure, systems, and data that are used to improve the safety and efficiency of a transportation network. Typical applications of ITS include being able to manage traffic signals and other traffic control devices in real-time from a centralized location, sharing information with travelers and other agencies about the transportation network, and monitoring traffic on corridors and intersections in real-time. Examples of ITS infrastructure includes traffic signals, detection, CCTV cameras, dynamic message signs, and software used to operate and manage the devices.

MANAGING INFRASTRUCTURE



SHARING INFORMATION WITH TRAVELING PUBLIC AND WITH OTHER DEPARTMENTS AND OTHER AGENCIES



The foundation of ITS rests on data collection and analysis, and the translation of the data into information. Information helps agencies make decisions on the planning and real-time management of their transportation network, and information is also disseminated to the public to allow travelers to make informed decisions about their trips. It is also shared among agencies to facilitate coordination between agency transportation operations and enable better collaboration for purposes of traffic management, incident management, and future infrastructure planning.

3. ITS Vision and Goals

3.1 City Vision and Goals for ITS

The City of Yuma's vision for ITS is:

Through centralized control of field devices and coordination between transportation agencies, the Yuma region employs advanced traffic operations and provides real-time traveler information to create an efficient and safe transportation network.

City goals for transportation and ITS guided direction and outputs of the ITS Strategic Plan:

- Invest in technology to take transportation system management to the next level and manage the transportation network more effectively, rather than trying to build the way out of congestion.
- Elevate the level of real-time coordination with other agencies for traffic and incident management to provide a consistent and efficient travel experience across municipal boundaries.
- Identify a framework for a TOC that facilitates centralized control of City field devices and provides opportunity to coordinate operations between agencies in the region.

3.2 Regional Vision and Goals for ITS

Stakeholder Input

Meetings were held with the different stakeholder agencies in the region, including the City of Yuma, Yuma County, the City of Somerton, and the Arizona Department of Transportation (ADOT), related to traffic operations and management and transportation technologies. The discussions highlighted the visions and priorities of the individual agencies and helped to form the collective vision for ITS in the region

In general, stakeholders see value in real-time coordination between agencies for traffic management and the use of technology and data to maintain a safe and efficient transportation network. However, the stakeholders identified some additional goals or nuances to the City's goals in relation to ITS:

- Ensure compatibility and functionality of technology to facilitate advanced operations and interoperability.
- Define a multi-agency model for operations and device ownership that is clear, efficient, and logical based on the regional transportation network.
- Deploy technologies that can support multiple functions and responsibilities related to traffic management, performance management, and public information dissemination.

4. Existing Transportation Overview

The Yuma region has seen an increase in population over the last 15 years. The regional economy has a diverse foundation with two major defense facilities, a regional/interstate medical facility, a high-tech agribusiness industry, and a growing industrial sector. The region also hosts more than 60,000 winter visitors annually, according to a recent study conducted by the Arizona Office of Tourism. The Yuma region serves as a gateway to both California and Mexico. State facilities including Interstate 8 (I-8), State Route 195 (SR 195), and State Route 95 (SR 95) all provide important access to these borders and connectivity in the region. Key local facilities, such as 4th Avenue, 16th Street, Avenue B, and 32nd Street are critical for the local movement of people and goods and will experience daily traffic volumes comparable to major regional corridors.

Infrastructure

The City currently operates 77 traffic signals. A majority of City-operated signals are within the western portion of the City, with only 15 signals east of the Marine Corps Air Station (Avenue 3E). **Figure 1** shows existing traffic signals in the region. Additional ITS infrastructure within the City includes the following:

- Currently, all City, County, and Somerton **traffic signals are locally controlled and not connected to a centralized management system via either wireless or fiber backbone** communication networks. City of Yuma does have City fiber infrastructure that connects key City facilities, but not City traffic signals. Figure 1 shows the existing City of Yuma enterprise fiber network.
- **All but two of the existing traffic signals within the City are actuated**, **meaning that they are informed by detection.** The two traffic signals without detection are not actuated, meaning they run on pre-set timing plans, and are located at 3rd Street and Avenue A and 8th Street and Orange Avenue in the north part of downtown, near City Hall.
- Emergency vehicle preemption (EVP) is used to provide emergency response vehicles, such as fire trucks, with priority signal phasing at intersections. **Currently, the City of Yuma has infrastructure to support EVP for City emergency response vehicles at City signals and signals within City boundaries that are owned by Yuma County**.
- **There are no CCTV cameras deployed at intersections, and none of the existing video detectors are connected to a central system**, so there is no real-time intersection monitoring performed in the region.

Table 1 summarizes the existing transportation infrastructure in the City and in surrounding agencies.

Table 1 – Existing Infrastructure by Agency

Device	City of Yuma	Yuma County	ADOT	Somerton	Cocopah
Traffic Signals	77 Signals	22 Signals (one owned by Cocopah)	17 Signals	4 Signals	2 Signals (one maintained by Yuma County)
Communications	None	None	Wireless	None	None
Vehicle Detection	50 Loops 25 Video	16 Loops 6 Video	Loops, Video, or Radar	4 Loops	None
Emergency Vehicle Preemption (EVP)	For City emergency vehicles	At signals within City boundaries	None	None	None

Maintenance and Operations

The City of Yuma Public Works department is responsible for the maintenance of all field equipment, including traffic signals and associated equipment (traffic signal cabinets and controllers, vehicle detection, etc.). There are currently three Traffic Signal Technicians and one Electrician that support maintenance of the City's almost 80 traffic signals. Public Works uses an operating budget to replace and upgrade traffic signal infrastructure as it is deemed necessary. The department has an active program to upgrade three intersections per fiscal year. The project allows the City to bring the infrastructure to current standards and modernize the traffic signal system.

The City of Yuma Engineering department is responsible for the operations of traffic signals in the City. Currently, reviewing and updating signal timing is largely completed in-house by engineering staff.

Table 2 summarizes the existing staff and responsibilities in the City and in surrounding agencies within the region.

Table 2 – Existing Staff by Agency

Staff	City of Yuma	Yuma County	ADOT	Somerton	Cocopah
Signal Technicians	3 Public Works staff	2	3 district staff	Contractor	Maintained by Yuma County
Support/Electrician	1 Electrician	5	-	-	-
Operations	Engineering	Consultant	Supported by statewide staff	City of Yuma Engineering	Yuma County

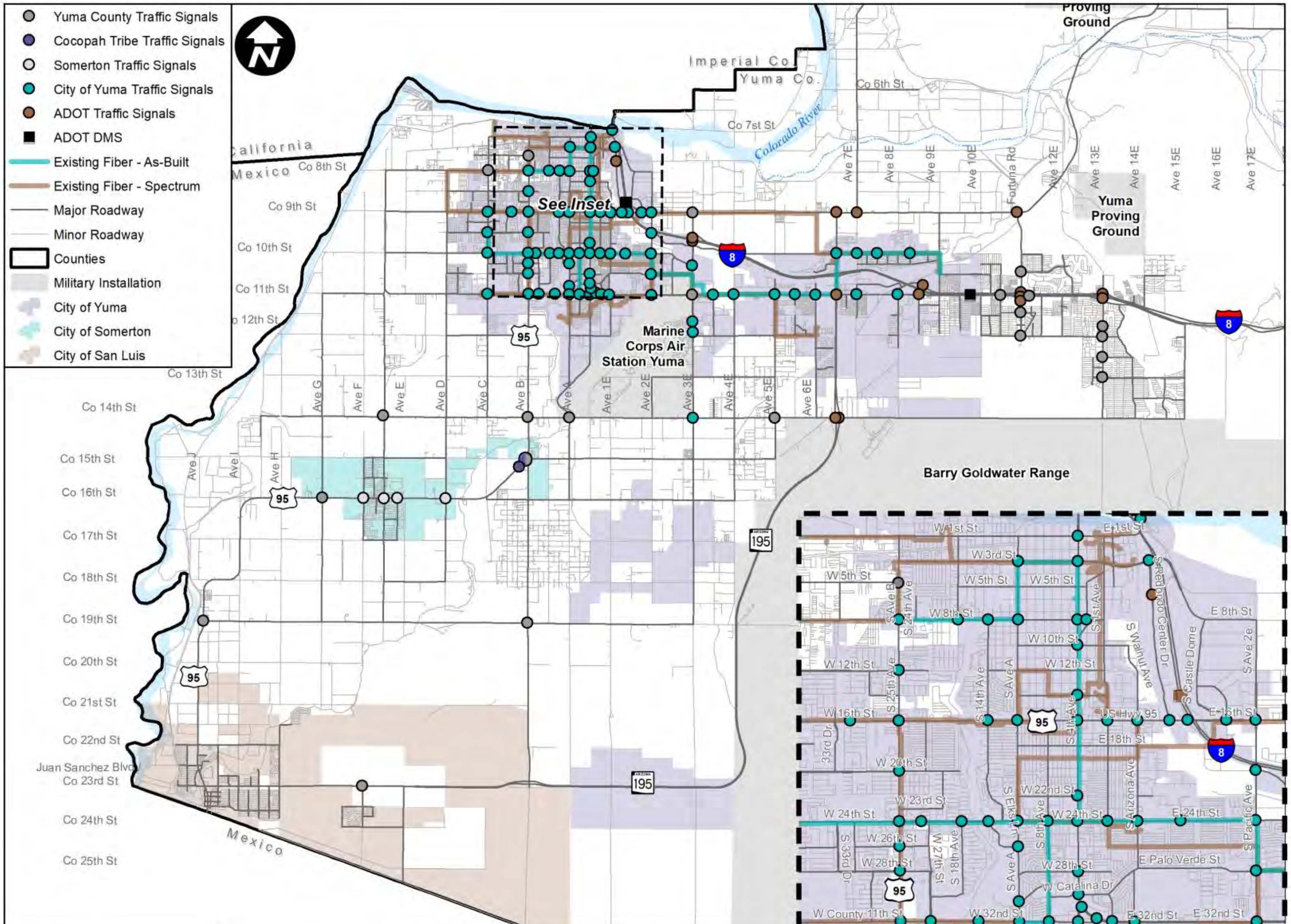


Figure 1 – Existing Traffic Signals

4.1 Funding and Programming

The City of Yuma uses a mixture of several funding sources to fund different types of projects. Many of the construction projects get funded through a combination of federal, state, and local funding sources. These include:

- Highway Safety Improvement Program (HSIP) funds – through YMPO TIP;
- Surface Transportation Block Grant (STBG) funds – through YPMO TIP;
- Highway User Revenue Funds (HURF) – through ADOT; and
- City Road Tax revenue funds – through City CIP.

Currently, the City of Yuma has an operating budget is that is used generally for signals, signing, and pavement marking. The operations budget comes from City road tax and state-allocated Highway User Revenue Funds (HURF). The budget is split between Engineering and Public Works. Field operations and maintenance, as well as any signal timing upgrades, are funded through the Public Works operating budget. Engineering analysis and management is funded through the Engineering budget.

Implementation of many recommended strategies is contingent upon the attainment of additional funding for infrastructure, systems, staff time, and contractor services. Being apprised of funding opportunities and their schedules will allow the City to have time to prepare necessary materials and applications. **Table 3** below shows potential funding opportunities for ITS infrastructure and systems:

Table 3 – ITS Funding Opportunities

Funding Source	Description	Relevant Schedule
YMPO Transportation Improvement Program (TIP)	A regional list of transportation projects selected for local, state, and/or federal funding within with YMPO Yuma County area.	TIP programming covers a period of 5 years.
City of Yuma Capital Improvement Program (CIP)	The City financial plan for local infrastructure improvement projects. Projects included are identified by all City Departments, reviewed by a review committee, and approved by City Council.	CIP programming covers a period of five years, updated each year for the following five-year period.
ADOT Local Public Agency (LPA) Program	A program that allows local agencies to utilize ADOT's on-call services with federal funding. The LPA program follows a four-step process for projects: Planning/Programming; Development/Design; Construction; and Final Acceptance.	The LPA process from planning/program to final acceptance is generally a 40-month to 72-month process depending on the scope of the project.
Development-driven projects	A potential source of project funding is through development driven improvements. Establishing ITS standards for developers to follow within private development projects or half street improvements can aide in the City ITS program buildout.	Infrastructure would be installed as development projects are established.

Funding Source	Description	Relevant Schedule
Federal Funding	Federal funding opportunities are released by the USDOT or other federal agency that can support agencies in planning for, designing, and/or constructing transportation infrastructure investments. Some examples include the Infrastructure For Rebuilding America (INFRA) discretionary grant and Better Utilizing Investments to Leverage Development (BUILD) Transportation discretionary grant. There are also some ITS/technology specific opportunities that area available – some recent examples are the Smart City Challenge, the Advanced Transportation and congestion Management Technologies Deployment (ATCMTD) grant, or the Automated Driving Systems (ADS) grant. Typically, federal funding is acquired by agencies like YMPO or ADOT, with local agencies are partners. Projects that show partnership and cooperation by multiple agencies in a region can elevate the attractiveness of applications for these federal opportunities.	Federal grant opportunities are often dictated by the current transportation legislation that is in place (the FAST Act is the current legislation). Some grants are one-time opportunities, while others occur on a recurring schedule.
State Funding	State agencies, including ADOT, will sometimes have funding available to regions or local agencies to support transportation investments. For example, ADOT's Planning assistance for Rural Areas (PARA) program provided funds to agencies for planning and preliminary scoping for transportation projects. The State Commerce Authority has programs that will support local government investments as they align with economic development and enhanced livelihood; for example, the Arizona Rural Broadband Development Grant makes funds available to act as grant match dollars to leverage additional federal resources to accelerate broadband deployment in underserved areas.	State funding opportunities may be dictated by the current federal legislation in place, while others use sale tax money or other local sources.

4.2 Agency Coordination

The transportation agencies in the region generally partner and coordinate well on transportation-related projects and operations. There are also partnerships with external agencies such as the California DOT (Caltrans) and the US Border Patrol, to support regional transportation.

All stakeholder agencies for this project noted that coordination between agencies for construction closures and detours is done proactively and effectively.

Other examples of traffic-related coordination between agencies or between agency departments are highlighted in

Table 4.

Table 4 – Existing Agency Coordination

Agencies	Coordination Purpose
City of Yuma and Somerton	Starting in 2020, Yuma will provide traffic engineering support to Somerton, including signal timing and other signal operations through an IGA
Yuma County and Cocopah Tribe	Yuma County operates and maintains two traffic signals that are owned by the Tribe along Highway 95 at County 15th Street and at the casino
ADOT and Caltrans	Coordinate for permitting, traffic control, and advanced warning for construction project and for long-term incident closures along I-8 that may have impacts that cross state lines
ADOT and Arizona Department of Public Safety (DPS)	Coordinate to manage incidents on state roadways; A DPS officer sits in the ADOT TOC, which facilitates good communication and information sharing
Somerton and Yuma County	Coordinate for incidents that occur and to implement a detour route for traffic; Somerton Police are included in the coordination to implement the detour
Yuma County Traffic Management Committee	Includes representatives from County Engineering, Public Works, and Sheriff who meet periodically to review issues related to safety and operations, complaints, and suggestions for improvements.
Yuma County and City of Yuma	Coordinate for incidents that require road closures and detours. There is also coordination between the County and the City for EVP equipment on County-owned signals within the City boundaries
Yuma County and ADOT	Coordinate traffic signal operations along the I-8 frontage road and the traffic interchange at Fortuna Road, where an ADOT-owned signal is located between County-owned signals.
Local/District ADOT Staff with ADOT TOC	ADOT TOC assists with incident management on the freeway. Public complaints related to traffic signals are often routed through the TOC and then back to local or district level
ADOT and US Border Patrol	ADOT District coordinates with Border Patrol if a lane or roadway closure impacts the checkpoint on I-8 Eastbound at Milepost 17

5. Needs and Gaps Assessment

This section identifies key needs and gaps related to the existing transportation infrastructure, systems, and processes that this ITS Strategic Plan should address.

Needs are being defined as those that were specifically acknowledged by the stakeholder agencies during the inventory and data collection process.

Gaps are those that identify inconsistencies between the vision and goals for ITS and traffic operations in the region and the existing conditions.

5.1 ITS and Operations Needs

Understanding the different priorities, there were a set of consistent needs for ITS and traffic operations in the region. Stakeholders identified these overarching needs as important for the establishment of a regional ITS Program:

- Upgrading traffic signal infrastructure, including detection, controllers, and cabinets, that are at end of life or not able support advanced operations functions that are desired.
- Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies.
- Determining agency responsibilities for operations and maintenance of traffic signals in the region.
- Identifying programming processes and funding sources that can more quickly and consistently support device replacement, upgrades, and funding for operations.
- Identify funding sources and programming processes for capital investments related to ITS and communications.
- Conducting outreach and education to elected/public officials and the public to garner support for the use of more advanced technologies (such as intersection cameras) to support regional transportation operations.

5.2 Gaps Related to ITS and Operations

The following are gaps in infrastructure and traffic operations and management that will need to be addressed to fully achieve the ITS vision and goals:

- No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time.
- Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.
- Limited agency procedures and processes (between departments within an agency and between different agencies) for coordination and joint decision making for day-to-day transportation operations.
- It is not clear if existing staff have the capacity and skill sets to support operations and maintenance of advanced traffic operations strategies, infrastructure, and systems.

6. Method for Strategy Development

Recommendations Based on Needs and Gaps

The needs and gaps are the basis for identifying recommended strategies that the City can pursue to make progress towards achieving their vision. Strategies include not only infrastructure and capital-based projects, but also consider improvements to or implementation of processes, partnerships, and other non-capital investments that will be important to creating a foundation for elevated traffic management and operations in the City.

ITS recommendations for the City of Yuma are organized into four categories:

- Infrastructure Strategies
- Program, Planning, and Policy Strategies
- Data Strategies
- Partnering Opportunities

While most of the strategies outlined for the City's ITS Program will likely be led by the Engineering department at the City, many of them will require coordination and partnerships with other departments or other agencies to successfully implement and sustain. There are also opportunities for ITS strategies to be expanded beyond City borders to provide inter-agency traffic operations benefits, understanding that the expectations of the traveling public related to traffic operations does not stop at or account for jurisdictional borders. The internal and external partnering opportunities are highlighted in the strategy summary tables in this document.

6.1 Priority Corridors

Many infrastructure strategies will be recommended for phased implementation, allowing the City to make feasible and smart investments over time. The recommended phasing is largely based on priority transportation corridors in the City, which are those corridors that carry the greatest amount of traffic and/or provide access to major activity areas or destinations in the City. Some of the priority corridors are also regional priority corridors that are important to regional travel between communities and between major regional destinations and attractions.

Figure 2 identifies the City priority corridors. The corridors are categorized as primary and secondary corridors. In the subsequent sections, the strategy descriptions identify when it is recommended that proposed devices and communications infrastructure should be first deployed along primary priority corridors, over time continue to be deployed along secondary corridors, and eventually to all signalized intersections in the City. The regional corridors identified in **Figure 3** show corridors that require coordination between agencies to be able to implement specific infrastructure strategies.

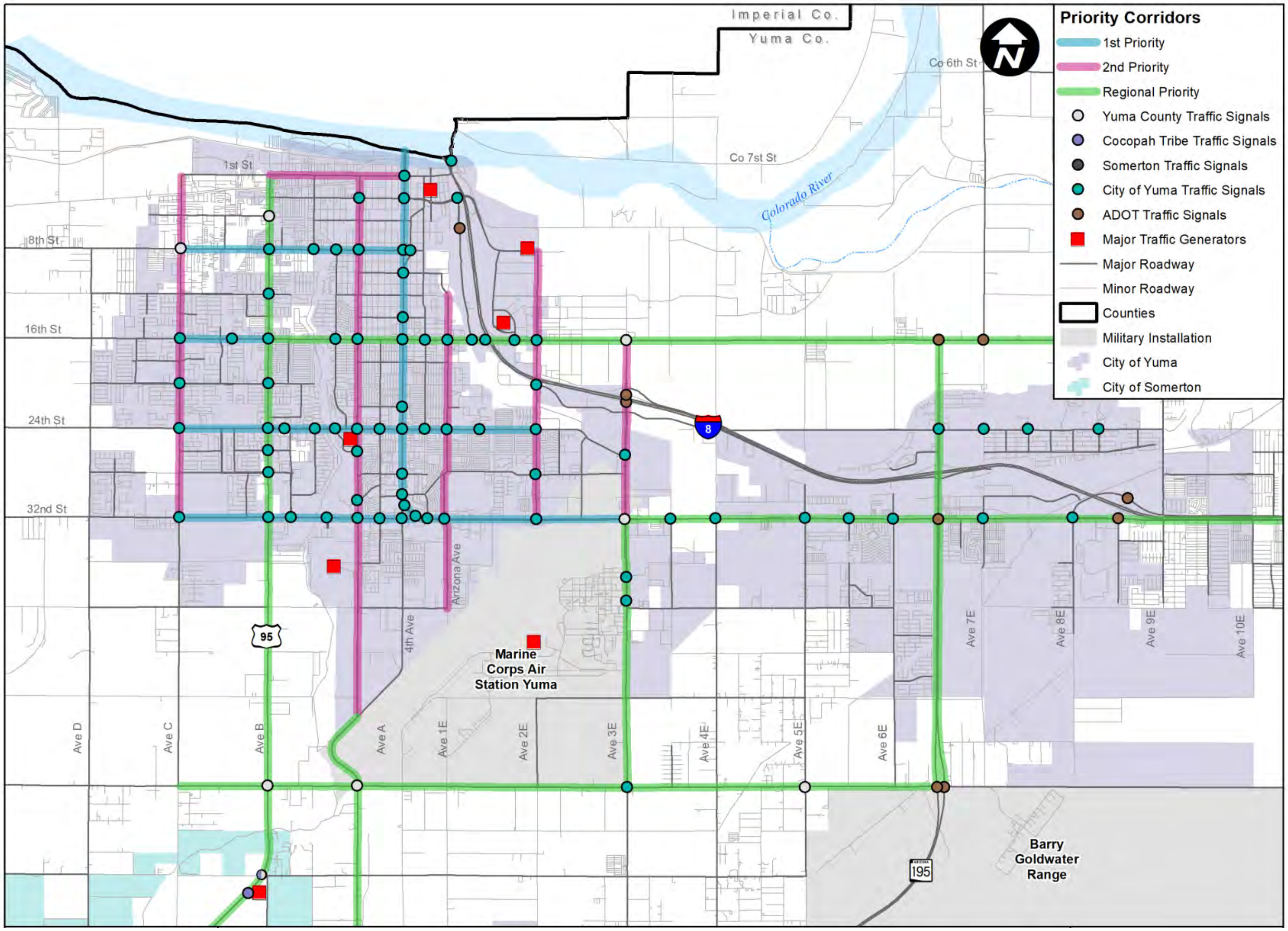


Figure 2 – City Priority Corridors for Transportation Operations

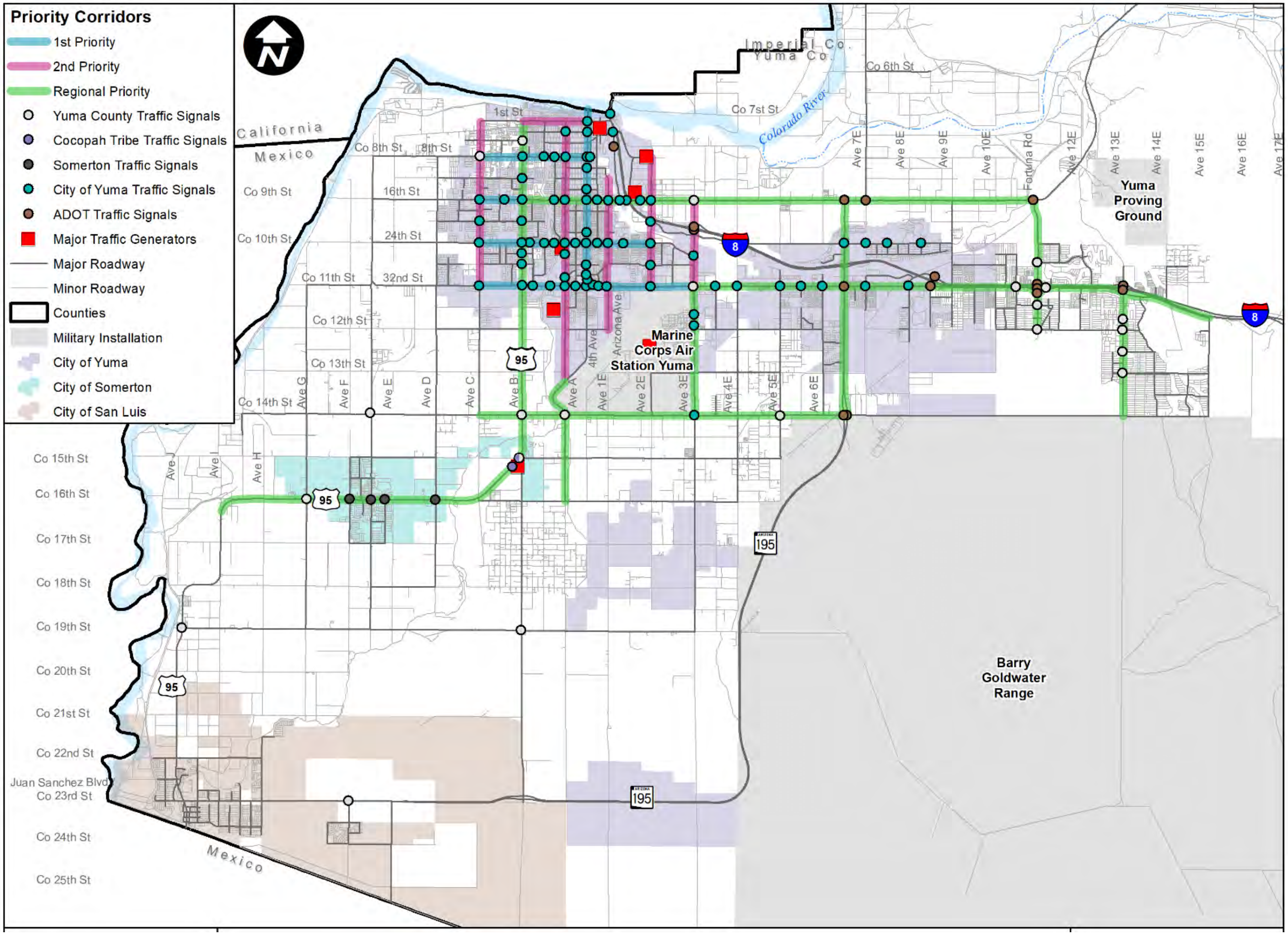


Figure 3 – Regional Priority Corridors for Transportation Operations

7. Infrastructure Strategies

This category recognizes the physical ITS and communications infrastructure that needs to be put in place or connected to build out an ITS program. Currently, the City has traffic signals and some associated infrastructure, such as traffic signal cabinets and controllers, vehicle detection, and emergency pre-emption devices. In order to take traffic management and operations to the next level in the City, there are two major infrastructure buildout strategies that will require significant investment:

1. Deploying transportation communications equipment, (fiber or wireless devices) along key corridors to connect traffic signals to a centralized management system; and

2. Establishing centralized management of ITS infrastructure to provide remote, real-time traffic monitoring and management capabilities.

These two major investment areas are described in the proceeding section. **Figure 4** depicts the relationship between the recommended infrastructure strategies and the sequence in which they should be pursued. Error! Reference source not found. summarizes the recommended infrastructure strategies.

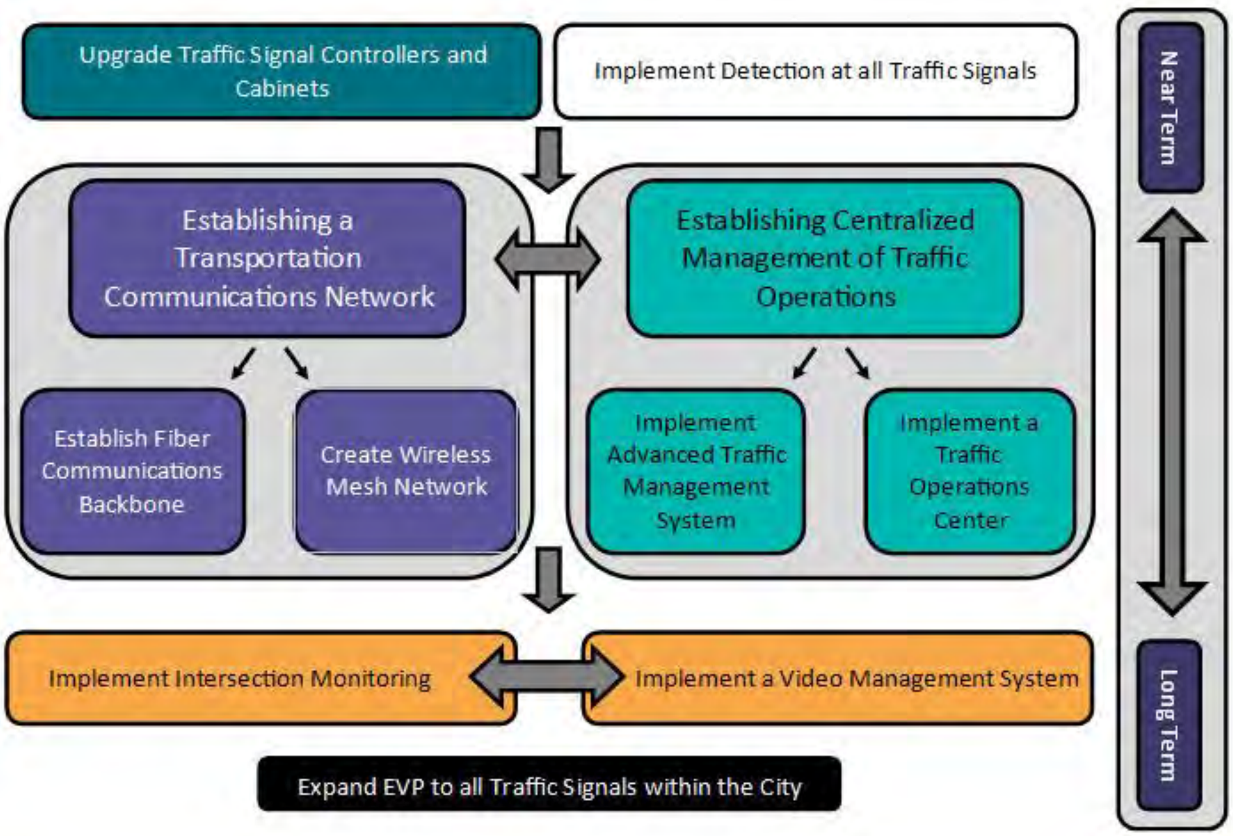


Figure 4 – Relationship and Sequence of Recommended Infrastructure Strategies

Table 5 – Infrastructure Strategies Summary

Infrastructure Strategies	Description	Benefits	Roles and Responsibilities
Establish a Transportation Communications Network	Deploy communications infrastructure, including a fiber backbone and a supportive wireless mesh network to connect traffic signals, other ITS devices, and key City facilities to provide centralized management.	Communications infrastructure allows for real time monitoring and remote operation of signals and for the collection and exchange of data amongst City facilities.	Requires Coordination with: IT
Implement a Traffic Operations Center	A TOC would provide a centralized location where an operator can remotely monitor and manage traffic operations in the City. All ITS systems and software servers will be housed in a location and will be connected to field devices via transportation fiber. Operators are able to access systems to collect data and send back out data or commands from a remote location.	A TOC will allow for remote, real-time management of traffic operations, including incident response, work zone management, and dissemination of traveler information. It can also support increased collaboration on real-time decision making and implementation of operational strategies.	Requires Coordination with: IT and potentially Police Provides opportunity for partnering with other regional agencies.
Implement an Advanced Traffic Management System (ATMS)	An ATMS centralizes collection of data for all traffic signals that are connected to communications and creates a user interface for remote access to and control of traffic signals and other ITS equipment.	An ATMS provides a centralized user interface for the City to remotely monitor and operate the traffic signals once they are connected. Functions of an ATMS may include equipment monitoring and connectivity, monitoring of signal timing and phasing, and collection and reporting on various performance measures related to signal operations.	Requires Coordination with: IT Provides opportunity for partnering with other regional agencies.
Upgrade Traffic Signal Cabinets and Controllers	Use traffic signal cabinets and controllers that enable traffic operations and management functions that the City envisions but may not currently use. Cabinets should have enough space to accommodate additional devices, including connections to a transportation communications network. Traffic signal controllers should support advanced traffic signal operations inputs and data, such as use of adaptive signal control or collection of turning movement count.	In addition to allowing better functionality of other infrastructure, updated cabinets and controllers will work more efficiently and provide the ability for the ITS capabilities at signals to grow beyond planned upgrades.	Requires Coordination with: Traffic Signal Group and external regional agencies
Implement Detection at all Traffic Signals	The City may need to add, upgrade, or replace some existing detection for more advanced traffic operations, such as bicycle detection or the collection of turning movement counts. The City should continue to evaluate new detection technologies as they emerge to make sure that they invest in equipment that enables advanced ITS and data capabilities that the City wants to pursue.	Detection at all traffic signals provides data to support decision-making on real-time traffic signal operations, as well as provide additional data on corridor volumes, queue length, and speed of vehicles.	Requires Coordination with: Traffic Signal Group

Infrastructure Strategies	Description	Benefits	Roles and Responsibilities
Implement Intersection Monitoring	Deploy intersection monitoring (CCTV or VIDs) at signalized intersections or other areas with significant traffic volumes or delays to provide the ability to remotely monitor intersection operations and support improved incident identification and response.	Images from CCTV supports a multitude of real-time operational responses. Images can be useful for data analysis of traffic conditions in response to incidents, events, or other non-recurring congestion. They can also be useful, under appropriate legal circumstances, for public safety to utilize in an investigation or surveillance situation where CCTVs monitoring travel lanes also happen to capture image of public safety incidents.	Requires Coordination with: IT and Police Provides opportunity for partnering with other regional agencies.
Implement a Video Management System	A video management system is the central management system that will allow for centralized management of cameras (if they provide pan-tilt-zoom capabilities) and access to real-time camera feeds.	Unlike detection and communications that can provide some benefits without active management by a staff member, the benefits of CCTVs are based on the availability of a staff member to view, in real time, and utilize the information gathered by actively managing them from a central location. City Police can be given access to the feeds to support incident identification and response after the TMC is in operation	Requires Coordination with: IT and Police Provides opportunity for partnering with other regional agencies.
Expand EVP to all Traffic Signals within the City	The City should make sure that key corridors in the City are completely outfitted with EVP, including at traffic signals that are own or operated by another agencies. The City should continue upgrading their EVP network to be GPS-based.	EVP directs the traffic signal to allow an emergency vehicle to pass through the intersection safely. This improves safety at intersections and reduces the number of stops and delays that the emergency vehicle encounters along its route to/from an incident or emergency situation.	Requires Coordination with: Fire, Traffic Signal Group, and external regional agencies

7.1 Establish a Transportation Communications Network

The City of Yuma does not currently have a communications network associated with Engineering or Public Works. At one time, the City did have a centralized traffic management system to which their traffic signals were connected, but that system has not been in place in many years and the infrastructure and systems are no longer viable.

The City Engineering Department and IT Department, along with other regional entities, are currently embarking on a Regional Fiber Master Plan to determine expansion of fiber communications throughout the region, as well as agreements and processes for installing and maintaining that network. This plan will not identify or include plans for detailed fiber routes nor any connections to traffic signals. However, the City IT department has a vision for what the future fiber ring topology should look like. **Figure 5** shows this City desired proposed fiber ring topology.

To be able to implement many of the infrastructure strategies that are proposed, the City will need to establish a detailed communications network beyond what is shown in **Figure 5** through the development of a Telecommunications Plan. The Telecommunications Plan differs from the Regional Fiber Master Plan because it will specify additional backbone rings or fibers required in addition to other City owned fiber and will identify branch cables or wireless communications to connect all traffic signals to the system. Because the City currently has no dedicated transportation telecommunications, it will be important for the City to have some working knowledge of various aspects of telecommunications (types of devices, configuration of devices, bandwidth considerations, etc.) in order to make informed decisions when pursuing or deploying strategies.

The Telecommunications Plan will need to identify configuration recommendations, the ultimate buildout of the telecommunications network, and near-term connectivity solutions to address.

A Telecommunications Plan should achieve the following objectives:

- *Create network connectivity* – by providing a connection to transportation infrastructure;
- *Increase network connectivity* – by growing geographically to cover a greater percentage of the City;
- *Increase bandwidth capacity* – by balancing the wireless-to-fiber optic cable deployment where bandwidth is needed in the City;
- *Reduce network latency* – by minimizing the number of wireless hops needed within the network; and
- *Increase network reliability* – by achieving the above four objectives, the network will be reliable as the telecommunications infrastructure and capabilities expand.

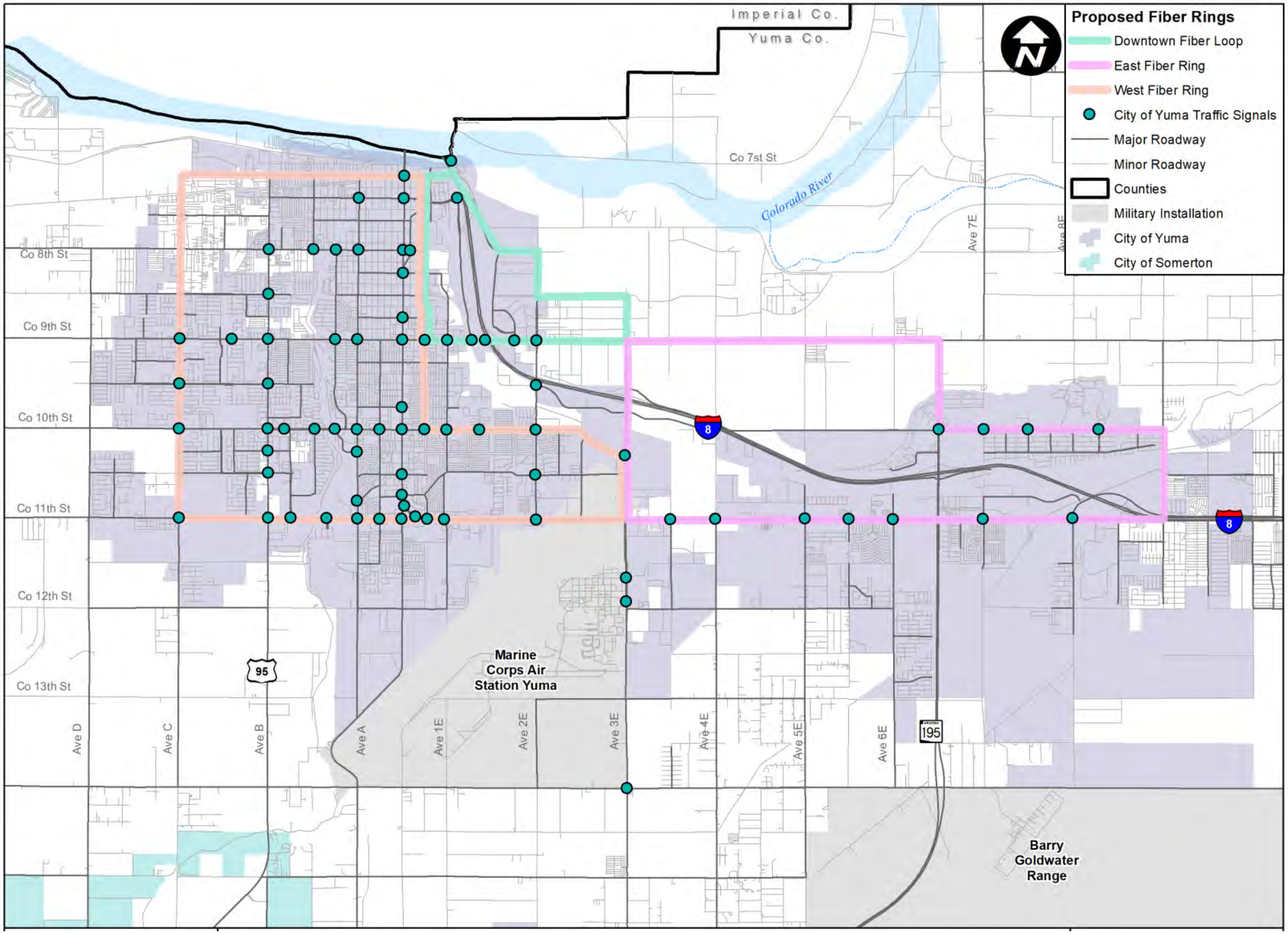


Figure 5 – City Future Fiber Network Plan

7.2 Establish Centralized Traffic Management

Given the size of the City of Yuma's transportation network and number of traffic signals, there could be significant benefits to traffic operations if the City Engineering staff had the ability to remotely monitor and operate traffic signals and other ITS devices in real-time. The communications build-out that was recommended in the previous strategy is a key step towards facilitating this real-time management capability. However, once the signals and devices are connected, the City will need a way to view the data coming in from the infrastructure that should centralize all of the data and information coming from the field devices.

Advanced Traffic Management System (ATMS)

An ATMS system is a central management system for traffic signal equipment. The ATMS system will provide a graphical user interface to allow someone to view data or status of field infrastructure and allow that person to remotely operate and make changes to the infrastructure settings. An ATMS system will also provide centralized data collection and storage.

Traffic Operations Center

The City has a desire to establish a Traffic Operations Center (TOC) to be able to centralize controls of the future ATMS system. Additionally, the TOC can be used to monitor traffic during incidents or work zones or used to observe traffic patterns to adjust signal timing. A TOC allows the City to remotely make those signal timing changes and reduces delay in responding to citizen complaints as it pertains to signal operations. The City may consider building out the TOC to

A Concept of Operations for a TOC will:

- Describe the desired TOC functions and how the TOC will operate from an agency perspective
- Establish a set of requirements that determine the overall size and type of TOC the City would like to implement and the type of functions and equipment and systems they would like included
- Include operational processes for daily operations of the TOC and roles and responsibilities
- Identify training and ongoing operations and maintenance needs of the TOC and its staff

accommodate the possibility for future expansion if other agencies decide to join in the operations.

To establish a TOC, it is recommended that the City first develop a Concept of Operations. This will describe the characteristics for the proposed TOC and what the desired capabilities and objectives are. It will include enough detail to develop a bid package for construction and implementation at a later time.

8. Program, Planning, and Policy Strategies

This category includes systems to implement in order to utilize and maximize the functionality of the physical ITS and communications infrastructure of an ITS program. The recommended systems include standard operating procedures, device standards, training, and scheduled programs.

These system strategy recommendations are described in the proceeding sections. **Table 6** summarizes the recommended program, planning, and policy strategies.

Table 6 – Program, Plans, and Policy Strategies Summary

Infrastructure Strategies	Description	Benefits	Roles and Responsibilities
Create/Update ITS and Communications Approved Product List	Develop a standard list of ITS devices that provide the functionalities desired by the City ITS program and are compatible with other City infrastructure and systems. Include ITS devices as part of traffic signal design standards, where possible.	Standardization improves interoperability of the system and makes sure that all devices provide the functionalities that the City desires. It will also increase maintenance efficiency, as there are fewer variations in the types of devices that need to be maintained and thus fewer maintenance practices to learn. It will also reduce the variation in device inventory that needs to be available.	Requires Coordination with: IT Provides opportunity for partnering with other agencies.
TOC Standard Operating Procedures	Develop standard operating procedures (SOPs) for the TOC and for the use of ITS devices by City staff.	SOPs will document processes and expectations for TOC and device/ system use so that they are agreed-upon and not contingent on the presence of specific individuals. SOPs will also help delineate roles and responsibilities for operations in the City to allow for the most coordinated and efficient operations.	Requires Coordination with: IT and potentially Police Provides opportunity for partnering with other agencies.
Road Closure Playbook	Collaborate with other City (and potentially other agency) traffic and public safety staff to identify and document agreed upon processes for coordinating on and responding to unplanned events that impact traffic on City roadways.	Having pre-determined plans and set notification procedures will allow the City to act faster and in a more coordinated manor in the case of an incident that disrupts traffic operations on City streets. This can help improve incident response and clearance times, improve safety at the scene and on the rest of the network, and	Requires Coordination with: IT and Police Provides opportunity for partnering with other agencies.

Infrastructure Strategies	Description	Benefits	Roles and Responsibilities
		improve traffic operations along impacted routes.	
Formalize Signal Timing Program	Develop and document City traffic signal timing standards and put into place a program that provides staff time and funding to periodically evaluate, and update as necessary, traffic signal timing along key corridors.	Optimizes traffic flow along the corridor based on current conditions. Reduces citizen complaints about red lights. Makes sure that key corridors within the City continue to operate efficiently as traffic increases or travel patterns change.	Requires Coordination with: IT, Police, and external agencies
Maintenance and Lifecycle Management Program	Formalize an asset and maintenance tracking program for new TOC equipment and for all ITS devices and systems. The program should identify expectations for maintenance and lifecycle planning and identify funding streams and staffing to support maintenance and replacement of equipment.	Allows for proactive lifecycle and maintenance planning for ITS Program to identify funding (including external funding opportunities) before device/system end of life	Requires Coordination with: IT and Traffic Signal Group
Operations and Maintenance Training	Identify and create opportunities for training staff on ITS, including for specific devices and systems, but also for operational strategies, such as traffic signal timing, traffic incident management, or technician training.	Providing staff with proper training will allow them to most efficiently and effectively operate and maintain the ITS program, resulting in the most effective traffic operations and maintenance processes.	Requires coordination with Public Works Provides opportunity for partnering with other agencies

9. Data Strategies

A primary benefit to ITS devices and systems put in place is the data that it captures and the information that data can provide. Data can provide situational awareness where there was none before and analysis tools and evaluation metrics that can be used to support decision-making and cost-savings. Data can be used for long-range planning and before-and-after analysis to determine successes and failures associated with growth and development.

New data is growing in scale and breadth as the transportation environment moves toward a Connected Vehicle environment. Data is quickly becoming a driver both locally and nationally for decision-making, and it is in the best interest of this ITS Strategic Plan to acknowledge that the ITS Program can provide a wealth of data to support mobility, efficiency, and economic and community drivers that the City is moving toward.

The key advancement suggested in the Data Strategies is the intentional use of data to support real-time decision-making, investment strategies, and public information dissemination. Error! Reference source not found. summarizes the recommended data strategies.

Table 7 – Data Strategies Summary

Infrastructure Strategies	Description	Benefits	Roles and Responsibilities
Data and Performance Tracking and Reporting – Internal and External	Create a plan to collect, share, track, and report on data and/or performance measures related to traffic operations and ITS. Data can support operational decision making and can be turned into information that can be shared to show the impacts of the ITS Program The City should make a performance report available to the public to show impacts of the City's investments in the transportation system and support public education related to ITS and traffic operations.	Tracking and reporting on data and performance measures will support City departments in sharing data and information and will allow City staff to see how they are progressing towards specific goals or how the City's transportation system is performing over time	Requires Coordination with: IT Provides opportunity for partnering with other regional agencies.
Traveler Information	Building off of the data and performance measure strategy, the City should consider ways to provide travelers with real-time traffic condition information.	Information on traffic conditions allows travelers to make trip planning and route determination decisions, which would support reduced congestion in the City. It will also be a highly visible City service to show that the City is using its resources to support its residents and visitors in ways that no other City is doing so.	Requires Coordination with: IT, POI, and Police Provides opportunity for partnering with other regional agencies.

10. Next Steps

10.1 Implementing the Plan

This ITS Strategic Plan identifies recommended strategies to consider based on the needs at the City. Many of the recommended strategies will require more resources, including funding, staff time and changes to institutional structures or processes in order to implement.

- A Traffic Management Center Concept of Operations will provide more details on the proposed TMC. The document will identify key user needs, detail out the desired functions and operational scenarios, identify key staff roles and responsibilities, and put forth some specific requirements to help pursue a TMC.
- An ITS Deployment Plan will identify the institutional foundation to successfully implement the ITS strategies. It will outline a 10-year implementation plan including summaries of costs, recommended staffing levels, and other key procedural items critical to implement the strategies.

10.2 Updating the Plan

This ITS Strategic Plan is a dynamic plan. To remain up-to-date and relevant amid constantly changing needs and evolving technologies, this Plan should be revisited and reviewed periodically as projects are implemented or expanded, agency priorities change, or other changes occur in the City, State, or at the federal level that impact ITS. **Table 8** are the proposed triggers for revisiting and updating specific components in the ITS Plan.

Table 8 – Proposed Triggers for Updating the ITS Plan

Trigger to Update	Update
Prior to the City CIP call for projects/budget items or YMPO TIP call for projects	Review ITS Recommended and Strategies for potential CIP/TIP projects and links to other departments/agencies to leverage the request for funding
After adoption of City CIP and budget	Update ITS Plan document
After approval of YMPO TIP	Review strategies and prioritization recommendations for updates needed based on recent projects included into YMPO TIP

Some key components of the plan that should be revisited during these updates include:

- GIS Maps – Keeping the infrastructure maps in this Plan up to date will help not only track progress and provide strategic direction, but will be useful as a repository for data. All ITS data, including as-builts, should be aggregated in a centralized location and should be updated as infrastructure and data becomes available. For the ITS Plan, locations of traffic signals, communications infrastructure and other ITS devices that were identified in the Plan should be kept up to date and accessible by City departments and external agencies who request it.
- Priority Strategies – A list of strategies are provided in this Plan, but new, revised, or updated strategies based on the success of strategy implementation should be documented and the next steps for strategy implementation should be identified.

Appendix A

ITS Vision and Needs Assessment Technical Memorandum

2020 ITS STRATEGIC PLAN for the City of Yuma

In partership with

ADOT

YMPO
Yuma
San Luis
Cocopah
Wellton
Somerton
Yuma County
ADOT

YUMA COUNTY ARIZONA

CITY OF SOMERTON ARIZONA 1898

Prepared by
Kimley»Horn

ITS Vision and Needs Assessment

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1. Project Overview

The City of Yuma is undergoing the development of a City Intelligent Transportation System (ITS) Strategic Plan. This ITS Strategic Plan will help guide the City's investments in ITS to support traffic management, traveler information, incident management, interagency communications, and coordination with other agencies in the region. The plan will provide a phased approach to implement and integrate existing and new ITS infrastructure, systems, and strategies.

1.1 Project Purpose

This plan will explore and propose a framework for the near- and long-term operations and management of transportation investments in the City. The framework will also highlight opportunities where other local, county, regional, and state agencies in the Yuma region may partner or contribute to processes, strategies, or projects that could elevate local and regional traffic operations.

This ITS Strategic Plan is the first phase of a multi-phased effort to define, plan for, and potentially implement advanced traffic management systems and strategies in the City. Upon completion of this ITS Strategic Plan, an ITS Deployment Plan will be developed to more specifically define recommended projects and propose a plan to implement them over time. The ITS Strategic Plan and the ITS Deployment Plan could be used as inputs to prepare potential grant applications for the City, or the larger region, to pursue funding for infrastructure implementation.

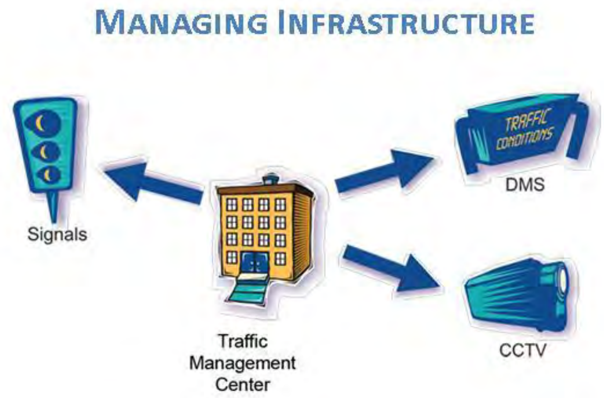
1.2 ITS Strategic Plan Process

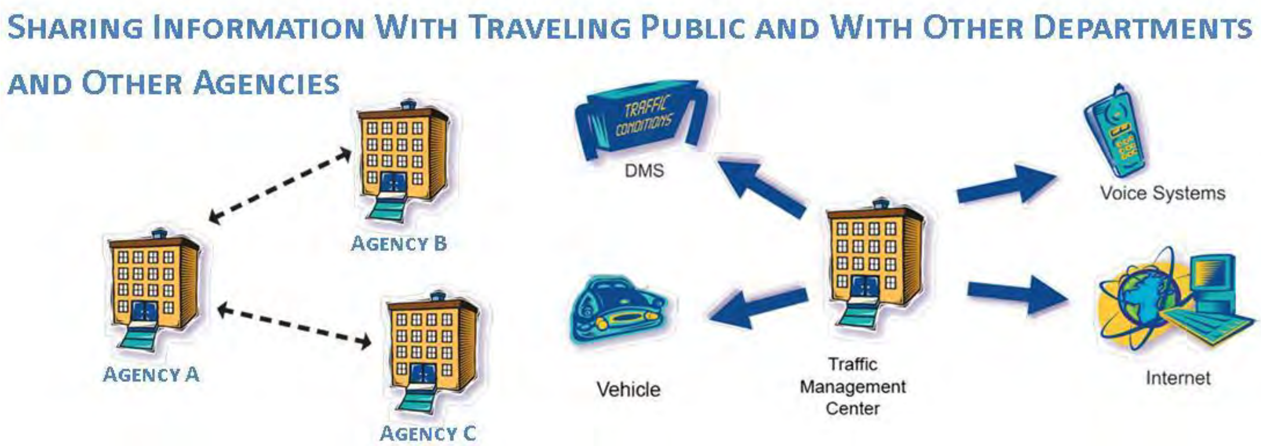
The key project phases of the Yuma ITS Strategic Plan include:

- **Vision and Goals** – Identifies the City vision, goals, and priorities related to traffic operations and management, with a focus on opportunities for transportation technologies and systems. This task also identifies some of the visions and goals of individual stakeholders in the region related to traffic operations and, specifically, any opportunities to coordinate or pursue joint operations.
- **Inventory and Needs** – Identifies and documents existing ITS devices and systems within the City and the Yuma region. This task also highlights existing and near-term projects for the City and other agency stakeholders that could support future ITS in the region. The inventory also explores documents such as agreements or trainings and identifies existing processes in place to coordinate with other agencies, program projects, and track and maintain transportation technology assets. The document determines gaps in the infrastructure and identifies traffic operations and management needs in the City including some that persist across the region.
- **Integration Recommendations** – Provides recommendations for infrastructure and non-infrastructure strategies that address needs and gaps. Strategies will include such items as:
    - Projects that need funding to support their implementation, such as device deployment or upgrades to existing equipment.
    - Resources needed to establish a City traffic operations center (TOC) and equipment to maintain the functionality and be able to grow long-term.
    - Opportunities to improve coordination with ADOT freeway operations and along major corridors for potential regional arterial operations.

2. Introduction to ITS

ITS is a term that encompasses the infrastructure, systems, and data that are used to improve the safety and efficiency of a transportation network. Typical applications of ITS include being able to manage traffic signals and other traffic control devices in real-time from a centralized location, sharing information with travelers and other agencies about the transportation network, and monitoring traffic on corridors and intersections in real-time. Examples of ITS infrastructure includes traffic signals, detection, CCTV cameras, dynamic message signs, and software used to operate and manage the devices.





The foundation of ITS rests on data collection and analysis, and the translation of the data into information. Information helps agencies make decisions on the planning and real-time management of their transportation network, and information is also disseminated to the public to allow travelers to make informed decisions about their trips. It is also shared among agencies to facilitate coordination between agency transportation operations and enable better collaboration for purposes of traffic management, incident management, and future infrastructure planning.

3. ITS Vision and Goals

Setting a vision for ITS in the Yuma region helps identify the conditions that the region is striving to reach and, when compared to the current state, allows identification of the strategies and projects that will be most relevant and effective towards reaching that vision. The vision and goals look to reflect input from the City of Yuma and the stakeholders within the wider Yuma region.

3.1 Stakeholder Input

Meetings were held with the different stakeholder agencies in the region, including the City of Yuma, Yuma County, the City of Somerton, and the Arizona Department of Transportation (ADOT), related to traffic operations and management and transportation technologies. The discussions highlighted the visions and priorities of the individual agencies and helped to form the collective vision for ITS in the region. The meetings included a joint kickoff meeting with all of the partner agencies to introduce the ITS Strategic Plan process and discuss, as a group, some key needs and opportunities for transportation in the region. Additionally, a series of agency-specific meetings were held to dive deeper into the goals, priorities, and needs of specific agency partners.

3.2 City Vision and Goals for ITS

The City of Yuma's vision for ITS is:

Through centralized control of field devices and coordination between transportation agencies, the Yuma region employs advanced traffic operations and provides real-time traveler information to create an efficient and safe transportation network.

A set of City goals will help drive the direction and outputs of the ITS Strategic Plan:

- Invest in technology to take transportation system management to the next level and manage the transportation network more effectively, rather than trying to build the way out of congestion.
- Work with partner agencies to elevate the level of real-time coordination for traffic and incident management to provide a consistent and efficient travel experience across municipal boundaries.
- Identify a framework for a TOC that facilitates centralized control of field devices and coordination between agencies while allowing each agency to maintain ownership of their infrastructure.

3.3 Regional Vision and Goals for ITS

In general, stakeholders sees value in real-time coordination between agencies for traffic management and the use of technology and data to maintain a safe and efficient transportation network.

However, the stakeholders identified some additional goals or nuances to the City's goals in relation to ITS:

- Ensure compatibility and functionality of technology to facilitate advanced operations and interoperability.
- Define a multi-agency model for operations and device ownership that is clear, efficient, and logical based on the regional transportation network.
- Deploy technologies that can support multiple functions and responsibilities related to traffic management, performance management, and public information dissemination.

4. Existing Transportation Overview

The Yuma region has seen an increase in population over the last 15 years. The regional economy has a diverse foundation with two major defense facilities, a regional/interstate medical facility, a high-tech agribusiness industry, and a growing industrial sector. The region also hosts more than 60,000 winter visitors annually, according to a recent study conducted by the Arizona Office of Tourism. The Yuma region serves as a gateway to both California and Mexico. State facilities including Interstate 8 (I-8), State Route 195 (SR 195), and State Route 95 (SR 95) all provide important access to these borders and connectivity in the region. Key local facilities, such as 4th Avenue, 16th Street, Avenue B, and 32nd Street are critical for the local movement of people and goods and will experience daily traffic volumes comparable to major regional corridors, as shown in **Figure 1** depicting 2015 average daily traffic (ADT) volumes in the region.

This section provides an overview of the existing facilities and the transportation network in the Yuma region, including the existing state of ITS deployment. It also considers processes and coordination that is in place to support transportation operations and maintenance. Understanding the existing state of ITS and transportation as it compares to the conditions described in the vision and goals will help uncover key needs and gaps that need to be addressed.

4.1 Transportation Technologies and ITS

Traffic Signals

The City currently operates 77 traffic signals. A majority of City-operated signals are within the western portion of the City, with only 15 signals east of the Marine Corps Air Station (Avenue 3E). Additional traffic signals in the Yuma region being considered in this ITS Strategic Plan are operated by: Yuma County (22 signals), Somerton (four signals), and ADOT (17 signals).

ADOT signals primarily serve traffic interchanges on I-8 and SR 195, though three of the signals operated by ADOT are on the principal arterial SR 95, north of I-8.

Figure 2 shows the existing traffic signals within in the region.

Communications

Currently, all City, County, and Somerton traffic signals are locally controlled and not connected to a centralized management system via communications. Two ADOT traffic signals in the region, I-8/Fortuna Road and I-8/Foothills Boulevard are connected to the ADOT central system via cellular communications.

City of Yuma does have non-transportation related fiber infrastructure that connects key City facilities. **Figure 3** shows the existing enterprise fiber and key facilities within city of Yuma. Though the fiber does not currently connect to City of Yuma traffic signals, 56 of the 77 City-operated signals are on an existing fiber path.

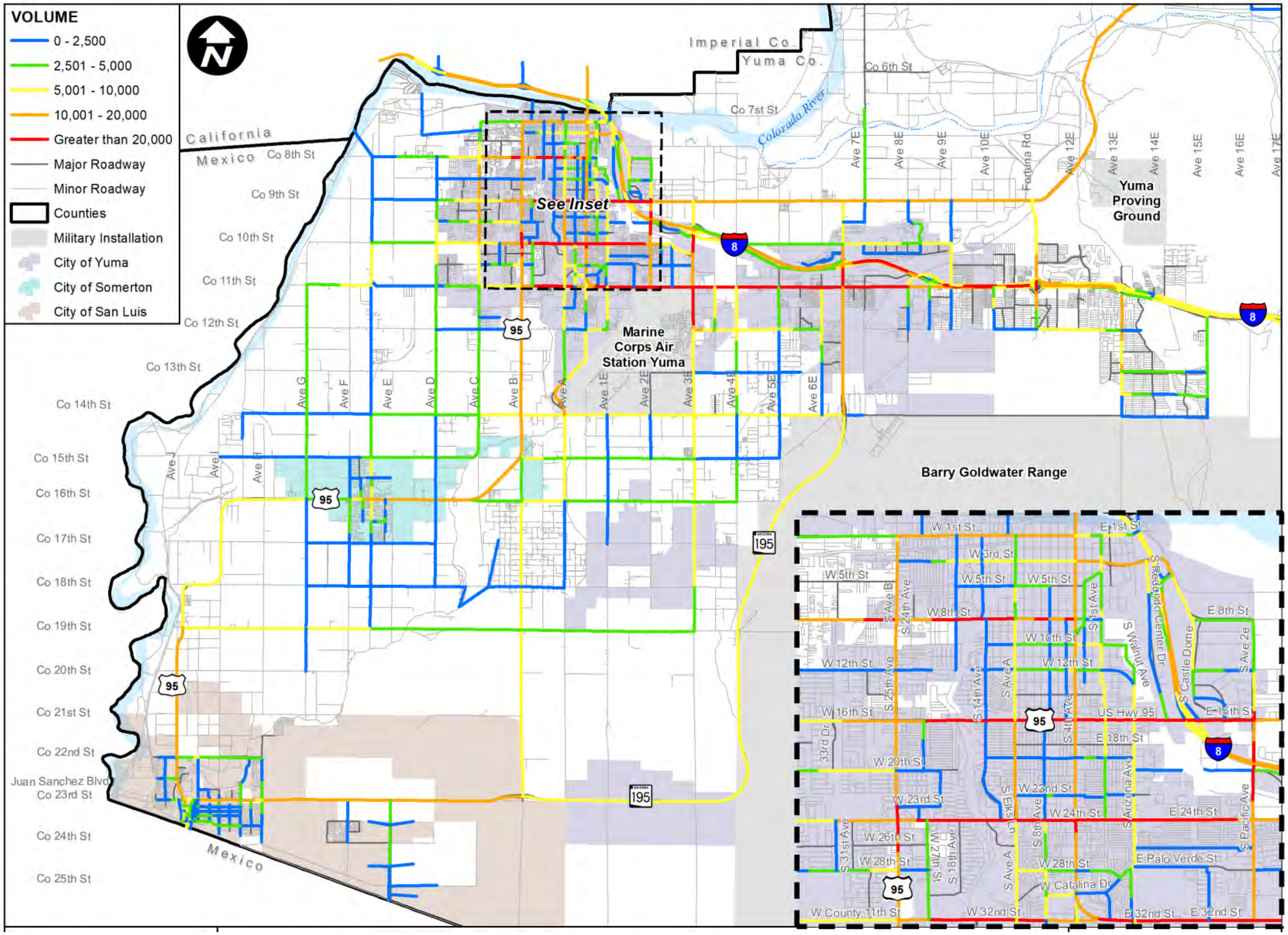


Figure 1 –Traffic Volumes (2015)

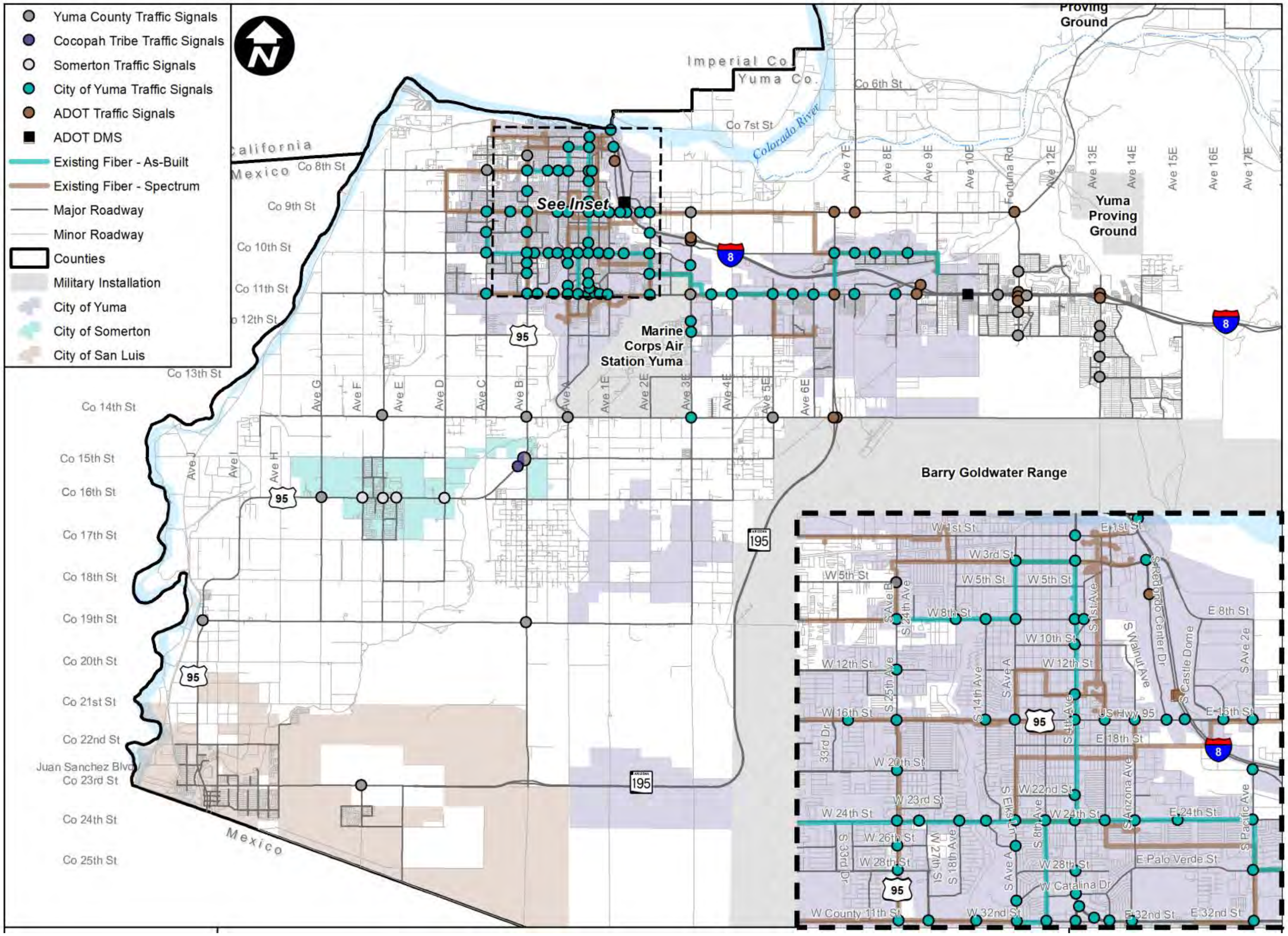


Figure 2 – Existing Traffic Signals

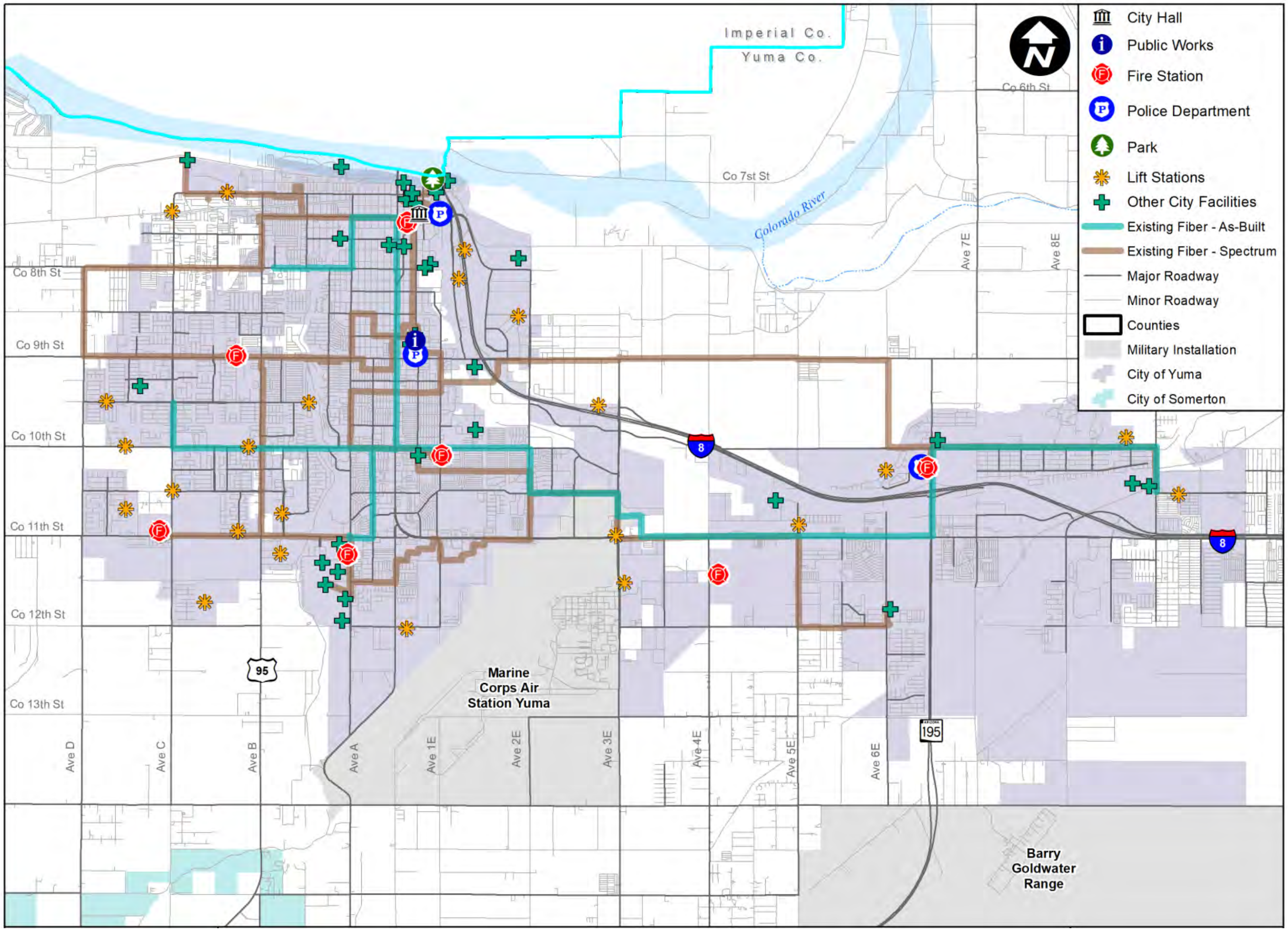


Figure 3 – City of Yuma Existing Fiber and Key Facilities

Vehicle Detection

Figure 4 shows the traffic signals that are equipped with vehicle detection and the type of detection used. All but two of the existing traffic signals within the City are actuated, meaning that they are informed by detection. 50 of the signals are equipped with loop detectors and 25 of the signals are equipped with video detection. The two traffic signals without detection are not actuated, meaning they run on pre-set timing plans, and are located at 3rd Street and Avenue A and 8th Street and Orange Avenue in the north part of downtown, near City Hall.

Yuma County traffic signals are all actuated. 16 of the County-operated signals are equipped with loop detectors and 6 of the signals are equipped with Gridsmart video detection. Four of the six County signals with video detection are within a 1.25-mile segment of Foothills Boulevard.

The four Somerton-operated signals are currently equipped with loop detection.

ADOT traffic signals are all equipped with vehicle detection, which include loops, video detection, and radar detection. Two kinds of radar detection are used by ADOT: Econolite and Wavetronix.

Emergency Vehicle Preemption (EVP)

EVP is used to provide emergency response vehicles, such as fire trucks, with priority signal phasing at intersections. EVP allows equipped vehicles to communicate with the traffic signal to indicate that the vehicle is approaching the intersection which directs the traffic signal to provide a green signal phase in the direction of the emergency vehicle to allow it to pass through the intersection safely.

Currently, the City of Yuma has infrastructure to support EVP for City emergency response vehicles at City signals and signals within City boundaries that are owned by Yuma County. No other agency signals have EVP, and non-City emergency vehicles are not outfitted with the equipment that would support preemption within the City.

Real-time Intersection Monitoring

Real-time monitoring of intersections can help to identify equipment malfunctions (such as a traffic signal in flash) and detect and verify incidents that may occur at an intersection. However, any equipment used for real-time monitoring, including closed-circuit television (CCTV) cameras and video detectors, must be connected to a centralized system to allow for remote monitoring of the streaming images.

Currently, there are no CCTV cameras deployed at intersections, and none of the existing video detectors are connected to a central system, so there is no real-time intersection monitoring performed in the region.

Traveler Information

ADOT owns and operates two dynamic message signs (DMS) along I-8 within the Yuma region. The DMS are connected via cellular communications to the ADOT TOC in Phoenix, which allows the TOC to operate the sign and post messages remotely. The DMS signs are used to provide information to freeway travelers about travel conditions on the freeway, including travel times, unplanned roadway restrictions, work zones, weather impacts, or can be used to post public service messages. The location of the DMS can be seen in Figure 2.

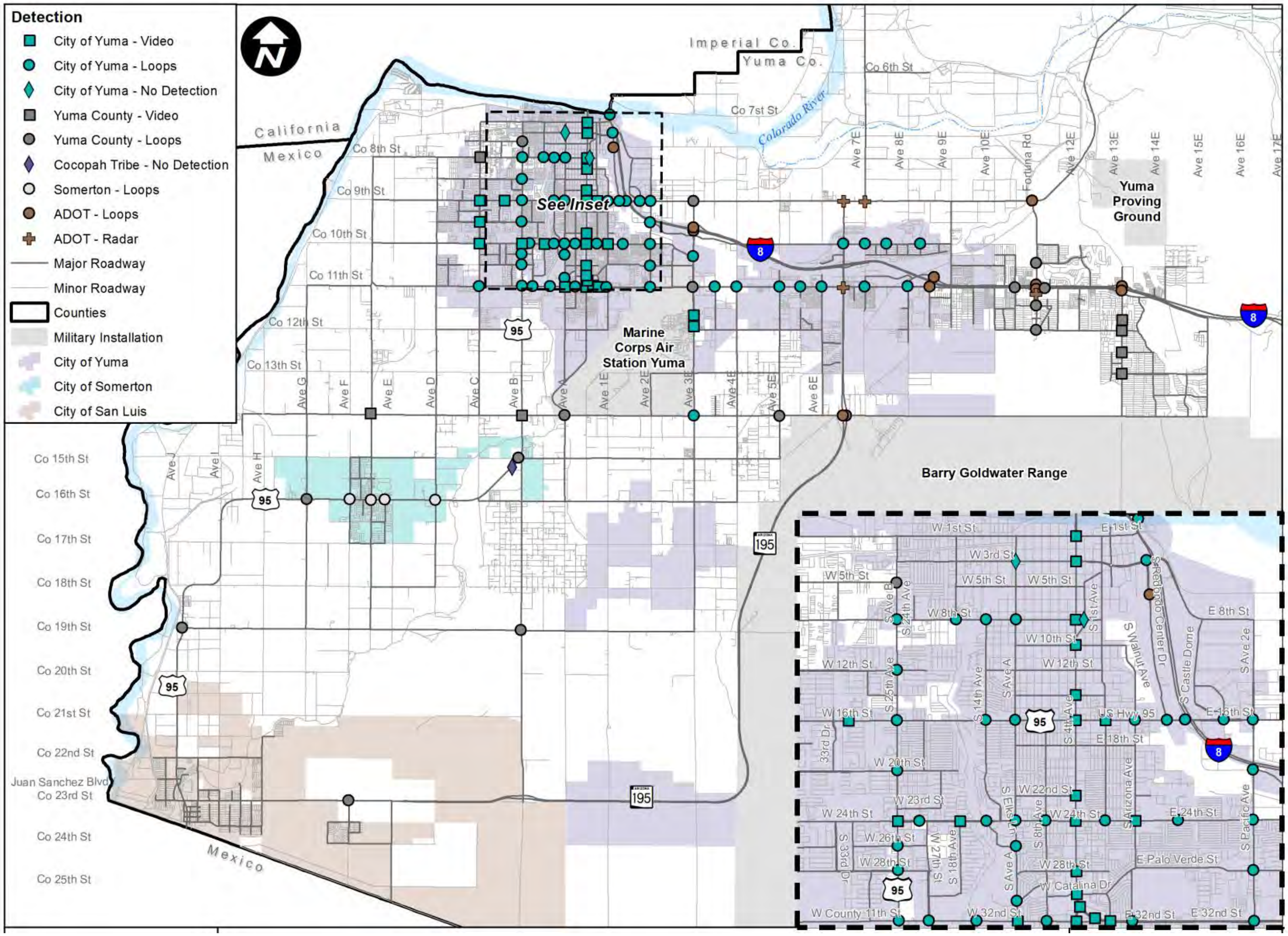


Figure 4 – Existing Detection at Traffic Signals

4.2 Alternative Modes of Transportation

Understanding the operations and network for non-single occupancy vehicles is helpful when taking a holistic view of traffic operations and ITS because: 1) there are technology applications to support safety and operations of these other modes; and 2) it helps identify key corridors in the region for mobility that may be prioritized for ITS and advanced operations strategies.

City of Yuma and surrounding areas are currently served by the Yuma County Area Transit (YCAT) system operated by Yuma County Intergovernmental Public Transportation Authority (YCIPTA). Existing YCAT routes can be seen on **Figure 5**. Currently, there are no existing processes or technologies deployed from the traffic side to specifically support transit operations.

There is a network of bicycle facilities, also shown in Figure 5, that are primarily located within the City of Yuma and the City of Somerton. ITS technologies have the ability to support safety and efficiency of bicycle travel, especially at intersections, if the elevation of this mode is a priority for future mobility in the region.

Another important mode of travel within the City of Yuma is freight travel, both by trucks and rail. The City of San Luis is bordered by Mexico to the south and contains two international ports of entry, and there are two domestic ports of entry along I-8 and Business 8 at the California border. Currently, there is no technology deployed at these port locations, however, ADOT is looking into implementing in a system at the inland ports to support enforcement of weight restrictions as well as licensure or credentials for freight traffic passing through those ports in the future.

There is one railroad company operating in the study area – the Union Pacific Railroad (UPRR), which operates regular rail freight services on its main east-west route. There are at-grade railroad crossings, where the railroad intersections with a surface street, on:

- Avenue 9E between 24th and 28th Street
- Fortuna Road south of County 9th Street
- 24th Street at S Industrial Avenue (see image)
- 1st Street, just north of Rodenbaugh Road

At these locations, there are active traffic control assemblies, including a lowering gate and flashing lights that get activated by an upcoming train. These devices are not currently connected to any centralized system and do not have advanced pre-emption.

Some railroad crossings, at railroad spur locations that do not experience high train traffic, do not have any dynamic controls at the at-grade crossing, as shown in the example below, located at 10th Street, east of 1st Avenue.

Other railroad crossings in the region are grade-separated so that the railroad does not conflict with a roadway or affect traffic operations at intersections.

Truck routes and railroads are shown on Figure 5.

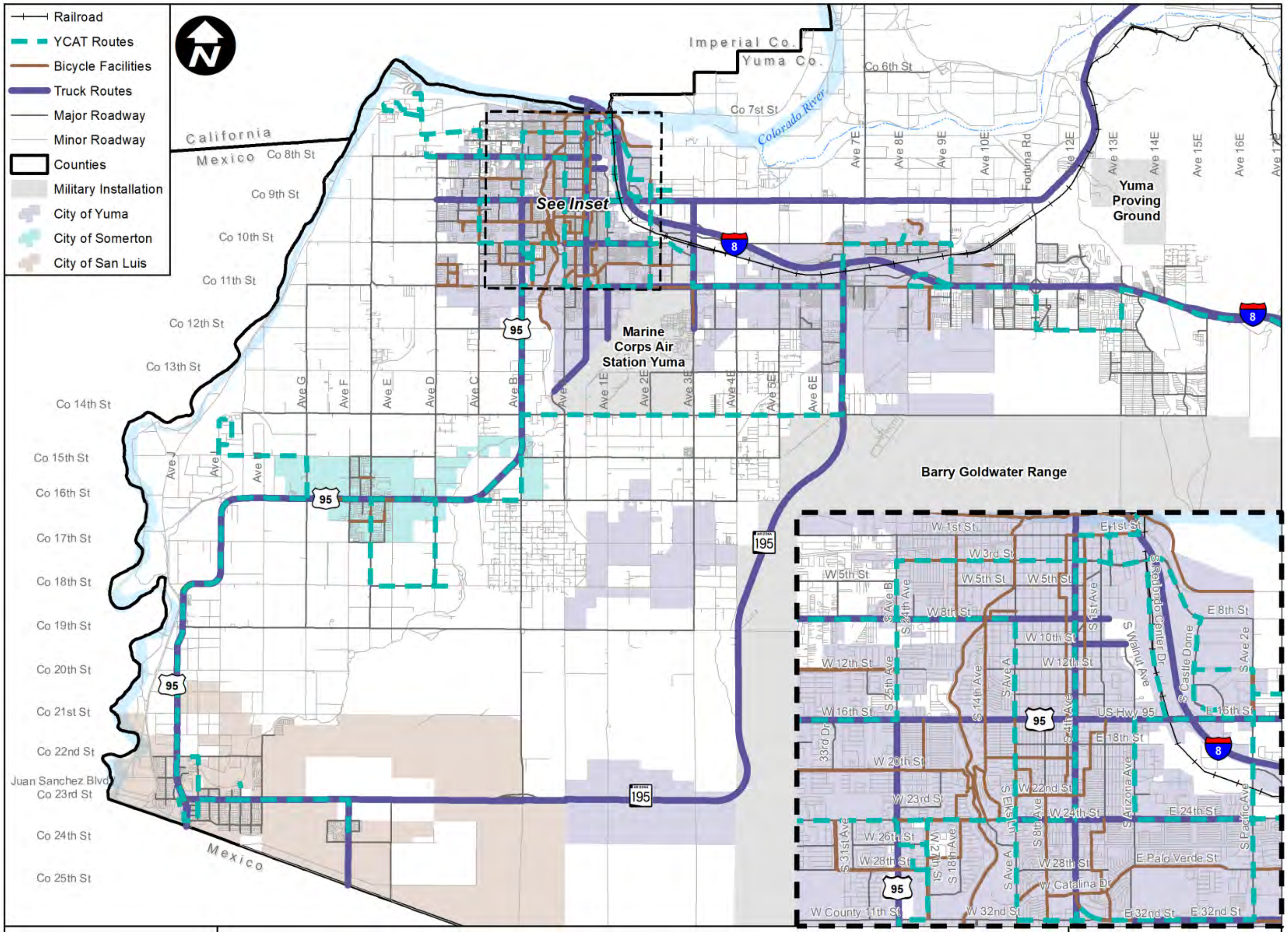


Figure 5 – Alternative Modes of Transportation

4.3 Traffic Operations

The City of Yuma Engineering is responsible for the operations of traffic signals in the City. Currently, reviewing and updating signal timing is largely completed in-house by engineering staff.

All Yuma County traffic signals were re-timed by an engineering consultant in 2018 and new timing plans were implemented at all traffic signals. In Yuma County, traffic signal timing is not updated on a regular basis but is instead updated as a result of one of the following circumstances: a new development is constructed that will change travel patterns along a corridor; multiple cases of public complaints about a traffic signal; or staff/elected official concerns about the level of service at an intersection. The County has an intergovernmental agreement (IGA) with the Cocopah Tribe to operate and maintain Tribe-owned traffic signals along Highway 95 at County 15th Street and at the casino entrance.

Somerton does not have an engineering department and will be partnering with the City of Yuma starting in 2020 for traffic engineering support. This is being facilitated through a formal IGA where Somerton will pay the City of Yuma to support traffic signal timing and other traffic operations functions. Somerton will retain the responsibilities for ownership and maintenance of the signals and associated infrastructure.

ADOT does not have a local traffic engineer for the Yuma region and is instead supported by the traffic engineers of the Central and the Northwest Regions. Any traffic operations needs related to traffic signals in the field are completed by local ADOT staff in the Yuma region. Other ADOT technology, such as the DMS sign on I-8, is operated by the ADOT Traffic Operations Center (TOC), which is located in Phoenix.

4.4 Device Maintenance and Upgrades

The City of Yuma Public Works department is responsible for the maintenance of all field equipment, including traffic signals and associated equipment (traffic signal cabinets and controllers, vehicle detection, etc.). There are currently three Traffic Signal Technicians and one Electrician that support maintenance of the City's almost 80 traffic signals. Public Works uses an operating budget to replace and upgrade traffic signal infrastructure as it is deemed necessary. The department has an active program to upgrade three intersections per fiscal year. The project allows the City to bring the infrastructure to current standards and modernize the traffic signal system.

Yuma County has two full time signal technicians and a total of seven staff who support signing and traffic signal maintenance on County roadways. The existing staffing provides adequate support for the preventative and responsive maintenance needs of County traffic signals. The County has a monthly preventative maintenance program for their traffic signals that has been very successful in reducing equipment failures and malfunctions, and thus has significantly reduced emergency maintenance call-outs for their traffic signal infrastructure.

The County allocates between $75,000 and $90,000 annually from the Public Works operations budget for equipment upgrades and has a separate maintenance budget to support maintenance activities. There has been an initiative to upgrade the vehicle detection at signalized intersections by leveraging development-related work; for example, they have seen significant activity from utility companies who are implementing new infrastructure and impacting existing in-pavement loop detectors. The County has been using the replacement costs from those loops to instead upgrade the detection to Gridsmart video detection.

The City of Somerton utilizes a contractor to provide maintenance on traffic signals and associated equipment in the City. They utilize a regular maintenance schedule to provide preventative maintenance to equipment a few times per year, but also provide responsive maintenance for when there are unplanned issues.

The ADOT Southwest District is responsible for maintenance and replacement of ITS equipment in the Yuma region. Currently, there are three traffic signal technicians, which is an adequate number of staff for the maintenance needs of the ADOT-owned signals in the region. Planned equipment maintenance, replacements, and upgrades are identified either through the Pecos asset management system, identified by local agency partners, or driven by a concurrent project.

4.5 Funding and Programming

The City of Yuma uses a mixture of several funding sources to fund different types of projects. Many of the construction projects get funded through a combination of federal, state, and local funding sources. These include Highway Safety Improvement Program (HSIP) funds, Surface Transportation Block Grant (STBG) funds, Highway User Revenue Funds (HURF), and City Road Tax revenue. HSIP and STBG funds are allocated through the YMPO Transportation Improvement Program (TIP), and HURF funds are allocated by ADOT. For local City funds, each fiscal year, City departments submit project requests to be considered for inclusion in the Capital Improvement Program (CIP). The CIP Administrator is responsible for collecting the requests and recommending a program of projects that will receive funding based on the available budget.

The City of Yuma has an operating budget is that is used generally for signals, signing, and pavement marking. The operations budget comes from City road tax and state-allocated Highway User Revenue Funds (HURF). The budget is split between Engineering and Public Works. Field operations and maintenance, as well as any signal timing upgrades, are funded through the Public Works operating budget. Engineering analysis and management is funded through the Engineering budget.

Traffic signals in Yuma County are usually programmed for construction through the County CIP process, where each department, including Public Works, has the opportunity to submit projects for inclusion in the County budget for a specific year. County Public Works also has an operating budget and a maintenance budget that can support ITS, although this budget is not dedicated to ITS and also includes signing, striping, signals, pavement management, and other important infrastructure and devices.

Somerton utilizes the YMPO Transportation Improvement Program (TIP) to fund transportation and traffic capital projects, including the construction of traffic signals and implementation of associated equipment. The TIP is used to allocate federal funds provided to the region for transportation.

At ADOT, device replacements and upgrades are funded through the District's annual operating budget. Unplanned replacement needs that arise outside of the annual budgeting process or devices that are installed as part of another project, are funded through the ADOT TSMO Division. Larger capital projects, such as construction of traffic signals or installation of conduit/fiber, are programmed in the ADOT 5-year program and may utilize a variety of funding sources, including state funds, Highway Safety Improvement Program (HSIP) funds, or other federal funding sources. To get projects included in the 5-year program, the District must submit the project for evaluation, and if the project is selected for funding, it will be included in the program to receive funding five years later.

4.6 Agency Coordination

The transportation agencies in the region generally partner and coordinate well on transportation-related projects and operations. There are also partnerships with external agencies such as the California DOT (Caltrans) and the US Border Patrol, to support regional transportation.

All stakeholder agencies for this project noted that coordination between agencies for construction closures and detours is done proactively and effectively.

Other examples of traffic-related coordination between agencies or between agency departments are highlighted in **Table 1**.

Table 1 – Existing Agency Coordination

Partners	Coordination Purpose
City of Yuma and Somerton	Starting in 2020, Yuma will provide traffic engineering support to Somerton, including signal timing and other signal operations through an IGA
Yuma County and Cocopah Tribe	Yuma County operates and maintains two traffic signals that are owned by the Tribe along Highway 95 at County 15th Street and at the casino
ADOT and Caltrans	Coordinate for permitting, traffic control, and advanced warning for construction project and for long-term incident closures along I-8 that may have impacts that cross state lines
ADOT and Arizona Department of Public Safety (DPS)	Coordinate to manage incidents on state roadways; A DPS officer sits in the ADOT TOC, which facilitates good communication and information sharing
Somerton and Yuma County	Coordinate for incidents that occur and to implement a detour route for traffic; Somerton Police are included in the coordination to implement the detour
Yuma County Traffic Management Committee	Includes representatives from County Engineering, Public Works, and Sheriff who meet periodically to review issues related to safety and operations, complaints, and suggestions for improvements.
Yuma County and City of Yuma	Coordinate for incidents that require road closures and detours. There is also coordination between the County and the City for EVP equipment on County-owned signals within the City boundaries
Yuma County and ADOT	Coordinate traffic signal operations along the I-8 frontage road and the traffic interchange at Fortuna Road, where an ADOT-owned signal is located between County-owned signals.
Local/District ADOT Staff with ADOT TOC	ADOT TOC assists with incident management on the freeway. Public complaints related to traffic signals are often routed through the TOC and then back to local or district level
ADOT and US Border Patrol	ADOT District coordinates with Border Patrol if a lane or roadway closure impacts the checkpoint on I-8 Eastbound at Milepost 17

5. Planned Development and Infrastructure

One of the most efficient methods for deploying ITS infrastructure is to leverage work already being done as part of other projects that impact a roadway, where deployment of devices or installation of communication infrastructure (conduit and fiber) may be included. Projects that involve disturbing pavement, and especially projects that include trenching, provide important opportunities to install conduit that can be used at a later time, given that the most expensive part of a communications project is the costs of trenching to install conduit.

The City of Yuma has established a process to consider the inclusion of communications infrastructure as part of all future transportation projects. Based on the Information Technology (IT) department's plans for a City-wide fiber backbone, any project that is on one of the designated communication backbone rings, or on a roadway that extends from the backbone to a signalized or potentially signalized intersection, are required to include installation of conduit and pull box infrastructure, at a minimum, as part of the project. **Figure 6** depicts the desired fiber backbone, as identified by the IT department.

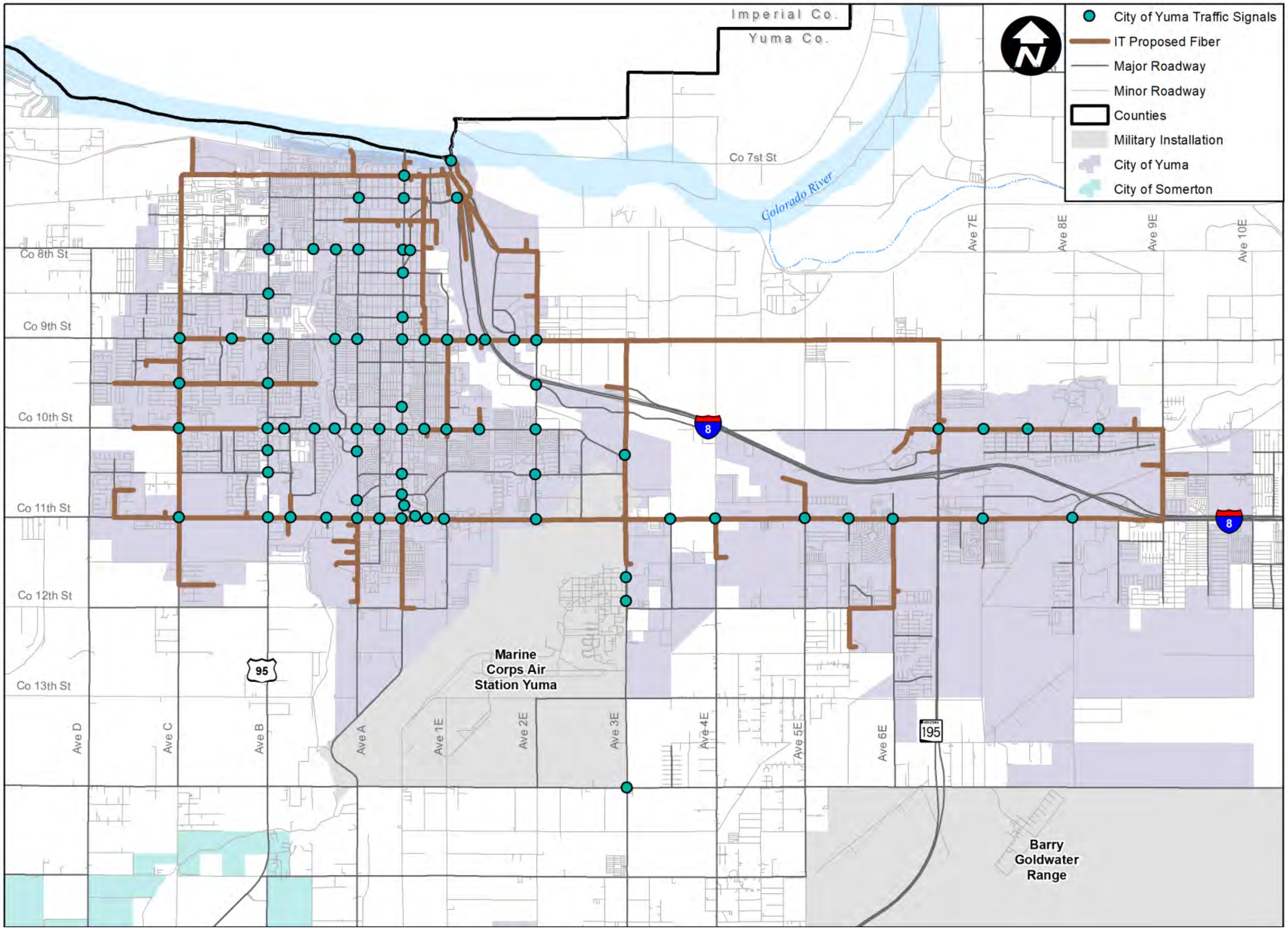


Figure 6 – City of Yuma Proposed IT Communication Backbone

For the other partner agencies in the region, funded projects that are found in the ADOT Statewide TIP (STIP) and the YMPO TIP were reviewed. **Table 2** identifies some projects that are programmed but not completed and the type of ITS improvements that could be included.

Table 2 – Funded Projects and Opportunities to Install ITS Infrastructure

Program	Project Name	Description	Potential ITS Opportunity
ADOT STIP	SR-95; at MP 32-34	Widen from 2 lanes to 4 lanes.	Install conduit and fiber during construction to connect to nearby traffic signals
	SR-95; at MP 35-39	Widen from 2 lanes to 4 lanes.	Install conduit and fiber during construction to connect to nearby traffic signals
	SR-95; at MP 39-48	Widen from 2 lanes to 4 lanes.	Install conduit and fiber during construction to connect to nearby traffic signals
YMPO TIP	Caro St to Fulton St	Construction - Widen from 2 lanes to 3 lanes	Install conduit and fiber during construction to connect to nearby traffic signals
	US 95, Avenue 9E to Fortuna Wash	Design - Roadway widening and reconstruction. Widen from 2 lanes to 5 lanes.	Include conduit and fiber during construction to connect to nearby traffic signals in design
	County 24th Extension	Construction - Ave F to Ave H - Widen from 0 lanes to 2 lanes	Install conduit and fiber during construction to connect to nearby traffic signals
	9th St Corridor	ROW - Giss Pkwy & 6th St to Pacific Ave & 12th St	The beacons are an ITS supported crossing treatment.
	County 14th & Ave 4E Traffic Signal - N/S Turn Lane	Traffic signal - N/S turn lane	Install conduit and fiber during construction
	Flashing Yellow Signals	Design - Flashing yellow arrow at 3 locations	Include upgraded traffic signal controller, EVP, and detection in design

6. Needs and Gaps Assessment

This section identifies key needs and gaps related to the existing transportation infrastructure, systems, and processes that this ITS Strategic Plan should address. *Needs* are being defined as those that were specifically acknowledged by the stakeholder agencies during the inventory and data collection process. *Gaps* are those that identify inconsistencies between the vision and goals for ITS and traffic operations in the region and the existing conditions.

It is important to have a clear connection between the ITS Vision and Goals, the needs and gaps, and the strategies and recommendation that will ultimately be identified in the ITS Strategic Plan. The ability to trace recommended strategies to needs or gaps fosters trust and buy-in from partners and create justification for pursuing the implementation of recommended strategies.

6.1 Agency Priorities

While the safety and efficiency of traffic operations is important to all agencies, the various stakeholder agencies in the Yuma region have different priorities for ITS and traffic operations.

These priorities are influenced by factors such as current traffic conditions, the priorities of executive staff and elected officials, and fiscal constraints, among other factors. Feedback on priorities that were discussed during this ITS Strategic Plan effort are summarized below.

The City of Yuma's main traffic operations priority is to deploy infrastructure and systems to allow for real-time, centralized management of their transportation network. This includes connecting their traffic signals with communications infrastructure for real-time data collection and remote operation of traffic signals through an ATMS system and installing CCTV cameras to allow remote monitoring of intersections. City of Yuma main maintenance priority is to bring the infrastructure to current standards to be able to modernize the traffic signal system to support expanded ITS functions.

The top traffic-related priority for Yuma County is upgrading and standardizing their traffic signal infrastructure and hardware, including upgrading to signal controllers to a standard that can be remotely accessed from a centralized system. They also would like to prioritize upgrading their traffic signal cabinets to be consistent and more compatible with their controllers. Another County priority is establishing agreement on ownership and maintenance of traffic signals, as there are cases where there is a lack of clarity or lack of agreement around who is responsible for the management and maintenance of some traffic signals in the region.

Somerton's traffic priorities are related to addressing congestion at Somerton Avenue and Main Street. This is one of the core intersections in the City's downtown area and the City would like to have the necessary tools and data to manage with congestion during peak times. Somerton is a small city and does not have the budgetary means to have an engineering department or operate their own signals. They have currently partnered with the City of Yuma to conduct their engineering services and intend to keep the agreement in place for the foreseeable future. Somerton would like to adopt ATMS and be part of a regional transportation operations strategy and would benefit from training when systems are in place.

ADOT's priorities for traffic operations and management are to expand the use of technologies to improve traffic management, traveler information, and safety. At a statewide level, ADOT is working towards get 100% of their traffic signals to be connected to the cloud for remote management and data collection. In the Yuma region, ADOT is looking to:

- Deploy infrastructure for the detection and notification of wrong-way drivers to rural areas, as they are currently doing at all urban interchange off-ramps.
- Implement smart work zones at all construction sites where possible, including the use of DMS, vehicle detection, and a centralized software system throughout work zones.
- Install CCTV cameras at their traffic signals to help with quicker response times.

6.2 ITS and Operations Needs

Understanding the different priorities, there were a set of consistent needs for ITS and traffic operations in the region. These overarching needs were identified by the stakeholders as important for the establishment of a regional ITS Program:

- Upgrading traffic signal infrastructure, including detection, controllers, and cabinets, that are at end of life or not able support advanced operations functions that are desired.

- Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies.
- Determining agency responsibilities for operations and maintenance of traffic signals in the region.
- Identifying programming processes and funding sources that can more quickly and consistently support device replacement, upgrades, and funding for operations.
- Identify funding sources and programming processes for capital investments related to ITS and communications.
- Conducting outreach and education to elected/public officials and the public to garner support for the use of more advanced technologies (such as intersection cameras) to support regional transportation operations.

6.3 Gaps Related to ITS and Operations

The following are gaps in infrastructure and traffic operations and management that will need to be addressed to fully achieve the ITS vision and goals:

- No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time.
- Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.
- Limited agency procedures and processes (between departments within an agency and between different agencies) for coordination and joint decision making for day-to-day transportation operations.
- It is not clear if existing staff have the capacity and skill sets to support operations and maintenance of advanced traffic operations strategies, infrastructure, and systems.

7. Next Steps

Using the needs identified during the project thus far as a foundation for moving forward, the next task in this project is to identify and develop infrastructure integration strategies to address the needs that have been identified. Strategies will be focused on those that can be implemented by the City of Yuma, but there will be strategies highlighted where there will need to be coordination with other agencies to implement and there will also be strategies where there could be opportunities for other stakeholders in the region to either partner with the City to implement the strategy or where another agency can chose to also implement the strategy in parallel. For each strategy or project, considerations for implementing strategy, such as costs, dependencies, and responsibilities, will be identified. Strategies may include infrastructure projects, process and coordination improvements that partner agencies should consider to improve traffic operations and management.

Appendix B

ITS Strategy Recommendations Technical Memorandum

2020 ITS STRATEGIC PLAN

for the City of Yuma

In coordination with

ADOT | YMPO | Yuma County Arizona | City of Somerton

Prepared by
Kimley»Horn

ITS Strategy Recommendations

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1. Introduction to the ITS Strategic Plan

The City of Yuma is undergoing the development of a City Intelligent Transportation System (ITS) Strategic Plan. This ITS Strategic Plan will help guide the City's investments in ITS to support traffic management, traveler information, incident management, interagency communications, and coordination with regional stakeholders. The plan will provide a phased approach to implement and integrate existing and new ITS infrastructure, systems, and strategies.

This plan will explore and propose a framework for the near- and long-term operations and management of transportation investments in the City. The framework will also highlight opportunities where other local, county, regional, and state agencies in the Yuma region may partner or contribute to processes, strategies, or projects that could elevate local and regional traffic operations.

This ITS Strategic Plan is the first phase of a multi-phased effort to define, plan for, and potentially implement advanced traffic management systems and strategies in the City. Upon completion of this ITS Strategic Plan, an ITS Deployment Plan will be developed to more specifically define recommended projects and propose a plan to implement them over time. The ITS Strategic Plan and the ITS Deployment Plan could be used as inputs to prepare potential grant applications for the City, or the larger region, to pursue funding for infrastructure implementation.

The key project phases of the Yuma ITS Strategic Plan include:

- **Vision and Goals** – Identifies the City vision, goals, and priorities related to traffic operations and management, with a focus on opportunities for transportation technologies and systems. This task also identifies some of the visions and goals of individual stakeholders in the region related to traffic operations and, specifically, any opportunities to coordinate or pursue joint operations.
- **Inventory and Needs** – Identifies and documents existing ITS devices and systems within the region. This task also highlights existing and near-term projects for the City and other agency stakeholders that could support future ITS in the region. The inventory also explores documents such as agreements or trainings and identifies existing processes in place to coordinate with other agencies, program projects, and track and maintain transportation technology assets. The document determines gaps in the infrastructure and identifies traffic operations and management needs in the City including some that persist across the region.
- **Integration Recommendations** – Provides general infrastructure integration strategies and high-level phasing. Strategies will include such items as:
  - Projects that need funding to support their implementation, such as device deployment or upgrades to existing equipment.
  - Resources needed to establish a City traffic operations center (TOC) and equipment to maintain the functionality and be able to grow long-term.
  - Opportunities to improve coordination with ADOT freeway operations and along major corridors for potential regional arterial operations.
  - Opportunities for coordinating ITS deployment with other capital improvement projects on the City's major arterials.

2. Method for Strategy Development

2.1 Recommendations Based on Needs and Gaps

The needs and gaps are the basis for identifying recommended strategies that the City can pursue to make progress towards achieving their vision. Strategies include not only infrastructure and capital-based projects, but also consider improvements to or implementation of processes, partnerships, and other non-capital investments that will be important to creating a foundation for elevated traffic management and operations in the City.

ITS recommendations for the City of Yuma are organized into four categories:

- Infrastructure Strategies
- Program, Planning, and Policy Strategies
- Data Strategies
- Partnering Opportunities

These strategy categories and the associated strategies are described in detail in this document.

2.2 Strategy Definitions

Individual strategies within the four categories are summarized in tables and further described in their associated sections of this document. An example of the format of the strategy summaries are provided in the following **Table 1**. While strategy identification and description are provided within the text of each section of the document, the summary tables at the end of each section provides additional detail for the steps, costs, and considerations for implementing each strategy.

Table 1: Format for Strategy Tables

Strategies		Description	Implementation Considerations	Benefits	Cost Considerations	Dependency Considerations	Original Need Warranting Strategy
A	Name	Detailed description and purpose of strategy	Things to consider for completing the strategy effectively	Benefits to deploying this strategy	High level unit costs for strategy effort	How this strategy impacts or is impacted by another	List of needs addressed by this strategy
B							
C							
D							

2.3 Cost Considerations

High-level cost estimates implementing each strategy is provided where a cost can be reasonably estimated. The cost information is a planning-level estimate of the capital expenditures needed to deploy the proposed ITS devices and communications to address the ITS and traffic operations needs and gaps in the City. There are many strategies that may not bear a monetary cost to implement but will require staff time to coordinate or implement. All cost estimates and other cost considerations are included in the strategy tables.

More detailed cost estimates will need to be calculated for infrastructure as part of the next phase of the project, the ITS Deployment Plan, as they are pursued for implementation. Individual cost elements may fluctuate depending upon the current conditions in the construction industry, such as costs for raw materials or labor. The City should also recognize that future project funding may require creative project scoping to fit existing budgeted amounts if costs rise unexpectedly.

2.4 Priority Corridors

Many infrastructure strategies will be recommended for phased implementation, allowing the City to make feasible and smart investments over time. The recommended phasing is largely based on priority transportation corridors in the City, which are those corridors that carry the greatest amount of traffic and/or provide access to major activity areas or destinations in the City. Some of the priority corridors are also regional priority corridors that are important to regional travel between communities and between major regional destinations and attractions.

Corridors with Annual Average Daily Traffic (AADT) volumes greater than 20,000 were automatically considered first priority corridors. We also evaluated major traffic generators in the Yuma region and determined what corridors serve as commuter routes. Corridors with AADT greater than 10,000 were considered second priority corridors. Commuter routes that were also paired with corridors with AADT greater than 5,000 were also reviewed and considered second priority. Routes that serve as conduits to special event locations were also included in our assessment of priority corridors. Any stretch of roadway that included traffic signals from multiple agencies was classified as a regional corridor.

Figure 1 identifies the City priority corridors. The corridors are categorized as primary and secondary corridors. In the subsequent sections, the strategy descriptions identify when it is recommended that proposed devices and communications infrastructure should be first deployed along primary priority corridors, over time continue to be deployed along secondary corridors, and eventually to all signalized intersections in the City. The regional corridors identified in **Figure 2** show corridors that require coordination between agencies to be able to implement specific infrastructure strategies.

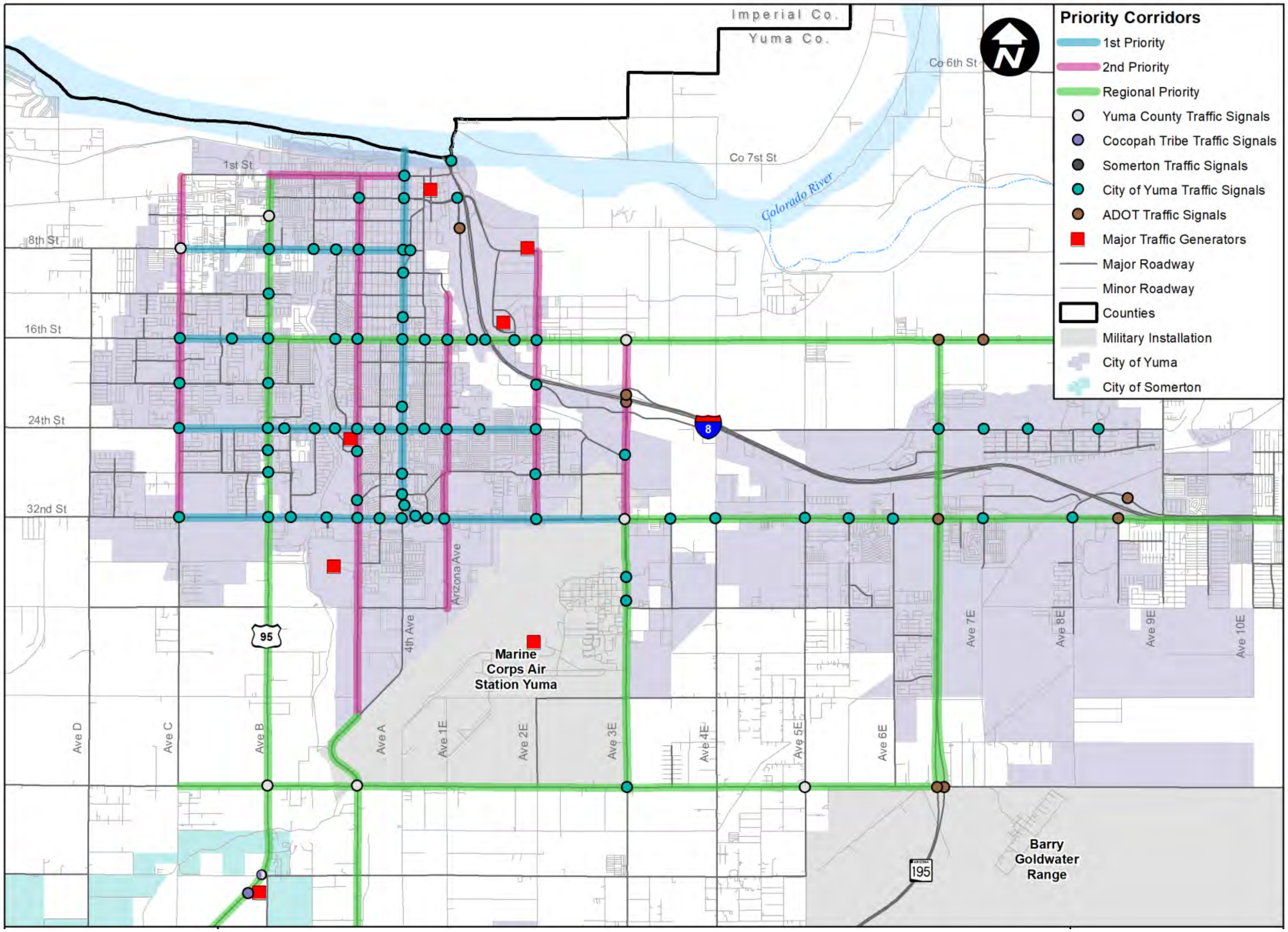

Figure 1 – City Priority Corridors for Transportation Operations

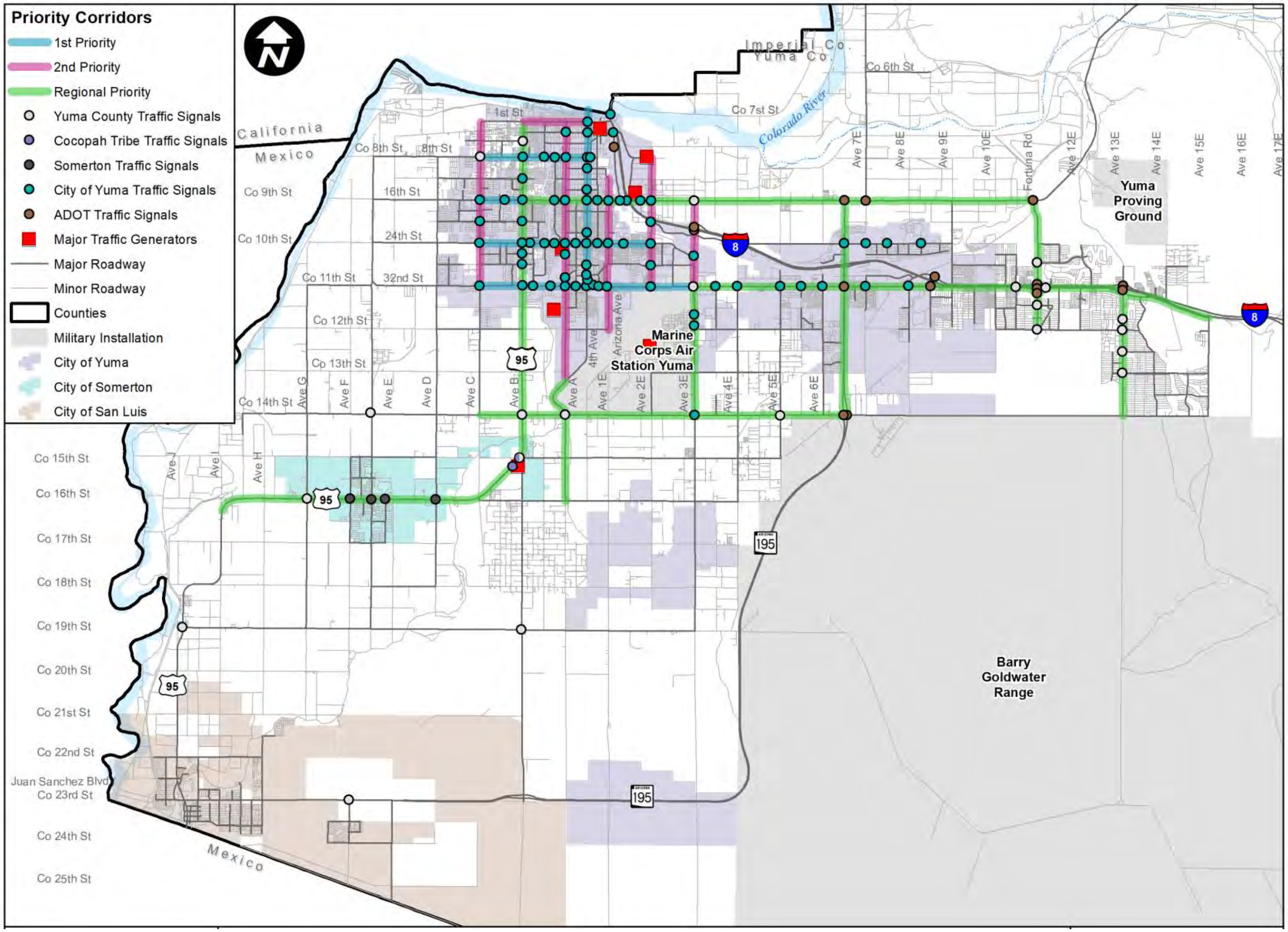

Figure 2 – Regional Priority Corridors for Transportation Operations

3. Infrastructure Strategies

This category recognizes the physical ITS and communications infrastructure that needs to be put in place or connected to build out an ITS program. Currently, the City has traffic signals and some associated infrastructure, such as traffic signal cabinets and controllers, vehicle detection, and emergency pre-emption devices. In order to take traffic management and operations to the next level in the City, there are two major infrastructure buildout strategies that will require significant investment:

1. Deploying transportation communications equipment, (fiber or wireless devices) along key corridors to connect traffic signals to a centralized management system; and

2. Establishing centralized management of ITS infrastructure to provide remote, real-time traffic monitoring and management capabilities.

These two major investment areas are described in the proceeding section. **Figure 3** depicts the relationship between the recommended infrastructure strategies and the sequence in which they should be pursued. **Table 2** summarizes the recommended infrastructure strategies.

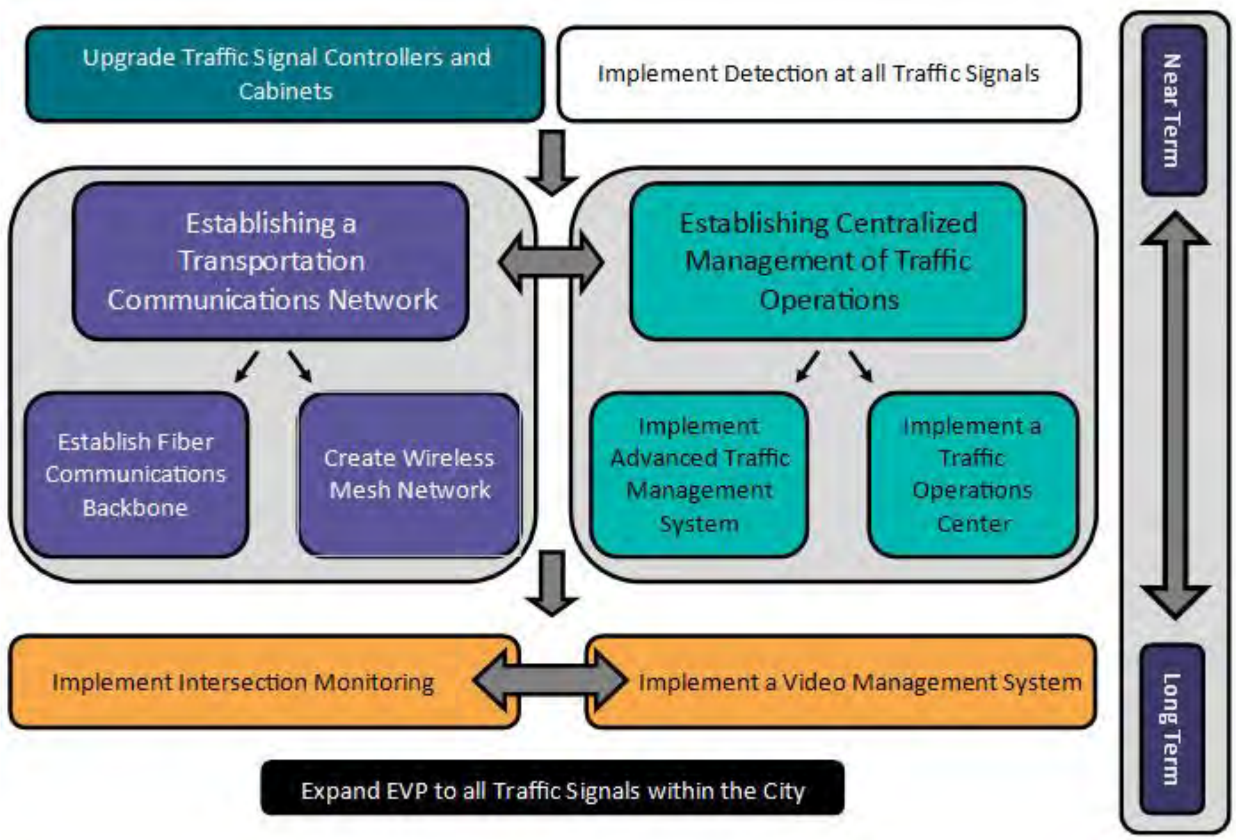

Figure 3 – Relationship and Sequence of Recommended Infrastructure Strategies

Table 2: Infrastructure Strategies Summary

	Infrastructure Strategies	Description	Implementation Considerations	Benefits	Cost Considerations	Dependencies	Original Need Warranting Strategy
A	Establish a Transportation Communications Network	Deploy communications infrastructure, including a fiber backbone and a supportive wireless mesh network to connect traffic signals, other ITS devices, and key City facilities to provide centralized management.	The City IT Department has put forth a framework to create a redundant communications backbone for the City. A transportation-specific communications network can leverage the IT network through an agreement for sharing conduit. Fiber and wireless radios will need to be installed to connect to traffic signals or devices that are not along the IT-supported path. In some cases, communications infrastructure (conduit, at a minimum) can be installed through private development requirements as part of half/street improvements	Communications infrastructure allows for real time monitoring and remote operation of signals and for the collection and exchange of data amongst City facilities.	Fiber unit cost for conduit and cable is $50/LF. Wireless radios are $4,500/EA. Ethernet Switches are $2,000/EA.	Traffic signal controllers or cabinets at or nearing end of life may need to be updated to be compatible with communications infrastructure. Establishment of a communications network within the City is a necessary precursor to the establishment of a TOC. Communications infrastructure is also dependent on the procurement of an ATMS system to manage the connected signals.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.
B	Implement a Traffic Operations Center	A TOC would provide a centralized location where an operator can remotely monitor and manage traffic operations in the City. All ITS systems and software servers will be housed in a location and will be connected to field devices via transportation fiber. Operators are able to access systems to collect data and send back out data or commands from a remote location.	A TOC is often a brick-and-mortar location but could also be done virtually through the cloud hosting. A physical TOC would include staff workstations and potentially equipment like a video wall, server room, or field-testing equipment. In addition to equipment and potentially a physical space, efforts to establish standard operating procedures, staff requirements, and schedules will be needed.	A TOC will allow for remote, real-time management of traffic operations, including incident response, work zone management, and dissemination of traveler information. It can also support increased collaboration on real-time decision making and implementation of operational strategies.	An annual budget for operations and process for maintenance, including tracking of assets and budgeting for necessary lifecycle replacements and upgrades, will be established.	An established communications network and ATMS system is necessary prior to the implementation of a TOC. Staffing requirements, infrastructure requirements and operational procedures must be determined for the TOC.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.
C	Implement an Advanced Traffic Management System (ATMS)	An ATMS centralizes collection of data for all traffic signals that are connected to communications and creates a user interface for remote access to and control of traffic signals and other ITS equipment.	The City needs to identify the functions of an ATMS system that they would like to have to determine the requirements of its new ATMS. This will ultimately determine from the system provider-perspective which modules or customization will be needed to achieve the City functions. Develop a Request for Proposals (RFP) to solicit a variety of system providers and to allow the City to select based on best fit with desired functions.	An ATMS provides a centralized user interface for the City to remotely monitor and operate the traffic signals once they are connected. Functions of an ATMS may include equipment monitoring and connectivity, monitoring of signal timing and phasing, and collection and reporting on various performance measures related to signal operations.	Initial system cost for Yuma signals only is $200,000 but it is important to consider maintenance, upgrades, and staffing when determining cost of the system.	Communications connection to traffic signals and associated ITS devices must be established for an ATMS system to be functional.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.

	Infrastructure Strategies	Description	Implementation Considerations	Benefits	Cost Considerations	Dependencies	Original Need Warranting Strategy
D	Upgrade Traffic Signal Cabinets and Controllers	Use traffic signal cabinets and controllers that enable traffic operations and management functions that the City envisions but may not currently use. Cabinets should have enough space to accommodate additional devices, including connections to a transportation communications network. Traffic signal controllers should support advanced traffic signal operations inputs and data, such as use of adaptive signal control or collection of turning movement count.	The City should document which current cabinets and controllers are not compatible with planned ITS infrastructure improvements and functions, and should program for replacement, whether though an asset replacement program or through a near-term project at the intersection.	In addition to allowing better functionality of other infrastructure, updated cabinets and controllers will work more efficiently and provide the ability for the ITS capabilities at signals to grow beyond planned upgrades.	Signal controller and cabinet is $30,000.	Installation of and ATMS system, intersection monitoring, and a transportation communications network is dependent on upgraded cabinets and controllers in areas where the current cabinets and controllers do not support ITS infrastructure.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. • Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies. • Upgrading traffic signal infrastructure, including detection, controllers, and cabinets, that are at end of life or not able support advanced operations functions that are desired.
E	Implement Detection at all Traffic Signals	The City may need to add, upgrade, or replace some existing detection for more advanced traffic operations, such as bicycle detection or the collection of turning movement counts. The City should continue to evaluate new detection technologies as they emerge to make sure that they invest in equipment that enables advanced ITS and data capabilities that the City wants to pursue.	The standard detection equipment that is agreed to provide the functions and data necessary for the City to pursue its ITS goals should be used when detection is being added or upgraded, whether as part of an asset replacement program or as part of a roadway project. For example, in-ground loop detectors are vulnerable to damage when trenching occurs. If a loop detection is damaged as part of a project, the City should replace the detection with the new standard that provides newer and more advanced functionality.	Detection at all traffic signals provides data to support decision-making on real-time traffic signal operations, as well as provide additional data on corridor volumes, queue length, and speed of vehicles.	Video image detection is about $7,500 per unit (need 4 per intersection) and about $25,000 for a single camera intersection detection system.	The value of an ATMS system to provide real-time monitoring and management of signalized intersections would be diminished if the intersection was not equipped with vehicle detection.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. • Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies. • Upgrading traffic signal infrastructure, including detection, controllers, and cabinets, that are at end of life or not able support advanced operations functions that are desired.
F	Implement Intersection Monitoring	Deploy intersection monitoring (CCTV or VIDs) at signalized intersections or other areas with significant traffic volumes or delays to provide the ability to remotely monitor intersection operations and support improved incident identification and response.	Identify signal infrastructure at or near end of life within the priority corridors identified for CCTV installation. Go through project development process to procure and install CCTV.	Images from CCTV supports a multitude of real-time operational responses. Images can be useful for data analysis of traffic conditions in response to incidents, events, or other non-recurring congestion. They can also be useful, under appropriate legal circumstances, for public safety to utilize in an investigation or surveillance situation where CCTVs monitoring travel lanes also happen to capture image of public safety incidents.	Camera with pan/tilt/zoom is $5,500/EA.	Dependent on communications infrastructure in order to transmit data received by cameras remotely. Also dependent on procurement of a video management system to create an operator interface for camera feeds.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.

	Infrastructure Strategies	Description	Implementation Considerations	Benefits	Cost Considerations	Dependencies	Original Need Warranting Strategy
G	Implement a Video Management System	A video management system is the central management system that will allow for centralized management of cameras (if they provide pan-tilt-zoom capabilities) and access to real-time camera feeds.	Identify and acquire the preferred video management system. Server location and capacity will need to be determined. The software could be installed on an existing City server or included on servers acquired with the TOC.	Unlike detection and communications that can provide some benefits without active management by a staff member, the benefits of CCTVs are based on the availability of a staff member to view, in real time, and utilize the information gathered by actively managing them from a central location. City Police can be given access to the feeds to support incident identification and response after the TMC is in operation	A video management system may be included as part of an ATMS system - cost may be embedded in the overall system cost or may be a specific system module that can be purchased separately.	Cameras must be connected via transportations communications to the central system for operators to view and operate cameras through the video management system.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.
H	Expand EVP to all Traffic Signals within the City	The City should make sure that key corridors in the City are completely outfitted with EVP, including at traffic signals that are own or operated by another agencies. The City should continue upgrading their EVP network to be GPS-based.	Identify ADOT or County-own signals within City operated corridors that do not have EVP installed. Consider ways to provide EVP benefits at these locations, which may include establishment of an agreement for the City to install and maintain EVP on a non-City-owned traffic signal. Additionally, the City should include EVP infrastructure in signal design standards and should track performance of upgraded EVP to show return on investment.	EVP directs the traffic signal to allow an emergency vehicle to pass through the intersection safely. This improves safety at intersections and reduces the number of stops and delays that the emergency vehicle encounters along its route to/from an incident or emergency situation.	An EVP unit is $3,000/EA.	The traffic signal cabinet must have room for the EVP connection. Agreements between the City and the County and the City and ADOT will likely be necessary in order to expand EVP along key corridors in areas where not all traffic signals are City-owned.	• Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. • Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies.

3.1 Establish a Transportation Communications Network

The City of Yuma does not currently have a communications network associated with Engineering or Public Works. At one time, the City did have a centralized traffic management system to which their traffic signals were connected, but that system has not been in place in many years and the infrastructure and systems are no longer viable.

There is some non-transportation-related fiber infrastructure that connects to key City facilities and it is recommended that the City coordinate with the current fiber owners to determine what fibers paths are available and if the City can use them. The City Engineering Department and IT Department, along with other regional entities, are currently embarking on a Regional Fiber Master Plan to determine expansion of fiber communications throughout the region, as well as agreements and processes for installing and maintaining that network. This plan will not identify or include plans for detailed fiber routes nor any connections to traffic signals. However, the City IT department has a vision for what the future fiber ring topology should look like. **Figure 4** shows this City desired proposed fiber ring topology.

To be able to implement many of the infrastructure strategies that are proposed, the City will need to establish a detailed communications network beyond what is shown in **Figure 4** through the development of a Telecommunications Plan. The Telecommunications Plan differs from the Regional Fiber Master Plan because it will specify additional backbone rings or fibers required in addition to other City owned fiber and will identify branch cables or wireless communications to connect all traffic signals to the system. Because the City currently has no dedicated transportation telecommunications, it will be important for the City to have some working knowledge of various aspects of telecommunications (types of devices, configuration of devices, bandwidth considerations, etc.) in order to make informed decisions when pursuing or deploying strategies.

A Telecommunications Plan must align the City's goals and objectives with appropriate telecommunications strategies that build a foundation of reliable, redundant, and City-owned communications. The goal of this Telecommunications Plan is to achieve the following objectives:

- Create network connectivity – by providing a connection to transportation infrastructure;
- Increase network connectivity – by growing geographically to cover a greater percentage of the City;
- Increase bandwidth capacity – by balancing the wireless-to-fiber optic cable deployment where bandwidth is needed in the City;
- Reduce network latency – by minimizing the number of wireless hops needed within the network; and
- Increase network reliability – by achieving the above four objectives, the network will be reliable as the telecommunications infrastructure and capabilities expand.

The Telecommunications Plan will need to identify configuration recommendations, the ultimate buildout of the telecommunications network, and near-term connectivity solutions to address.

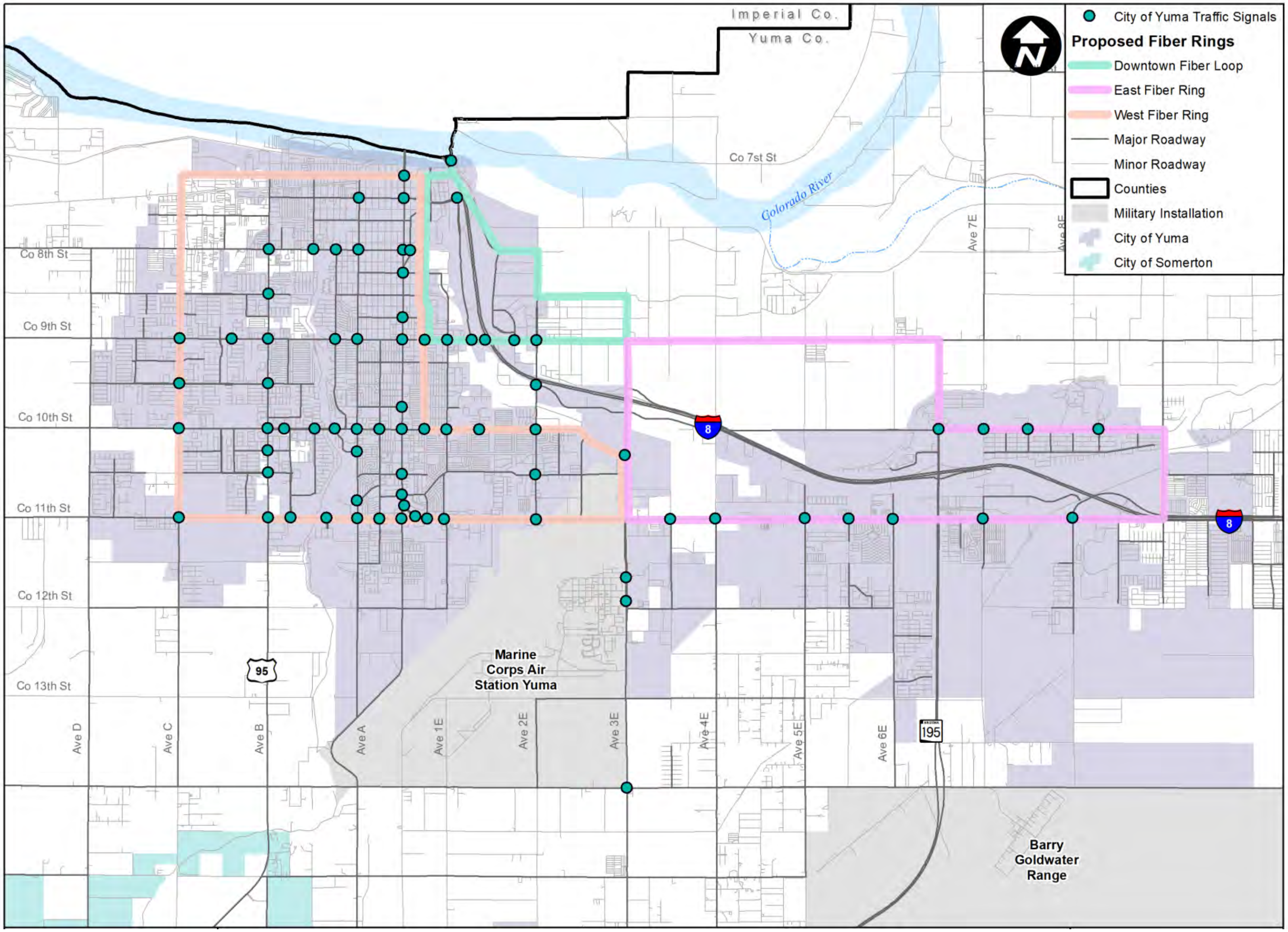

Figure 4 – City Future Fiber Network Plan

Fiber Network

It is recommended that the City consider the following while planning and implementing a fiber network:

- The City should build off the Regional Fiber Master Plan to build the Telecommunications Plan and determine what paths will be necessary for a fiber backbone that will serve near-term and long-term planned ITS infrastructure. Building out a fiber backbone requires having some vision for how many strands of fiber the City will ultimately need and building it out in an effective way that allows for future additional fiber strands.
- In the near-term, the City will need to serve priority corridors first, as shown in **Figure 1**. The City will need to plan where the backbone should be in relation to the priority corridors and how branch cables will be used to connect to infrastructure or facilities off of the backbone path.
- The City will need to deploy fiber infrastructure to connect the existing traffic signals to that fiber on these first priority corridors and make sure the existing traffic signals controller cabinets have the necessary equipment (switches, ethernet transceivers, etc.) to be connected. The City will need to prioritize intersections and phase fiber infrastructure improvements for first and secondary priority corridors.
- The City should also work with the CIP group and developers to require ITS conduit and fiber be installed on all future projects as feasible.

The City currently has specific Standards, Specifications, and Design Details as it relates to traffic signals and ITS equipment. The City should review their current standards to include new technology and compatibility with existing standards and equipment. There are some ITS standards that may want to be considered but not only once more infrastructure and vehicle congestion is realized. Updates to be added to the ITS standards later include:

- Bicycle Detection Equipment;
- Advanced Railroad Preemption; and
- DMS and Structures.

Wireless Mesh Network

Where it is costly or not feasible to install fiber optic conduit and cables, wireless mesh radios can be used to fill in the communications gaps. Wireless mesh radios offer ease of deployment at a relatively low cost and provide a significant amount of path diversity that makes the network highly reliable. There is a limit on the number of these radios that can be deployed within a given area without a backbone fiber optic connection that would provide a high bandwidth backhaul. Wireless radios are a preferred ITS communications technology over cellular devices to connect to ITS infrastructure due to the ongoing costs and potential for lapse in cellular coverage.

As part of the Telecommunications Plan, gaps in communications coverage should be identified, and wireless mesh radios should be planned. There is a practical limit of how much network traffic can be passed via a wireless network without saturating the capacity of the wireless network and introducing latency which reduces the usefulness of the network. The City needs to create wireless access points which will take the network traffic off of the wireless network and divert it into the fiber optic network because fiber is better suited for transporting large amounts of network traffic over longer distances. That is why it is important for the implementation of wireless communications to be closely planned in conjunction with the fiber optic communication network.

Sharing Responsibility

Both Engineering and IT Departments have an interest in a telecommunications network. The City IT Department is leading the development of a Regional Fiber Master Plan in partnership with the City Engineering Department. There will be a follow-up effort to develop a transportation-specific Telecommunications Plan, and this creates an opportunity for both departments to partner with Public Works and share infrastructure responsibilities. The following are some strategies on shared responsibilities that need to be established in the Telecommunications Plan:

- Both departments should agree to be responsible for “Blue Staking” the fiber conduit pathways and maintaining all the fiber cables.
- Either IT or Public Works (not both) should be responsible for the maintenance of the fiber network path throughout the City. It is recommended that the IT Department has maintenance and uptime responsibilities of the City fiber network because of the multiple potential uses of fiber/conduit infrastructure.
- Either IT or Public Works (not both) should be responsible for the maintenance of the wireless radio communication to ITS devices. Currently, IT is responsible for the management of radio communications, but it is recommended that the Public Works Department has maintenance and uptime responsibilities of the wireless radio communication to ITS devices because of the primary use of wireless radios being for the ITS Program.
- The Traffic Signal Group should be responsible for their branch cable between the traffic signal / ITS device cabinet and the pull box immediately in front of the cabinet that connects the device to the fiber network path.

3.2 Establish Centralized Traffic Management

Given the size of the City of Yuma’s transportation network and number of traffic signals, there could be significant benefits to traffic operations if the City Engineering staff had the ability to remotely monitor and operate traffic signals and other ITS devices in real-time. The communications build-out that was recommended in the previous strategy is a key step towards facilitating this real-time management capability. However, once the signals and devices are connected, the City will need a way to view the data coming in from the infrastructure that should centralize all the data and information coming from the field devices.

Advanced Traffic Management System (ATMS)

An ATMS system is a central management system for traffic signal equipment. The ATMS system will provide a graphical user interface to allow someone to view data or status of field infrastructure and allow that person to remotely operate and make changes to the infrastructure settings. An ATMS system will also provide centralized data collection and storage.

The following considerations should be accounted for when planning for acquisition of an ATMS system for the City:

- Identify the functions that the City would like to be able to operate through the ATMS. This will determine the requirements that the City needs of its new ATMS and will ultimately determine from the system provider-perspective which modules or customization will be needed to achieve the City functions. Functions may include camera management, traffic signal timing plans, performance reporting, specific user interface and display, etc.
- Identify the required maintenance cycle that would need to be included in a selection of a new system such as one year, two years, five years, or more. Typically, a one-year warranty is provided for all new ATMS systems installed, so the City would need to decide how many additional years should be provided within the funding allocation for this initial ATMS implementation.
- Develop a Request for Proposals (RFP) to solicit a variety of system providers and to allow the City to select based on best fit with desired functions or based on cost, depending on the City directive and applicable requirements are at the time of RFP development.

Once an ATMS system is acquired, the following would need to be considered:

- Identify ongoing operations and maintenance costs including periodic software upgrades that will become available and what warranty the ATMS provider will offer.
- The City will have the ability to purchase or acquire additional ATMS modules as the ITS and traffic operations program expands and the City desires to support additional or more advanced functions. The City should work with the ATMS vendor when new or different needs arise to discuss how the ATMS system can most effectively be upgraded or expanded to achieve the desired functionality.

The City will need to develop and pursue each of these considerations in further detail at the time the ATMS system is implemented.

Traffic Operations Center

The City has a desire to establish a Traffic Operations Center (TOC) to be able to centralize controls of the future ATMS system. Additionally, the TOC can be used to monitor traffic during incidents or work zones or used to observe traffic patterns to adjust signal timing. A TOC allows the City to remotely make those signal timing changes and reduces delay in responding to citizen complaints as it pertains to signal operations.

The City will need to evaluate its needs for TOC sizing and workspaces to properly plan for design and construction costs. **Table 3** provides a high-level cost intended to give a comparison of what equipment, furniture, and cabling upgrades would cost per relative size in square footage. These costs do not include the building costs, including architectural, mechanical, electrical, and structural.

Table 3: TOC Size and Cost Comparison

Relative Size	Square Footage	High-Level Cost
Small	2,500	$1,000,000
Medium	3,500	$2,000,000
Large	5,000	$3,500,000

The City will also need to consider staffing requirements for operation of a TOC and maintenance of new infrastructure. **Table 4** provides a comparison of staffing numbers at other cities who have TOCs or traffic management centers (TMCs) and have a similar number of traffic signals as Yuma.

Table 4: ITS Staffing Comparison of Comparable Cities

City	City of Surprise	City of Goodyear	City of Peoria
Total # of traffic signals / # signals connected to a TOC/TMC	49 / 46	88 / 56	118 / 116
# of ITS operations staff	1	1	2
# of ITS / Signal maintenance staff	2	4	5
# of CCTVs	47	53	62
Operations staff per connected signal	1 : 46	1 : 56	1 : 58
Operations staff per CCTV	1 : 47	1 : 53	1 : 31
Maintenance staff per signal	1 : 25	1 : 22	1 : 24
Maintenance staff per CCTV	1 : 24	1 : 14	1 : 13

To establish a TOC, it is recommended that the City first develop a Concept of Operations. This will describe the characteristics for the proposed TOC and what the desired capabilities and objectives are. It will include enough detail to develop a bid package for construction and implementation. The City can also consider building out the TOC to accommodate the possibility for future expansion if other agencies decide to join in the operations.

The Concept of Operations for the TOC will include the following:

1. **Goals and Objectives** – This will identify what the TOC is and what the City hopes to achieve with it.

2. **Operational Processes** – This will outline processes for daily the operations within the TOC, as well as processes when external communications are required such as with IT, Emergency Response, Public Works, the public, etc.

3. **Business Plan** – This will identify buildout and annual costs associated with the TOC, as well as staff (operators, engineers, analysts, etc.) required and their cost.

4. **Functional Requirements** – This will establish a set of requirements that determine the overall size and type of TOC the City would like to implement and the type of functions and equipment they would like included.

    a. **TOC Design Requirements** – This will give specific plan details and specifications for the TOC to be able to be constructed.

    b. **ATMS System Requirements** – ATMS systems will be evaluated and one system that best fit the City needs will be identified. Technical specifications for the ATMS system will be developed.

5. **Agreements** – This will identify specific agreements required to be modified or formed related to the establishment of the TOC and operational partnerships with other department and agencies.

6. **Training** – A training process will be determined, and a manual will be established for training current and future staff. All TOC staff will need to undergo a training program for understanding TOC equipment and operations.

7. **Maintenance Plan** – This will identify ongoing operations and maintenance costs associated with any new TOC equipment. Lifecycle timeframes will be identified for all TOC equipment, and a plan for asset management and replacement will be created.

Once the Concept of Operations is established, the City can use it for establishing funding, as well as for bidding purposes and initiating construction. The City will need to keep up with the ongoing requirements outlined within the Concept of Operations to continue to have a successful TOC.

3.3 Upgrade Existing Technologies

Upgrade Traffic Signal Cabinets and Controllers

Traffic signals rely on controllers and cabinets to operate. A controller provides the inputs and commands to the traffic signal related to signal timing and phasing. The cabinet houses the controller and all the additional infrastructure and components (power, wiring, etc.). As the City expands and advanced its ITS and traffic operations program, both traffic signal cabinets and controllers may need to be upgraded. Controllers will need to accommodate more advanced traffic signal operations input and data, thus may need upgraded software or data storage capacity/memory. Traffic signal cabinets need to have enough space to accommodate any upgraded or new infrastructure that the City will deploy, including new controllers that may be needed. Cabinets will also need to accommodate infrastructure related to the transportation communications network, through fiber and wireless technologies.

The City currently has a new standard for signal controllers and cabinets that should have the space and functional capabilities to support any new ITS infrastructure and more advanced traffic management capabilities that are envisioned in this plan. As both industry standards and City standards get updated, the equipment should be vetted by all staff who have a stake in the ITS program to make sure it can support the expanded vision of ITS for the City, and all parties should communicate so that new equipment specifications can be added to reflect these changes.

Upgrade Detection

Vehicle detection is essential for the operation of traffic signals. Most City intersections have detection, but it will be important to make sure all existing detection is reliable and functional; thus, the City may need to upgrade or replace some existing detection.

The City has standard type of vehicle detection that is verified to provide the data collection needs and advanced functionalities that are identified in this Plan. The City is currently deploying this standard equipment when detection is being added or upgraded, whether as part of an asset replacement program or as part of a roadway project that allows for upgrading/adding detection. As new and more advanced technologies emerge, the City should continue the process of evaluating these new technologies from a multi-departmental perspective to make sure that any technology they invest in is in line advanced ITS and data capabilities that the City wants to pursue.

3.4 Deploy Newer Technologies

Intersection Monitoring

Devices at intersections that allow for the remote, real-time monitoring of intersection operations can support improved traffic operations, equipment monitoring and maintenance, and emergency and incident management. A useful ITS technology that supports real-time intersection monitoring is closed-circuit television (CCTV) cameras that offer pan-tilt-zoom (PTZ) capabilities. Another technology that could also support this function is video image detection (VID) that is installed at each leg/direction of an intersection that does not move, but at minimum, provides visual confirmation of real-time conditions. VIDs can be provided at any intersection configuration (signalized intersection, roundabout, or heavily used access point to business or event center) or mid-mile locations to collect and report current traffic conditions.

Camera image observation can be used for verifying the results of traffic management strategies, such as signal timing changes or work zone diversions, and for detection and verification of crashes. Real-time camera images facilitate rapid response to incidents that affect traffic flow. Cameras deployed at intersections have also been used for verifying the conditions of a crash scene, resulting in more effective dispatching of emergency services and clearing of crashes.

Video Management System

Unlike detection and communications that can provide some benefits without active management by a staff member, the benefits of real-time intersection monitoring are based on the availability of a staff member to view and utilize the video information. As CCTVs are deployed, there is a benefit to begin utilizing them right away, and this will require a centralize video management system, which could be part of an ATMS system or could be a standalone system.

Viewing CCTV camera feeds can support traffic operations and maintenance identification, but they could also be shared with other City departments or agencies to support wider City functions. Police and other first responders can be given access to the real-time video feeds to support incident identification and response. Other agencies, including ADOT, may be given access to real-time video streams to support coordinated operations and incident management at jurisdictional borders or along regional corridors that are operated by multiple agencies.

Expand Emergency Vehicle Preemption

EVP is used to provide emergency response vehicles, such as fire trucks, ambulances, and sometimes police, with priority signal phasing at intersections to reduce delay and facilitate a faster response to incidents. In order to be effective, the emergency vehicle and all traffic signals along a corridor must be outfitted with EVP infrastructure, which includes on-board devices and devices installed at traffic signals.

Currently, all City-owned and operated traffic signals are outfitted with EVP field devices, and all City fire and EMS vehicles have the corresponding on-board devices. The City is in the process of upgrading their EVP network to transition to GPS-based EVP, which has been gaining traction as a more reliable and efficient option for emergency responders. As the system is upgraded and operational, the City should make an effort to track the performance of the upgraded system and help show the return-on-investment of more advanced transportation technologies, which can help gain management-level support for additional ITS investments to be made in the City.

While all City-owned signals have existing EVP devices, there are key City corridors where one or more of the intersections are owned or operated by either ADOT or Yuma County. It will be important for the City to partner with these agencies to discuss deploying City EVP at their intersections so that the benefits are continuous along corridors and are not negated due to a non-outfitted intersection. This may be accomplished by an agreement where the City may support the maintenance of the EVP device on another agency's traffic signal.

4. Program, Planning, and Policy Strategies

This category includes systems to implement in order to utilize and maximize the functionality of the physical ITS and communications infrastructure of an ITS program. The recommended systems include standard operating procedures, device standards, training, and scheduled programs.

These system strategy recommendations are described in the proceeding sections. **Table 5** summarizes the recommended program, planning, and policy strategies.

Table 5: Program, Plans, and Policy Strategies Summary

Programs, Plans, and Policy Strategies		Description	Implementation Considerations	Benefits	Cost Considerations	Dependencies	Original Need Warranting Strategy
A	Create/Update ITS and Communications Approved Product List	Develop a standard list of ITS devices that provide the functionalities desired by the City ITS program and are compatible with other City infrastructure and systems. Include ITS devices as part of traffic signal design standards, where possible.	Identify specific ITS devices that will address City needs, including, but not limited to traffic signal controllers and cabinets, vehicle detection, traffic signal heads, fiber and conduit, wireless radios, and network switches. Create or update traffic signal design standards that include desired ITS infrastructure (i.e. detection, controller, communications). Standards for communications equipment should be identified in partnership with the City IT Department Consider engaging other agencies in the region to discuss opportunities to create regional devices standards to support interoperability and combability.	Standardization improves interoperability of the system and makes sure that all devices provide the functionalities that the City desires. It will also increase maintenance efficiency, as there are fewer variations in the types of devices that need to be maintained and thus fewer maintenance practices to learn. It will also reduce the variation in device inventory that needs to be available.	There is no cost associated with establishing a list of standard equipment, with the exception of staff time.	Prior to establishing or updating signal device standards, the City must determine which combination of devices will support the ITS vision and goals. The standards will need to be updated as device needs change and devices are upgraded or replaced with newer technology.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. • Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies. • Upgrading traffic signal infrastructure, including detection, controllers, and cabinets, that are at end of life or not able support advanced operations functions that are desired.
B	TOC Standard Operating Procedures	Develop standard operating procedures (SOPs) for the TOC and for the use of ITS devices by City staff.	SOPs for the TOC may include details about TOC operations (hours of operations, personnel access), general operator expectations (answering phone calls, logging information, monitoring devices/systems), and operator processes for specific conditions (notifications and response to incidents, processes for changing signal timing, work zone management). The SOPs should also include agreed upon processes for inter-departmental use of ITS – such as Police or Fire use of cameras during incidents or special events and agreed upon intra-jurisdictional coordination or sharing.	SOPs will document processes and expectations for TOC and device/ system use so that they are agreed-upon and not contingent on the presence of specific individuals. SOPs will also help delineate roles and responsibilities for operations in the City to allow for the most coordinated and efficient operations.	There is no cost associated with establishing SOPs, with the exception of staff time.	SOPs should be established prior to full operation of a TOC. However, the ATMS and/or video management system should be in place before establishing SOPs and any agreements with other departments/agencies on their sharing and use	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. • Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies. • It is not clear if existing staff have the capacity and skill sets to support operations and maintenance of advanced traffic operations strategies, infrastructure, and systems.
C	Road Closure Playbook	Collaborate with other City (and potentially other agency) traffic and public safety staff to identify and document agreed upon processes for coordinating on and responding to unplanned events that impact traffic on City roadways.	Coordinate with police and other responders to identify standard processes for notifying City staff of incidents on City arterials or ADOT facilities that will impact City traffic operations. Identify preferred alternate routes to ADOT-owned roads if they are closed. Identify roles and responsibilities of different responders related to responding to the incident and supporting traffic management. The Playbook processes and plans can be expanded to include other agencies who are interested in coordinating more on incident management.	Having pre-determined plans and set notification procedures will allow the City to act faster and in a more coordinated manor in the case of an incident that disrupts traffic operations on City streets. This can help improve incident response and clearance times, improve safety at the scene and on the rest of the network, and improve traffic operations along impacted routes.	Could be accomplished in-house at no cost with the exception of staff time	Identifying and implementing agreed upon notification processes and roles and responsibilities as part of a Playbook has no dependencies. Identifying signal timing plans to implement in response to an incident requires traffic signals to be connected to a central management system and requires a traffic operations staff person to implement and monitor plans.	• Determining agency responsibilities for operations and maintenance of traffic signals in the region. • Limited agency procedures and processes (between departments within an agency and between different agencies) for coordination and joint decision making for day-to-day transportation operations.

Programs, Plans, and Policy Strategies		Description	Implementation Considerations	Benefits	Cost Considerations	Dependencies	Original Need Warranting Strategy
D	Formalize Signal Timing Program	Develop and document City traffic signal timing standards and put into place a program that provides staff time and funding to periodically evaluate, and update as necessary, traffic signal timing along key corridors.	Identify the staff skill sets and time required to support traffic signal retiming efforts. Determine and allocate annual budget for retiming efforts. Create traffic signal retiming standards that includes City policy on signal timing components (i.e. green time, clearance intervals, reference phase for coordination).	Optimizes traffic flow along the corridor based on current conditions. Reduces citizen complaints about red lights. Makes sure that key corridors within the City continue to operate efficiently as traffic increases or travel patterns change.	Cost associated with maintaining licenses and the current versions of analysis programs (City currently has Synchro and Vissim) and staff time. Contractor signal retiming costs around $1,800 per signal.	Having communications to traffic signals and an ATMS system is highly recommended, although technically not required, prior to implementation of a regular signal timing program. Having detection at intersections to provide accurate data is important for signal timing efforts	• Limited agency procedures and processes (between departments within an agency and between different agencies) for coordination and joint decision making for day-to-day transportation operations.
E	Maintenance and Lifecycle Management Program	Formalize an asset and maintenance tracking program for new TOC equipment and for all ITS devices and systems. The program should identify expectations for maintenance and lifecycle planning and identify funding streams and staffing to support maintenance and replacement of equipment.	Include all TOC equipment and systems in the City's Lucity asset management program to track maintenance, upgrades, and lifecycle planning (install date; anticipated replacement date). Coordination with Public Works will be necessary to ensure proper maintenance and upgrades for ITS field devices. Coordination with IT will be necessary to ensure proper maintenance and upgrades of communications equipment	Allows for proactive lifecycle and maintenance planning for ITS Program to identify funding (including external funding opportunities) before device/system end of life	Establish a reliable and consistent budget for maintenance and replacement; identify staff time necessary to implement desired maintenance program	Staff may require training on proper maintenance of new devices or systems that may be installed. Establishing standards for ITS equipment will support an efficient maintenance and upgrade program.	• No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. •Standardizing traffic operations infrastructure, including detection, controllers, and cabinets to facilitate maintenance of devices and support compatibility across agencies. •Upgrading traffic signal infrastructure, including detection, controllers, and cabinets, that are at end of life or not able support advanced operations functions that are desired.
F	Operations and Maintenance Training	Identify and create opportunities for training staff on ITS, including for specific devices and systems, but also for operational strategies, such as traffic signal timing, traffic incident management, or technician training.	Gather information on existing training programs, such as the American Traffic Safety Services Association (ATSSA) and the International Municipal Signal Association (IMSA), among others Consider where trainings might be useful beyond those immediate to the City ITS program, including other City departments or other agencies. There may be opportunity to collaborate with YMPO or other agencies in the region to put on regional training that may be widely applicable. Consider reaching out to other agencies or MPOs in the state to see if any application trainings are being held that City staff could attend.	Providing staff with proper training will allow them to most efficiently and effectively operate and maintain the ITS program, resulting in the most effective traffic operations and maintenance processes.	Device and system training should be part of some vendor contracts at no additional cost. Other trainings may have an additional cost. Consider partnering with other departments or agencies to share costs	Establishing ITS equipment standards will help identify any device-specific training needs Establishing SOPs for traffic signal timing and for TOC and ITS device use will help identify any device- or system-specific training needs	• It is not clear if existing staff have the capacity and skill sets to support operations and maintenance of advanced traffic operations strategies, infrastructure, and systems.

4.1 Establish Standard Practices

ITS and Communications Standards

As the City implements the Infrastructure Strategies in the document, it is recommended that staff consider identifying device standards for ITS and communications equipment that are deployed in the City, which may include, but is not limited to: traffic signal controllers and cabinets, vehicle detection, traffic signal heads, fiber and conduit, wireless radios, and network switches.

A standard for some of the devices may include multiple vendors or models but documenting some level of standard will help make sure that equipment is procured and deployed that is compatible with other City infrastructure and systems and provides the functionalities that the City needs. Where possible and appropriate, the City may look to create or update traffic signal design standards that include desired ITS infrastructure (such as detection, traffic signal cabinets, or fiber and wireless communications). Standards for communications equipment should be identified in partnership with the City IT Department.

Standardization of devices will also increase maintenance efficiency for the ITS program. There will be fewer variations in the types of devices that need to be maintained and thus fewer maintenance practices or nuances to be trained on. It will also reduce the variation in device inventory that needs to be available to replace a device if it unexpectedly fails.

It is recommended that the City consider engaging with other agencies that operate and maintain ITS devices in the region to discuss opportunities to create regional devices standards to support interoperability and combability between agency networks and systems, which will support any future, regional operations that may be pursued.

Traffic Operations Standard Operating Procedures

TOC Operator SOPs

As the City implements and expands their ITS program to provide more real-time management of the transportation network, it is recommended to develop standard operating procedures (SOP) relative to TOC use and ITS device and systems. SOPs for the TOC may include details about TOC operations (hours of operations, personnel access), general operator expectations (answering phone calls, logging information, monitoring devices/systems), and operator processes for specific conditions (notifications and response to incidents, processes for changing signal timing, work zone management).

The SOPs should also include agreed upon processes for inter-departmental use of ITS – such as Police or Fire use of cameras during incidents or special events and agreed upon intra-jurisdictional coordination or sharing. SOPs will document processes and expectations for TOC and device/system use so that they are agreed-upon and not contingent on the knowledge and understanding of specific individuals. SOPs will also help delineate roles and responsibilities for operations in the City to allow for the most coordinated and efficient operations.

Road Closure Playbook

One specific SOP that should be pursued is the development of a Road Closure Playbook or set of agreed-upon notification and response processes for when there are incidents that will significantly impact City transportation operations. This will be helpful as the City establishes centralized management of the traffic signal network and eventually pursues a TOC. This may include unplanned closures of City arterials due to incidents or emergency situations, but it might also address conditions when a major regional roadway, including a freeway, is unexpectedly closed and traffic is diverted to City streets.

The Road Closure Playbook would be an inter-departmental and potentially an inter-agency plan that designates:

- Preferred alternate routes based on the location of a closure (with focus on a freeway closure);
- Signal timing plans that would be activated to focus on moving vehicles along the route;
- Notification and coordination processes between public safety, traffic, and maintenance responders; and
- Roles and responsibilities of different responders as part of the incident response and management process and the resulting traffic management needs.

Collaborative development and use of a Playbook could improve coordination for City first responders, such as Police, maintenance crews, and traffic operations staff. An incident response playbook will improve incident response and safety and most efficiently move vehicles around the restriction by optimizing the use of the City roadway network.

Traffic Signal Timing Program

Traffic signal timing coordination and optimization can be one of the most cost-effective methods for improving mobility and traffic flow. Traffic signal optimization is done to:

- Adjust signal timing to account for changes in traffic patterns due to new developments and traffic growth;
- Reduce motorist frustration and unsafe driving by reducing stops and delay;
- Improve traffic flow through a group of signals, thereby reducing emissions and fuel consumption; and
- Postpone the need for costly long-term road capacity improvements by improving traffic flow with existing resources.

The objective is to maximize the progression of traffic along a corridor by coordinating timing plans on all signals based on the speeds and volumes of the corridor. Optimization helps minimize the number of stops, amount of delay, fuel consumption, and emissions experienced by drivers. Further, there is a federal regulation that, when the population of a municipality reaches 50,000, that agency is required to undergo signal optimization projects as part of air quality standards.

Thus, it is recommended that the City of Yuma establish a signal timing program. This should include establishing City signal timing standards and the formalization of a program for City Engineering staff to look at and potentially update traffic signal timing along key corridors in the City on a regular basis. It is recommended that a corridor get reevaluated on average of every two to three years.

There are some corridors in the City where there are traffic signals that are not operated by the City, so these optimization projects will have to be collaborative efforts that involve partnership and support from other agencies, including Yuma County and ADOT.

4.2 Maintenance and Lifecycle Management Program

This set of strategies relates to criteria for a lifecycle management and maintenance program for ITS devices, which highlights the need for on-going support for ITS Program devices and systems after they are initially deployed. The number of devices and systems that need to be maintained throughout the City of Yuma will increase as the City develops and grows ITS infrastructure network within the City. These devices and systems need to be appropriately and effectively replaced, upgraded, and maintained to provide accurate, reliable, and timely information.

Operation and maintenance (O&M) of ITS technologies and systems extends beyond simply keeping the equipment working. Reacting to emergency failure conditions, maintaining accurate maintenance logs, and conducting preventive maintenance programs all require processes in place to plan for and react to needs, and fully train staff to perform them. A comprehensive inventory will help to plan for when device upgrade or replacement should occur and can track the tradeoff costs of maintaining equipment beyond its lifecycle versus replacing the equipment. A maintenance management system may help track maintenance cycles and failures to help with tracking and prevention.

ITS Maintenance Program

The City has funding to support maintenance of traffic signal devices to keep devices in a functional state. Currently, the City is upgrading three-to-four traffic signal intersections every year as part of an asset replacement program. It would be beneficial for the City to have a similar program established for all of the current and new traffic signal and ITS infrastructure based on the projected lifecycles and speed of technology advancement for different technologies.

There are two maintenance types to consider, preventative and responsive maintenance. The following are descriptions of what these two maintenance types entail:

- **Preventive 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.

Recommended maintenance activities are based on device-type general guidelines, rather than required activities. Maintenance programs are limited by resource availability and it is recommended that the City to identify areas where maintenance activities could be introduced based on resource availability.

Preventative Maintenance

Preventive maintenance is a set of procedures that involve repetitive upkeep of ITS devices and system. It is performed to ensure the reliability and longevity of the mechanical and electrical operations of an ITS device or system and will reduce failures in equipment, cost of responsive maintenance, road user costs, and liability exposure. Preventive maintenance includes minor and major maintenance needs, making the frequency of maintenance an important consideration.

As the City's ITS infrastructure grows over time and maintenance efforts increase, the City will need to expand and formalize their preventative maintenance program to include additional devices, including new types of devices and systems that are deployed. A formalized program, including documented processes and regular training, is particularly important to have in place as new staff is added to support the growth. **Table 6** outlines the preventive maintenance activities and frequencies that vary by ITS device, device components, and systems. This table can be used as a reference or used as a checklist when incorporating new signals, new ITS infrastructure, or new staff. The City should review and revise the preventive maintenance procedures on an annual basis to ensure new issues are being addressed.

Table 6: Preventive Maintenance Recommendations

Intersection Preventative Maintenance	Recommended Interval
Interior Cabinet Check	
Clean cabinet Interior Check controller lamp and door switch Check fan and thermostat Check filter Check door fit and gasket Check locks and hinges Check/verify for cabinet timing and log sheet Check field block terminal connections Check conflict monitor indications	Annually
Check all detectors	Quarterly
Exterior Cabinet and Field Check	
Check condition of cabinet exterior Check all signal indications Check all pedestrian indications Check pole conditions and hand hole covers	Annually
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 loops	Quarterly
Visual check of other traffic system related cabinets	Annually
Typical CCTV Check List Items	**Recommended Interval**
Visual check of assembly CCTV receiver Video transmitter Fiber distribution unit Cabinet equipment Pole or exterior condition	Annually

Responsive Maintenance

ITS devices and systems have specific maintenance requirements per the manufacturer's maintenance manual for 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 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 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 and other heavy equipment.
- *Major Rehabilitation* – Major rehabilitation or complete replacement is contemplated for devices that experience frequent malfunctions or failures.

Table 7 identifies the typical frequency of minor and major maintenance, major rehabilitation, and lifecycle timeframes for a range of ITS devices. The following are resources that were utilized in the development of recommended ITS device maintenance guidelines for the City of Yuma:

- Recommended Practice for Operations and Management of ITS (ITE Publication); and
- International Municipal Signal Association (IMSA) Preventive Maintenance of Traffic Signal Equipment Program.

The City is encouraged to utilize these guidelines to create their maintenance program, understanding there may be constraints on resources in some situations.

Table 7: ITS Device and Communications Maintenance Guidelines

Equipment Type	Minor Maintenance	Major Maintenance	Major Rehabilitation	Lifecycle Timeframe
Traffic Signal Systems				
Cabinets	26 weeks	2 – 5 years	10 years	10 years
Signal Heads	26 weeks	2 – 5 years	10 years	20 years
Electronics	13 weeks	N/A	N/A	10 years
Poles	26 weeks	5 years	15 years	50 years
CCTV Camera Systems				
PTZ Units	26 weeks	1 year	3 years	10 years
Vehicle Detection Systems				
Loop Detectors and Cables	26 weeks	1 years	5 years	10 years
Cabinets	---	26 weeks	10 years	20 years
Power Supply	26 weeks	5 years	10 years	20 years
Grounding	1 year	5 years	10 years	25 years
Controllers	---	26 weeks	2 years	7 years
ITS Telecommunications Systems				
Fiber Optic Cable Plant	1 year	5 years	25 years	25 years
Fiber Optic Plan Video and Data Equipment	---	26 weeks	3 years	10 years
TOC Equipment				
Servers	26 weeks	1 year	2 years	5 years
Rack Equipment	-	1 year	2 years	5 years

Equipment Type	Minor Maintenance	Major Maintenance	Major Rehabilitation	Lifecycle Timeframe
Workstations	26 weeks	2 years	2 years	5 years
Workstation Displays	26 weeks	1 year	3 years	5 years
Uninterruptible Power Supply	1 year	5 years	10 years	20 years

These guidelines should be updated as information becomes available to incorporate the increased reliability that may be the result as new technologies are implemented or devices are upgraded.

As additional and new types of devices and systems are implemented, including new field devices and the TOC, the departments who are responsible for tracking the various assets should keep a detailed inventory of maintenance activities that have occurred in the Lucity asset management system. The following standard operating procedures should be tracked in Lucity:

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

This tracking will allow the ITS Program to identify devices that are not reliable, not 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 more costly than upgrading to a newer technology. It is also recommended the City implement a Quality Assurance procedure as part of the program to ensure that the maintenance activities are occurring in a timely manner. The City is also encouraged to find ways for maintenance staff to address both preventative and responsive maintenance concurrently where it is feasible. This can help reduce maintenance cost and maximize staff effectiveness.

Replacement/Upgrades

Replacement of equipment can be suggested if a device has experienced frequent malfunctions, communications or operating failures, irreparable damage, or has exceeded its lifecycle expectancy. Lifecycle timeframe estimates for ITS infrastructure relevant to the City of Yuma are provided in the previous **Table 7** and will be further discussed within the ITS Deployment Plan. While some agencies have replaced various components of a device as it fails, the City of Yuma is encouraged to utilize preventive maintenance to decrease the frequency of ITS device replacement.

Agencies are currently experiencing much shorter replacement/upgrade timeframes because of rapidly changing technology. Occasionally, older technologies do not reach their lifecycle timeframe because of the development and need for newer technology. Emerging technologies such as those for Connected and Automated Vehicles, or real-time congestion information through Bluetooth, Anonymous Re-identification (ARID) devices, or Wi-Fi devices are experiencing a sub-three-year upgrade cycle. Agency's procurement processes and funds may not be able to respond to such rapid technology turnover.

It is recommended that, within the 10-year timeframe, the City focus on deploying a basic level of ITS deployment of communication to signals and detection until there is a comfort-level with managing and using that infrastructure, prior to extending functionality to newer and lesser-proven technologies.

Institutional Support for Maintenance and Lifecycle Management

Ongoing support for this maintenance and lifecycle planning requires a reliable funding source and an adequate number of skilled and trained technicians to provide maintenance throughout the ITS devices and system lifecycles.

Funding of ongoing support O&M costs will likely need to be built into the Public Works, Engineering, and IT annual budgets based on the equipment. Maintenance for field equipment deployed at intersections is the responsibility of the Public Works department. All equipment related to the TOC will be the responsibility of the Engineering department for maintenance and upgrades. The IT Department will likely play a significant role in the maintenance and tracking of the communications network. Though all of these functions are eligible for funding through HURF, it is recognized throughout the state that HURF may not provide all of the needed funding for this program in addition to all of the other HURF related activities.

It is anticipated that all of the maintenance operations for ITS devices or systems (detection, traffic signals, and CCTV cameras, fiber) are inherently governmental operations; therefore, will be accomplished in-house. The roles and responsibilities, maintenance guidelines, and requirements of various maintenance staff (necessary trainings, certifications, and skills sets) should be included in the official duties for relevant staff positions.

4.3 Operations and Maintenance Training

As the City's ITS program is expanded and enhanced, City staff will need to be trained on a variety of new devices, systems, processes and advanced operations strategies. Trainings should include those specific to devices and systems, but may also include operational strategy training, such as on traffic signal timing or traffic incident management. Providing staff with proper training will allow them to most efficiently and effectively operate and maintain the ITS program, resulting in the most cost-effective traffic operations and maintenance processes.

Device and system training should be part of some specific vendor contracts at no additional cost to the City. There are also online training resources as well as other trainings that the City could investigate bringing, such as Traffic Incident Management (TIM) Responder training, which is provided as part of the Statewide TIM Coalition. As Engineering and Public Works identifies trainings that their staff need or trainings that are available, it may be pertinent and beneficial to reach out to other City departments or other agencies in the region to see if there is larger interest in the training, which might help share costs and could help elevate traffic operations and management in the City or the region. There may also be opportunity to collaborate with YMPO or other agencies in the region to put on regional training in areas that are deemed widely applicable and beneficial.

5. Data Strategies

A primary benefit to ITS devices and systems put in place is the data that it captures and the information that data can provide. Data can provide situational awareness where there was none before. Data can provide analysis tools and evaluation metrics that can be used to support decision-making and cost-savings. Data can be used for long-range planning and before-and-after analysis to determine successes and failures associated with development and economic growth.

New data is growing in the scale, the breadth, and the source as the transportation environment moves toward a Connected Vehicle environment. Data is quickly becoming a driver both locally and nationally for decision-making, and it is in the best interest of this ITS Strategic Plan to acknowledge that the ITS Program can provide a wealth of data to support mobility, efficiency, and economic and community drivers that the City is moving toward.

The key advancement suggested in the Data Strategies is the intentional use of data to support real-time decision-making, investment strategies, and public information dissemination. **Table 8** summarizes the recommended data strategies.

Table 8: Data Strategies Summary

	Data Strategies	Description	Implementation Considerations	Benefits	Cost Considerations	Dependencies	Original Need Warranting Strategy
A	**Data and Performance Tracking and Reporting – Internal and External**	Create a plan to collect, share, track, and report on data and/or performance measures related to traffic operations and ITS. Data can support operational decision making and can be turned into information that can be shared to show the impacts of the ITS Program The City should make a performance report available to the public to show impacts of the City's investments in the transportation system and support public education related to ITS and traffic operations.	Identify metrics that would be beneficial to track or report on – both for Engineering as well as for other City departments. Identify the sources of the data and a way to collect it at an appropriate frequency, which may require partnership with other departments. Establish a format and method for sharing data and presenting performance metrics so that that is accessible internally to City staff across all departments. Consider partnering with other agencies who might benefit from the data or who have interest in performance tracking on a regional level	Tracking and reporting on data and performance measures will support City departments in sharing data and information and will allow City staff to see how they are progressing towards specific goals or how the City's transportation system is performing over time	Staff time will be required to collect and analyze data and to create a performance report. Additional costs would arise if the City wanted to create a centralized database for data collection or for automating performance reporting	Deployment of devices and system to collect the desired data is necessary The ability to collect and aggregate data is necessary, which will be facilitated through implementing the recommended transportation communications network and the use of a centralized management system	• Conducting outreach and education to elected/public officials and the public to garner support for the use of more advanced technologies (such as intersection cameras) to support regional transportation operations. • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations. • No ability to remotely access and centrally manage traffic signals and associated infrastructure in real-time.
B	**Traveler Information**	Building off of the data and performance measure strategy, the City should consider ways to provide travelers with real-time traffic condition information.	Create a publicly available interface for traffic data; at a minimum, provide planned roadway restrictions as a result of planned road work, but, if possible, provide real-time information, such as congestion or traffic incidents (may involve working with public safety for crashes). The interface may be a City-run website, such as a map or could be accomplished through social media. The City may also consider partnering with a third party, such as Google, to integrate City data into an existing platform	Information on traffic conditions allows travelers to make trip planning and route determination decisions, which would support reduced congestion in the City. It will also be a highly visible City service to show that the City is using its resources to support its residents and visitors in ways that no other City is doing so.	Creating and updating a static map with construction restrictions or utilizing social media to provide information would have no cost besides staff time; Providing a real-time condition map may require software development, but may leverage the ATMS investment that Engineering will pursue to reduce costs	The functionality of the map is dependent on data being available and collected by the City. For real-time data, availability is dependent on implementation of communications to connect ITS devices and a central management platform to allow for data collection	• Conducting outreach and education to elected/public officials and the public to garner support for the use of more advanced technologies (such as intersection cameras) to support regional transportation operations. • Lack of availability of real-time data at traffic signals that support day-to-day operations and emergency response as well as planning for operations.

5.1 Data and Performance Tracking and Reporting – Internal & External

ITS Data

Table 9 presents a list of data that can be collected from ITS devices or could be collected by a traffic operations or maintenance log pertaining to the operations of ITS devices. The data types range from data that is inherent in the device (whether it is on or off), to more involved data that may have to be actively created (hours of preventative maintenance).

Some of these data are useful for internal City consumption while others can be turned into information and disseminated into the public. For data targeted for City use, some of it will be most relevant to traffic engineering to support real-time traffic condition monitoring and decision making, while other data could be useful to groups such as IT or signal maintenance related to network performance and uptime.

Table 9: ITS Data Types and Sources

Detection	CCTV
• Status – on/off • Communication transmission success/failure • Volume • Classification of vehicle • Vehicle occupancy • Anonymous ID location and time • Pedestrian actuation and movement • Bicycle actuation and movement • Stopped vehicle notification • Turning movement counts	• Status – on/off • Communication transmission success/ failure • Image speed (frames per second) • Occupancy start/end • Stopped vehicle notification • Queue length
Fiber	**Wireless Radio**
• Status – on/off • Communication transmission success/failure • Bandwidth consumption • Timestamp of bandwidth usage	• Status – on/off • Communication transmission success/ failure • Bandwidth consumption • Location of bandwidth consumption • Timestamp of bandwidth usage
Emergency Vehicle Preemption	**Automatic Vehicle Location**
• Status – on/off • Activation timestamp at location	• Location of vehicle (Fire, Police, Transit, Ambulance)
TOC Operator	**System Activity**
• Incident response initiation of activity • Congestion response initiation of activity • Timestamp of sending notification by any method (email, system note, text, social media, etc.) • Incident location/time • Timestamp of receiving incident or system performance notification (email, system note, text, social media, etc.) • Reason for signal timing change (manual log)	• Signal plan change time • Timestamp of time when camera image is accessed • Number of incidents (Police/Fire Computer-Aided Dispatch (CAD)) • Incident location, start/end time and duration (Police/Fire CAD)

Traffic and ITS Performance Measures

It will be important to keep track of the performance of the ITS program by using the available data from ITS devices to calculate and/or tracking performance measures. Tracking the performance of the system will:

- Increase accountability for the upkeep and performance of the system, because any flaws or areas of low performance will be tracked and visible.
- Identify opportunities for increased investment and expansion of the system (physically and financially).
- Justify past and future investments into the system, both internally and to the public.
- Support public education related to ITS and traffic operations and act as positive publicity for the City.

Performance measures can help the City assess the outputs and outcomes of the ITS program. These measures may provide good indication of how well an ITS Program is performing with respect to some of its main outcomes. The following are examples of performance metrics that could be calculated from ITS data and could help track the performance of the ITS/traffic operations program:

- Travel times along key (regional) corridors
- Incident response time and incident clearance time
- ITS device and communications uptime
- Vehicle delay/queue length at intersections
- Vehicle delay during unplanned traffic events

As the City implements its ITS vision, it will be important to track performance to be able to justify investments and to understand what can be shared with other departments to support their mission and goals. Performance reports can also be shared with the public to provide information on the return on investment of City funds for transportation and to help education the public on ITS and the potential benefits of investing in and using transportation technologies.

5.2 Traveler Information Dissemination

The City should consider using the data and functionalities provided by ITS infrastructure and systems to create a publicly available interface for the data. Considering the robust data set that ITS can provide, there are benefits to providing data to the traveling public to support them in making informed travel decisions. At a minimum, the City should provide planned roadway restrictions that result from planned roadwork, and this data should be kept as up to date as possible. If possible, the City should consider how to also provide real-time condition information, such as congestion or traffic incidents; the latter may involve working with public safety

The public interface for presenting the data may be:

- A City-run website, such as a map on the City Engineering website,

- Use of social media platforms (Twitter, Facebook) managed by the City, either as a traffic-specific account or part of the City's general social media accounts.
- An agreement with a third-party provider, such as Google, to integrate City data into an existing traveler information platform.

6. Coordination and Partnerships for Implementation

While most of the strategies outlined for the City's ITS Program will likely be led by the Engineering department at the City, many of them will require coordination and partnerships with other departments or other agencies to successfully implement and sustain. There are also opportunities for ITS strategies to be expanded beyond City borders to provide inter-agency traffic operations benefits, understanding that the expectations of the traveling public related to traffic operations does not stop at or account for jurisdictional borders.

The next phase of this ITS strategic planning process for the City is to develop a Deployment Plan, which will explore specific details of the recommendations, including more detailed costs, implementation timeframes, operations and maintenance planning, and specific policies or agreements to pursue. The general needs and opportunities for collaboration and partnership on ITS initiatives are described in this section.

6.1 Strategies that Require Coordination

ITS will inherently be a multi-departmental effort in the City of Yuma. At a minimum, traffic operations is the responsibility of City Engineering. The maintenance of traffic signals and other devices at intersections is the responsibility of City Public Works. The City's approach to establishing a comprehensive and redundant communications network is being championed by the City IT department. There are also a variety of other departments and other agencies in the region that will either have stake or a role in an ITS-related strategy.

Strategies that require the Engineering Department to coordinate with *another City Department* include:

- Establish a Transportation Communications Network - IT
- Implement a TOC – IT, Police (if co-location is desired)
- Implement an ATMS – IT
- Upgrade Traffic Signal Cabinets and Controllers – Traffic Signal Group
- Implement Detection at all Traffic Signals – Traffic Signal Group
- Implement Intersection Monitoring – IT, Police
- Implement a Video Management System - IT, Police
- Expand EVP to all Traffic Signals within the City – Fire, Traffic Signal Group
- Create/Update ITS and Communications Standards - IT
- Road Closure Playbook – IT, Police,
- Maintenance and Lifecycle Management Program – IT, Traffic Signal Group

- ITS Performance Measure Tracking and Reporting - IT
- Traveler Information Plan – IT, POI, Police
- Public Education Campaign - POI, Police

Strategies that require coordination with *another agency* include:

- Upgrade Traffic Signal Cabinets and Controllers
- Expand EVP to all Traffic Signals within the City
- Formalize Signal Timing Program

6.2 Strategies that Provide Opportunities for Partnering

The City of Yuma's vision and goals for an expanded ITS program will also benefit and be supported by partnering with other City departments and externally with other agencies. While these partnerships may not be required, partnering and collaboration will both strengthen and elevate ITS strategies and the benefits that can be realized for traffic operations in the City and potentially beyond the City into the larger Yuma metro area.

Some key areas where partnering and coordination would support elevated benefits include incident management, data sharing, and cohesive traffic operations. The strategies that would benefit from partnering and coordination with other agencies include:

- **Implement a TOC** – opportunity for other agencies to participate in establishing and operating a TOC to support regional traffic operations.
- **Implement an ATMS** – opportunity to consider a regional ATMS system that would provide interoperability between agencies.
- **Infrastructure Upgrades** – opportunity to standardize ITS equipment across the region.
- **Implement Intersection Monitoring and a Video Management System** – opportunity to share real-time visual monitoring capabilities between agencies.
- **Create/Update ITS and Communications Standards** – opportunity to standardize ITS equipment across the region.
- **Road Closure Playbook** – opportunity to coordinate notification and traffic management processes for incident and emergency management across the region.
- **ITS Performance Measure Tracking and Reporting** – opportunity to share data and track and report on operational performance measures across the region.
- **Traveler Information Plan** – opportunity to provide traveler information at a regional scale to support traveler decision making.
- **Public Education Campaign** – opportunity to disseminate information and provide education to the public on ITS and traffic management throughout the region.

7. Funding

Implementation of many strategies is contingent upon the attainment of additional funding for infrastructure, systems, staff time, and contractor services. Being apprised of funding opportunities and their schedules will allow the City to have time to prepare necessary materials and applications. **Table 10** below shows potential funding opportunities for ITS infrastructure and systems:

Table 10: ITS Funding Opportunities

Funding Source	Description	Relevant Schedule
YMPO Transportation Improvement Program (TIP)	A regional list of transportation projects selected for local, state, and/or federal funding within with YMPO Yuma County area.	TIP programming covers a period of 5 years.
City of Yuma Capital Improvement Program (CIP)	The City financial plan for local infrastructure improvement projects. Projects included are identified by all City Departments, reviewed by a review committee, and approved by City Council.	CIP programming covers a period of five years, updated each year for the following five-year period.
ADOT Local Public Agency (LPA) Program	A program that allows local agencies to utilize ADOT's on-call services with federal funding. The LPA program follows a four-step process for projects: Planning/Programming; Development/Design; Construction; and Final Acceptance.	The LPA process from planning/program to final acceptance is generally a 40-month to 72-month process depending on the scope of the project.
Development-driven projects	A potential source of project funding is through development driven improvements. Establishing ITS standards for developers to follow within private development projects or half street improvements can aide in the City ITS program buildout.	Infrastructure would be installed as development projects are established.
Federal Funding	Federal funding opportunities are released by the USDOT or other federal agency that can support agencies in planning for, designing, and/or constructing transportation infrastructure investments. Some examples include the Infrastructure For Rebuilding America (INFRA) discretionary grant and Better Utilizing Investments to Leverage Development (BUILD) Transportation discretionary grant. There are also some ITS/technology specific opportunities that area available – some recent examples are the Smart City Challenge, the Advanced Transportation and congestion Management Technologies Deployment (ATCMTD) grant, or the Automated Driving Systems (ADS) grant. Typically, federal funding is acquired by agencies like YMPO or ADOT, with local agencies are partners. Projects that show partnership and cooperation by multiple agencies in a region can elevate the attractiveness of applications for these federal opportunities.	Federal grant opportunities are often dictated by the current transportation legislation that is in place (the FAST Act is the current legislation). Some grants are one-time opportunities, while others occur on a recurring schedule.

Funding Source	Description	Relevant Schedule
State Funding	State agencies, including ADOT, will sometimes have funding available to regions or local agencies to support transportation investments. For example, ADOT's Planning assistance for Rural Areas (PARA) program provided funds to agencies for planning and preliminary scoping for transportation projects. The State Commerce Authority has programs that will support local government investments as they align with economic development and enhanced livelihood; for example, the Arizona Rural Broadband Development Grant makes funds available to act as grant match dollars to leverage additional federal resources to accelerate broadband deployment in underserved areas.	State funding opportunities may be dictated by the current federal legislation in place, while others use sale tax money or other local sources.

8. Next Steps

This document identifies the recommended strategies to consider based on the needs at the City. Many of the recommended strategies will require more resources, including funding, staff time and changes to institutional structures or processes in order to implement.

In the next phase of the project, the ITS Deployment Plan, the procedural, resource and staffing requirements that are needed to undertake the strategies will be explored. It will identify key agreements, partnerships and coordination efforts, programming processes, and recommended staffing and business models for supporting these strategies at the City. It will also involve outlining a 10-year implementation plan including summaries of costs per timeframe per funding source as well as recommended staffing levels needed for effective traffic management and operations and will include coordinating potential ITS projects with planned projects. The plan will provide guidance for the City on how to create the institutional foundation to successfully implement the ITS strategies and reach the desired ITS program that is defined in the vision and goals.

CONCEPT OF OPERATIONS FOR

Yuma Traffic Operations Center

Prepared for

CITY OF Yuma

In coordination with

ADOT

YMPO

YUMA COUNTY ARIZONA

CITY OF SOMERTON ARIZONA 1898

CITY OF SAN LUIS, AZ INC. 1979

Prepared by

Kimley»Horn

June 2021

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List of Acronyms

ADOT – Arizona Department of Transportation
ATMS – Advanced Traffic Management System
ATSSA –American Traffic Safety Services Association
CAD – Computer Aided Dispatch
CCTV camera – Closed Circuit Television camera
ConOps – Concept of Operations
CPU – Central Processing Unit
EVP – Emergency Vehicle Preemption
IGA – Intergovernmental Agreement
IMSA – International Municipal Signal Association
IT – Information Technology
ITS – Intelligent Transportation Systems
MUTCD – Manual on Uniform Traffic Control Devices
PD – Police Department
PW – Public Works
RMS – Records Management System
TOC – Traffic Operations Center
TSMO – Transportation Systems Management and Operations
UPS – Uninterruptible Power Supply
YMPO – Yuma Metropolitan Planning Organization
YRCS – Yuma Regional Communications System

1. Introduction

The City of Yuma (City) is pursuing the planning and eventual implementation of a Traffic Operations Center (TOC) as a part of the development of an Intelligent Transportation System (ITS) Strategic Plan. The implementation of a TOC is a strategy to elevate the City's ability to operate and manage a safe and efficient transportation network and contribute to the management of the larger transportation network in the Yuma Region.

The City of Yuma has the largest number of traffic signals and other traffic management equipment within the Yuma region but does not have the ability to monitor or actively operate its network. There could be significant safety, efficiency, and public relations benefits if the City Engineering staff, and potentially other regional partners, had the ability to monitor and operate traffic signals and other ITS devices in real-time from a centralized location. A TOC will allow for this centralization and real-time operations for the City of Yuma network and creates an opportunity for multiple agencies to coordinate and collaborate on traffic operations and management strategies at the regional level.

Establishing a TOC in Yuma also supports the City of Yuma's Vision and Strategic Outcomes and will specifically help make progress towards the 'Safe and Prosperous' strategic outcome.

- A TOC will enable implementation of traffic management strategies to reduce delay that travelers experience from congestion and uncoordinated traffic signal timing.
- More efficient traffic management will support travel time savings, reduced emissions, and reduced traveler frustration associated with congestion.
- Having a safe, efficient, and modern transportation network may provide a competitive advantage for the City and the region and incentivize people to live and bring their businesses to Yuma.

1.1 Concept of Operations and Functional Priorities Description

This TOC Concept of Operations (ConOps) will help to answer the critical questions that will define the components of a TOC required to meet the specific traffic management needs of the City of Yuma:

- What are the critical functions that the TOC needs to perform to address needs and gaps, meet the safety and mobility goals, and maximize benefits for the traveling public within the City and as part of the larger Yuma region?
- What are the TOC physical space needs to effectively manage and operate the current and future transportation network within the City and as part of the larger regional transportation network?
- What are the equipment needs that the systems and functions of the TOC will require?
- What are the staffing needs for the TOC to most effectively carry out Yuma's role in traffic management and operations, incident management, information dissemination, both within the City and as part of the larger region?

Functions are defined in this context as transportation or emergency-related services such as operating a traffic signal system, supporting incident management response, and supporting the dissemination of traveler information. TOC functions will be evaluated for their impacts to space requirements within the TOC for personnel, equipment, and access needs. All functions identified for the TOC need to be considered and prioritized for importance in the fundamental responsibilities of the TOC to make certain that the ultimate resource plan and spatial layout fits within the space needs and budget allotted.

1.2 Project Development Process

Figure 1 depicts the process for defining and crafting the overall functional picture of the Yuma TOC. It is important that the process be transparent and traceable back to a set of goals and needs to make sure that resulting capital investment and software system recommendations are consistent with the original intent of the TOC to support efficient and justifiable investments.

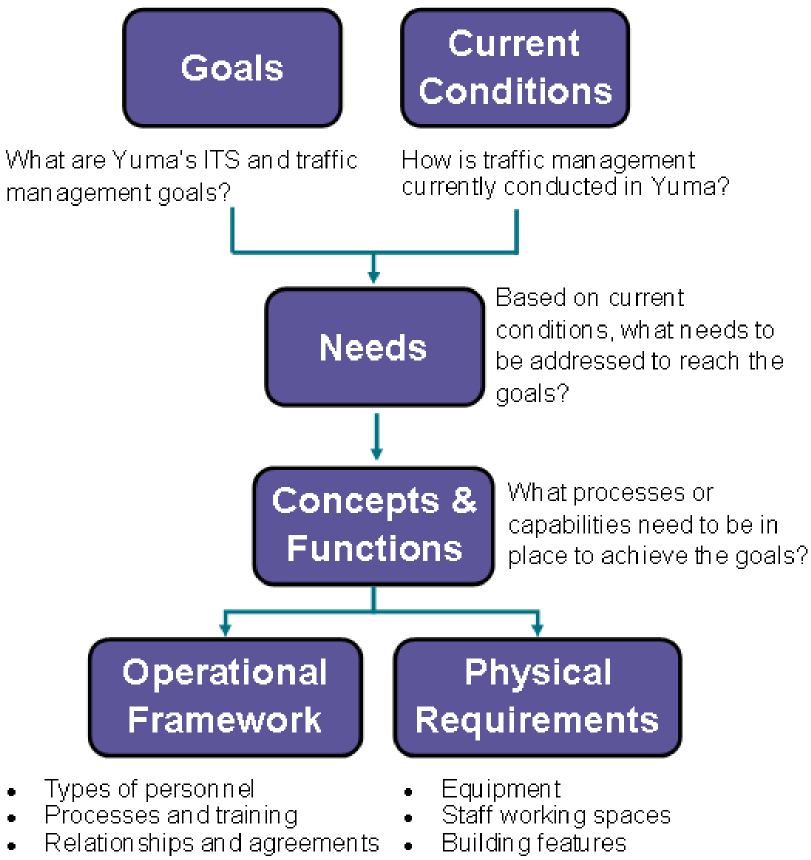

Figure 1 – TOC ConOps Development Process

1.3 Stakeholders

The Yuma Transportation Systems Management and Operations (TSMO) group was the lead for developing this ConOps and defining TOC processes. Because of the potential benefits of the TOC for other departments at the City and for other agencies within the region who are responsible for management of the regional transportation network, a variety of stakeholders were invited to participate in the planning and development process for the TOC concept.

Other City of Yuma departments that participated included:

- City of Yuma Police
- City of Yuma Fire
- City of Yuma Information Technology (IT)
- City of Yuma Public Works (PW)
- City of Yuma Public Affairs/Communications

Other agencies within the Yuma region that participated included[1]:

- Yuma County PW and Sheriff's Office
- City of Somerton PW
- City of San Luis PW
- Arizona Department of Public Transportation (ADOT) Southwest District
- Yuma Metropolitan Planning Organization (YMPO)

2. Goals and Needs

Strategic goals help guide decision making both for day-to-day operations as well as for identifying and justifying investments.

2.1 Intelligent Transportation System and TOC Goals

As part of the Yuma ITS Strategic Plan effort, a set of City ITS goals were identified to help establish a direction for a program that utilized advanced technologies and strategies to support a safe and efficient traffic network. The City ITS Goals are:

- Invest in technology to take transportation system management to the next level and manage the transportation network more effectively, rather than trying to build the way out of congestion (i.e. technology in lieu of construction).
- Work with partner agencies to elevate the level of real-time coordination for traffic and incident management to provide a consistent and efficient travel experience across municipal boundaries.
- Identify a framework for a TOC that facilitates centralized control of field devices and coordination between agencies while allowing each agency to maintain ownership of their infrastructure.

These ITS goals were translated into a set of TOC-specific goals to help guide the process of defining functions and equipment and space requirements through this ConOps. The Yuma TOC Goals are:

[1] Participation and input from the Cocopah Tribe was pursued but not obtained during the development of this ConOps. The input and participation of the Cocopah Tribe will be important for regional operations and connectivity given the location of their traffic signal infrastructure in the middle of regional corridors.

- Elevate the City's ability to manage their transportation network in real-time through improving the City's and traveler's ability to make informed, data-driven decisions.
- Improve inter-agency coordination for traffic management and emergency response within the Yuma region.
- Identify a TOC space and operating concept that is scalable to accommodate current functions, future functions as well as a more regional-role, if desired in the future.

2.2 Traffic Management and TOC Needs

The Yuma ITS Strategic Plan also identified a set of needs and gaps that need to be addressed in order to make progress towards achieving the ITS Goals. From these needs and gaps, a list of specific needs from the perspective of a user of the TOC based on the goals are highlighted in **Table 1** to help guide the concept development for the TOC.

Table 1 – TOC User Needs

TOC User Need	Description
1. Need to have the ability to centrally manage and monitor traffic signals and associated infrastructure	The TOC needs to be connected to an ITS communications network and have a centralized traffic management system that allows an operator to remotely monitor infrastructure status and make changes to the infrastructure operations without having to be in the field.
2. Need improved data and information to support real-time operational decision making and dissemination of traveler information	The TOC needs to have access to real-time data about the transportation network to support real-time decision making about traffic operations and incident response, and to support the City in making real-time condition information available to the public.
3. Need coordination between traffic and first responders for incidents that will impact the City or regional transportation network	There is a need for more intentional coordination and more established processes between traffic and public safety for incident response and management.
4. Need coordination of traffic operations at jurisdictional boundaries and along regionally significant corridors	There is a need for more intentional operational coordination and integrated traffic management strategies between different agencies at jurisdictional boundaries and along multi-jurisdictional corridors.
5. Need to have trained staff to support the TOC functions	Staff need to be designated and trained to support the TOC functions, including the use of new systems, implementation of new traffic management strategies, and participation in inter-departmental and inter-agency coordination for traffic management.

3. Current Operating Conditions

The Yuma region has seen an increase in population over the last 15 years. The regional economy has a diverse foundation with two major defense facilities, a regional/interstate medical facility, a high-tech agribusiness industry, and a growing industrial sector. The region also hosts more than 60,000 winter visitors annually, according to a recent study conducted by the Arizona Office of Tourism. The Yuma region serves as a gateway to both California and Mexico. State facilities including Interstate 8, State Route 195, and State Route 95 all provide important access to these borders and connectivity in the region. Key local facilities, such as 4th Avenue, 16th Street, Avenue B, and 32nd Street are critical for the local movement of people and goods and will experience daily traffic volumes comparable to major regional corridors.

3.1 Current Infrastructure

Traffic Management Infrastructure

Five agencies within the Yuma region own and operate traffic signal infrastructure. The City of Yuma is responsible for the largest network and currently operates 75 traffic signals. A majority of City-operated signals are within the western portion of the City, with only 15 signals east of the Marine Corps Air Station (Avenue 3E). In addition to the City of Yuma, Yuma County, ADOT, the City of Somerton, the Cocopah Tribe, and the City of San Luis also operate traffic signals within their jurisdictions.

All but two of the existing traffic signals within the City are actuated, meaning that traffic signal timing is informed by data from vehicle detection. The two traffic signals without detection run on pre-set timing plans and are located at 3rd Street and Avenue A and 8th Street and Orange Avenue in the north part of downtown, near City Hall.

There are no closed circuit television (CCTV) cameras deployed at intersections, and none of the existing video detectors are connected to a central system, so there is no real-time intersection monitoring performed in the region.

Table 2 summarizes the existing transportation infrastructure in the City and in surrounding agencies.

Table 2 – Existing Transportation Infrastructure Summary

Device	City of Yuma	Yuma County	ADOT	Somerton	Cocopah Tribe	San Luis
Traffic Signals	75 Signals	24 Signals	17 Signals	4 Signals	2 Signals (one maintained by Yuma County)	4 Signals (all maintained by Yuma County)
Vehicle Detection	Loops and video	Loops and video	Loops, video, and radar	Loops	None	Loops

Transportation Communications Infrastructure

Currently, all City, County, and Somerton traffic signals are locally controlled and not connected to a centralized management system via an ITS communication network. Without a communications network, any traffic signal timing changes that are needed require someone to go out into the field and manually update traffic signal timing plans. The only way to monitor that the new timing plan is in effect and that it is performing correctly is to wait and observe the traffic signal in the field.

The City of Yuma IT department is partnering with the TSMO group to plan and ultimately implement a City-wide backbone communications network to connect City facilities and traffic signals to communications infrastructure. This backbone fiber would provide dedicated strands for a traffic communications network, allowing for signals along the route of the fiber backbone to connect to the network. The City backbone communications network will not connect to all City traffic signals, so the TSMO group is also identifying additional traffic-specific communications projects to provide communication to signals not in the immediate vicinity of the fiber backbone network. Successful planning and implementation of this communications network will ultimately provide a complete transportation communications network to provide connectivity to all signalized intersections within the City.

3.2 Current Processes and Systems

Traffic Management Processes

Day-to-day traffic operations are managed by each individual agency, with no established processes for coordination between the various agencies within the region. As of 2020, there is an intergovernmental agreement (IGA) between the City and Somerton for the City to provide traffic engineering support to Somerton. Additionally, Yuma County is responsible for the operation and maintenance of two traffic signals owned by the Cocopah Tribe.

All stakeholder agencies for this project noted that coordination between agencies during construction closures and detours is done proactively and effectively. Internally, Public Affairs/Communications coordinates with Engineering and Public Works to provide a weekly newsletter regarding planned events. Externally, Yuma County currently coordinates with the City of Yuma, Somerton, San Luis and ADOT for planned construction activities, while ADOT additionally coordinates with Caltrans and US Border Patrol for regional transportation support.

Incident Management Systems and Processes

Emergency vehicle preemption (EVP) is used to provide emergency response vehicles, such as fire trucks, with signal phase priority at intersections. Currently, the City of Yuma has infrastructure to support EVP for City emergency response vehicles at City signals. The program to install and support EVP infrastructure is a partnership between City Public Works and Fire. Other agencies do not have EVP deployed on their traffic signals.

Incidents are identified by a 911 call sent to a dispatch center who will send out responders right away. Dispatch will also enter incident information into the Computer Aided Dispatch Records Management System (CAD RMS) and also New World, a regional program used to send information between responders and dispatch. The entire County is also part of YRCS (Yuma

Regional Communications System) which has individual radio channels as well as common channels for inter-agency coordination that are accessible to all public safety officers. Additional internal communication includes a Fire exception report to notify their chain of command, including the City Administrator and City Public Affairs/Communications staff. Typically, communications to the public regarding incidents is done by the Police and Fire social media accounts.

If the supervisor on scene for Police determines that Public Works is necessary to help manage traffic at the scene, they will notify the on-call emergency response team. The main priority of Public Works emergency response team is to implement traffic control signs and barricades and potentially detour signage as necessary. Public Works also responds to incidents that involve damage to public infrastructure where staff may need to rectify the issue immediately or put temporary measures in place while the issue can be resolved. Police officers on scene will make the decision to turn off or put a traffic signal in flash and manually manage traffic within an intersection if warranted by the incident conditions.

ADOT is responsible for coordinating incident management on freeways through their TOC in Phoenix and will coordinate with local agencies if they expect significant impacts to arterials as a result of a freeway event. This function of monitoring and coordinating responses for incidents on the state freeway network is the primary function of the ADOT; ADOT TOC does not monitor or manage traffic signals.

4. Proposed TOC Concepts and Functions

This section outlines the conditions that support the development of a TOC and identifies the TOC capabilities that will need to be in place to elevate the current operating environment towards addressing the goals. This section will identify TOC priorities, with emphasis given to functions that can be implemented in a near-term scenario. It also identifies a long-term operational vision and capabilities that could be pursued in the future based on near-term successes.

4.1 Justifications for a TOC

A Yuma TOC was identified as a key strategy in the Yuma ITS Strategic Plan to reach the City's ITS and traffic management goals. There are three main conditions within the City and the larger Yuma region that justifies the need for a TOC – day-to-day traffic management; traffic device maintenance and uptime; and regional traffic and incident management.

Day-To-Day Traffic Management

The City of Yuma and other agencies within the region have made significant investments in traffic infrastructure to support safe, efficient, and seamless travel for residents and visitors. A TOC will allow the City, and potentially other regional agencies, to centrally monitor and manage traffic signals and associated infrastructure. Centralized traffic management abilities will create opportunities for improving traffic flow along key corridors and allow the City to collect and utilize traffic condition data to support more informed decision making both for traffic operations and for infrastructure/capital investment planning purposes. The centralized management and data collection opportunities afforded by a TOC would optimize the use of existing infrastructure investments and capitalize on opportunities to improve efficiency, safety, and data-driven decision making.

Traffic Device Maintenance and Uptime

Infrastructure maintenance and device operational issues, such as having a traffic signal out or in flash, can have negative impacts on traveler mobility, public perception, and public safety. It is important for the City to keep its infrastructure in working order and properly maintained, and TOC system will support that. With traffic signal and other devices centrally connected to a TOC, City staff can be alerted of device malfunctions right when they occur so that they can respond in a timely manner.

Regional Traffic and Incident Management

Travelers in the Yuma region expect a safe and seamless transportation experience regardless of which agency owns and operates a roadway. Currently, there is minimal coordination for traffic operations, such as traffic signal timing strategies, between agencies at jurisdictional borders or along multi-agency corridors. Managing advanced infrastructure and systems from a TOC, and implementing more formalized processes for traffic operations, will support this type of coordination and improve the traveler's experience within the region.

Similarly, a more coordinated approach to incident response and management, within the City and between adjacent jurisdictions, would provide safety and efficiency benefits for travelers and incident responders. The TOC can support more formalized and widespread incident notifications and data sharing, especially between first responders and those responsible for traffic operations and management. Additionally, the TOC and its centralized systems will be able to support incident response and management; the video feeds from detection will allow responders to assess an incident scene before any responders are on-scene to support a more efficient response, and the TOC can support remote operations of traffic signals to support traffic management around the scene, freeing up first responders to focus on securing and investigating the incident rather than focusing on traffic management.

4.2 Near-Term TOC Functions

This section documents the functions envisioned for the Yuma TOC in the near-term. The TOC functions were derived from the TOC goals, user needs, and stakeholder discussions.

The near-term functions of the Yuma TOC are depicted in **Figure 2** and focus on implementing systems and processes to elevate traffic management within the City to provide a safer and more efficient network and to improve maintenance response time and device uptime of the traffic network.

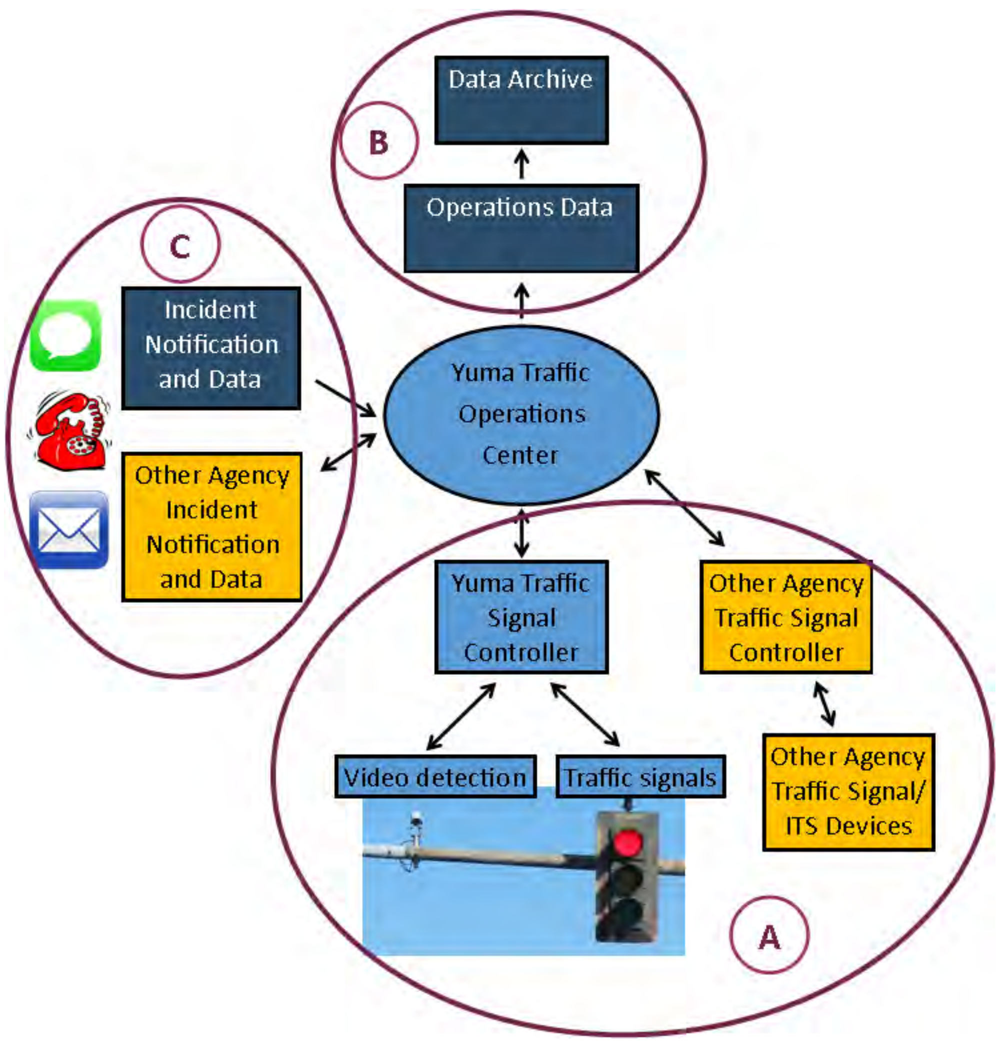

Figure 2 – Near-Term TOC Concept

(A) Connecting and Centrally Managing ITS Devices

One of the primary goals of the Yuma TOC in the near-term is to actively manage and monitor traffic through connected ITS devices. To accomplish this goal, devices in the field must be able to send data to and receive data from the TOC through a communications network. The City plans to deploy a network of video detection cameras, upgraded traffic signal controllers, fiber optic cable, and wireless radios to provide the data and communications to support this goal. Yuma IT will establish technical specifications to create secure connectivity into the infrastructure, including method of access, identity management, duration of connection, and requirements of connecting devices or networks. More information on the communications network and device buildout can be found in the Yuma ITS Infrastructure Implementation Plan, which is a separate document that is being developed as part of the larger ITS Strategic Plan effort.

The TOC will establish base infrastructure and systems to allow the opportunity to connect to and remotely monitor and manage other agency ITS devices if an agency is interested. This will be accomplished and detailed through formal partnerships and agreements. In the near-term, the City of Somerton has expressed interest in connecting their traffic signal infrastructure to a TOC system when a TOC is established[2]. The City of Somerton currently has an IGA with the City of Yuma for traffic operations and management support; this existing IGA provides a foundation to amend or expand the IGA to include connecting and operating Somerton traffic signals from the TOC.

Advanced Traffic Management System (ATMS)

The implementation of an advanced traffic management system (ATMS) will allow for remote monitoring, real-time operations, and data collection for traffic signals and video detection. As traffic signals are outfitted and connected via ITS communications, they can be connected to the ATMS. The ATMS will allow for the following functions to be implemented for the Yuma TOC:

- Utilize real-time traffic operations and condition data from connected devices to inform traffic signal timing strategies and allow implementation of a more dynamic signal timing program to better respond to current traffic conditions.
- Modify and test alternative traffic signal timings and store timing plans in a database;
- Operate the traffic signal system from various points on the city's communications network. It provides flexibility for TOC operators to make adjustments when they are not in the TOC;
- Receive maintenance alerts from field devices and communications equipment that are not functioning properly;
- Support incident management response by remotely operating traffic signals when there is a crash that requires lane restrictions at an intersection. This will allow the Police

[2] To successfully connect City of Somerton infrastructure to the City of Yuma network, participation and connections to traffic signals owned by the Cocopah Tribe will be necessary, so this concept is also predicated on coordination with the Cocopah Tribe.

Department (PD) officers on-scene to focus on public safety and incident investigation, rather than on traffic management; and

- Support traffic management for planned events like construction or a special event that may require roadway restrictions and traffic detours through pre-planned signal timing strategies. Signal timings will be stored in the database and implemented when appropriate. This will improve existing detour processes by providing ability to adjust signal timing remotely and in-real time, rather than having to go to each controller to update the timing. It will also support signal timing from a corridor level for optimizing timings along a corridor rather than just being able to focus on the signal intersection.

During system design and procurement, a detailed set of ATMS software requirements should be developed to identify the specific requirements that a system must meet for the Yuma TOC. This ConOps should provide the foundation for developing these detailed system requirements.

The TOC will also provide a physical location for staff to work from to actively manage and monitor the real-time traffic conditions. The TOC location will include workstations for staff to manage traffic and signal operations, house the servers for the traffic network and collected data, and provide a video wall for more efficient monitoring.

(B) Collecting and Archiving Operations Data

ITS devices connected to the central system will collect operational data that can be used to inform the active traffic management within the City. Initially, video detectors can provide information on vehicle speeds, vehicle counts, and real-time (not historical[3]) video feeds. This data will allow the TOC to monitor traffic flow to make real-time adjustments to signal timing and to observe intersection conditions during an incident. Police Dispatch can be provided with remote access to video feeds to support incident verification when they receive a 911 call and help make sure that the appropriate response is taken depending on the incident circumstances that may be visible through the cameras.

Additional data that will be available through the TOC is device status information, such as if the device is on or off, if the communication connection is working, and if the device is functioning properly. This will allow the operators to dispatch maintenance crews to address any issues. Providing Yuma Police Dispatch with access to the ATMS for traffic signal status information will also allow them to remotely monitor and better manage and respond to 911 calls related to traffic signal malfunctions. TOC software can improve equipment asset management, tracking equipment repair and maintenance activities, and scheduling routine maintenance.

The central system in the TOC will automatically compile, generate, and archive reports including data and information such as active traffic signal timing, timing plans, operator-driven traffic signal timing changes, equipment malfunctions, and travel speeds. The database of these reports can be utilized to maintain historical records of signal timing plans. The City should pursue both internal City discussions and discussions with other agencies around data retention

[3] At this time, any video feeds that are available will be used for traffic management purposes only and will not have any surveillance purposes. Video feeds will only be available in real-time and will not be recorded or stored.

policies during the development of ATMS requirements to make sure that the equipment and systems are procured can accommodate the data storage and processing functions desired by the City.

The City can use historical data to support traffic studies, review of signal timing plans, and safety studies.

(C) Real-time Incident Data Exchange

Notifications about incidents within the City of Yuma go through the Police Dispatch Center, where the Dispatcher gathers more information about the event and relays the information to appropriate responders who will then respond to the incident. The TOC will be one of those responders who will be able to support the incident response by supporting and coordinating traffic management.

The TOC will receive notification and high level details about an incident through an automated email or text message generated from Yuma PD Dispatch. For concepts where Yuma County or City of Somerton traffic signals are operated from the TOC, this notification would come from the respective jurisdictions dispatch center. To identify freeway events that may impact the City of Yuma network, the TOC will follow the ADOT 511 and social media networks.

Knowing that there is an active incident, the TOC can implement traffic management strategies to support incident-related traffic management, and the TOC can also help provide notifications and information to other traffic management agencies who might be impacted by the event. When the Yuma TOC is notified about an incident that may have multi-jurisdictional impacts, the TOC operator will be responsible for notifying the other agency traffic staff to make sure they are aware of the event and allow them to mobilize to respond if/when it is needed.

4.3 Long-Term TOC Functions

As Yuma and the region grow the functions and capabilities of the TOC may grow as well. Future, long-term focus areas for the TOC include expanding data collection, supporting traveler information dissemination, and elevating interagency coordination at the TOC. Long-term functions for the TOC are depicted in **Figure 3**.

As these long-term functions become relevant, the City and any other partners who are participating in the TOC at that point may need to revisit and update software and hardware reequipments, and understand implications on staffing, systems, and security, to make sure they align with the expanded TOC concepts that are being pursed.

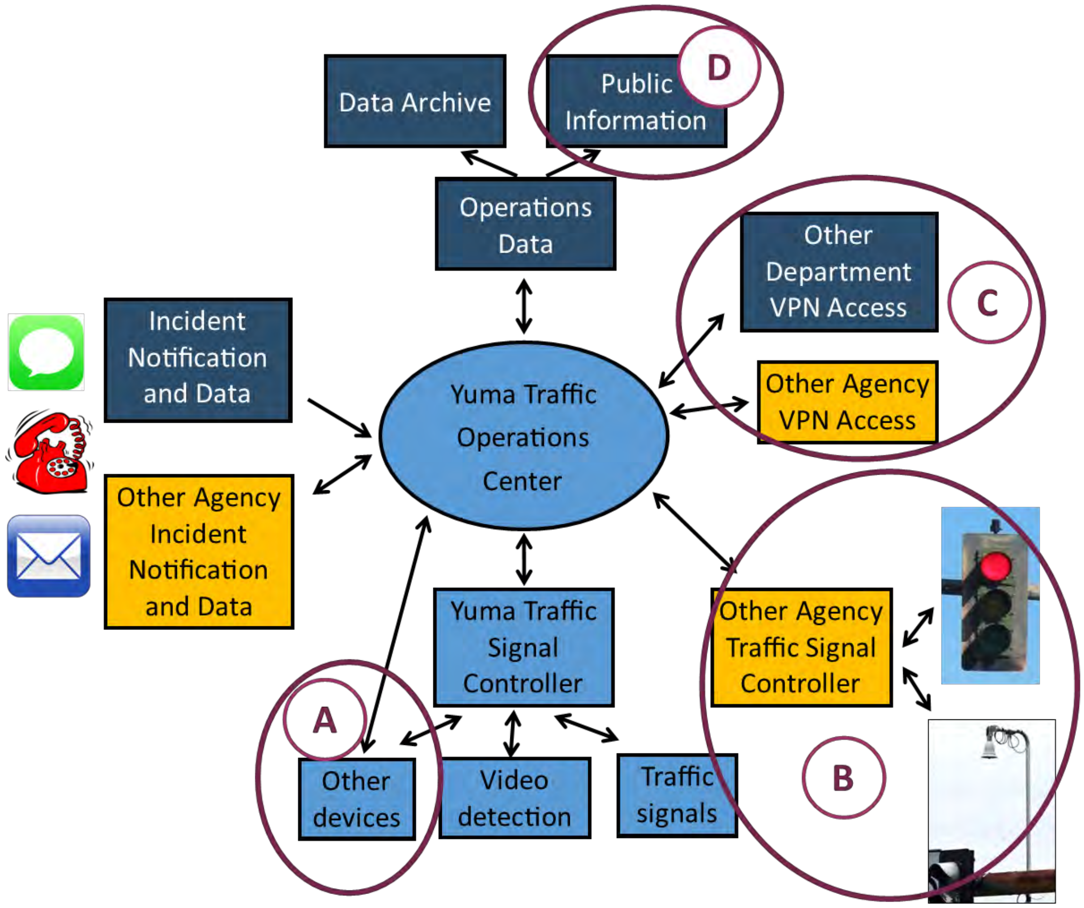

Figure 3 – Long-Term TOC Concept

(A) Expanding City of Yuma Connected Devices

As Yuma's ITS program expands, the TOC will be able to connect to and operate more devices of systems that are deployed within the City. Many other ITS/traffic management devices or more advanced traffic management systems that the City might choose to deploy may be connected to the TOC for centralized management and operations. Future, advanced devices might include traffic-specific CCTV cameras, permanent count stations, bicycle detection, weigh-in-motion systems, or other new devices that can be connected back to the TOC and centrally monitored and managed similar to traffic signals and video detection. Future systems may include more advanced traffic management systems that automatically adapt traffic signal timing based on real-time traffic conditions (known as adaptive traffic signal control) and connected vehicle systems that enable vehicles and roadway infrastructure to communicate and exchange data about traffic conditions. An example of a scenario in a connected vehicle environment is that a traffic signal would broadcast a message about the signal timing and phasing of the signal so that vehicles would know how to react most safely or efficiently; a broadcast message about a traffic light that about to turn red would allow the vehicle to start slowing down in advance to safely stop at the intersection.

There will also be opportunities to connect devices and systems that might not directly support traffic management, but that are important for City safety and mobility. Examples might include something like a hazardous materials detection system, automated weigh-in-motion, or smart lighting. The deployment of any non-transportation oriented devices or systems will be driven by other departments and will be connected and monitored through a formalized partnership with the TOC.

(B) Expanding Connectivity to Other Agency Devices

In the near-term concept, the City of Somerton has expressed interest in connecting their traffic signals to the Yuma TOC where they will be centrally monitored and managed by the Yuma TOC staff alongside the City of Yuma infrastructure. This capability can be expanded to include additional agencies and additional devices from other agencies if they decide that they would like to participate at any time; other agencies who would have the opportunity to connect to the TOC at any time if they chose to participate would include Yuma County, the Cocopah Tribe, and City of San Luis. Any inter-agency connectivity or joint operations will be formalized and outlined in more detail as part of specific interagency agreements that are developed if the agency chooses to connect their infrastructure to the Yuma TOC.

(C) Inter-Departmental or Inter-Agency System Access

As other City departments and other agencies in the region become more connected with the Yuma TOC and more familiar with the TOC functions, systems, and outputs, there may be interest in providing non-TOC staff with remote access to the Yuma TOC systems through a virtual private network (VPN) or other remote access function. Having remote access would allow someone to view real-time camera feeds from connected monitoring devices; review the real-time status of traffic signals, including signal timing information and device status; review real-time detector data that is being collected; and a variety of other data and system functions that might be available at that time. Partnership with the Yuma IT Department will be important to understand implications of implementing VPN access on City equipment and hardware.

Any non-TOC City department or agency who has equipment or systems that are centrally connected to the Yuma TOC but furnished by the other entity will be provided remote access. This will enable them to view and manage their equipment or systems as part of an agreement that will be established to govern how equipment will be connected and managed from the TOC. Providing remote access to other non-TOC users may either take the form of view-only access, meaning that other users would only be able to view status and would not be able to make any changes, or access could be elevated to provide the VPN user with a level of operational control. The level of access and security that will be pursued at this stage must be discussed and vetted in more detail with the IT departments of the involved agencies.

A reasonable scenario for this concept is a desire by non-TOC staff to view real-time video feeds from video detection or any future intersection monitoring equipment that may be deployed in the long-term. An agreement will need to dictate whether a non-TOC user will only have remote access to view the video feed without being able to change any settings of the device, or if they have the ability to change device settings or position in addition to being able to view the video feed. The decision on level of access for non-TOC users to different systems will be made at the time of implementation and will be governed by an inter-departmental or inter-agency agreement.

Additionally, a center-to-center (C2C) communication may be established between the ADOT central management system and a compatible system at the Yuma TOC. This connection would provide the Yuma TOC with view-only access to ADOT's traffic signal system so that the Yuma TOC will be able to see the traffic signal timing and signal status of ADOT traffic signals and use that input when making decisions about signal timing at Yuma-owned traffic signals.

(D) Traveler Information Dissemination

In the long-term, the City may choose to invest in equipment and systems that allow the TOC to support the dissemination of traveler information. Providing this function could take many different forms, depending on City policy decisions about their role in the traveler information space. In one form, the City could provide a real-time traffic condition website that is publicly accessible and is updated by TOC data in real-time. Another concept would be that the City chooses to make their data available through a data portal so that private sector entities such as Google, Waze, TomTom or vehicle manufacturers, can take the data and use it to populate their own platforms or applications. In either form, there will need to be an additional function built into the data engine of the Yuma TOC systems that will process and make operational data available external to the TOC.

A decision may also be made to have the TOC function as a media point of contact for traffic information. To support this concept, detailed guidelines will have to be developed specifying what information the TOC can divulge versus what information must come through other departments, such as Media & Public Affairs/Communications.

4.4 Summary of TOC Functions

Table 3 provides a summary of the various TOC functions that are envisioned for the near-term and long-term. A level of priority (high/medium/low) is also identified in the table to help prioritize where investments should be made in the case of limited funding and resource availability.

Table 3 – Summary of Yuma TOC Functions and Priorities

Near-term	Long-term	Priority	TOC Function
Real-Time Traffic Management			
X		High	Remotely operate and control traffic signals, including implementing traffic signal timing plans based on conditions
X		High	Coordinate traffic signal timing on City and regionally shared corridors
X		High	View video detection camera feeds
	X	Medium	Operate and control CCTV cameras (if implemented) for traffic management, including incident management
X		High	Collect and archive detector data on City arterials
X		Medium	Coordinate traffic operations and information sharing between TOC and other cities in the region, Yuma County, and ADOT
	X	High	Coordinate joint operations and information sharing between TOC and other non-traffic management entities in the region (ex: border patrol, port of entry, transit)
X		High	Operate TOC during peak hours and planned events

Near-term	Long-term	Priority	TOC Function
	X	High	Operate TOC during extended hours (through AM and PM peak, events, after-hours incidents)
	X	Medium	Establish a C2C system to allow for real-time data exchanges with ADOT or other traffic management agencies
X		High	Undertake signal calibration to perform a variety of test on intersection equipment to ensure that if functions as intended
X		High	Routinely monitor traffic signal data to assist with identifying maintenance, traffic operations, and safety needs
	X	Medium	Disseminate connected vehicle data
Traveler Information			
X		High	Provide road condition, emergency, incident, work zone and special event information with public affairs/communication staff to disseminate to travelers
	X	Medium	Provide road condition, emergency, incident, work zone and special event information directly to the media and public
	X	Low	Maintain and provide arterial traffic speed maps
	X	Low	Provide camera images to the public via City website or social media
	X	Medium	Consolidate arterial work zone information to provide a central point of information
Incident and Emergency Management			
X		High	Use real-time data and video feeds to support more efficient incident response and management from a traffic management perspective
X		Medium	Make data and systems available for first responders to use to gather additional information about incidents
X		Medium	Share video detection camera feeds (if implemented) with public safety agencies

As previously noted, at ATMS is a key component of the future TOC and will facilitate or contribute to many of the above priority functions. During system design and procurement, a detailed set of ATMS software requirements should be developed to identify the specific requirements that a system must meet based on the desired functions and priorities described in this ConOps. Included in these requirements should be exploration of data sharing or integration requirements between the ATMS or other TOC systems and existing City systems, such as the Police CAD system.

5. Proposed TOC Operational Requirements

This section outlines the business-oriented concepts for the TOC that will be needed to support the implementation and day-to-day operations of the TOC.

5.1 TOC Staffing Structure and Roles

A basic staffing structure is needed to support TOC functions. The near-term concepts will necessitate a streamlined staffing structure with only a few key operations staff positions to support management and operations of the TOC.

Proposed Near-term Staffing

For the near-term TOC concept, the following roles will need to be provided. The roles may be accomplished by designated TOC staff positions or a combination of existing staff who take on TOC-specific roles as part of their current position:

- **Management** – Responsible for overseeing and managing the TOC, the ITS network, and general City traffic operations.
- **Analysis** – Responsible for managing and implementing traffic signal timing in the City.
- **Operations** – Responsible for the real-time operation and management all of ITS equipment and systems to support real-time and coordinated traffic operations from the TOC.

ITS device and traffic signal maintenance responsibilities will remain with the Public Works Department, which will be external of the TOC. Similarly, the responsibilities for network administration and maintenance responsibilities will be provided by the City IT Department, which will also be external of the TOC.

Table 4 provides details on specific responsibilities of each function that will be necessary for the near-term implementation of a TOC in Yuma.

Table 4 – TOC Near-Term Staffing Functions Responsibilities

TOC Role	Specific Responsibilities
Management	• ITS Network Management o Oversees and manages the planning, design, operations and implementation of the ITS network o Assists with creating specifications for ITS related equipment and systems. • TOC Management o Organizes and supervises daily operation of the TOC. o Prepares, reviews, and updates TOC standard procedures and policies o Develops annual TOC budget and administration of expenses. o Coordinates ITS/TOC asset management and annual programming. o Establishes ITS and TOC design and construction projects in the Capital Improvement Program and manages projects and project planning. • Traffic Operations o Oversees preparation of traffic signal timing and coordination. o Oversees resolution of public complaints on traffic signal operations.

TOC Role	Specific Responsibilities
	o Reviews temporary Traffic Control Plans for construction projects; coordinates the release of information regarding upcoming traffic restrictions to the public for construction or special events. o Plans, designs, and coordinates traffic control and transportation activities for special and major events.
Analysis	• Traffic Operations o Manages signal timing and coordination, traffic signal studies, and computerized traffic signal programming and control. o Gets approval for signal timing plans. • Data Analysis and Reports o Creates spreadsheets and provide basic manipulation of data from ITS devices, traffic signals, and other systems. o Assists with reports and maps, timing letters, and reviews production statistics and reports trends.
Operations	• Real-time Traffic Operations and Management o Monitors traffic signal system and video management system and makes appropriate adjustments to traffic signal timing plans in response to real-time traffic conditions. o Implements traffic signal coordination plans using the traffic signal system. o Notifies appropriate staff, supervisors, internal and external departments, and authorities of emergency situations. o Coordinates real-time traffic management and incident response according to established procedures. o Supports documentation of response actions to incidents or special events. o Reviews temporary traffic control plans and provides details regarding signals and interconnects for construction projects and special events. o Conducts in-field observations to test traffic signal timing programs and related ITS operations. o Supports development and updates to TOC operating procedures, manuals and guidelines. • Equipment and System Monitoring o Monitors operation status for ITS devices and systems and ITS communications; troubleshoots when needed and escalate issues to appropriate technical staff. o Enters new devices and data into the central management system.
Maintenance	• Public Works will be responsible for maintenance of all ITS and traffic signal infrastructure in the field
Networking	• Information Technology will be responsible for the management and maintenance of networking equipment and systems utilized by the TOC. o Systems and equipment specification for the TOC and communications network (including the ATMS) o Design, configuration, and integration for the TOC and ITS network o Systems and equipment maintenance for ITS network (not field devices) o System hardware, software, and networking support and troubleshooting o Hardware and software asset management and lifecycle replacement o Budgeting and programming for replacements and upgrades o Database management and backup o Network/user security

In the near-term, the above roles and responsibilities will be accomplished by a combination of four existing positions within the TSMO group – the City Traffic Engineer, the Civil Engineer dedicated to Traffic, and Senior Technicians. There will also be support from City Public Works and IT. The TOC-related responsibilities will represent a portion of the overall responsibilities of each of those positions.

Proposed Long-term Staffing

In the long-term, the TOC will mature, and TOC functions will be added or expanded. More time will need to be dedicated to the near-term responsibilities for the various roles, but it may also result in new functions associated with the core TOC roles.

Operations Role

- Monitoring and operating any new devices that are connected, such as CCTV or dynamic message signs (DMS) if decisions are made by City management that these devices are desired
- Operating any new systems that the City might choose to install, such as an adaptive traffic signal system.
- Supporting traveler information dissemination, depending on prevailing concept.

Management Role

- Manages the continuous and real-time traffic management services provided by the TOC
- Responsible for developing and maintaining partnerships with other jurisdictions to solve regional traffic management issues
- Provides technical advice on traffic operation issues to other City departments and regional partners
- Supervises and evaluates the TOC staff
- Prepares and updates coordination and incident management agreements and processes with law enforcement
- Prepares TOC performance monitoring plans and maintains records

In addition to added functions, a long-term TOC concept may also necessitate additional staff to support the core TOC roles. It is likely that this will be accomplished by identifying additional staff to support the Operations role as part of their job; however, if the amount of infrastructure and operational functions provided by the TOC is great enough, the City may consider establishing staff positions for the Operator role and the Management role that are dedicated to the TOC (i.e. TOC Operator and TOC Manager).

Based on industry trends, including those of other cities in Arizona that have TOCs, a relative threshold for indicating the need for an additional staff person to support the Operator role is when the TOC is responsible for operating more than 100 traffic signals. In the long-term, it is likely the number of City of Yuma traffic signals will reach this 100 signal threshold and warrant an additional staff person to support the Operator role.

In the long-term, new staff roles may also need to be considered. The long-term oriented TOC functions that may be pursued in a more build-out scenario include:

- *IT Liaison/Network Administrator* – While the IT Department is responsible for networking and communications management, there may be a need to identify a specific IT liaison to the TOC that is specifically responsible for supporting the TOC and ITS program. This person would have familiarity with the TOC and its functions, systems, and processes to provide more specific and tailored support for the TOC and traffic management functions. If this role is deemed necessary in the future, there will need to be discussions with the IT Department to make sure that staffing and training is adequate to provide the function.
- *Public Safety Liaison* – As the TOC expands its functionality and proof of concept, there may be a benefit to identify a public safety staff person that understands the TOC functions and provides direct coordination and exchange of information. Initially, this liaison will have a method of real-time communication with the TOC to allow for coordination during incidents or special events. Eventually, it may make sense to co-locate a public safety liaison in the TOC to allow for more direct coordination between the TOC and police dispatch and officers in the field.
- *Public Information Liaison* – It may make sense to eventually partner with Media & Public Affairs/Communications staff to facilitate the exchange and dissemination of information between the TOC and other City departments and the public. The Public Information Liaison would facilitate direct and frequent communication with TOC staff to collect and disseminate information collected by the TOC, as appropriate. Similarly, the identified liaison would follow and manage sources of information, such as social media, and provide relevant information to TOC staff.
- *Other Agency Operations Staff* – The long-term concept includes having other agency devices connected to and operated from the Yuma TOC, including Yuma County and the City of San Luis. Depending on the agreement between the agencies and the City of Yuma, these other agencies may choose to monitor or operate their own network from a dedicated workstation in the TOC. If this is the case, then additional staff from other agencies may be co-located in the TOC alongside the City of Yuma TOC staff.

5.2 TOC Hours of Operation

The City of Yuma departments currently operate from 7:00 AM - 5:00 PM Monday through Friday. In the near-term concept, the TOC will generally operate within those business hours (normal hours), although there may be some special circumstances where extended hours are warranted[4].

Normal Hours: 7:00 AM – 5:00PM Monday through Friday.

Extended Hours: There may be instances where the TOC should be staffed outside of regular operating hours to support traffic management during prolonged incidents or planned special

[4] TOC hours of operation describes hours where someone is physically sitting in the physical TOC space. The ATMS system will be operating 24/7 and staff will have the ability to access and manage the system from a laptop or similar device even when not located physically in the TOC building.

events that require after-hours restrictions or result in unusual off-peak traffic demands. Another condition where TOC hours might be extended is to support traffic management through a construction restriction that is in place during peak hours and whose impacts extend peak hour travel. In these cases, the TOC on-call staff person would be responsible for continuing their monitoring and operational duties either in an in-person capacity or a remote access capacity to make sure that traffic is moving safely and efficiently. For the cases of planned special events or planned construction, the operator would be responsible for monitoring and implementing pre-planned and approved traffic management strategies.

For the long-term concept, the TOC operating hours should be expanded to 7:00AM to 7:00 PM Monday through Friday to cover the morning and evening peak travel times. This would require two operator shifts that operate on an 8-hour a day/5 days per week schedule: 7:00AM to 3:00PM and 11AM to 7:00PM.

5.3 TOC Operating Procedures

A set of TOC Operating Procedures or a TOC Operators Manual will need to be developed to outline and describe processes, responsibilities, and expectations for staff operating the TOC. Suggested section and content for this manual is identified in **Table 5**.

Table 5 – TOC Operating Procedures Overview

Topic	Suggested Contents
General	Area of coverage, services provided, TOC goals, stakeholder roles and responsibilities, general and emergency contact information (TOC staff, Engineering staff, building maintenance, permitting, Police and Fire, other agency traffic/transportation, other agency Dispatch
TOC Responsibilities	Daily shift organization and procedures, after-hours responsibilities, coordination with police and other responders, coordination with other agencies, calls from citizens; TOC reports and logs
ITS Device and System Operations	• ATMS software user guide – start-up/shut down, user interface, alerts/alarms, data retrieval and creating reports • Video management system user guide – start-up/shut down, user interface, guidelines, device IDs and management
Performance Measures	Performance measures for TOC, traffic management, and incident management
Traffic Signal Timing	Guidelines, traffic signal operations, interagency coordination, field device ID and management, citizen reports
Incident Management Procedures	What to do to identify, respond to, and end an incident; responder coordination and notification processes, traffic management, incident activity reporting, public information coordination processes
Roadwork Procedures	What to do when maintenance or construction activity is present – device operations, coordination, public information dissemination
Special Event Procedures	TOC responsibilities for traffic management during special events, departmental coordination

TOC Reports and Logs

As part of operating procedures, TOC operators should be responsible for assembling and filling out different reports or logs depending on circumstances experienced during their shift. The reports and logs that should be created and part of established TOC Operating Procedures are:

- **Incident Reports** – TOC-specific form that documents actions and responses to incidents. Includes date and time, road name, incident description/information, response actions taken (signal timing changed, notification sent, information/data generated and disseminated), ending time, operator who prepared report.
- **Shift Transition Report** – At shift change, the outgoing operators are required to record all active incidents and equipment issues. The form also records shift start times, and outgoing and incoming operators.
- **Device Malfunction Report** – Device malfunctions should be logged to identify device type, device identification number, location, description of the problem, date, time, and the operator that recorded the information.

Examples of these types of reports that are currently used by other agencies can be found in **Appendix A**.

Shift Change Procedures

Processes for shift changes should center around a Shift Transition Form that provides documentation of any recently completed or ongoing activities that occur through a shift transition. The outgoing operator should fill out the Transition Form and complete all Incident Reports and Device Malfunction Forms and review information on the forms with the incoming shift operators, focusing on any active incidents and device malfunctions.

Procedures for Changing Signal Timing

The TOC will need to establish procedures for updating or revising signal timing plans implemented at City signals. These procedures should include timing policies and standard basic timing forms to standardize the process and ensure consistency for all future signal timing changes. They will establish the conditions that would warrant signal timing updates, such as citizen complaints, school drop-off and pick-up times, incident conditions that cause traffic restrictions/impacts, or regularly scheduled periodic timing reviews.

Signal timing procedures will need to identify who in the TOC is responsible for determining the appropriate timing plan, analyzing the effects of updated timings, and implementing the new plans. This chain of command will provide accountability for signal timing adjustments.

In addition to establishing procedures on how to change signal timing plans, the TOC will also need to determine how utilizing an ATMS system will coincide with existing policies regarding signal timing plan file storage and historical records. It will be important to maintain consistent records of signal timing plans across existing platforms and newly implemented platforms as part of the TOC.

Incident Management Procedures

One major role of a TOC is to support traffic management and information exchange during incidents within or directly adjacent to the City of Yuma. Incident management procedures will involve the TOC as well as other departments and agencies. **Table 6** identifies the proposed process and roles for different departments and agencies for incident management

Table 6 – TOC Incident Management Procedures Overview

Agency/Department	Activity
	Incident Initiation and Notification
Yuma PD Dispatch	- Yuma PD Dispatch receives initial 911 call or notification from County Dispatch about and event that will impact a Yuma roadway - Dispatch notifies TOC of incident location and conditions through an automated email or text message through the SMTP paging system
Yuma TOC	- Receive notification from Yuma PD or Yuma County Dispatch about incident - Verify incident using video feed (if available) by accessing video management system - Notify other departments and agencies of event and impacts via email if necessary given incident conditions: o Notify Public Works if infrastructure maintenance is needed o Notify Public Affairs/Communications if impacts to travelers will be significant and/or for a long duration o Notify other agencies (County PW, Somerton PW, ADOT TOC, or San Luis PW) if event will impact traffic on a regional corridor, another agency traffic signal, or an ADOT ramp)
Yuma PW	- Receive email or call from TOC about incident
Yuma Public Affairs/ Communications	- Receive email or call from TOC about incident
County, Somerton, San Luis, and ADOT TOC	- Receive email or call from TOC about incident
	Incident Response and Management
Yuma PD Dispatch	- Arrive on-scene and verify conditions and resources needed - Decide if any long-term traffic management or traffic signal timing changes are needed; if needed, contact TOC to support
Yuma TOC	- Monitor traffic conditions through ATMS system and video feeds - If signal timing changes are needed, coordinate with field officer to support signal timing changes - If long-term traffic management or detours are needed, consider corridor-level signal timing strategies to support detour using ATMS - If conditions or status of the incident changes, coordinate with City Public Affairs/Communications to provide them with an update that can be disseminated to the public
Yuma PW	- Support any infrastructure maintenance or temporary traffic control needs
Yuma Public Affairs/ Communications	- Provide information about the traffic impacts to the public via City social media and website; provide updates, as necessary, as more information is provided by the TOC
County, Somerton, San Luis, and ADOT TOC	- Support any infrastructure maintenance or temporary traffic control needs - If traffic signals are connected to the Yuma TOC and there are real-time operational capabilities, coordinate with TOC to update signal timing at impacted intersections or corridors - ADOT may provide traveler information via 511, social media, or other outlets as necessary based on impacts to ADOT roadways.
	Incident Close-Out
Yuma PD Dispatch	- On-scene officer will identify when event is considered cleared - Dispatch notifies TOC of the all-clear status
Yuma TOC	- Receive notification of all-clear - Provide email notification to Public Affairs/Communications and other agencies of event conclusion

Agency/Department	Activity
	Continue to monitor intersection operations until traffic conditions return to normal; revert to regular signal timing plans when normal conditions are reached
Yuma PW	Support infrastructure maintenance as needed Remove any traffic control that had been placed
Yuma Public Affairs/ Communications	Provide information about conclusion of the event to the public through active information outlets
County, Somerton, San Luis, and ADOT TOC	Support infrastructure maintenance as needed Remove any traffic control that had been placed ADOT will update and close-out any active traveler information outlets for the event.

5.4 Training

Identifying and implementing a formal training program and set of materials will be important to support TOC staff. Training will improve periods of staff transition/turnover and during periods where ATMS software upgrades are expected.

At a minimum, ATMS user manuals and vendor training materials should be incorporated into the TOC Operating Procedures document. A spare workstation with offline access to ATMS software can provide TOC operators an opportunity to practice with the software without effecting any changes to field devices. A hard copy and online version of the operations manual should be available to TOC staff.

The Engineering Department should consider creating and internal training program to help train any new TOC staff as they are hired. Internal training should include training on any TOC systems and devices that an operator will use (this can be accomplished through the TOC Operating Procedures document, the ATMS user manuals, and vendor training materials) as well as any formalized coordination procedures that are in place for the TOC to support Yuma Police/Fire and other agencies with traffic management during incidents, roadwork, or special events.

It is recommended that regular tabletop exercises be conducted between Yuma Police, Fire, and TOC staff to walk through different incident or emergency scenarios and talk through various roles and responsibilities for identifying, verifying, responding to, and eventually closing out the event. These types of activities should occur at least annually but could occur more frequently if deemed necessary based on changing processes or staff turnover.

In addition to City-provided training materials and activities, there are other sources of TOC operator training that are available and may be useful to TOC operators. There is not a formalized or universally required training program for TOC operators and staff, there are training and certification opportunities that provide TOC staff with knowledge and awareness that would help elevate traffic management processes. A full set of certification and training opportunities for transportation operations and management staff can be found in **Appendix B**, but some specific and widely known and used resources include:

- American Traffic Safety Services Association (ATSSA)
  - Temporary Traffic Control Considerations for Work Zones – addresses work zones in more populated and congested areas, particularly the considerations necessary to address work zones in urban environments.
  - Introduction to the Manual on Uniform Traffic Control Devices (MUTCD) – examines the MUTCD, its content, and its applicability to streets open to the public in the United States, including private streets. Emphasis will be given on temporary traffic control.
- International Municipal Signal Association (IMSA)
  - Transportation Center Systems Specialists Level 1 – designed for transportation professionals whose role encompasses control and operation of a road network in a TOC. The program provides an understanding of key concepts and the technology used for devices, equipment, and software that a TOC may utilize in daily operations.
  - Transportation Center Systems Specialists Level 2 – emphasizes material on data collection, vehicle detection, data integrity and integration, C2C protocols, TOC consoles, video and CCTV technologies, stand by power systems, software sub-systems, DMS, field device operations and system administration and troubleshooting

5.5 Stakeholder Roles and Responsibilities

City of Yuma Engineering Staff will be the primary users of the TOC and its associated devices and systems; however, as described in this ConOps, there will be other City of Yuma staff and potentially other agency staff who support traffic management in the Yuma region who may interact with, or eventually connect to, the Yuma TOC. This section summarizes all stakeholder roles and responsibilities for both the near-term and long-term timeframes.

Stakeholders

Table 7 identifies the key stakeholders that will support the operations and coordination with the TOC for traffic management.

Table 7 – TOC Stakeholder Functions and Responsibilities

Stakeholder	Roles and Responsibilities	
	Near-Term	Potential Long-Term
TOC Operations		
City of Yuma Engineering	• Responsible for operations of traffic signals and traffic signal timing in the City of Yuma • Will be primary operator of the TOC systems and connected devices	• Responsible for operations of traffic signals and traffic signal timing for other agencies
City of Yuma IT	• Responsible for maintenance and management of City communications backbone and associated infrastructure • Responsible for maintenance and management of networking equipment, computer equipment, and City-owned systems.	

Stakeholder	Roles and Responsibilities	
	Near-Term	Potential Long-Term
TOC/Traffic Management Coordination		
City of Yuma Police	• Receives initial information about traffic incidents in the City of Yuma • Responsible for initial incident notifications to the TOC • First responder during incidents to provide verification and to coordinate and make decisions for necessary traffic restrictions	• Able to access streaming video from video detection and/or CCTV (if installed) • Law enforcement liaison locates within TOC
City of Yuma Public Works	• Responsible for maintenance of ITS field devices • Provides emergency infrastructure maintenance and emergency traffic management	• Able to access streaming video from video detection and/or CCTV (if installed)
City of Yuma Public Affairs/ Communications	• Responsible for public outreach and information dissemination for planned roadway restrictions • Has a role in public information dissemination for unplanned events	• Utilize traffic condition data collected by the TOC for real-time and planned traveler information dissemination • Able to access streaming video from video detection and/or CCTV (if installed)
City of Yuma Fire	• First responder during incidents in the City of Yuma	• Able to access streaming video from video detection and/or CCTV (if installed)
Yuma County Sheriff's Office	• Receives initial information about traffic incidents in the County and is responsible for initial notifications to other staff and agencies • First responder during incidents to provide verification and to coordinate and make decisions for necessary traffic restrictions	• Able to access streaming video from video detection and/or CCTV (if installed)
Yuma County Public Works	• Responsible for operations and maintenance of traffic signals and associated field equipment at County traffic signals, including those within or adjacent to City of Yuma jurisdiction and along regional corridors	• Able to access streaming video from video detection and/or CCTV (if installed) • VPN access into TOC central system to monitor County devices
City of Somerton	• Responsible for operations and maintenance of traffic signals and associated field equipment at City of Somerton traffic signals, including those along regional corridors	• Able to access streaming video from video detection and/or CCTV (if installed) • VPN access into TOC central system to monitor City of Somerton devices
Cocopah Tribe[5]	• Responsible for operations and maintenance of traffic signals and associated field equipment at City of Somerton traffic signals, including those along regional corridors	• Able to access streaming video from video detection and/or CCTV (if installed) • VPN access into TOC central system to monitor City of Somerton devices

[5] Participation and input from the Cocopah Tribe was pursued but not obtained during the development of this ConOps. The input and participation of the Cocopah Tribe will be important for regional operations and connectivity given the location of their traffic signal infrastructure in the middle of regional corridors.

Stakeholder	Roles and Responsibilities	
	Near-Term	Potential Long-Term
City of San Luis	• Responsible for operations and maintenance of traffic signals and associated field equipment at City of San Luis traffic signals, including those along regional corridors	• Able to access streaming video from video detection and/or CCTV (if installed)
ADOT	• Responsible for operations and maintenance of ADOT facilities (I-8, US 95, and SR 195), including interstate ramp operations, traffic signals located at ramp and along ADOT roadways • Monitors conditions and responds to incidents and hazards from the Statewide TOC and provides real-time information via AZ511 and traveler information via ADOT social media outlets	• Able to access streaming video from video detection and/or CCTV (if installed) • Provides view-only C2C system feed to TOC if Yuma TOC system is compatible with ADOT's MaxView system

Information Sharing

The collection, processing, and exchange of data and information is one of the primary functions of the TOC. **Table 8** outlines flows of data and information that are important for traffic management and operations and highlights where data originates and where data and information should be exchanged. Some foundational data types are:

- ITS field devices will collect traffic condition information and make it available for the TOC to review, share, or archive.
- Law enforcement dispatch is the source of incident notifications and response status updates. However, the TOC will play a role in supporting the wider dissemination of real-time information about incidents as they relate to traffic conditions.
- Device and communications operational and maintenance status will be available through the TOC systems and alerts about malfunctions will be provided through the system. The TOC will be responsible for passing along changes to device or equipment status to the department responsible for maintaining the equipment – for field devices along the roadway, including traffic signals, this is Public Works; for communications equipment and systems, this is IT.
- Information about planned roadwork, including traffic control plans, will be generated by the Design & Construction Management Section of Engineering or the Development Engineering Section of Engineering. It will be important for that information to be shared with the TOC, and ideally provided to the TOC for review and comment during the project development process, given that the TOC will play a primary role in supporting traffic operations and management during construction utilizing the central management system.

Table 8 – Summary of Stakeholder Information Sharing

Data/Info *O = origin of information* *R = receiver of information*	Yuma TOC	Yuma PW	Yuma Utilities	Yuma PD	Yuma Development Engineering	Yuma Public Affairs/ Communications	Yuma IT	County Sheriff	County PW	Somerton	San Luis	ADOT
Traffic Management												
Real-time traffic conditions	O			R		R			R	R	R	
Real-time video feed (view only)	O			R				R				
ITS field equipment status	O	R										
ITS communications equipment status	O						R					
Incident Management												
Initial incident notification	R			O				O				
Incident verification notification	O	R				R			R	R	R	R
Incident response status update	O	R				R			R	R	R	R
Traffic control request	R	R		O				O	R			
Emergency maintenance request	O	R	O	O				O	R	R	R	R
Detour route request	R		O	O				O				
Detour route implementation and status	O			R		R		R	R	R	R	R
Planned Construction												
Traffic control plans	R	O		R	O	R		R	R	R	R	R
Real-time construction restriction status	O			R		R		R	R	R	R	R
Planned Special Event												
Special event-related traffic restrictions or control plans	R	R		O		R		R	R	R	R	R
Special event-related real-time traffic conditions	O			R		R		R	R	R	R	R

5.6 Coordination and Agreements

To accomplish the proposed TOC vision and functions outlined in this ConOps, there will need to be heightened coordination between City departments and between the City and other agencies in the region. Some of this coordination will occur informally, meaning that formal documentation may not be required, but that there is general agreement on processes and roles and responsibilities; these relationships are shown in **Figure 4**. Other functions, especially those that involve the sharing of financial, system, or staff resources, will require formal agreements, such as IGAs to implement; these formalized agreements are shown in **Figure 5**.

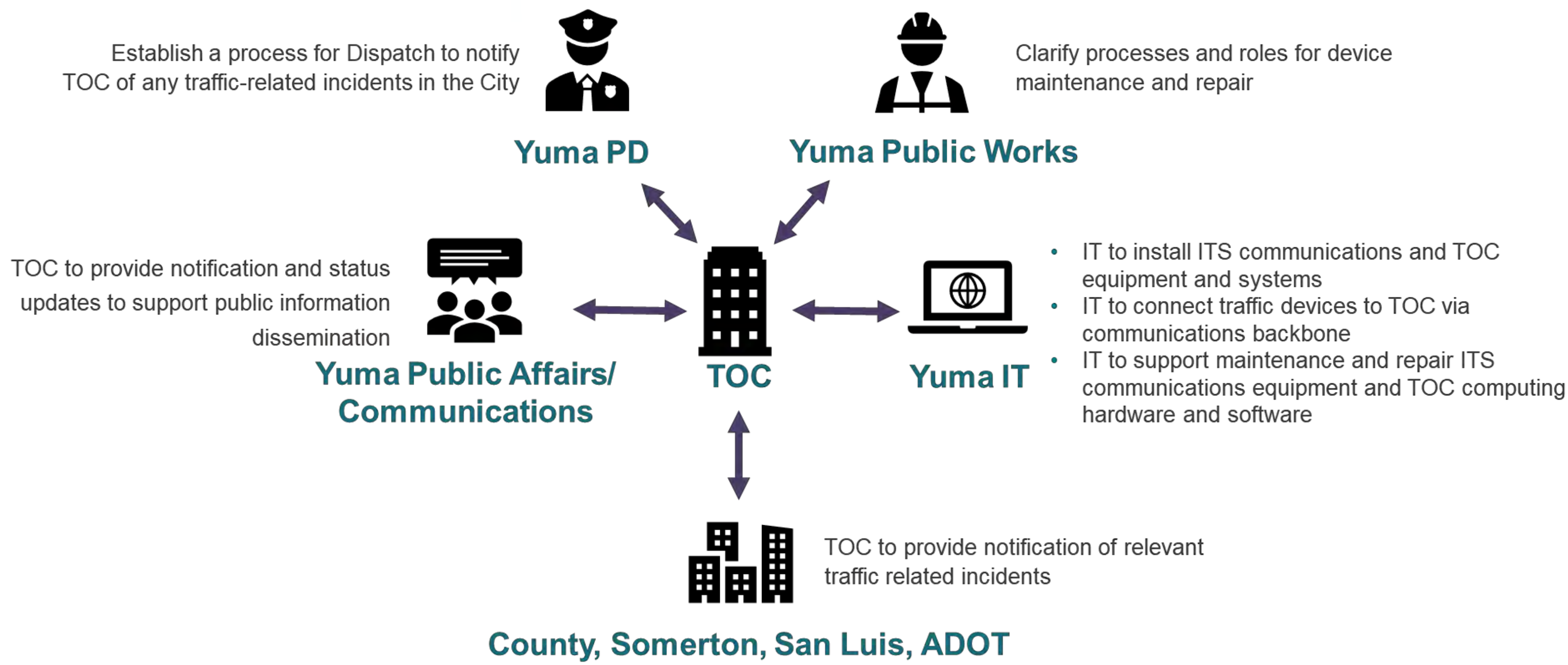

Figure 4 – Recommended Coordination/Operational Procedures

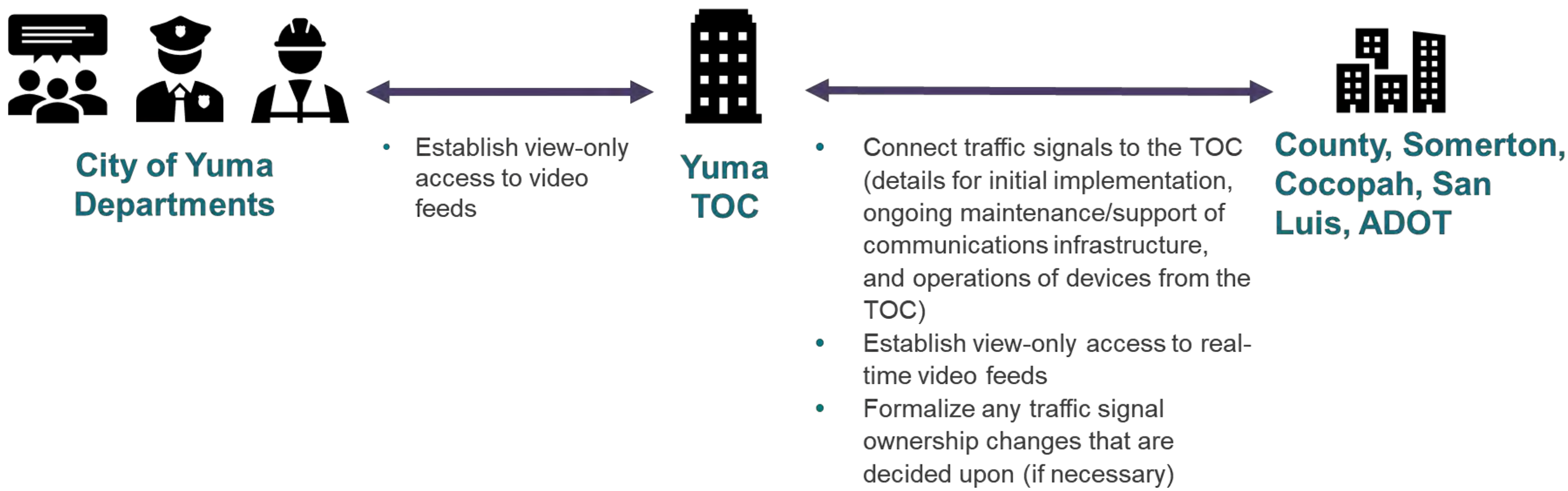

Figure 5 – Recommended Formal Agreements (IGA or Policy)

6. Proposed TOC Physical Requirements

This section outlines the physical attributes and support systems that are necessary to accommodate the TOC functions and operational policies.

A physical TOC space will have five core components:

- **Operations floor workstations** will provide access to TOC-specific systems, such as the ATMS and video management system, and City Enterprise systems for email and other intranet applications. The primary purpose of the operators on the floor is to operate/manage the TOC systems that support real-time traffic management, incident management, and information sharing. Additional workstation monitors may be warranted based on expanded roles of these operators or the participation of other agencies or departments in the TOC.
- **Office space** will be provided for management to allow for closed-door space, if needed, while still having access to TOC system and view of the video wall.
- A **video wall** will enable operators, managers, and other TOC personnel to share a common view of situational information.
- **Common area** items, including storage, library, shelving/filing space, and other amenities that should need to be accessible to all staff in the TOC.
- A **communications/server room** is needed to house the rack and server space needed to support the video wall and all equipment in the TOC.

Each position that is required to be physically in the TOC needs to be considered in the TOC's spatial requirements in the near-term. The long-term vision for the facility needs to be carefully analyzed and prioritized for most efficient use of the allowable expansion budget. Considerations are shown in **Table 9**.

To accommodate staffing needs, especially for operating the TOC, at least two operator workstations are needed; one to support the Operations role and a spare workstation in the case of equipment failure. While the Operations role necessitates the most physical space considerations, the management and analysis functions also have spatial requirements within the TOC.

Table 9 – TOC Functions and Spatial Requirements

TOC Function	Responsibilities	Spatial Requirements
Operations	Real-Time Traffic Management Equipment and System Monitoring	Near-term • Three monitors for display of systems used in TOC operations • Drawers – under mount • Workstation requires view of video wall Long-term • Space for an additional monitor to accommodate any new systems or networks that come online

TOC Function	Responsibilities	Spatial Requirements
Analysis	Traffic Operations Data Analysis and Reports	Near-term • May not require designated space in the TOC but could use available workstation if necessary Long-term • Minimum of three monitors for display of systems for traffic signal operations and real-time and historical traffic data • Drawers – under mount • Plan review space – not necessarily adjacent to workstation space • Vertical storage for manuals/TIAs • Workstation requires view of video wall
Management	ITS Network Management TOC Management Traffic Operations	Near-term • Ideally, this position is provided separated office space • Minimum three monitors for display of systems used in TOC operations • Plan review space • Drawers – under mount • Vertical storage Long-term • If not provided in the near-term, separated office with view of video wall • Minimum three monitors for display of systems used in TOC operations • Plan review space – in office • Drawers – under mount • Vertical storage

There may also be consideration for a **shared workstation** that could be utilized by public safety, a PIO, another agency traffic operations staff member, vendor, or contractor requiring a temporary space in the TOC. This workstation would be equipped with minimal equipment and one monitor, which would provide access to the internet and to the City's Enterprise system.

6.1 Workstation Features

Below is a list of specific equipment that should be considered to be included at each operator workstation:

- Central Processing Units (CPUs) may be either tower, desktop, or laptop – laptops are desired;
- Flat screen monitors are desired—it is anticipated that three monitors will be required – two for monitoring the traffic network and one for the City Enterprise network;
- Articulated monitor stands are desired;
- One standard size panel phone should be at each workstation;

- One standard storage drawer for workstation manuals/materials applicable to the TOC personnel type at that workstation;
- Built-in power strips and cable management; and
- It is desirable to have workstation furniture that would permit the operator to electronically adjust the workstation height, allowing the operator to either sit or stand.

6.2 Office Features

Offices in the TOC will contain much of the same equipment as the operator workstations to provide the same operational functionality as the general workstations. Offices should be equipped with a surface that can accommodate plan review within the office. It is important for the offices to have closed-door privacy as well as unobstructed view of the video wall.

6.3 Video Wall Features

A video wall is a matrix of television or computer monitors used as a single display. Each individual monitor can be used to display a single image or can be used to compose part of a larger display. Typical displays to be provided on the video wall include real-time camera feeds, traffic signal system displays, other mapping displays (such as Google maps), or local and national news media. A centralized video wall allows all those on the floor to view the same camera images during critical coordination efforts.

In the near-term, the video wall should consist of a minimum of four monitors mounted on the wall to create the matrix display. The wall should be configured to permit the expansion of the video wall over time, as more systems and devices come online. The video wall technology, including associated displays and server equipment, should be incorporated into the design of the TOC.

6.4 Control Room Common Area Features

Additional items that should be considered within the common area of the TOC control room are:

- Storage for manuals applicable to all TOC personnel (such as equipment or systems manuals), such as a shelving unit and space to review materials or a layout counter space;
- Individually locking drawers for storage of personal items—drawers will be reserved for each person;
- General work area for a printer/scanner;
- A phone dedicated to the TOC where people can directly call the TOC operations floor for immediate needs;
- A hanging system/coat rack is desired for storage of jackets; and
- Refrigerator/microwave.

As the TOC expands, there may be a need to provide a TOC-specific conference room that could function as a backup Emergency Operations Center for the City or region. The room would have to be big enough to be occupied by TOC and other responding staff from the City and other agencies, have access to view and manipulate the video wall, and have teleconferencing capabilities. The Infrastructure Implementation Plan, which is a separate but related document to this ConOps, provides conceptual layouts for the Yuma TOC to show how the TOC can be implemented in the near-term based on the spatial requirements ConOps identified in this ConOps.

6.5 Server Room Features

The TOC will need to house a server room that will support communications connections into the TOC and the servers and associated equipment needed to support the TOC equipment and traffic network. This server room should be climate controlled through HVAC to protect the equipment located within the room. Additionally, access to this room should be limited and protected to provide security for the traffic communications network.

6.6 TOC Building Features

The TOC is envisioned to be located within an existing City of Yuma building by retrofitting an existing space. The size of the TOC space is largely driven by the amount of infrastructure that will be operated from the TOC which is the driving factor for the number of operators that will be staffed in the TOC. Based on current practices, TOCs that operate fewer than 400 traffic signals have an average square footage of between 700 and 1,400 square feet[6], which is inclusive of the operations floor and common spaces, offices, and server room.

In addition to square footage, other considerations for the TOC space are:

- **Entry security** – there should be secure entry into the building that houses the TOC and into the TOC space itself.
- **Power backup** – there should be consideration for Uninterruptible Power Supply (UPS) devices to power equipment during power interruptions and, in the long-term, a backup generator may be considered for the TOC.
- **Communications security** – there should be measures taken to protect the communications lines into the TOC.

More detailed information about the equipment and systems of the proposed TOC, including equipment quantities, costs, maintenance and lifecycle considerations, and phasing for implementation will be available in the Infrastructure Implementation Plan, which is a separate document that is being developed as part of the larger ITS Strategic Plan effort.

[6] https://www.dvrpc.org/reports/10044.pdf; Table 13

Appendix A – Example Forms Used by Other Agencies

Example Incident Report

PennDOT – Eastern RTMC
FORM TMC-100: Incident Reporting Form

RCRS Closure ID Number:
(If this incident has been entered into RCRS stop here, save in appropriate P:\ drive folder. Otherwise complete the remainder of the form and save in appropriate P:\ drive folder)

1. SR: ______________________________
2. Direction: __________________________

3. Cause (Choose one):

☐ Crash ☐ Winter Weather ☐ Flooding ☐ Road Work ☐ Bridge Outage
☐ Down Utility ☐ Down Tree ☐ Debris/Obstruction ☐ Special Event
☐ Other

4. Status: __________ Closed __________ Lane Restriction
5. Police Jurisdiction: __________ PSP __________ Local
6. Beginning County: ____________________
7. Beginning Location: ____________________
8. Ending County: ________________________
9. Ending Location: ______________________
10. Fatality? ☐ Yes ☐ No
11. School bus? ☐ Yes ☐ No
12. Hazardous Material? ☐ Yes ☐ No
    Placard ID Number: _____________ Name of Material: _______________
13. Description of Incident

    ____
    ____
    ____

14. Date and Time Closed: ______________________________________
15. Estimated Date and Time to Reopen: ______________________________
16. Actual Date and Time Reopened: ________________________________
17. Information reported by: ______________________________________
18. Phone Number: ____
19. Date and Time Reported: ______________________________________

Example Shift Transition Report

pennsylvania
DEPARTMENT OF TRANSPORTATION

DISTRICT 6 TRAFFIC MANAGEMENT CENTER

SHIFT PASSDOWN REPORT

Date______________________________ Next Shift Start________________________

Outgoing Operators___________________________ Incoming Operators____________________________

District 6

Incidents / Roadwork	RCRS (Enter ID)	Equipment Issues

District 5

Incidents / Roadwork	RCRS (Enter ID)	Equipment Issues

District 4

Incidents / Roadwork	RCRS (Enter ID)	Equipment Issues

Comments____

____

____

Example Device Malfunction Report

FORM TMC-120: ITS Device Malfunctioning Reporting Form
Eastern RTMC

DISTRICT -0

Date	Time	Device Type	Device I.D.	County	Location: Roadway/Direction	Description of Problem	Reported By
00-00-00	0:00 XM	HAR	000-00-000				

Appendix B – Training and Certification Resources

Certification Resources

Certification Name	Certification Description and Requirements	Pre-requisites	Certification Course Length	Cost* (Member/ Non-Member Fees)	Access	Certification Process
APPLICABLE FOR OPERATIONS POSITIONS						
American Traffic Safety Services Association (ATSSA)						
Traffic Control Supervisor (TCS)	Second level course designed to train those actively involved in designing or setting up and maintaining temporary traffic control in a work zone.	Passing the Traffic Control Technician Course	16 hours/two days	$355/405	http://www.atssa.com/TrainingCertification/CourseInformation/TrafficControlSupervisorTCS.aspx	• Pass TCT and TCS courses with 80% or greater • Possess two years (4,000 hours) temporary traffic control experience • Compete application and pay fee • Provide two references • Be approved by the ATSSA Certification Board
Traffic Control Design Specialist (TCSD)	Course focused on the entire process of designing, installing, maintaining, and evaluating temporary traffic control in work zones. This course teaches engineering concepts to properly design effective traffic control plans.	TCS Certification	16 hours/two days	$295/$395	http://www.atssa.com/TrainingCertification/CourseInformation/TrafficControlDesignSpecialistTCDS.aspx	• Pass TCSD course with 80% or greater • Possess one year (2,000 hours) temporary traffic control experience • Compete application and pay fee • Provide two references • Be approved by the ATSSA Certification Board
International Municipal Signal Association (IMSA)						
Work Zone Temporary Traffic Control Technician	This course focuses on the principles of design, installation and maintenance of traffic control devices.	None	16 hours/two days	$270	https://www.imsafws.com/training	• Pass the Work Zone course
Transportation Center Systems Specialist Level I	This certification program is designed for transportation professionals whose role encompasses control and operation of a road network in a Transportation Management Center (TMC). The program provides an understanding of key concepts and the technology used for devices, equipment, and software that a TMC may utilize in daily operations.	None	*Contact Florida Section for additional information on this certification* *386-301-5575*		http://www.imsasafety.org/IMSA/Certification/Programs/IMSA/Certification/Certification_Overview.aspx?hkey=960978e7-c6d9-4c71-98ec-c2482334ba4b	• Pass the Transportation Center System I Course
Transportation Center Systems Specialist Level II	This program emphasizes material on data collection, vehicle detection, data integrity and integration, Center-To-Center protocols, TMC consoles, video and closed-circuit television technologies, stand by power systems, software sub-systems, dynamic message signs, field device operations and system administration and troubleshooting	Transportation Center System Specialist Level I	*Contact Florida Section for additional information on this certification* *386-301-5575*		http://www.imsasafety.org/IMSA/Certification/Programs/IMSA/Certification/Certification_Overview.aspx?hkey=960978e7-c6d9-4c71-98ec-c2482334ba4b	• Pass the Transportation Center System I Course • Pass the Transportation Center System II Course
OSHA						
OSHA 10 Hour Training for Construction	OSHA recommends workplace safety training for a safe and healthful work environment, specifically for hazard avoidance on the job site. This training covers specific OSHA regulations and requirements as they apply to the Construction Industry.	None	10 hours	$59	https://www.oshaeducationcenter.com/osha-10-hour-training-construction.aspx *Or other sites*	• Earn OSHA Education Center 10-Hour Card
APPLICABLE FOR MAINTENANCE AND INCIDENT MANAGEMENT POSITIONS						
American Traffic Safety Services Association (ATSSA)						
Traffic Control Technician (TCT)	Introductory course focused on temporary traffic control in work zones for individuals who work in the field installing and removing traffic control devices.	None	8 hours/one day	$180/$205	http://www.atssa.com/TrainingCertification/CourseInformation/TrafficControlTechnicianTCT.aspx	• Pass TCT course with 80% or greater • Possess one year (2,000 hours) temporary traffic control experience • Compete application and pay fee • Provide two references • Be approved by the ATSSA Certification Board
Traffic Control Supervisor (TCS)	Second level course designed to train those actively involved in designing or setting up and maintaining temporary traffic control in a work zone.	Passing the Traffic Control Technician Course	16 hours/two days	$355/405	http://www.atssa.com/TrainingCertification/CourseInformation/TrafficControlSupervisorTCS.aspx	• Pass TCT and TCS courses with 80% or greater • Possess two years (4,000 hours) temporary traffic control experience • Compete application and pay fee • Provide two references • Be approved by the ATSSA Certification Board
Traffic Control Design	Course focused on the entire process of designing, installing, maintaining, and evaluating temporary traffic control in work zones. This course teaches engineering	TCS Certification	16 hours/two days	$295/$395	http://www.atssa.com/TrainingCertification/CourseInformation/TrafficC	• Pass TCSD course with 80% or greater • Possess one year (2,000 hours) temporary traffic control experience

Certification Resources

Certification Name	Certification Description and Requirements	Pre-requisites	Certification Course Length	Cost* (Member/ Non- Fees)	Access	Certification Process
Specialist (TCSD)	control in work zones. This course teaches engineering concepts to properly design effective traffic control plans.	TCS Certification	16 hours/two days		fication/CourseInformation/TrafficControlDesignSpecialistTCDS.aspx	• Compete application and pay fee • Provide two references • Be approved by the ATSSA Certification Board
Pavement Marking Technician (PMT)	Course designed to provide instruction on pavement marking materials, application processes, quality control and pavement marking standards.	None	16 hours/two days	$450/$565	http://www.atssa.com/TrainingCertification/CourseInformation/PavementMarkingTechnicianPMT.aspx	• Pass PMT course with 80% or greater • Possess two years (4,000 hours) pavement marking experience • Compete application and pay fee • Provide two references • Be approved by the ATSSA Certification Board
International Municipal Signal Association (IMSA)						
Work Zone Temporary Traffic Control Technician	This course focuses on the principles of design, installation and maintenance of traffic control devices.	None	16 hours/two days	$270	https://www.imsafws.com/training	• Pass the Work Zone course
Traffic Signal Technician Level I	This course covers the concepts and terminology associated with signalized traffic control systems and devices. This course is designed for entry level technicians that have had some prior training or experience in electrical technology.	IMSA Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager.	16 hours/two days	$280	https://www.imsafws.com/training	• Pass the Work Zone course • Pass the Traffic Signal Technician course
Traffic Signal Inspection Level I	This course is designed to ensure public safety by helping individuals to understand fundamental concepts associated with the inspection for construction of traffic signal installations.	IMSA Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager.	16 hours/two days	$280	https://www.imsafws.com/training	• Pass the Work Zone Traffic Control Safety Course • **Effective August 1, 2018 IMSA Traffic Signal Technician Level I Certification**
Traffic Signal Inspector for Advanced Technologies	Material covered in this program includes test equipment, control components, power systems, foundations, intersection wiring, detection systems, Intelligent Transportation System (ITS) devices, and communications.	IMSA Work Zone Traffic Control Safety Certification OR equivalent as approved by the IMSA Education & Certification Manager Traffic Signal Inspector	16 hours/two days	$290	https://www.imsafws.com/training	• Pass the Work Zone Traffic Control Safety Course • Pass the Traffic Signal Inspector Course • **Effective August 1, 2018 IMSA Traffic Signal Technician Level I Certification**
Fiber Optics Technician	Fiber Optic Technician for ITS, Traffic, Fire Alarm, and Communication Systems is primarily aimed at installers who need the basic knowledge, skills and abilities to install fiber optic outside plant networks properly.	Attendees will be expected to complete an IMSA online self-study fiber optic course and get a certificate of completion to bring to class (you will get the link when you register). Some experience working in the field of fiber optics and communications networks is recommended	24 hours/three days	$1,250	https://www.imsafws.com/training	• Completion of the self-study fiber optics course • Fiber optics and networks field experience
Traffic Signal Bench Technician Level II	This course includes programming, application and maintenance of controllers, conflict monitors, vehicle and pedestrian detection systems and the communication and power wiring of the cabinet. This course also explains electronic circuit operation and fault diagnosis, and the test equipment for diagnosis and certification of control cabinet equipment.	IMSA Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager. IMSA Traffic Signal Technician Level I Certification	16 hours/two days	$290	https://www.imsafws.com/training	• Pass the Work Zone Traffic Control Safety Course • Pass the Traffic Signal Technician course • Pass the Traffic Signal Bench Technician II course

Certification Resources

Certification Name	Certification Description and Requirements	Pre-requisites	Certification Course Length	Cost* (Member/ Non-Member Fees)	Access	Certification Process
Traffic Signal Construction Technician Level II	Instruction for this course includes traffic signal control system construction, safety, materials, methods, and equipment. Activities covered include: safe operation of construction equipment (from concrete saws to cranes), planning activities, documentation, and installation of conduits, poles, mast arms, signal heads, cabinets, and inductive loops.	IMSA Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager IMSA Traffic Signal Technician Level I Certification	16 hours/two days	$290	https://www.imsafws.com/training	• Possess two years of experience in the traffic signal field • Pass the Work Zone Traffic Control Safety Course • Pass the Traffic Signal Technician course • Pass the Traffic Signal Construction Technician II course
Traffic Signal Senior Bench Technician Level III	This certification includes topics such as NEMA traffic signal equipment functions and specifications for controllers, flashers load switches and conflict monitors.	Must the an IMSA Traffic Signal Bench Technician Level II	Exam Only	$300	https://www.imsafws.com/training	• Possess two years of experience in the traffic signal field • Pass the IMSA Traffic Signal Senior Bench Technician Level III exam • Pass the IMSA Microprocessors In Traffic Signals Technician exam • Five years of experience as a Traffic Signal Bench Technician • Certification as a Traffic Signal Bench Technician Level II
Traffic Signal Senior Field Technician Level III	This certification includes topics such as NEMA Standards, 170/2070 Standards, detection methods, lightening protection, video detection, wire and cable specifications.	Must the an IMSA Traffic Signal Field Technician Level II	Exam Only	$300	https://www.imsafws.com/training	• Pass the IMSA Traffic Signal Senior Field Technician Level III exam • Five years of experience as a Traffic Signal Bench Technician • Certification as a Traffic Signal Field Technician Level II
Signs and Pavement Markings Technician Level I	This course provides an introduction to the latest technology, materials, and rules and regulations that are used for the installation and maintenance of signs and pavement markings on today's roadways.	Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification	16 hours/two days	$280	https://www.imsafws.com/training	• Pass the Work Zone Traffic Control Safety Course • One year of field traffic operations experience
Signs Technician Level II	An advanced certification program designed to build upon the fundamental of the Signs & Markings Level I program. The Level II program covers an advanced level of knowledge and skill sets required specifically for sign design, installation, and maintenance. In this program the sign technician will expand their understanding of the criteria for the application of signs in accordance with the MUTCD and other references.	Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager, and have the Signs and Pavement Markings Technician Level I Certification.	16 hours/two days	$290	https://www.imsafws.com/training	• Pass the Work Zone Traffic control Safety Course • Certification as a Signs and Marking Technician I • Possess two years of field traffic operations experience
Signs Senior Technician Level III	This certification tests the knowledge and skill sets that are specifically required for sign design, installation and maintenance.	Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager, and have the Signs	Exam Only/one day	$300	https://www.imsafws.com/training	• Certification as a Signs Technician Level II • Possess five years of field experience related to the design, installation and maintenance of signs
Pavement Markings Technician Level II	This certification gives an advanced understanding of pavement marking materials, installation, and maintenance	Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager Signs and Pavement Markings Technician Level I	16 hours/two days	$290	https://www.imsafws.com/training	• Possess two years of field traffic operations experience

Certification Resources

Certification Name	Certification Description and Requirements	Pre-requisites	Certification Course Length	Cost* (Member/ Non-Member Fees)	Access	Certification Process
Pavement Technician Level III	This certification is designed to test the knowledge and skill sets that are specifically required for pavement markings design, installation and maintenance.	IMSA Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification	Exam Only	$300	https://www.imsafws.com/training	• Certification as a Pavement Markings Technician Level II • Possess five years of related field experience
Roadway Lighting Technician Level I	Certification review program for qualified personnel designed to cover the fundamental knowledge and skill sets required for individuals working on Roadway Lighting. The material addresses electrical safety and codes, basic electricity, laws, jurisdictional requirements and basic construction and maintenance.	IMSA Work Zone Traffic Control Safety Certification or equivalent as approved by the IMSA Education & Certification Manager	16 hours/two days	$280	https://www.imsafws.com/training	• Pass the Work Zone Traffic Control Safety Class
Roadway Lighting Technician Level II	An advanced certification program that is designed to build upon the fundamentals of the Roadway Lighting Level I program. The Level II program covers an advanced level of knowledge and skill sets required specifically for roadway lighting design, installation, management and maintenance.	Work Zone Temporary Traffic Control Technician Certification or equivalent as approved by the IMSA Education & Certification Manager and Roadway Lighting Technician Level I	16 hours/two days	$290	https://www.imsafws.com/training	• Pass the Work Zone Traffic Control Safety Course • Certification as a Roadway Lighting Technician Level I • Two years of roadway lighting field experience
OSHA						
OSHA 10 Hour Training for Construction	OSHA recommends workplace safety training for a safe and healthful work environment, specifically for hazard avoidance on the job site. This training covers specific OSHA regulations and requirements as they apply to the Construction Industry.	None	10 hours	$59	https://www.oshaeducationcenter.com/osha-10-hour-training-construction.aspx *Or other sites*	• Earn OSHA Education Center 10-Hour Card

*Costs in this version are current as of September 2018

Training Resources

Training Course Name	Course Description and Requirements	Pre-requisites	Course Length	Cost* (Member/Non-Member Fees)	Access
APPLICABLE FOR OPERATIONS POSITIONS					
American Traffic Safety Services Association (ATSSA)					
Temporary Traffic Control Considerations for Urban Work Zones	This course addresses work zones in more populated and congested areas, particularly the considerations necessary to address work zones in urban environments.	None	16 hours/two days	$355/$405	http://www.atssa.com/TrainingCertification/CourseInformation/TemporaryTrafficControlUrbanWorkZones.aspx
Temporary Traffic Control for Utility Operations	This course provides an introduction to temporary traffic control for utility work.	None	8 hours/one day	$180/$205	http://www.atssa.com/TrainingCertification/CourseInformation/TemporaryTrafficControlUtility.aspx
Introduction to the MUTCD	This course examines the Manual on Uniform Traffic Control Devices (MUTCD), its content, and its applicability to streets open to the public in the United States, including private streets. Emphasis will be given on temporary traffic control.	None	2 hours	$65/$65	http://www.atssa.com/TrainingCertification/CourseInformation/IntroductiontotheMUTCD.aspx
Consortium for Innovative Transportation Education (CITE)					
Data Archiving and Analytics for Planning, Operations and Safety	This course is designed to explain the benefits of creating an open and accessible data archive.	None	8 hours	$399	http://www.citeconsortium.org/cite-courses/blended-courses/
Improving Highway Safety with ITS	This course is an introduction to ITS-based strategies and tools available for improving highway safety. This course is intended for ITS, transportation operations, and safety professionals, including, but not limited to, planners, operators, designers, emergency management, and maintenance personnel.	None	10 hours	$250	http://www.citeconsortium.org/cite-courses/blended-courses/
Network Design and Deployment Considerations for ITS	The overall goal of this course is to provide a system-level understanding of the operation of modern broadband transportation communications networks. This course focuses on how to plan and implement telecommunications networks to support a major Intelligent Transportation System (ITS) infrastructure.	None	10 hours	$239	http://www.citeconsortium.org/cite-courses/blended-courses/
Traffic Signal Operations	This course provides an understanding of both the theory and practice of traffic signal timing and its impact on traffic operations. It gives students an overview of the terms associated with signal timing; discusses the concepts of cycle length, split, offset, midblock friction, phase sequences, the signal timing process, and signal timing optimization; and looks at the types of actuated controllers, passage time, extension, and the coordination of actuated and pre-timed controllers.	None	10-15 hours	$239	http://www.citeconsortium.org/cite-courses/blended-courses/
ITS Awareness	This course presents an overview of Intelligent Transportation Systems (ITS) and discusses their role in Transportation Systems Management and Operations (TSMO). In general, it covers how systems (ITS) are applied (through TSMO) to achieve a wide range of benefits.	None	4 hours	$199	http://www.citeconsortium.org/cite-courses/individual-courses/
Pavement Marking	This course is an introduction to pavement marking standard practices and defines the functions and characteristics, materials, manufacturing, application, installation and evaluation.	None	6 hours	$150	http://www.citeconsortium.org/cite-courses/individual-courses/
TSMO 101: What is this TSMO Thing Anyway?	This course discusses congestion and its continued spread and intensify; the levels of incidents, delays, and disruptions; and the level of service and reliability of the roadways in many areas as it continues to decline.	None	2 hours	$70	http://www.citeconsortium.org/cite-courses/individual-courses/
Federal Highway Administration (FHWA)					
Advancing Transportation Systems Management and Operations through Scenario Planning	The intent of this session is to inform planners, operators, and other transportation systems management and operations (TSMO) practitioners on the use of scenario planning to advance TSMO, including why and when to use it and how to apply the phases of scenario planning to TSMO. This session will provide a general understanding of scenario planning and a framework for applying scenario planning to advance TSMO.	None		Free	https://ops.fhwa.dot.gov/plan4ops/resources/traing.htm
Applying Archived Operations Data in Transportation Planning	The purpose of this web-based informational session is to assist transportation planners and their operations partners in effectively using archived operations data for developing, analyzing, and evaluating transportation plans and programs.	None		Free	https://ops.fhwa.dot.gov/plan4ops/resources/traing.htm
National Highway Institute (NHI)					
Strategies for Developing Work Zone Traffic Analyses	This course provides the participants with practical experience in developing a transportation modeling approach in a collaborative process that considers issues ranging from work zone characteristics, performance measurement, technical risk assessment, and resource constraints.	None	4 hours	$50	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=133110

Training Resources

Training Course Name	Course Description and Requirements	Pre-requisites	Course Length	Cost* (Member/Non-Member Fees)	Access
Maintenance Training Series: Basics of Work Zone Traffic Control	This course offers an overview of the MUTCD's structure and requirements regarding traffic control devices and their applications, flagging operations and procedures, and pedestrian and worker safety.	None	1 hour	$25	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=134109
Transportation Asset Management Overview	This training explains the basics of asset management and why asset management is important. After you complete this training, you'll have new terms, and new ways of thinking about what you're already doing.	None	2 hours	$25	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=136113
Introduction to Performance Measurement	This course is one in a series of introductory courses that fall within the subject area of Transportation Performance Management. Transportation Performance Management is a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals.	None	2 hours	$25	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=138003
Webinars					
National Operations Center of Excellence (NOCoE)	Design to offer a suite of resouces to serve the TSMO community including technical services such as peer exchange workshops and webinars, ongoing assessments of best practices in the field, and on-call assistance. Regular webinars are hosted by NOCoE.	None	1 to 4 hours	Free	https://transportationops.org
ITS Joint Programs Office ITS Professional Capacity Building Program - Talking Technology and Transportation (T3) Webinars	T3 webinars are designed to help agencies feel confident about deploying and operating ITS technologies as a means to address challenges in their transportation systems. Includes such topics as ITS planning, design, procurement, deployment, and operations. Standard webinars are 90 minutes. T3 Lite webinars are 30 minutes followed by a question and answer period.	None	30-90 minutes	Free	https://www.pcb.its.dot.gov/t3_webinars.aspx
APPLICABLE FOR MAINTENANCE AND INCIDENT MANAGEMENT POSITIONS					
American Traffic Safety Services Association (ATSSA)					
Temporary Traffic Control Considerations for Urban Work Zones	This course addresses work zones in more populated and congested areas, particularly the considerations necessary to address work zones in urban environments.	None	16 hours/two days	$355/$405	http://www.atssa.com/TrainingCertification/CourseInformation/TemporaryTrafficControlUrbanWorkZones.aspx
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Introduction to the MUTCD	This course examines the Manual on Uniform Traffic Control Devices (MUTCD), its content, and its applicability to streets open to the public in the United States, including private streets. Emphasis will be given on temporary traffic control.	None	2 hours	$65/$65	http://www.atssa.com/TrainingCertification/CourseInformation/IntroductiontotheMUTCD.aspx
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Traffic Signal Operations	This course provides an understanding of both the theory and practice of traffic signal timing and its impact on traffic operations. It gives students an overview of the terms associated with signal timing; discusses the concepts of cycle length, split, offset, midblock friction, phase sequences, the signal timing process, and signal timing optimization; and looks at the types of actuated controllers, passage time, extension, and the coordination of actuated and pre-timed controllers.	None	10-15 hours	$239	http://www.citeconsortium.org/cite-courses/blended-courses/
National Highway Institute (NHI)					
Maintenance Training Series: Basics of Work Zone Traffic Control	This course offers an overview of the MUTCD's structure and requirements regarding traffic control devices and their applications, flagging operations and procedures, and pedestrian and worker safety.	None	1 hour	$25	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=134109
Maintenance of Traffic for Technicians	The Maintenance of Traffic for Technicians Web-based training presents information about the placement of, field maintenance required for, and inspection of traffic control devices.	None	5 hours	$50	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=133116
Maintenance of Traffic for Supervisors	The Maintenance of Traffic for Supervisors Web-based training presents information about the placement of, field maintenance required for, and inspection of traffic control devices.	None	5 hours	$50	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=133117
Transportation Asset Management Overview	This training explains the basics of asset management and why asset management is important. After you complete this training, you'll have new terms, and new ways of thinking about what you're already doing.	None	2 hours	$25	https://www.nhi.fhwa.dot.gov/course-search?tab=0&typ=3&cat=22%2C5%2C8%2C23%2C11&sf=0&course_no=136113

*Costs in this version are current as of September 2018

ITS STRATEGIC PLAN

Infrastructure Implementation Plan

Prepared for

CITY OF Yuma

In coordination with

ADOT · YMPO · Yuma County Arizona · City of Somerton · City of San Luis, AZ

Prepared by

Kimley»Horn

June 2021

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1. Introduction and Background

The City of Yuma (City) is formalizing an Intelligent Transportation System (ITS) program to provide advanced traffic management and operations on the City transportation network and on other roadways that have direct impact on the City transportation network. This initiative is being pursued as a multi-phased effort to help the City plan, design, and ultimately implement the envisioned ITS network and advanced transportation functions.

1.1 City of Yuma ITS Strategic Plan

The City's ITS Strategic Plan was completed in 2020 to help guide the City's investments in ITS to support traffic management, traveler information, incident management, interagency communications, and coordination with regional stakeholders. The ITS Strategic Plan outlined an ITS vision and goals for the City and for the greater Yuma region.

The City's vision for ITS is:

Through centralized control of field devices and coordination between transportation agencies, the Yuma region employs advanced traffic operations and provides real-time traveler information to create an efficient and safe transportation network.

City goals for transportation and ITS from the ITS Strategic Plan include:

- Invest in technology to take transportation system management to the next level and manage the transportation network more effectively, rather than trying to build the way out of congestion.
- Elevate the level of real-time coordination with other agencies for traffic and incident management to provide a consistent and efficient travel experience across municipal boundaries.
- Identify a framework for a TOC that facilitates centralized control of City field devices and provides opportunity to coordinate operations between agencies in the region.

Stakeholders identified additional goals from the regional perspective, which include:

- Ensure compatibility and functionality of technology to facilitate advanced operations and interoperability.
- Define a multi-agency model for operations and device ownership that is clear, efficient, and logical based on the regional transportation network.
- Deploy technologies that can support multiple functions and responsibilities related to traffic management, performance management, and public information dissemination.

The ITS Strategic Plan also identified a set of needs and gaps related to the existing transportation infrastructure, systems, and processes that must be addressed to make progress towards the vision, which include:

- No ability to remotely access and centrally manage traffic signals

- Lack of real-time data at traffic signals that support day to day traffic operations and emergency response
- New traffic operations infrastructure standards to facilitate maintenance of devices and support compatibility across agencies
- Upgraded traffic signal equipment (detection, controllers, cabinets) to support advanced traffic management

From the vision, goals, and needs, the ITS Strategic Plan put forth a set of recommendations, two of which were major infrastructure-based recommendations:

- Deploy transportation communications equipment, (fiber or wireless devices) along key corridors to connect traffic signals to a centralized management system; and
- Establish centralized management of ITS infrastructure to provide remote, real-time traffic monitoring and management capabilities.

1.2 Purpose of the ITS Infrastructure Implementation Plan

The purpose of this City of Yuma ITS Infrastructure Implementation Plan is to provide the City with necessary information to pursue, and ultimately implement, the two critical infrastructure recommendations from the ITS Strategic Plan.

A set of ITS Corridor Projects are identified that, if implemented, will result in the ITS build-out network to address the infrastructure needs and gaps and help the City make progress towards achieving the ITS vision and goals. The Infrastructure Implementation Plan includes project details such as costs, phasing suggestions, agreements that may be necessary, and potential funding sources. In addition to specific projects, this Infrastructure Implementation Plan also identifies programmatic and organizational recommendations, such as key staffing needs, operational and maintenance (O&M) considerations, and programmatic costs, that will be necessary to successfully implement, operate, and maintain the ITS network.

The document includes the following sections:

- **ITS Infrastructure Projects** – identifies and provides details on logical infrastructure projects to implement the buildout condition for the City ITS network and considerations for ITS infrastructure on the regional priority transportation network
- **ITS Staffing** – identifies staffing needs to support O&M of the ITS buildout network
- **ITS Infrastructure Capital and Programmatic Costs** – identifies costs to implement the ITS Corridor Projects for both the City and the regional priority network and identifies ongoing O&M and lifecycle replacement costs
- **Implementation Phasing** – discusses the approach to project prioritization and phased implementation in pursuit of eventually implementing the build-out network
- **Coordination and Agreements** – outlines agreements that will be necessary to implement, operate, and maintain the ITS build-out network, including both inter-departmental agreements between City departments and inter-agency agreements between regional stakeholders if multi-agency projects are pursued.

- **Funding Sources** – describes potential funding sources for the capital and ongoing O&M costs for the ITS network.

Within this plan, there are projects, costs, staffing, and other considerations related to implementing a City Traffic Operations Center (TOC). As part of a concurrent effort, a Concept of Operations (ConOps) for a City TOC was developed to identify the functionalities and conceptual considerations for establishing a TOC to provide centralized and active management of the City's ITS network. The ConOps also included opportunities where the City might partner with other transportation management agencies within the region to connect their infrastructure to be managed by the TOC. Information developed in the TOC ConOps document was used to develop information in this document relevant to the TOC. The relationship of the elements within the Infrastructure Plan is shown in **Figure 1**, which is an output from the ITS Strategic Plan.

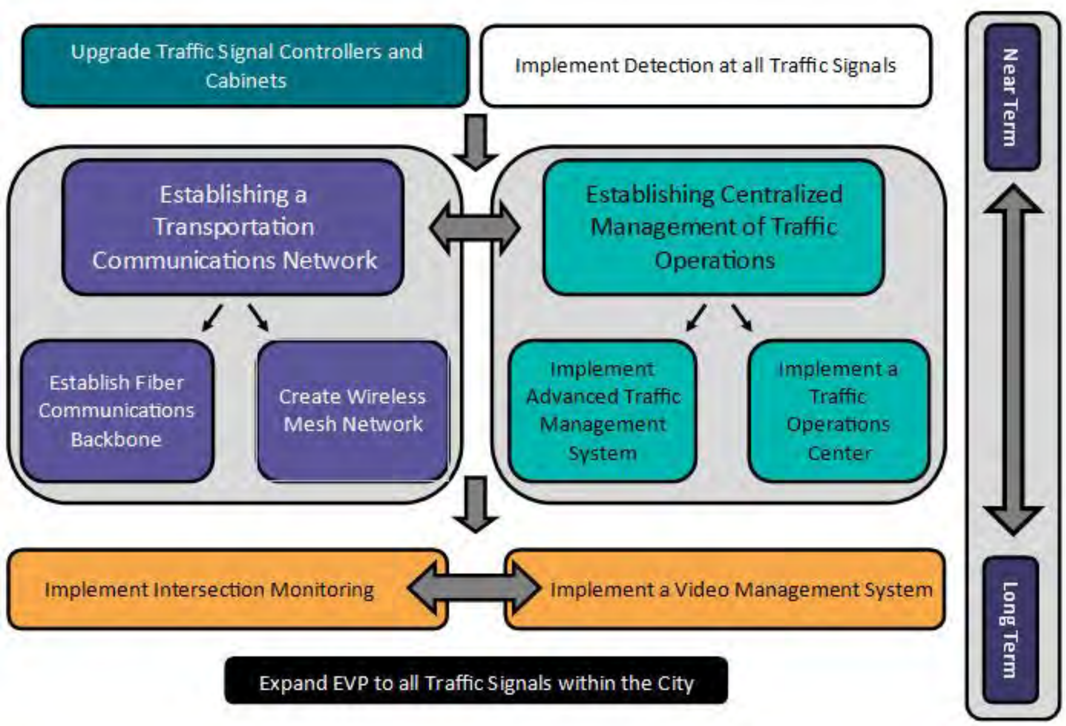


Figure 1 – Recommended ITS Infrastructure Strategies

2. ITS Infrastructure Projects

This section describes the comprehensive set of infrastructure improvements that would reach the build-out state for ITS in the City. A 'Project' is a suite of infrastructure and/or systems within a stretch of roadway that is logical to pursue collectively from an operational and capital investment perspective.

2.1 Inputs for Identifying Projects

The infrastructure projects include specific locations where investments related to ITS devices and communications infrastructure are needed. Inputs that were collected and used to identify and define projects in this section include:

- **Operational priority corridors**: The ITS Strategic Plan identified a set of City priority corridors and regional priority corridors for transportation operations. These corridors that carry the greatest amount of traffic and/or provide access to major destinations or employment in the City and the region. The priority corridors are found in **Figure 2**.
    - Corridors with Annual Average Daily Traffic (AADT) volumes greater than 20,000 were considered first priority corridors.
    - Corridors that provided access to major traffic generators in the Yuma region were considered first priority corridors.
    - Corridors with AADT between 10,000 and 20,000 were considered second priority corridors.
    - Corridors that were regional commuter routes with AADT greater than 5,000 were considered second priority corridors.
    - Corridors that included traffic signals from multiple agencies were classified as regional corridors.
- **City communications priorities**: City of Yuma Information Technology (IT) Department identified a fiber ring topology for the City Enterprise network that would connect to all City facilities and would also support communications connectivity to traffic signals along the ring. This proposed typology is shown in **Figure 3**.
- **Regional operational and infrastructure priorities**: Several meetings with staff from various departments in the City, Yuma County, City of Somerton, the Arizona Department of Transportation (ADOT), and the Yuma Metropolitan Planning Organization (YMPO) to discuss needs, concepts, and priorities for infrastructure and operational functions to support elevated and coordinated traffic management in the region.

Based on these inputs, it was determined that much of the City's traffic signal infrastructure needs to be upgraded – including traffic signal controllers, traffic signal cabinets, preemption devices and detection equipment – and that a transportation communications network needs to be implemented on key corridors. A concept for a TOC that supports real-time traffic management and data collection was also developed and is documented in the separate TOC ConOps, as previously described.

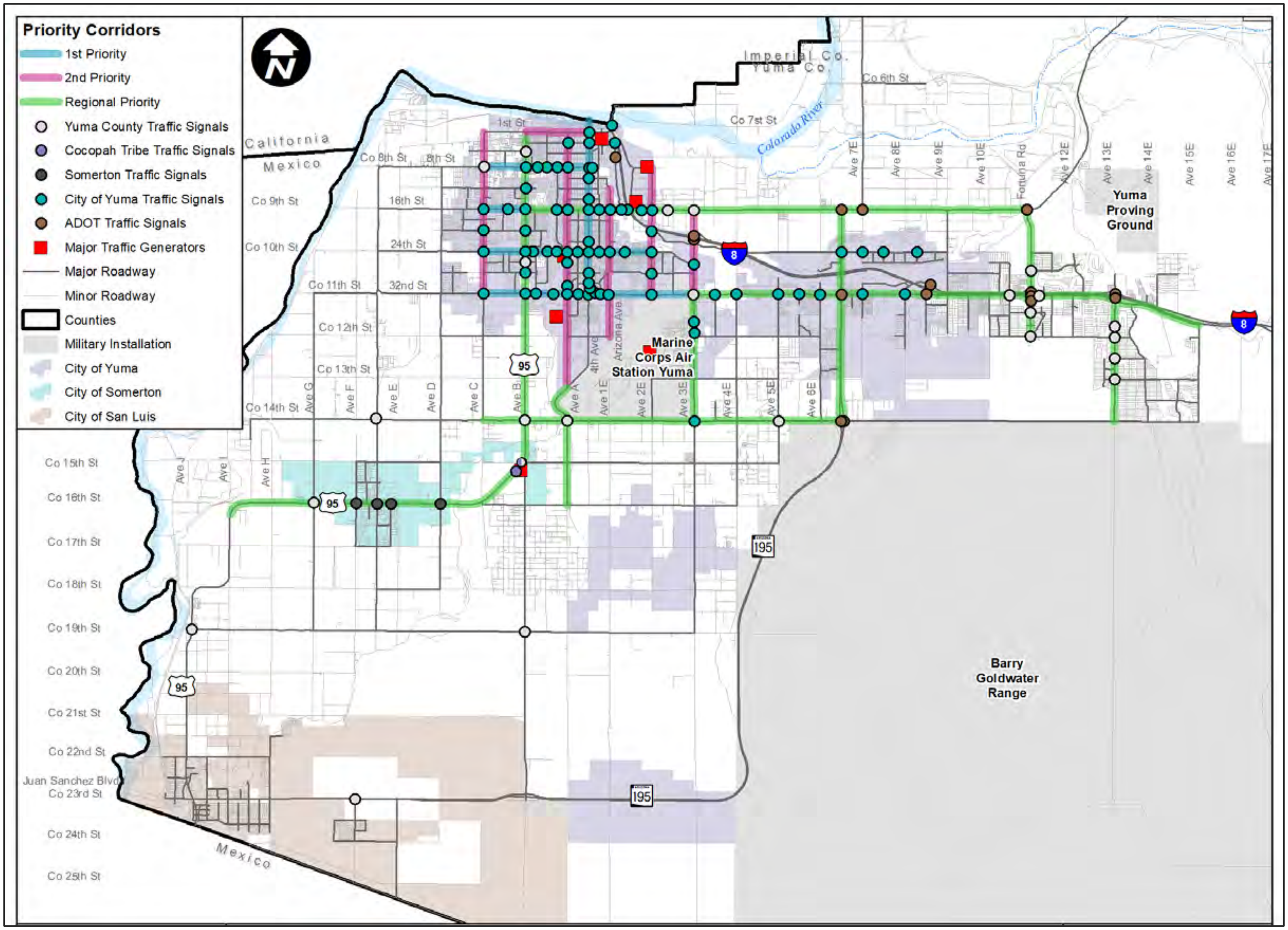


Figure 2 – City and Regional Priority Corridors

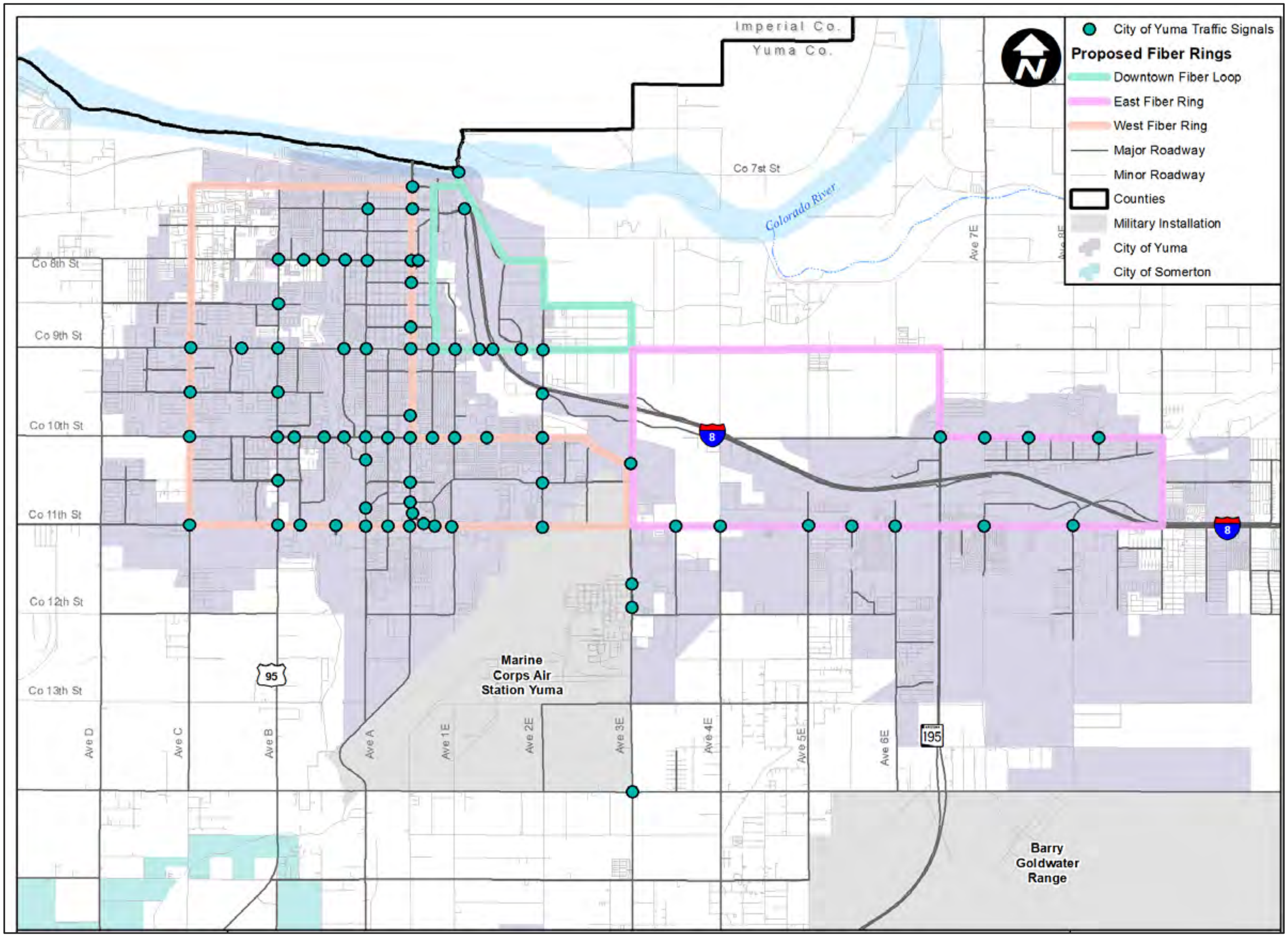


Figure 3 – IT Proposed Fiber Backbone

2.2 ITS Device Standards

To support the implementation of an ITS Program and a TOC in Yuma, the City should review and update their device standard details and specifications for new traffic signals and ITS devices and technology required. Establishing a standard layout for technology at intersections sets the expectation for data collection as required by the future Yuma TOC. The benefits of making a technology standard for major intersections are increased economies of scale, improved maintenance experience/time, and improved uniformity and compatibility.

The ITS and communications elements that should be reviewed for standardization and incorporation into details and specifications for the City include the following categories:

- Conduit
- Pull Boxes and Vaults
- Cabling
- Vehicle Detection Equipment
- Emergency Vehicle Preemption (EVP)
- Closed-Circuit Television (CCTV) Intersection Cameras
- Traffic Signal Cabinets
- Power Supply Backup Systems (Uninterrupted Power Supply, UPS)
- ITS Communications Equipment/Controllers
- Splicing
- Flashing Yellow Arrow (FYA) Functional Requirements

ITS Communications Standard Infrastructure

Fiber optic communication cable is the preferred communications medium to connect signalized intersections and other technology throughout the City, where possible. If fiber optic communications cabling is not feasible to be implemented at a major signalized intersection, wireless radios (with antennas) or cellular technology should be used to connect back to the nearest fiber cabling. As the City's fiber optic communications network expands, intersections and devices should continue to be connected to the City's fiber network.

The network that will connect ITS devices to the Yuma TOC, once established, is called Center-to-Field or C2F network. To achieve the network C2F infrastructure needs of the City ITS program, the C2F network requires the continued implementation of:

- Installation of 1-4" conduit for ITS use and other City needs. Any roadway reconstruction or widenings need to continue to include implementing conduit infrastructure at the edge of right-of way so that conduit does not end up buried under the road.

Redundancy in the ITS communications network architecture is needed to limit the amount of network down time. Network downtime is undesirable because it:

- Limits the City's ability to respond quickly and efficiently to a traffic incident or other event;
- Limits the City's ability to actively manage congestion which can translate to increased emissions; and
- Lowers the overall quality of service and signal operations that the City is able to provide to commuters within the City.

Path diversity and equipment redundancy within the C2F network will protect the network from single points of failure and provide the greatest reduction in system down time.

- *Path diversity* provides options to interconnect field devices and facilities to the fiber backbone network. Two paths are recommended when connecting all devices and facilities on the fiber network so each device has redundant communications and communications to the device is not lost if one path has a failure.
- *Redundancy* is achieved through the connection of at least two separate sets of equipment in the Yuma TOC. If one set of equipment is not working, the other set of equipment is ready to accept the role of communications in its place. With redundant communications hub equipment, the network can sustain planned or unplanned down time of the hub equipment without the City's stakeholders losing connectivity.

To achieve the network reliability needs of the City's ITS program, the ITS C2F networks require:

- A standard of one 48-fiber Single Mode Fiber Optic (SMFO) cable for the ITS C2F field network.
- Fiber branch cables to connect ITS devices to the 48-fiber SMFO backbone cable should be of size 12 fibers.
- Consider the use of communications network redundancy for the ITS fiber optic network by including a network switch in each traffic signal cabinet and using a splicing method that can offer alternate paths if part of the network loses connectivity.

Standard Intersection Technology for Major Corridors

This section provides detail about the equipment and the appropriate layout needed for technology at signalized intersections along major corridors, primarily focusing on the locations where major streets cross with other major streets.

The ITS communications network will need to support communications between the TOC and the traffic signal controller cabinets. Communications connectivity is needed to transfer signal status and device data between each signal cabinet and the TOC. This allows for efficient management and remote control of signal timing plans, pre-emption devices, and detection equipment from the TOC.

One **Advanced Traffic Controller Cabinet (ATCC)** is located at each of the City's signalized intersections and houses the traffic signal control equipment. There are four main components needed within each traffic signal controller cabinet to control local intersection operations and provide the necessary connectivity:

- **Traffic Signal Controller** – the "brain" at an intersection that gets real-time information from detection and tells each signal display when to change the signal phase. Currently, the majority of the controllers in the City are Econolite ASC/3, although the City is in the process of upgrading all intersections to Cobalt by Econolite.
- **Malfunction Management Unit (MMU)** – detects and responds to improper and conflicting signals and improper operating voltages in a traffic control system.
- **Vehicle Detection** – non-intrusive, video-based vehicle detection sensors are installed at each direction of approach at signalized intersection. Detection devices provide traffic speed, volume, and roadway occupancy data and can help with early detection of incidents or develop an archived record of traffic volumes to assist in planning for future roadway improvements. The detection devices will connect directly into the local traffic signal controller to report real time traffic data. Video-based vehicle detection sensors also provide streaming video that can be viewed to remotely configure the detection zones of these devices. The C2F network will need to support bringing these HD video streams back to the TOC to view the traffic in the camera's field of view and remotely calibrate activities for the sensor's detection zones.
- **Ethernet switch** – a communication device that allows remote access to a traffic signal controller as well as other devices connected at that signalized location. Switches should be capable of accepting optical transceivers for communications over fiber-optic cable and have a minimum of eight 100 Megabits per second (Mbps) ethernet ports for other devices connected to the traffic signal infrastructure. An ethernet switch is required at each signalized intersection to connect to the ITS network. An ethernet switch is also required at unsignalized locations with a standalone wireless pole.

In addition to the ATCC and its main internal components, the following external signal equipment is beneficial in areas where power failures may be common and would interfere with the reliability of the ITS communications network:

- **Uninterrupted Power Supply (UPS)** – an external device that provides a backup power source in the event of a power outage or other failure of the main power source. The benefit of a UPS device over other battery backup systems is that it provides essentially instantaneous power when an interruption occurs.

The following optional signal equipment is not a necessary component of a functional ITS system, but has been included in the ITS projects to support emergency response:

- **Emergency Vehicle Preemption (EVP) Devices** – device that is mounted on the traffic signal mast arm and detects active emergency vehicles approaching the intersection. The device is paired with equipment in the cabinet that preempts the system to extend the green time or change the timing schedule to give the emergency vehicle a green light.

It should be noted that CCTV and FYAs are excluded from the corridor project upgrades, because they are not necessary components for a functional ITS system. However, CCTV and FYA would provide additional functionality, safety, and efficiency benefits to operations staff and should be considered for implementation in the long term.

2.3 ITS Infrastructure Projects

ITS Fiber Network

City IT developed a backbone topology consisting of three rings to implement in the near future. The backbone is planned to consist of only 12 strands of fiber optic cable with two strands dedicated to ITS/traffic needs. The strands dedicated to traffic will be used to connect traffic signals along the backbone.

Branch cables and wireless controllers are used to connect to traffic signals not along the backbone and route them back to the fiber rings. Connecting back to the fiber rings is necessary to be able to connect the traffic signals to the TOC and other agency resources. Select signals will be equipped with wireless controllers rather than branch cables to reduce infrastructure capital costs. Roadways within Yuma's City core and major routes within the priority corridors will be connected with branch cables. Areas that have minimal connections to city resources, traffic signals, or ITS equipment, or areas that are further out from the City core will be connected with wireless radios to connect back to the fiber backbone. Some traffics signals that are connected with fiber may also be connected with wireless receivers to act as the communication between the standalone wireless signals and the TOC.

ITS Corridor Projects

Utilizing the fiber priority corridors, backbone topology, and input from City staff and other transportation management agencies in the region, 13 projects have been identified that, if implemented, would allow the City to upgrade all of the necessary traffic signal infrastructure and connect all City traffic signals to a transportation communications network. The 13 projects are shown in **Figure 4** and are included below in order of priority:

1. 4th Avenue (32nd Street to 1st St)
2. 32nd St (Ave B to Ave 3E) *
3. 16th St (Ave C to Pacific Ave) *
4. 24th St (Ave C to Pacific Ave)
5. 8th St (Ave C to Orange Ave) *
6. 32nd St (Ave 3E to Ave 8½ E) *
7. Ave 3E (24^{th} St to MCAS Main Gate/Quilter St) *
8. Ave B (5th St to 28th St) *
9. US 95 (County 14th St to Ave G) *
10. County 14th St (Ave B to Araby Road) *
11. Ave A (3rd St to 32nd St)
12. Pacific Ave (16th St to 32nd St)
13. 24th St (Araby Rd to Ave 7E), 1st St (4th Ave to Penitentiary Ave Signal), 3rd St (4th Ave to Redondo Center Drive)

A complete list of intersections included in each project is provided in **Appendix C**.

The City would like to partner with other agencies in the region to upgrade and connect traffic signals along City or regional priority corridors that are owned by another agency to support improved coordination and operations across jurisdictional boundaries. For this reason, there are projects identified that will require involvement from other agencies in the region to pursue. **Projects requiring multi-agency involvement are identified with an asterisk (*) in the list above.**

The level of involvement required from other agencies will depend on the scope of each specific project. Reasons for other-agency involvement may include installation of new ITS infrastructure at an intersection owned by another agency or potential for encroachment into another jurisdiction's right-of-way. Additional details about ownership and involvement are provided in the map in **Figure 4** , the Project Descriptions later in this section, and the intersection lists in **Appendix C**.

***Note**: The ITS Corridor Projects described in this section all assume that the IT fiber backbone will be constructed separate from any ITS communications projects. **Appendix A** considers an alternative scenario where an IT fiber backbone is not available for use, and a new ITS backbone would be constructed jointly with the ITS device upgrades; this scenario would result in a different project list and an altered IT fiber backbone, all of which is described in detail in **Appendix A**.*

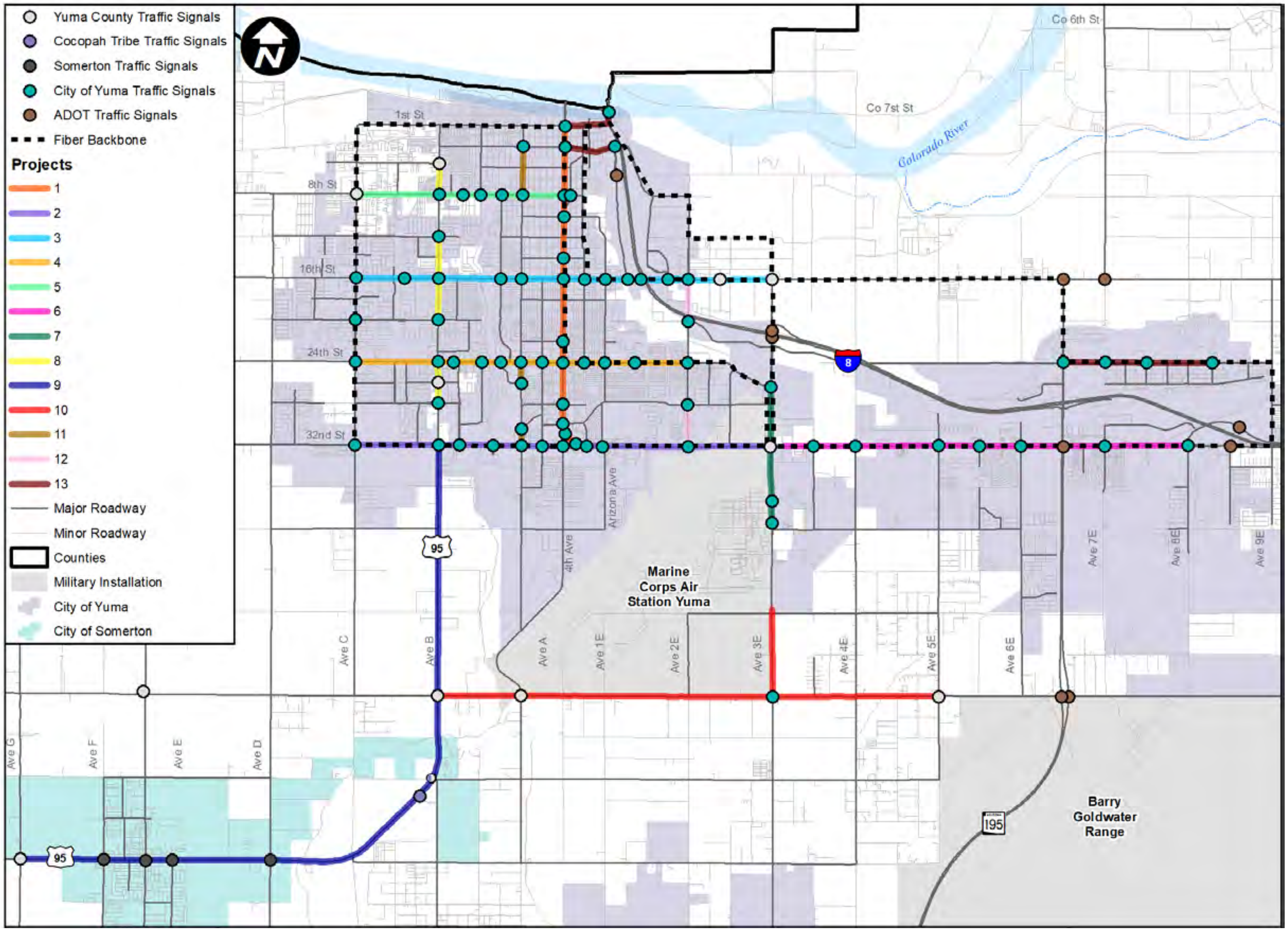


Figure 4 – ITS Infrastructure Projects Locations

Project Locations and Sequence

The sequence of the ITS Projects was determined using the following prioritization strategy:

1. **Projects 1 through 5** address the highest-priority City corridors identified in the 2020 ITS Strategic Plan, to ensure the facilities and corridors with the greatest need for new ITS infrastructure are attended to first.

2. After first-priority corridors were addressed, projects along the regional-priority corridors and the second-priority City corridors were addressed. The sequence of **Projects 6 through 13** leverage the planned IT fiber backbone and the infrastructure put in place by prior projects to complete the regional network:
   - Projects 7, 8 ,11, and 12 connect to the remaining priority signals based on the infrastructure put in place by previous projects.
   - Projects 9 and 10 were developed to connect the City's infrastructure with existing traffic signals in the City of Somerton, Cocopah Tribe, and Yuma County.
   - Project 10 connects back to Projects 7 and 9, thus reducing gaps encountered on County 14th St from SR 195 to US-95.
   - Project 13 connects the remaining Yuma signals that lie on the edges of the City and uses infrastructure put in place by the fiber backbone rings and projects previously completed.

Project Descriptions

A brief description of each project is provided below, followed by a summary of anticipated quantities. A project map, including wireless device locations, is shown in **Figure 5**. A complete list of intersections included in each project is provided in **Appendix C**.

Project 1 – This project is located on 4th Ave from 32nd St to 1st St and impacts a total of 12 signalized intersections, all owned by the City. Because a portion of this project is located along the existing fiber backbone, ITS improvements are limited to individual 12-Fiber SMFO intersection connections in the section north of 24th St. Full improvements are planned for the section south of 24th St to 32nd St. This project includes approximately 2.0 miles of new fiber optic cable and new signal controllers where upgrades are needed.

Project 2 – This project is located on 32nd St from Ave C to Ave 3E and impacts a total of 11 signalized intersections (10 Yuma, 1 County). This project will connect the west half of the 32nd St corridor to the existing fiber backbone. Because this project is located along the existing fiber backbone, ITS improvements are limited to individual 12-Fiber SMFO intersection connections. This project includes approximately 0.7 miles of new fiber optic cable and upgrades to new video detection, new emergency vehicle preemption (EVP), new uninterrupted power supply (UPS) devices, new advanced traffic control cabinets (ATCC), and new signal controllers where needed.

Project 3 – This project is located on 16th St from Ave C to Ave 3E and impacts a total of 13 signalized intersections (11 Yuma, 2 County). The I-8 interchange has offset signal poles operating off one signal controller and is therefore considered to be one intersection for purposes of this report. This project will connect the 16th St corridor to the existing fiber backbone midway through the corridor near Arizona Ave. Therefore, a new fiber and conduit branch will be installed on the west half of the project only. This project includes approximately 3.8 miles of new fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 4 – This project is located on 24th St from Ave C to Pacific Ave and impacts a total of 11 signalized intersections, all owned by the City. This project will connect the 24th St corridor to the existing fiber backbone midway through the corridor near Arizona Ave. Therefore, new fiber and conduit will be installed on the west half of the project only. This project includes approximately 3.4 miles of new fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 5 – This project is located on 8th St from Ave C to Orange Ave and impacts a total of 6 signalized intersections (5 Yuma, 1 County). The City-owned HAWK at 8th St west of 21st Ave is excluded from the project. This project will connect the 8th St corridor to the existing fiber backbone at Ave C. This project includes approximately 3.2 miles of new fiber optic cable, upgrades to video detection, new EVP, a new UPS device, new ATCCs, and new signal controllers where needed.

Project 6 – This project is located on 32nd St from Ave 3E to Ave 8½E and impacts a total of 7 signalized intersections, all owned by the City. There are 2 signalized intersections along 32nd St that are owned by ADOT, but it is assumed that these ADOT signals will not be connected to the Yuma fiber network. Because the proposed fiber improvements will bypass the ADOT signal at 32nd St and SR-195, an encroachment permit from ADOT will be necessary for any work that needs to be performed within ADOT's right-of-way. This project will connect the east half of the 32nd St corridor to the existing fiber backbone. Since this project is located along the existing fiber backbone, ITS improvements are limited to individual 12-Fiber SMFO intersection connections. This project includes approximately 0.5 miles of fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 7 – This project is located on Ave 3E from 24th St to MCAS Main Gate (Quilter St) and impacts a total of 3 signalized intersections, all owned by the City. Coordination will be needed with the County to connect to the County signal located at 32nd St and Avenue 3E (Project 2). This project will connect the southern portion of the Ave 3E corridor to the existing fiber backbone at 32nd St. A wireless device at the southern end of the project will be used to create a future wireless connection to the County 14th St corridor (Project 10) via the signal at County 14th St and Ave 3E. This project includes approximately 1.2 miles of fiber optic cable, 1 wireless radio, and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 8 – This project is located on Ave B from 5th St to 28th St and impacts a total of 4 signalized intersections (3 Yuma, 1 County). The County-owned HAWK at 5th St and Avenue B is excluded from the project. This project will connect standalone intersections on Ave B to the nearest built-out ITS corridors via branch connections on 8th St (Project 5), 16th St (Project 3), and 24th St (Project 4). This project includes approximately 2.3 miles of fiber optic cable and upgrades to video detection, new EVP, a new UPS device, new ATCCs, and new signal controllers where needed.

Project 9 – This project is located on US-95 from County 14th St to Ave G and impacts a total of 8 signalized intersections (2 County, 2 Cocopah, 4 Somerton). This is a regional project which will connect signals belonging to the County, Cocopah, and Somerton to the existing fiber backbone at 32nd St. A wireless device located midway through the project at County 14th St will be used to create a future wireless connection to the County 14th St corridor (Project 10). This project includes approximately 10.5 miles of fiber optic cable, 1 wireless radio, and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 9B – This project is a cost-savings alternative to Project 9 and is shown in **Figure 6**. The original Project 9 is depicted in **Figure 5** and shows a fiber connection between the City traffic signals and the Cocopah, Somerton and County signals along US 95. For the Project 9B option, the communications between these signals would be achieved exclusively via wireless devices in lieu of fiber optic cable. The project limits would be the same as in Project 9 but would impact a total of 12 intersections – the 8 signalized intersections (2 County, 2 Cocopah, 4 Somerton) from Project 9, plus 3 additional unsignalized intersections (3 County). This project would include 12 wireless radios and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed. The following items are of note:

- The new wireless devices will connect the intersections along the US-95 corridor with the fiber backbone located at 32nd St and the wireless devices on County 14th St (Project 10).
- Because new wireless devices will be installed at 3 unsignalized intersections, each of these locations will require additional equipment including a new pole and foundation, a power meter with electrical service, ethernet switch, and an ITS cabinet.
    - Three of the new wireless devices are proposed to be installed on new poles at unsignalized intersections along US 95. Typical wireless communication has a range of about 2 miles with good visibility and good terrain. Since the distance between some of the signalized intersections exceeds this range, supplemental devices are needed. Based on the geographic location of the proposed devices, they are assumed to be County devices.

Project 10 – This project is located on County 14th St from Ave B to Araby Rd and impacts a total of 7 intersections – 3 signalized intersections (1 Yuma, 2 County) and 4 unsignalized intersections (1 Yuma, 3 County). There are 2 additional intersections to the east that are owned by ADOT, but it is assumed that no new ITS equipment or other improvements will be installed at the ADOT intersections. This project includes 7 wireless radios and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed. The following items are of note:

- The new communications infrastructure is proposed to consist exclusively of wireless devices to reduce costs for the County.
- A wireless connection is needed to connect the County 14th St corridor back to the fiber backbone. Wireless devices are accounted for in the estimated quantities for Project 7 (1 location) and Project 9 (1 location) to create this connection to the backbone.

- Because new wireless devices will be installed at 4 unsignalized intersections, each of these locations will require additional equipment including a new pole and foundation, a power meter with electrical service, ethernet switch, and an ITS cabinet.
  - Three of the new wireless devices are proposed to be installed on new poles at unsignalized intersections along County 14th St between Ave A and Ave 3E. Typical wireless communication has a range of about 2 miles with good visibility and good terrain. Since the distance between some of the signalized intersections exceeds this range, supplemental devices are needed. Based on the geographic location of the proposed devices, they are assumed to be County devices.
  - One of the new wireless devices is proposed to be installed on a new pole near the unsignalized intersection of Ave 3E and County 13th St. This supplemental device is required due to the range limitations for wireless communication. This location is on the border of the City and Yuma County but is located between a series of City intersections and is therefore assumed to be a City device.

Project 11 – This project is located on Ave A from 3rd St to 32nd St and impacts a total of 3 signalized intersections, all owned by the City. This project will connect standalone intersections on Ave A to the fiber backbone via branch connections on 8th St (Project 5), 24th St (Project 4), and 32nd St (Project 2). This project includes approximately 1.3 miles of fiber optic cable and upgrades to new video detection, new EVP, a new ATCC, and new signal controllers where needed.

Project 12 – This project is located on Pacific Ave from 16th St to 32nd St and impacts a total of 2 signalized intersections, both owned by the City. This project will connect standalone intersections on Pacific Ave to the fiber backbone at 16th St (Project 3) and 32nd St (Project 2). This project includes approximately 1.3 miles of fiber optic cable and upgrades to new video detection, new EVP, new ATCCs, and new signal controllers where needed.

Project 13 – This project is located on 24th St from Araby Rd to Ave 7E, 1st St from 4th Ave to Penitentiary Ave Signal, and 3rd St from 4th Ave to Redondo Center Dr and impacts a total of 6 signalized intersections, all owned by the City. This project will connect the 1st St corridor and Harold Giss Pkwy corridor to the existing fiber backbone at 1st Ave. This project will also connect the east portion of the 24th St corridor to the existing fiber backbone. Since the 24th St portion is already located along the existing fiber backbone, ITS improvements for that segment are limited to individual 12-Fiber SMFO intersection connections. This project includes approximately 1.8 miles of fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

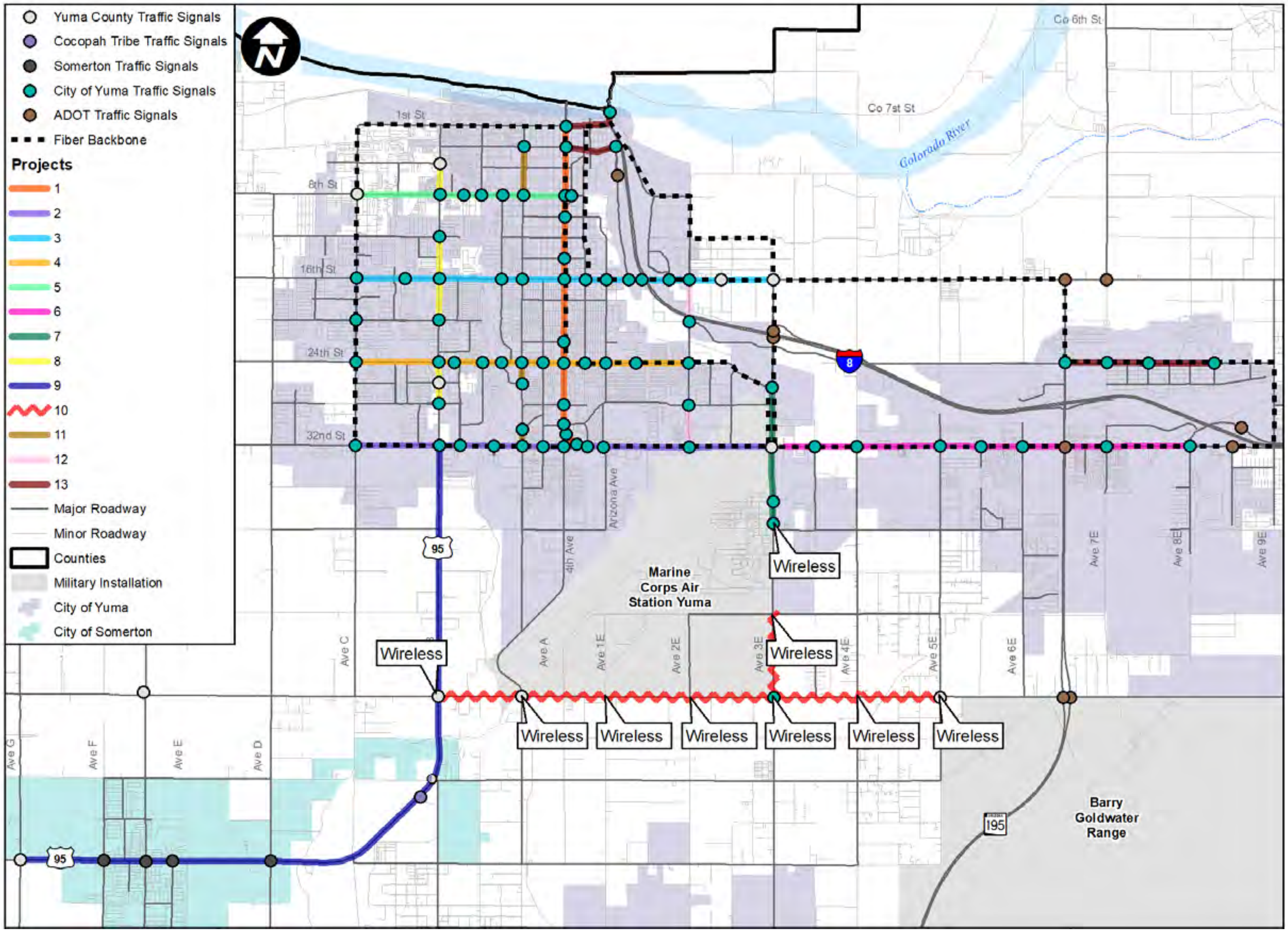


Figure 5 – ITS Infrastructure Projects Map with Wireless Device Locations (Project 9 Alternative)

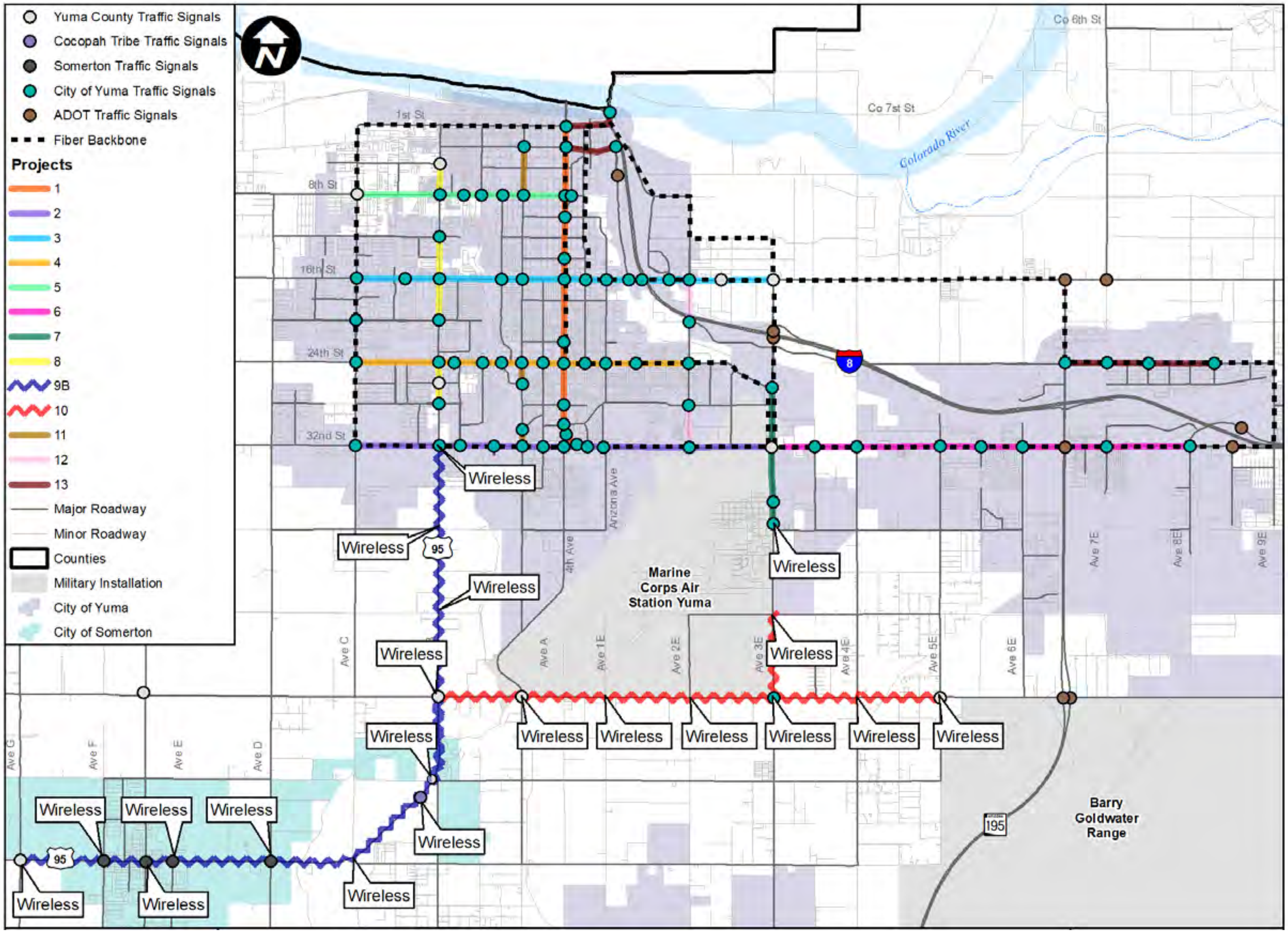


Figure 6 – ITS Infrastructure Projects Map with Wireless Device Locations (Project 9B Alternative)

Estimated ITS Project Quantities

Quantity assumptions for the new ITS infrastructure associated with each project are summarized **Table 1**. A comparison of quantities for Project 9 and the Project 9B Alternative is provided in **Table 2**.

Table 1: Estimated ITS Infrastructure Quantities

Corridor Project #	Corridor	Limits	Quantity of New ITS Infrastructure Needed								
			Miles of New Fiber	Miles of Conduit	No. of Signals in Project	Controller & Cabinet Equipment	EVP Units	Video Detection Units	No. 7 Pull Box with Extension	No. 9 Pull Box	Wireless Radio
1	4th Avenue	1st Street to 32nd Street	2.0	1.7	12	4	0	0	6	12	0
2	32nd Street	Avenue C to Avenue 3E	0.7	0.5	11	10	31	31	0	11	0
3	16th Street	Avenue C to Avenue 3E	3.8	3.4	13	11	20	41	15	13	0
4	24th Street	Avenue C to Pacific Avenue	3.4	3.1	11	9	30	26	14	11	0
5	8th Street	Avenue C to Orange Avenue	3.2	2.9	6	6	23	19	14	6	0
6	32nd Street	Avenue 3E to Avenue 8E	0.5	0.3	7	7	28	28	0	7	0
7	Avenue 3E	24th Street to MCAS Main Gate	1.2	1.1	3	3	11	3	6	3	1
8	Avenue B	5th Street to 28th Street	2.3	2.1	4	4	12	16	11	4	0
9	US 95	Avenue G to 32nd Street	10.5	9.8	8	8	31	27	50	8	1
10	County 14th Street	US 95 to Avenue 5E	0.0	0.0	3	7	12	12	0	0	7
11	Avenue A	3rd Street to 32nd Street	1.3	1.2	3	2	11	11	6	3	0
12	Pacific Avenue	16th Street to 32nd Street	1.3	1.2	2	2	8	4	6	2	0
13	1st Street	4th Avenue to Ocean to Ocean Bridge	1.8	1.6	6	6	21	21	7	6	0
	Harold C Giss Parkway	4th Avenue to Redondo Center Drive									
	24th Street	Araby Road to Otondo Drive									
Total Infrastructure Once All ITS Projects Are Completed:			***32.0***	***29.1***	***89***	***79***	***238***	***239***	***135***	***86***	***9***
			Miles of New Fiber in New & Existing Conduit	***Miles of New Conduit***	***Signals Improved with ITS Infrastructure***	***All signals will have up-to-date Controller, EVP, and Video Detection Equipment***			***New No. 7 Pull Boxes***	***New No. 9 Pull Boxes***	***Wireless Radios***

Table 2: Estimated ITS Infrastructure Quantities (Project 9 vs Project 9B)

Corridor Project #	Corridor	Limits	Quantity of New ITS Infrastructure Needed								
			Miles of New Fiber	Miles of Conduit	No. of Signals in Project	Controller & Cabinet Equipment	EVP Units	Video Detection Units	No. 7 Pull Box with Extension	No. 9 Pull Box	Wireless Radio
9	US 95	Avenue G to 32nd Street	10.5	9.8	8	8	31	27	50	8	1
9B	US 95	Avenue G to 32nd Street	0.0	0.0	8	8	31	27	0	0	12

Project Phasing

The ITS Corridor Projects are not targeted to be implemented on a particular time frame. Projects will be implemented as funding becomes available based on the priority level of the project and the stipulations of the funding source.

Multi-Agency Implementation Opportunities

If pursued as a multi-agency initiative, the region may be competitive to apply for federal grants to support implementation of the ITS network and or the TOC; if the region is successful in securing a grant, it will likely be for regional priority corridors that support regional travel, so those projects may be implemented earlier on than other projects.

Near-Term Implementation: Infrastructure Ownership Considerations

Because implementation of some ITS Corridor Projects is contingent upon multi-agency agreements or a multi-agency grant application, the implementation of the build-out network may not ultimately be feasible in a foreseeable timeframe. This is especially true of some of the other agencies that are not able to prioritize implementation of ITS Corridor Projects in the near-term.

The City has identified the implementation of the ITS network and the TOC to be a strategic priority, so the City may look to implement City-priorities for the network even if other agencies are not ready to pursue implementation. There are cases where the City should consider having discussions with Yuma County to swap intersection ownership to allow the City to implement and operate a cohesive ITS and traffic network. If Yuma County decides not to prioritize implementation of ITS Corridor Projects in the near-term, the following infrastructure ownership changes should be discussed:

- City takes ownership of the traffic signal at Ave B and 26th St
- City takes ownership of the traffic signal at Ave 3E and 32nd St
- Yuma County takes ownership of the traffic signal at Ave 3E and County 14th St

Additionally, the City may consider having discussions with ADOT on the possibility of taking ownership of the traffic signal at Araby Rd and 32nd St. Ownership of this traffic signal has been discussed before, with ADOT retaining ownership as the traffic signal is on SR 195. After the City implements its ITS program and begins to actively manage the system, the City may see benefits in re-engaging ADOT, through the Southwest District Engineer, in this discussion.

2.1 Traffic Operations Center

The City has the largest number of traffic signals and other traffic management equipment within the Yuma region but does not have the ability to monitor or actively operate its network. There could be significant safety, efficiency, and public relations benefits if the City Engineering staff, and potentially other regional partners, had the ability to monitor and operate traffic signals and other ITS devices in real-time from a centralized location. A TOC will allow for this centralization and real-time operations for the City network and creates an opportunity for multiple agencies to coordinate and collaborate on traffic operations and management strategies at the regional level.

The Yuma TOC ConOps defines the components of a TOC required to meet the specific traffic management needs of the City in a near-term and long-term concept. The TOC ConOps document is summarized in this section.

Proposed TOC Concept

A near-term and long-term concept for the TOC are detailed in the Yuma TOC ConOps document. A summary is provided below.

Near-Term

The near-term functions of the Yuma TOC focus on implementing systems and processes to elevate traffic management within the City to provide a safer and more efficient network and to improve maintenance response time and device uptime of the traffic network. The primary near-term functions are listed below and are depicted in **Figure 7**:

A. Connecting and Centrally Managing ITS Devices
B. Collecting and Archiving Operations Data
C. Real-Time Incident Data Exchange

A key component of the near-term concept is the implementation of an **advanced traffic management system (ATMS)**. The ATMS will allow TOC staff to collect and use real-time traffic operations and condition data to inform traffic signal timing strategies and allow TOC operators to make adjustments to traffic signal timing when they are not in the TOC. It will also enable remote infrastructure monitoring and provide alerts when there are malfunctions to ITS and communications equipment so that TOC staff can address equipment issues quickly.

Long-Term

As Yuma and the region grow, the functions and capabilities of the TOC may grow as well. Future, long-term focus areas for the TOC include expanding data collection, supporting traveler information dissemination, and elevating interagency coordination at the TOC. Long-term functions for the TOC are listed below and are depicted in **Figure 8**.

A. Expanding City of Yuma Connected Devices
B. Expanding Connectivity to Other Agency Devices
C. Inter-Departmental or Inter-Agency System Access
D. Traveler Information Dissemination

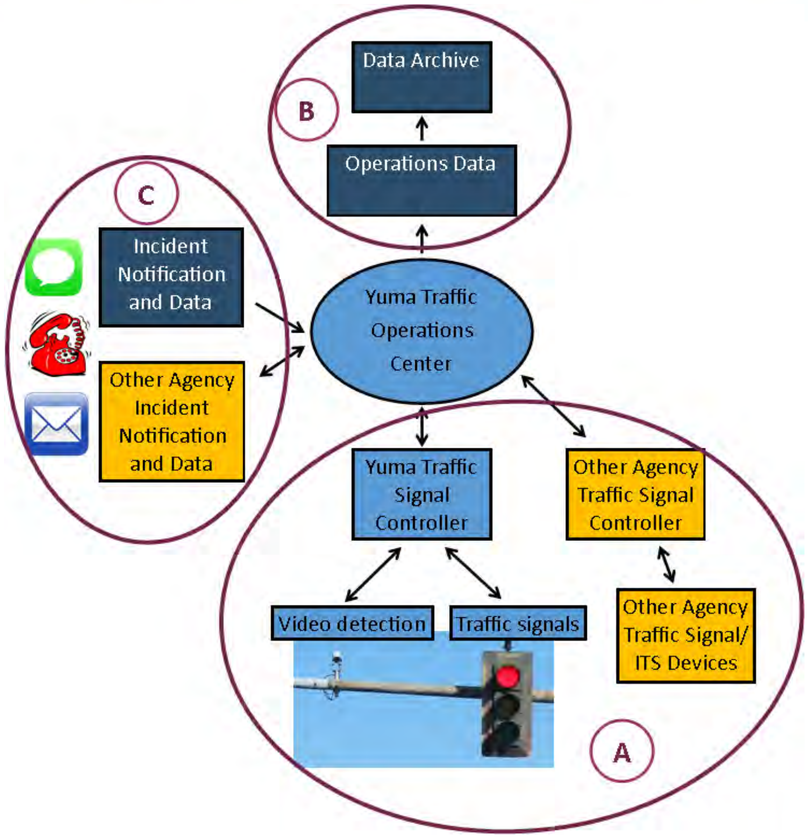


Figure 7 – Near-Term TOC Concept

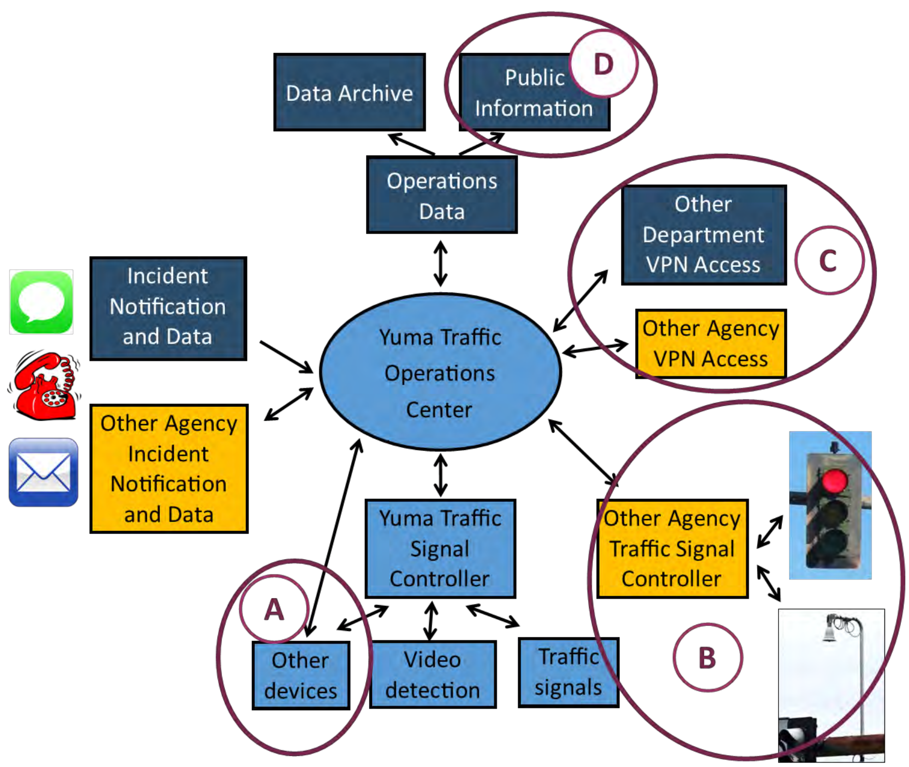


Figure 8 – Long-Term TOC Concept

TOC Infrastructure and Systems

Construction of a centralized TOC is expected to consist of near-term and long-term improvements that will occur in two phases – Initial Buildout and an Expansion Project. As outlined in the ConOps document, the physical TOC space will need to have the following five categories of physical components:

1. **Operations floor workstations** will provide access to TOC-specific systems, such as the ATMS and video systems that provide the ability to see video detection images, and City Enterprise systems for email and other intranet applications. The primary purpose of the operators on the floor is to operate/manage the TOC systems that support real-time traffic management, incident management, and information sharing.
   - The Initial Buildout is expected to include:
     - 1 Operations staff workstation
     - 1 Analysis staff workstation
     - 1 Spare/Shared workstation for temporary use by TOC staff, public safety, PIO, other agency staff, vendors, or contractors or for use by Operations/Analysis staff in the event of equipment failures at the primary Operations/Analysis workstation
     - Plan review space
   - The Expansion is expected to include:
     - 1 Analysis staff workstation
     - 1 additional monitor for the Operations workstation and 1 additional monitor for the Spare/Shared workstation to support workstation upgrades and/or additional systems.
2. **Office space** will be provided for management to allow for closed-door space, if needed, while still having access to TOC system and view of the video wall.
   - The Initial Buildout is expected to include 1 Management staff office workstation.
   - No additional equipment is needed for the Expansion.
3. A **video wall** will enable operators, managers, and other TOC personnel to share a common view of situational information.
   - The Initial Buildout is expected to include 4 flat panel displays (plus hardware, cables, and vendor support) for a 2x2 video wall grid
   - The Expansion is expected to include an additional 5 flat panel displays (plus hardware, cables, and vendor support) for a 3x3 video wall grid
4. **Common area** items, including storage, library, shelving/filing space, and other amenities that should need to be accessible to all staff in the TOC.
   - The Initial Buildout is expected to include:

    - Common furnishings such as shelving units, counters/review space, locking storage for staff, and a coat rack
    - Common office equipment such as a dedicated TOC phone and printer/scanner
  - An optional Conference Table could be included in the Expansion to provide a dedicated meeting area for TOC staff.

5. A **communications/server room** is needed to house the rack and server space needed to support the video wall and all equipment in the TOC.
   - The Initial Buildout is expected to include:
     - Dedicated HVAC system
     - 1 server and associated equipment
   - The Expansion is expected to include 2 additional servers and associated equipment

In addition to the costs for these components, TOC construction costs will also include building renovations and the initial ATMS system.

Building renovations will be needed to retrofit an existing City building space to accommodate the TOC common area, office, and server room.

- The Initial Buildout is expected to include:
  - A security system for the main TOC door and the server room
  - Miscellaneous renovations including possible wall relocations and relocating, adding, and/or removing windows and doors needed to accommodate the initial buildout components such as the office and server room
- The Expansion is expected to include:
  - 1 backup generator
  - Miscellaneous renovations including possible wall relocations and relocating, adding, and/or removing windows and doors, if needed for TOC upgrades

Initial setup of the **ATMS system**.

- The Initial Buildout is expected to include:
  - ATMS system software, licenses, and hardware
  - Vendor support for implementation and staff training plus 3 years of included maintenance
- The Expansion will not require any physical changes to the ATMS system, although there will be needs related to system upgrades or license expansions to accommodate additional infrastructure.

A Preliminary Layout for Existing Conditions, Initial Buildout, and the Expansion Phase is provided in **Appendix D**. The layouts assume an existing City building space will be used to house the TOC and are intended to show an example of how the TOC could be configured to include the necessary equipment outlined in this report and the associated Concept of Operations. The City may wish to use the Preliminary Layouts as a conceptual starting point for design of the TOC in the future, but it should be noted that the layouts are not to scale and should not be used for construction purposes. Separate architectural and structural plans will need to be developed for construction.

Costs associated with the near-term TOC construction and long-term upgrades are discussed in the Cost section of this document.

3. Project Implementation Costs

3.1 Capital Costs

ITS Corridor Projects Costs

ITS Cost Estimator

A planning-level cost estimate was developed for each of the 13 ITS corridor projects using the quantity assumptions in the previously referenced **Table 1**. This cost estimates include:

- Costs for installing new communications infrastructure and ITS devices, including conduit, fiber, wireless radios, and other ITS devices at traffic signals that have been identified to build out the City's ITS network.
- Costs to upgrade existing devices, including signal controllers, emergency preemption equipment, and video detection, where needed, to bring all intersections up to the current standards.

Unit pricing was estimated using current bid tabs for similar projects in the Yuma region and throughout the state of Arizona.

The planning-level cost calculations were developed using an ITS Cost Estimator spreadsheet which has been provided to the City in Microsoft Excel and in PDF format in (see **Appendix B**). The ITS Cost Estimator provides a breakdown of:

- ITS costs by item including above-the-line capital costs by ITS device;
- Below-the-line design, traffic control, construction, mobilization, and contingency costs to help calculate total project cost;
- Inflation rate assumptions to estimate project costs in future years;
- And suggested operations and maintenance costs associated with ITS devices.

This estimator worksheet is provided in Microsoft Excel format to be used for two specific purposes:

1. Estimating ITS costs during project development for ITS-specific projects; and
2. Estimating ITS costs for capital projects that can incorporate ITS elements and require cost estimation to include in the total project budgets.

The ITS Cost Estimator provides unit cost assumptions for a base year of 2021. Because the projects will require a design phase and construction is expected to be phased over several fiscal years, present-day costs were also projected out using a 5% growth rate per year for five years. This projection accounts for increases in unit costs between now and project deployment.

If used in the future, the City should confirm the unit cost assumptions against prevailing costs at that time to address potential unit cost changes that are dictated by changing technologies and fluctuations in material costs. A specific example of such a unit cost change occurred around 2005 when the price of steel rose significantly due to a material shortage driven by a rapidly-growing economy. A more general example of a unit cost change is when new technologies are invented and replace older and more costly technologies. Steel and other primary materials used in construction of ITS infrastructure, as well as technology cost changes, will dictate the cost estimator calculations.

It should be noted that future signal installations are not included in the project list and have been excluded from the estimate. As new signals are constructed and come online, they will need to be connected to the ITS network. All upcoming and future signal projects will need to take this into consideration and account for the necessary ITS infrastructure during design and when estimating construction costs. The ITS Cost Estimator Spreadsheet can be used as a tool when planning for these future installations. A list of known future signals is included with the intersection list in **Appendix C**.

Multi-Agency Project Cost Considerations

Notably, some of the projects will include facilities owned and operated by other agencies. At this time, it is unknown how project costs will be shared between agencies. For estimating purposes, costs have been broken down by agency based on the signals currently under their jurisdiction. For example, if a County signal is located at the end of a corridor (e.g. Project 2), it is assumed that the County will pay for all conduit, fiber, pull boxes, and wireless devices required to connect that signal to the next signalized intersection along the ITS backbone. If a County signal is located between two non-County signals (e.g. Project 8), it is assumed that the County will pay for all conduit, fiber, pull boxes, and wireless devices required to connect that signal to the backbone from one direction. Costs associated with the connection from the other direction would be assigned to the agency owning the next signal in the network. Any device upgrades including controllers, EVP, and video detection at the County signal are also assumed to be a County cost in this example.

Project Cost Estimates

A planning-level breakdown of the combined total costs for all 13 projects is provided in **Table 3**, by agency.

Table 3: Summary of Total Infrastructure Projects Costs by Agency

Agency	Current Cost (2021)	Future Cost (2026)
Total Yuma	$14,200,000	$18,100,000
Total Cocopah	$900,000	$1,100,000
Total Somerton	$2,200,000	$2,900,000
Total County	$3,500,000	$4,400,000
Total (All)	**$20,800,000**	**$26,500,000**

Table 4 summarizes the total project costs by project and per agency using present-day (2021) cost assumptions. **Table 5** summarizes the total project costs by project and per agency using future-year cost projections for a deployment year of 2026.

Table 4: Breakdown of Infrastructure Project Costs by Project (2021)

Current-Year Project Costs (2021)					
Project	Yuma Cost	County Cost	Cocopah Cost	Somerton Cost	Current Project Total
1	$1,000,000	N/A	N/A	N/A	$1,000,000
2	$1,200,000	$200,000	N/A	N/A	$1,400,000
3	$2,400,000	$400,000	N/A	N/A	$2,700,000
4	$2,300,000	N/A	N/A	N/A	$2,300,000
5	$1,400,000	$500,000	N/A	N/A	$2,000,000
6	$1,100,000	N/A	N/A	N/A	$1,100,000
7	$700,000	N/A	N/A	N/A	$700,000
8	$900,000	$400,000	N/A	N/A	$1,300,000
9	$0	$1,500,000	$900,000	$2,200,000	$4,600,000
10	$200,000	$500,000	N/A	N/A	$800,000
11	$800,000	N/A	N/A	N/A	$800,000
12	$700,000	N/A	N/A	N/A	$700,000
13	$1,400,000	N/A	N/A	N/A	$1,400,000
Total	$14,100,000	$3,500,000	$900,000	$2,200,000	$20,800,000

Table 5: Breakdown of Infrastructure Project Costs by Project (2026)

Future-Year Project Costs (2026)					
Project	Yuma Cost	County Cost	Cocopah Cost	Somerton Cost	Future Project Total
1	$1,200,000	N/A	N/A	N/A	$1,200,000
2	$1,600,000	$200,000	N/A	N/A	$1,800,000
3	$3,000,000	$500,000	N/A	N/A	$3,500,000
4	$3,000,000	N/A	N/A	N/A	$3,000,000
5	$1,800,000	$700,000	N/A	N/A	$2,500,000
6	$1,400,000	N/A	N/A	N/A	$1,400,000
7	$900,000	N/A	N/A	N/A	$900,000
8	$1,100,000	$500,000	N/A	N/A	$1,700,000
9	$0	$1,900,000	$1,100,000	$2,900,000	$5,900,000
10	$300,000	$700,000	N/A	N/A	$1,000,000
11	$1,100,000	N/A	N/A	N/A	$1,100,000
12	$900,000	N/A	N/A	N/A	$900,000
13	$1,800,000	N/A	N/A	N/A	$1,800,000
Total	$18,100,000	$4,500,000	$1,100,000	$2,900,000	$26,700,000

Alternative Project 9B

As mentioned previously, a cost-savings alternative was developed for Project 9 in which wireless radios are used exclusively instead of ITS fiber and conduit. **Table 6** displays the breakdown, by agency, for the combined cost of all 13 projects if this alternative is used. **Table 7** and **Table 8** show the estimated difference in current and future costs between Project 9 and the Project 9B Alternative.

Table 6: Summary of Total Infrastructure Projects Costs by Agency – Project 9B

Agency	Current Cost (2021)	Future Cost (2026)
Total Yuma	$14,200,000	$18,100,000
Total Cocopah	$400,000	$400,000
Total Somerton	$600,000	$800,000
Total County	$2,400,000	$3,100,000
Total (All)	**$17,600,000**	**$22,400,000**

Table 7: Breakdown of Infrastructure Project Costs (Project 9 vs Project 9B) (2021)

Current-Year Project Costs (Alternative 9 vs 9B) (2021)					
Project	Yuma Cost	County Cost	Cocopah Cost	Somerton Cost	Current Project Total
9	$0	$1,500,000	$900,000	$2,200,000	$4,600,000
9B	$0	$400,000	$400,000	$600,000	$1,400,000

Table 8: Breakdown of Infrastructure Project Costs (Project 9 vs Project 9B) (2026)

Future-Year Project Costs (Alternative 9 vs 9B) (2026)					
Project	Yuma Cost	County Cost	Cocopah Cost	Somerton Cost	Future Project Total
9	$0	$1,900,000	$1,100,000	$2,900,000	$5,900,000
9B	$0	$500,000	$400,000	$800,000	$1,700,000

As shown above, there is a current-year cost savings of around 3 million dollars if Alternative 9B is used. In the future year, the cost savings is closer to 4 million dollars.

However, it should be noted that while the estimated cost for the County, Cocopah, and Somerton would be greatly reduced, this alternative would not reduce the cost for the City of Yuma as Project 9 does not fall within the City's jurisdiction.

TOC Costs

A planning-level cost estimate was developed for the construction of a TOC based on the assumptions outlined in the ConOps document. The estimate includes costs associated with remodeling an existing City building to house a centralized TOC over two construction phases – Initial Buildout (near-term) and Expansion (long-term). Detailed information about the equipment and systems of the proposed TOC, including assumptions for physical TOC requirements, can be found in the ConOps document. Preliminary TOC Layouts (Not for Construction) are included in **Appendix D**.

TOC Initial Buildout

Table 9 summarizes major Initial Buildout costs for the TOC. This includes the operations floor workstations, office space, video wall, common area, server room, and building renovations.

Table 9: TOC Initial Buildout Costs

TOC Initial Buildout Costs	
Category	**Cost**
OPERATIONS FLOOR WORKSTATIONS	$ 39,300
OFFICE SPACE	$ 13,200
VIDEO WALL	$ 24,500
COMMON AREA (CONTROL ROOM)	$ 11,800
COMMUNICATIONS / SERVER ROOM	$ 127,300
BUILDING	$ 57,500
ATMS SYSTEM	$ 250,000
Total Element Cost	$ 523,600
Contingency (15%)	$ 80,000
Integration and Professional Services (7%)	$ 40,000
Total Project Cost	**$ 643,600**
Total Project Cost in Future Year	**$ 820,000**

TOC Expansion

Table 10 summarizes major Expansion costs for the proposed TOC expansions, including additional workstations and/or upgrades to existing workstations, video wall expansion, server upgrades, and associated building renovations.

Table 10: TOC Expansion Costs

TOC Expansion Costs	
Category	**Cost**
OPERATIONS FLOOR WORKSTATIONS	$ 13,700
VIDEO WALL	$ 29,750
COMMON AREA (CONTROL ROOM)	$ 5,000
COMMUNICATIONS / SERVER ROOM	$ 17,000
BUILDING	$ 55,000
Total Element Cost	$ 120,450
Contingency (15%)	$ 20,000
Integration and Professional Services (7%)	$ 10,000
Total Project Cost	**$ 150,450**
Total Project Cost in Future Year	**$ 190,000**

A detailed breakdown of the cost calculations for the initial buildout and expansion projects are included in the TOC Cost Estimator spreadsheet (see **Appendix D**).

Multi-Agency TOC Cost Considerations

The Initial Buildout costs for the TOC assumes that only City infrastructure is being connected and operated from the TOC. However, the TOC ConOps was developed to create opportunities for other agencies in the region to connect their traffic signal and ITS infrastructure to the TOC so that it can be operated and managed. The Agreements section of this document discusses considerations for legal and process-related logistics for making these connections and monitoring and operating devices between agencies; during these agreement discussions, there may be consideration for sharing TOC expansion costs between agencies based on the magnitude of new costs that will be generated to connect and operate other agency devices. **Table 11** outlines cost considerations for implementing a multi-agency TOC.

Table 11: Cost Considerations for TOC Expansion to Support Multiple Agencies

Additional TOC Need	Cost	When Cost Might be Considered
New Workstation	$13,100 per workstation	If an agency requires a dedicated workstation to monitor and operate their ITS infrastructure
Integration	Labor cost	If a vendor or consultant is required to help integrate any new devices or systems into the TOC systems and servers

These Multi-Agency Expansion costs assume that the proposed TOC space is sufficient for any proposed upgrades or expansions, including additional workstations or servers for other agencies. Should it be determined that additional physical building space is needed, there would be additional construction costs not accounted for in this version of the Infrastructure Plan.

3.2 Operating and Maintenance Costs

It is important for the City to establish a lifecycle management and maintenance program for ITS devices. O&M of ITS technologies and systems extends beyond keeping the equipment working. Reacting to emergency failure conditions, maintaining accurate maintenance logs, and conducting preventive maintenance programs all require processes to be in place and trained staff to perform them. A comprehensive inventory of devices will help in planning for when device upgrade or replacement should occur and can track the tradeoff costs of maintaining equipment beyond its lifecycle versus replacing the equipment.

ITS Maintenance Program

The City has funding to support maintenance of traffic signal devices to keep devices in a functional state. Currently, the City is upgrading three-to-four traffic signal intersections every year as part of an asset replacement program. The City should establish a similar program for the current and new traffic signal and ITS infrastructure based on the projected lifecycles and speed of technology advancement for different technologies.

There are two maintenance types to consider – preventative and responsive maintenance.

- **Preventive 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.

Preventative Maintenance

Preventive maintenance is a set of procedures that involve repetitive upkeep of ITS devices and systems to ensure the reliability and longevity of the mechanical and electrical operations of an ITS device or system and reduce failures. Preventive maintenance includes minor and major maintenance, making the frequency of maintenance an important consideration.

Table 12 outlines the preventive maintenance activities and frequencies for various ITS devices, device components, and systems. This table can be used as a reference or used as a checklist when incorporating new signals, new ITS infrastructure, or new staff. The City should review and revise the preventive maintenance procedures on an annual basis to ensure new issues are being addressed.

Table 12: Preventive Maintenance Recommendations

Intersection Preventative Maintenance	Recommended Interval
Interior Cabinet Check	
Clean cabinet Interior Check controller lamp and door switch Check fan and thermostat Check filter Check door fit and gasket Check locks and hinges Check/verify for cabinet timing and log sheet Check field block terminal connections Check conflict monitor indications	Annually
Check all detectors	Quarterly
Exterior Cabinet and Field Check	
Check condition of cabinet exterior Check all signal indications Check all pedestrian indications Check pole conditions and hand hole covers	Annually
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 detectors	Quarterly
Visual check of other traffic system related cabinets	Annually

Responsive Maintenance

ITS devices and systems have specific maintenance requirements per the manufacturer's maintenance manual for 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 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 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 and other heavy equipment.

- *Major Rehabilitation* – Major rehabilitation or complete replacement is contemplated for devices that experience frequent malfunctions or failures.

Table 13 identifies the typical frequency of minor and major maintenance, major rehabilitation, and lifecycle timeframes for a range of ITS devices. The following are resources that were utilized in the development of recommended ITS device maintenance guidelines for the City:

- Recommended Practice for Operations and Management of ITS (ITE Publication); and
- International Municipal Signal Association (IMSA) Preventive Maintenance of Traffic Signal Equipment Program.

The City is encouraged to use these guidelines to create their maintenance program, understanding there may be constraints on resources in some situations.

Table 13: ITS Device and Communications Maintenance Guidelines

Equipment Type	Minor Maintenance	Major Maintenance	Major Rehabilitation	Lifecycle Timeframe
Traffic Signal Systems				
Cabinets	26 weeks	2 – 5 years	10 years	10 years
Signal Heads	26 weeks	2 – 5 years	10 years	20 years
Electronics	13 weeks	N/A	N/A	10 years
Poles	26 weeks	5 years	15 years	50 years
Vehicle Detection Systems				
Cabinets	---	26 weeks	10 years	20 years
Power Supply	26 weeks	5 years	10 years	20 years
Grounding	1 year	5 years	10 years	25 years
Controllers	---	26 weeks	2 years	7 years
ITS Telecommunications Systems				
Fiber Optic Cable Plant	1 year	5 years	25 years	25 years
Fiber Optic Plan Video and Data Equipment	---	26 weeks	3 years	10 years
TOC Equipment				
Servers	26 weeks	1 year	2 years	5 years
Rack Equipment	-	1 year	2 years	5 years
Workstations	26 weeks	2 years	2 years	5 years
Workstation Displays	26 weeks	1 year	3 years	5 years
Uninterruptible Power Supply	1 year	5 years	10 years	20 years

These guidelines should be updated as information becomes available to incorporate the increased reliability that may be the result as new technologies are implemented or devices are upgraded.

As additional and new types of devices and systems are implemented, including new field devices and the TOC, the departments who are responsible for tracking the various assets should keep a detailed inventory of maintenance activities that have occurred in the Lucity asset management system. This tracking will allow the ITS Program to identify devices that are not reliable, not 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 more costly than upgrading to a newer technology.

ITS Operations and Maintenance Annual Program Budget

Initially, the focus of the ITS network will be on capital design and implementation. As more infrastructure is implemented, the focus will have to begin to shift towards operations and maintenance of the network. The City should look to establish an annual operations & maintenance budget for the ITS network and the TOC that can be used to keep the ITS and field infrastructure up-to-date and in working order.

An annual O&M budget for ITS should support needs arising from routine maintenance, necessary updates/upgrades, and lifecycle replacements of infrastructure. Replacement of equipment may be necessary when a device has experienced frequent malfunctions, communications or operating failures, irreparable damage, or has exceeded its lifecycle expectancy.

To help with the annual budget planning for these devices, annual O&M costs were established for each equipment type. Estimated annual O&M costs at build-out conditions (when all ITS Corridor Projects are completed) are summarized in **Table 14**.

Table 14: Annual ITS and TOC Operations and Maintenance Costs at Build-out

Equipment Type	Annual O&M Cost per Unit	Ultimate Planned Devices	Total Annual O&M
ITS Communications Assets			
Field Network Switches	$200	75	$15,000
Wireless Radio	$250	6	$1,500
Traffic Signal Assets			
Traffic Signal Controller	$500	75	$37,500
Video Image Detection	$150	300	$45,000
Emergency Vehicle Preemption	$500	63	$37,500
Traffic Operations Center Assets			
Computer equipment, video wall, central systems, work stations, servers and associated equipment			$50,000
TOTAL CITY OF YUMA ANNUAL O&M COST AT BUILD-OUT			**$186,500**

4. Staffing

Specific staff roles and a minimum number of staff will be needed to properly maintain new ITS infrastructure to be deployed as part of the ITS Corridor Projects and staff the TOC.

4.1 ITS Device Maintenance Staffing

The City will need to consider staffing requirements for maintenance of new ITS infrastructure. **Table 15** provides a comparison of staffing numbers at other Arizona public department of transportation agencies that have TOCs and have a similar number of traffic signals as the City.

Table 15: ITS Staffing Comparison of Comparable Cities

	City of Surprise	City of Goodyear	City of Peoria
Total # of traffic signals / # signals connected to a TOC	49 / 46	88 / 56	118 / 116
# of ITS maintenance staff	2	4	5
Maintenance staff per traffic signal	1 : 25	1 : 22	1 : 24

Based on these comparisons, the City should look to maintain a maintenance staff-to-infrastructure ratio of around 25 traffic signals per ITS/signal technician. The City should pursue technicians that can support both traffic signal and ITS maintenance by cross training staff to achieve the 25-to-1 ratio. At the build-out condition, the City intends to have 75 intersections with ITS infrastructure that are connected to the TOC, so there should be a total of three (3) ITS or signal technicians (who are cross-trained) available to support ITS device maintenance.

4.2 TOC Staffing

The following roles may be accomplished by designated TOC staff positions or a combination of existing staff who take on TOC-specific roles as part of their current position:

- **Management** – Responsible for overseeing and managing the TOC, the ITS network, and general City traffic operations.
- **Analysis** – Responsible for managing and implementing traffic signal timing in the City.
- **Operations** – Responsible for the real-time operation and management of ITS equipment and systems to support real-time and coordinated traffic operations from the TOC.

The TOC ConOps goes into further detail of the responsibilities of the three TOC roles. ITS device and traffic signal maintenance responsibilities will remain with the Public Works Department, which will be external of the TOC. Similarly, the responsibilities for network administration and maintenance responsibilities will be provided by the City IT Department, which will also be external of the TOC.

In the near-term, the TOC roles will be accomplished by a combination of four existing positions within the TSMO group – the City Traffic Engineer, the Civil Engineer dedicated to Traffic, and Senior Technicians. There will also be support from City Public Works and IT. The TOC-related responsibilities will represent a portion of the overall responsibilities of each of those positions.

A long-term TOC concept may necessitate additional staff to support the core TOC roles. It is likely that this will be accomplished by identifying additional staff to support the Operations role as part of their job; however, if the amount of infrastructure and operational functions provided by the TOC is great enough, the City may consider establishing staff positions for the Operator role and the Management role that are dedicated to the TOC (i.e. TOC Operator and TOC Manager).

Based on industry trends, including those of other cities in Arizona that have TOCs, a relative threshold for indicating the need for an additional staff person to support the Operator role is when the TOC is responsible for operating more than 100 traffic signals. In the long-term, it is likely the number of City traffic signals will reach this 100-signal threshold and warrant an additional staff person to support the Operator role.

5. Agreements

To accomplish the proposed ITS Corridor Projects and the TOC vision and functions, there will need to be additional agreements and coordination between City departments and between the City and other agencies in the region. Some coordination will occur informally, meaning that formal documentation may not be required, but that there is general agreement on processes. Other functions, especially those that involve the sharing of financial, system, or staff resources, will require formal agreements, such as IGAs, to implement.

Recommended Coordination/Informal Agreements

Figure 9 shows the items that would require coordination or informal agreements between the TOC and other city departments and other agencies to execute the items in this plan.

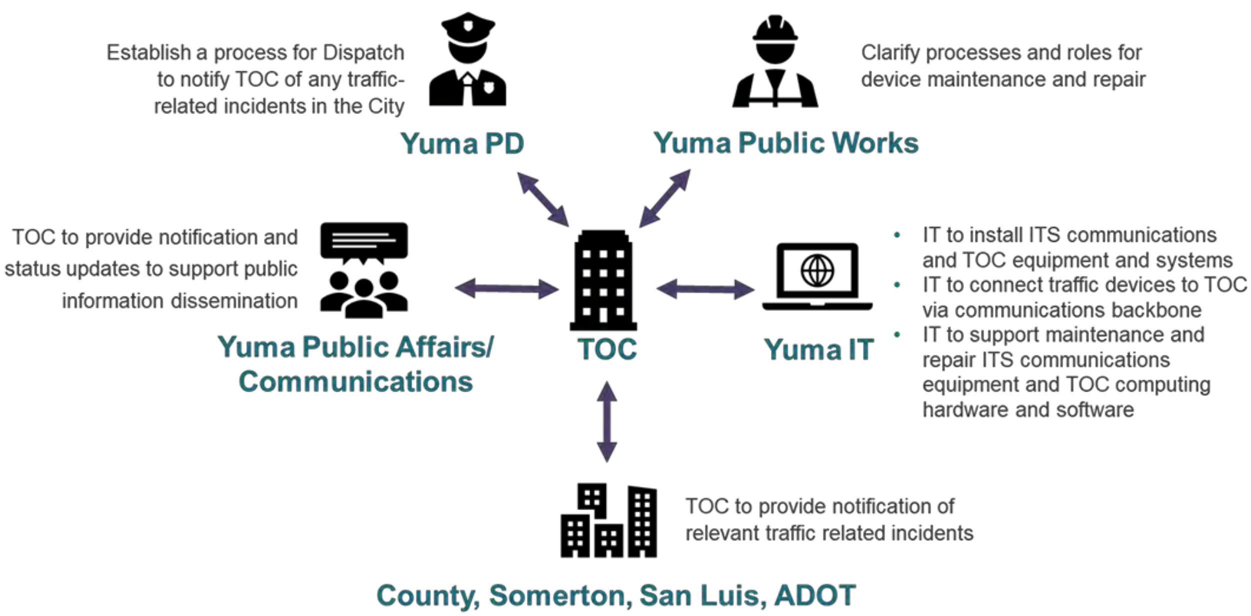


Figure 9 – Summary of Coordination / Informal Agreements

Recommended Formal Agreements

Figure 10 shows the items that would require formal agreements, which could take the form of IGAs, policies, or other formalized documents, that will need to be in place between the TOC and other City departments and between the City of Yuma and other agencies to execute the items in this plan.

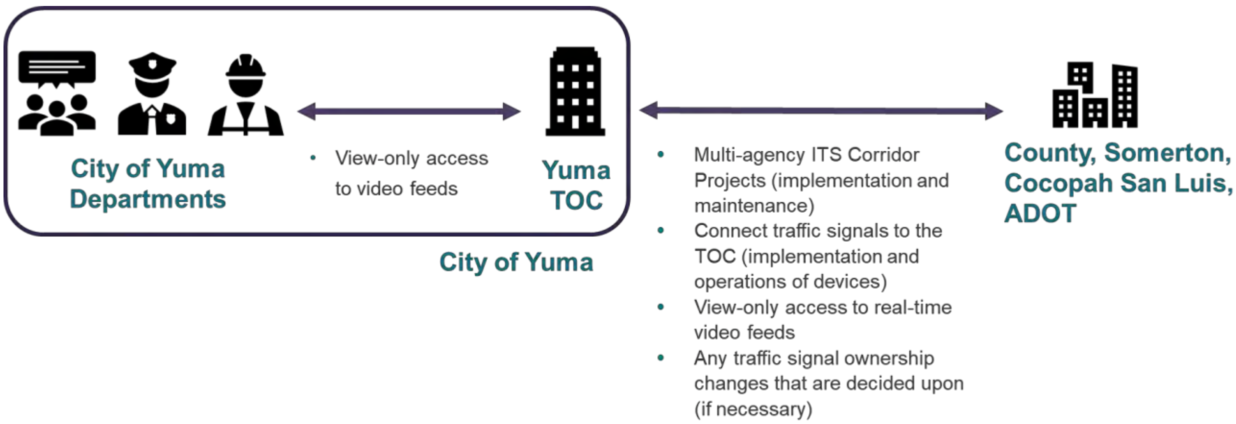


Figure 10 – Summary of Formal Agreements or Policies

6. Funding

The City uses a mixture of several funding sources to fund different types of projects. Many of the construction projects get funded through a combination of federal, state, and local funding sources. These include:

- Highway Safety Improvement Program (HSIP) funds – through YMPO TIP;
- Surface Transportation Block Grant (STBG) funds – through YPMO TIP;
- Highway User Revenue Funds (HURF) – through ADOT; and
- City Road Tax revenue funds – through City CIP.

Currently, the City has an operating budget is that is used generally for signals, signing, and pavement marking. The operations budget comes from City road tax and state-allocated Highway User Revenue Funds (HURF). The budget is split between Engineering and Public Works. Field operations and maintenance, as well as any signal timing upgrades, are funded through the Public Works operating budget. Engineering analysis and management is funded through the Engineering budget.

Implementation of the ITS Infrastructure Plan projects is contingent upon the attainment of additional funding for infrastructure, systems, staff time, and contractor services. **Table 16** presents potential funding opportunities for ITS infrastructure and systems.

Table 16: ITS Funding Opportunities

Funding Source	Description	Relevant Schedule
YMPO Transportation Improvement Program (TIP)	A regional list of transportation projects selected for local, state, and/or federal funding within with YMPO Yuma County area.	TIP programming covers a period of 5 years. The TIP process occurs each year and the City should stay apprised of project submittal requirements.
City of Yuma Capital Improvement Program (CIP)	The City financial plan for local infrastructure improvement projects. Projects included are identified by all City Departments, reviewed by a review committee, and approved by City Council.	CIP programming covers a period of five years, updated each year for the following five-year period. The CIP process occurs each year and the City should stay apprised of project submittal requirements.
Development-driven projects	A potential source of project funding is through development driven improvements. Establishing ITS standards for developers to follow within private development projects or half street improvements can aide in the City ITS program buildout.	Infrastructure would be installed as development projects are established.
Federal Funding	Federal funding opportunities are released by the USDOT or other federal agency that can support agencies in planning for, designing, and/or constructing	Federal grant opportunities are often dictated by the current transportation

Funding Source	Description	Relevant Schedule
	transportation infrastructure investments. Some examples include the Infrastructure For Rebuilding America (INFRA) discretionary grant and Better Utilizing Investments to Leverage Development (BUILD) Transportation discretionary grant. There are also some ITS/technology specific opportunities that area available – some recent examples are the Smart City Challenge, the Advanced Transportation and congestion Management Technologies Deployment (ATCMTD) grant, or the Automated Driving Systems (ADS) grant. Typically, federal funding is acquired by agencies like YMPO or ADOT, with local agencies are partners. Projects that show partnership and cooperation by multiple agencies in a region can elevate the attractiveness of applications for these federal opportunities.	legislation that is in place (the FAST Act is the current legislation). Some grants are one-time opportunities, while others occur on a recurring schedule.
State Funding	State agencies, including ADOT, will make funding available to regions or local agencies to support transportation investments. ADOT's Planning assistance for Rural Areas (PARA) program provided funds to agencies for planning and preliminary scoping for transportation projects. The State Commerce Authority has programs that will support local government investments as they align with economic development and enhanced livelihood; for example, the Arizona Rural Broadband Development Grant makes funds available to act as grant match dollars to leverage additional federal resources to accelerate broadband deployment in underserved areas.	State funding opportunities may be dictated by the current federal legislation in place, while others use sale tax money or other local sources. The state funding processes occur each year and the City should stay apprised of project submittal requirements.

Appendix A – No Existing Fiber Backbone Scenario

As discussed in Section 2 of this document, the City IT department has a vision to implement City fiber backbone to support City enterprise and telecommunications needs with a redundant, ring typology. This desired layout was shown in **Figure 3**. The assumption for ITS Corridor Projects 1 through 13 (the "Original Project List") is that the IT-lead fiber backbone will be in place prior to construction of any transportation-specific telecommunications. This section provides an overview of a Modified Project List in the event that the IT fiber backbone is not in place prior to implementation of ITS Corridor Projects and instead considers how the ITS networks would be implemented along with a new backbone.

A.1 Modified Project List

In this modified scenario, a Fiber Backbone Ring will still be constructed prior to implementation of the other ITS Corridor Projects, although this proposed backbone ring would be a simplified loop in the southwest portion of the City and include segments on 16th St, 4th Ave, 32nd St, and Ave C. This is shown as the dotted line in **Figure A1**. This is referred to as Project 0 in the modified project list in this section.

The Modified Project List and the respective limits of each are provided below. The strategy and considerations behind the project corridors and communications infrastructure are generally the same as the Original Project List, but the scope and physical limits of each project is slightly different due to the modified backbone layout. Items marked with an asterisk (*) have new project limits and/or a modified scope compared to the original project. Items marked with a double asterisk (**) represent a brand-new project.

0. Fiber Backbone Ring **
1. 4th Ave (16th St to 1st St) *
2. 32nd St (4th Ave to Ave 3E) *
3. 16th St (4th Ave to Pacific Ave) *
4. 24th St (Ave B to Pacific Ave) *
5. 8th St (Ave C to Orange Ave)
6. 32nd St (Ave 3E to Ave 8½ E) *
7. Ave 3E (24th St to MCAS Main Gate/Quilter St) *
8. Ave B (5th St to 28th St)
9. Interstate 95 (County 14th St to Ave G)
10. County 14th St (Ave B to Araby Road)
11. Ave A (3rd St to 32nd St)
12. Pacific Ave (16th St to 32nd St)
13. 24th St (Araby Rd to Ave 7E), 1st St (4th Ave to Penitentiary Ave Signal), 3rd St (4th Ave to Redondo Center Dr), Araby Rd (24th St to 32nd St) *

Projects 1 through 13 could commence after construction of the fiber backbone (Project 0).

The Modified Project locations and backbone ring are shown in **Figure A1**. A project map, including wireless device and necessary network switch locations, is shown in **Figure A2**. Like the Original Project List, there are Project 9 and Project 9B Alternatives, where Project 9B provides a fully wireless alternative; this alternative is shown in **Figure A3**.

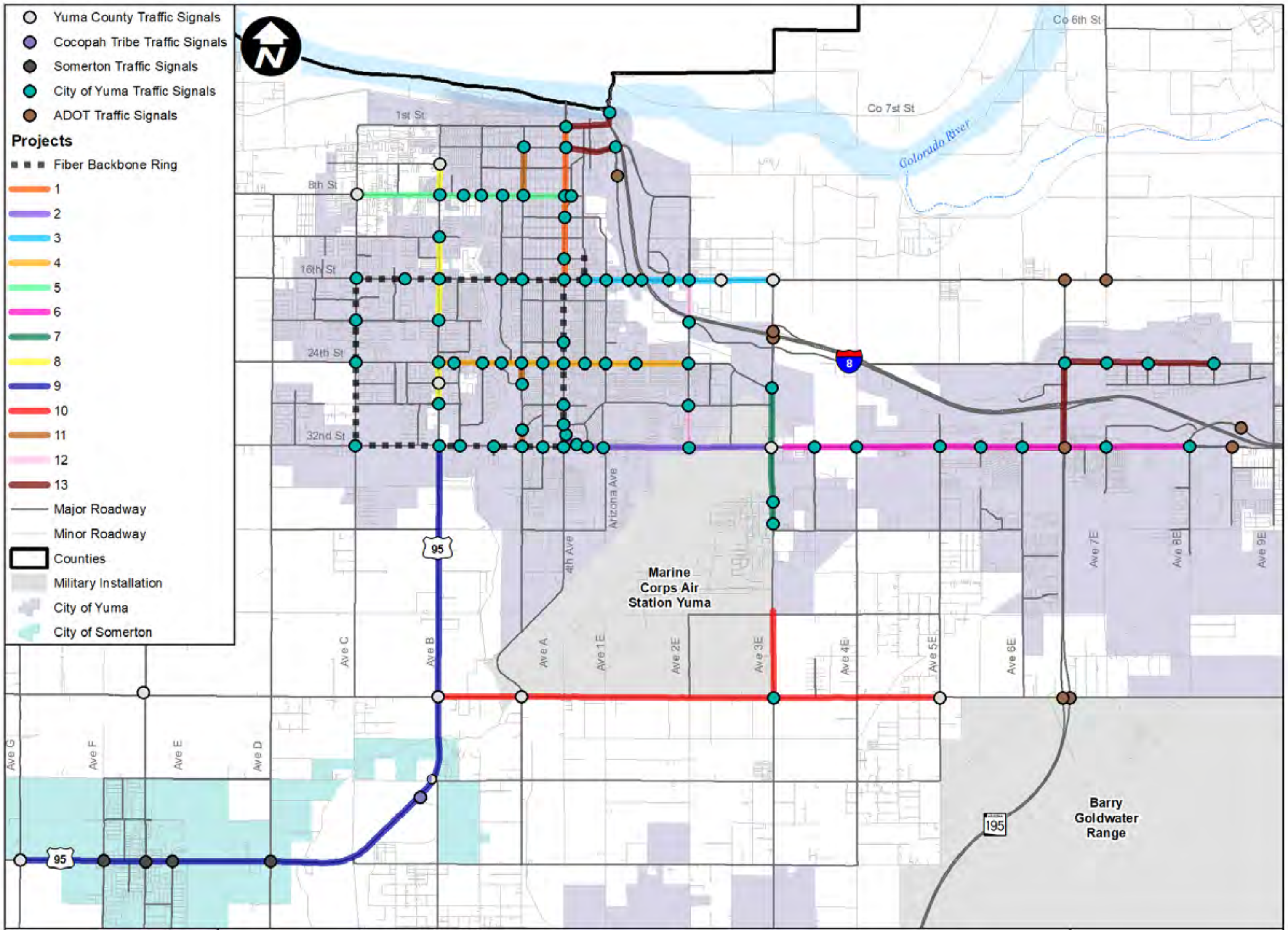


Figure A1 – ITS Infrastructure Projects Locations (Modified Project List for No Existing Backbone)

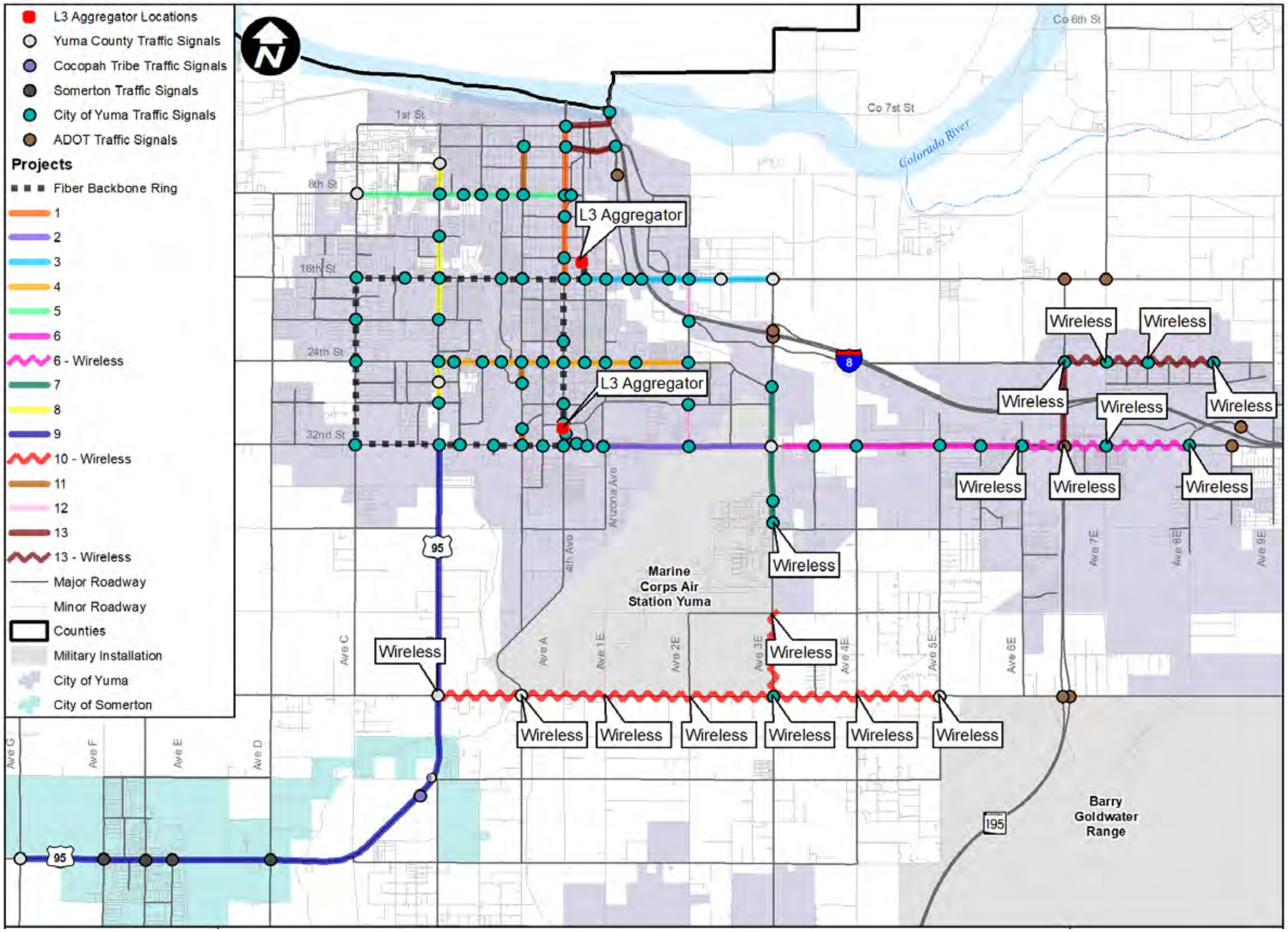


Figure A2 – ITS Infrastructure Projects Map with Wireless Device Locations (Project 9 Alternative) (Modified Project List for No Existing Backbone)

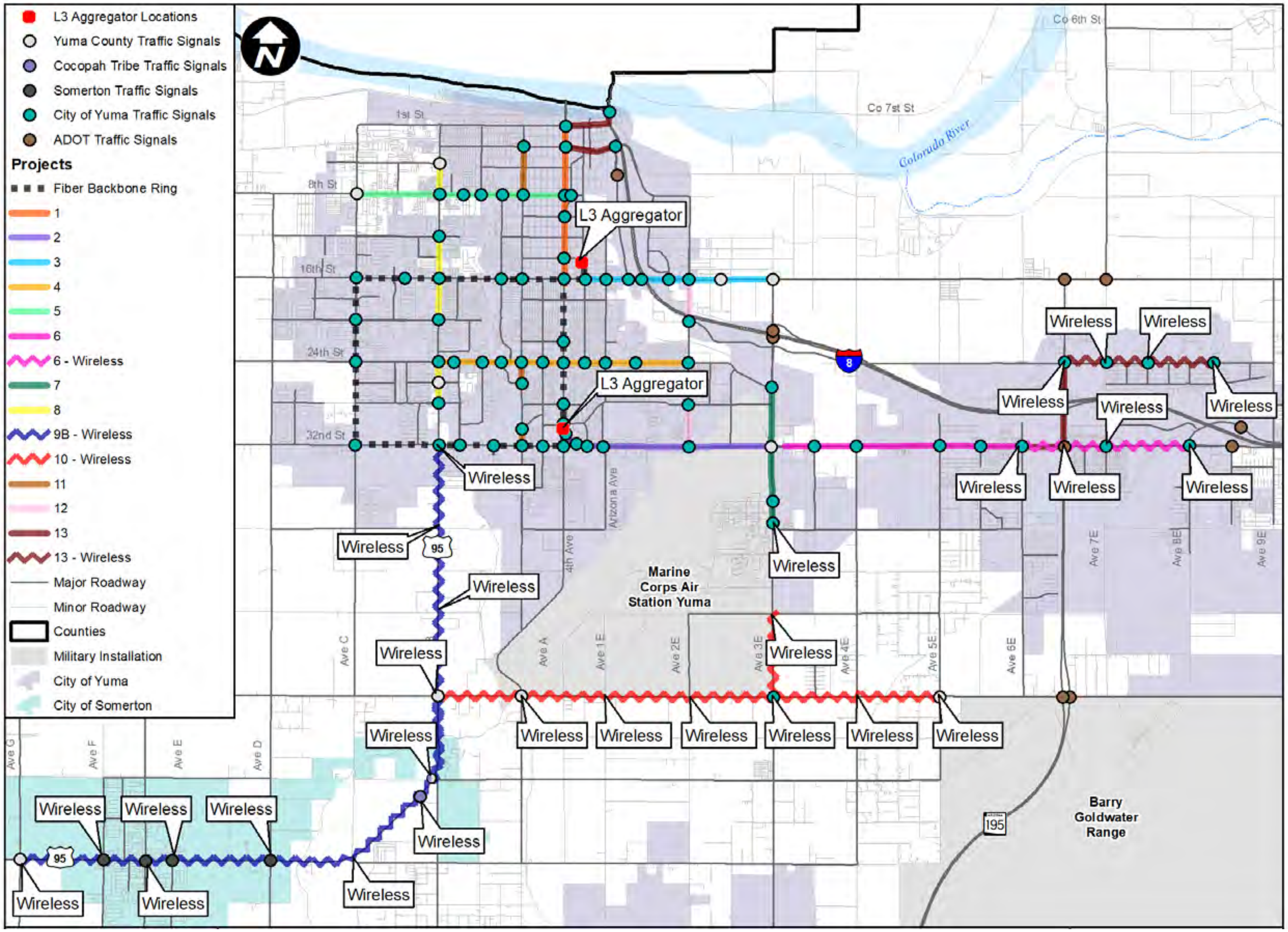


Figure A3 – ITS Infrastructure Projects Map with Wireless Device Locations (Project 9B Alternative) (Modified Project List for No Existing Backbone)

A brief description of each modified project is provided below:

Fiber Backbone Ring – This project is located on 1st Ave from 14th St to 16th St, 16th St from Ave C to 1st Ave, 4th Ave from 16th St to 32nd St, 32nd St from 4th Ave to Ave C, and Ave C from 32nd St to 16th St. This project impacts 21 signals, all owned by the City. This project will establish a fiber backbone loop in the southwest portion of the City that other projects can connect to via branch connections and will include Layer 3 (L3) Aggregator Switch locations as shown on the map. The project includes approximately 11.7 miles of new fiber optic cable, inclusive of backbone fiber and branch cables, and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 1 – This project is located on 4th Ave from 16th St to 1st St and impacts a total of 5 signalized intersections, all owned by the City. This project will connect the 4th Ave corridor to the fiber backbone at 16th St. This project includes approximately 2.3 miles of new fiber optic cable and new signal controllers where upgrades are needed.

Project 2 – This project is located on 32nd St from 4th Ave to Ave 3E and impacts a total of 5 signalized intersections (4 Yuma, 1 County). This project will connect the middle portion of the 32nd St corridor to the fiber backbone. This project includes approximately 2.8 miles of new fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 3 – This project is located on 16th St from 4th Ave to Pacific Ave and impacts a total of 7 signalized intersections (5 Yuma, 2 County). This project will connect the 16th St corridor to the fiber backbone at 1st Ave. This project includes approximately 2.9 miles of new fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 4 – This project is located on 24th St from Ave B to Pacific Ave and impacts a total of 10 signalized intersections, all owned by the City. This project will connect the 24th St corridor to the fiber backbone at 4th Ave. This project includes approximately 3.9 miles of new fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 5 – This project has the same scope as the Original Project List, except the project will not connect directly to the fiber backbone. Instead, it will connect the 8th St corridor to the fiber backbone via a branch connection at 4th Ave. See Section 2 for additional details.

Project 6 – This project is located on 32nd St from Ave 3E to Ave 8½E and impacts a total of 7 signalized intersections, all owned by the City. There are 2 additional intersections along 32nd St that are owned by ADOT, but it is assumed that no new ITS equipment or other improvements will be installed at the ADOT intersections. This project will connect the east half of the 32nd St corridor to the fiber backbone via a branch connection at Ave 3E (Project 2). In this scenario, wireless radio would be used as a cost-savings measure in lieu of fiber to communicate with the signalized intersections east of Ave 6E. The wireless device located at the ADOT intersection would be installed on a new pole to avoid impacts to existing ADOT signal infrastructure and equipment. This project includes approximately 3.5 miles of fiber optic cable and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 7 – This project is located on Ave 3E from 24th St to MCAS Main Gate (Quilter St) and impacts a total of 3 signalized intersections, all owned by the City. Coordination will be needed with the County to connect to the County signal located at 32nd St and Avenue 3E (Project 2). This project will connect the Ave 3E corridor to the fiber backbone via a branch connection at 32nd St (Project 2). A wireless device at the southern end of the project will be used to create a wireless connection to the County 14th St corridor (Project 10). This project includes approximately 2.0 miles of fiber optic cable, 1 wireless radio, and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Project 8 – This project has the same scope as the Original Project List, except the project will now tie directly into the fiber backbone. The County-owned HAWK at 5th St and Avenue B is excluded from the project. This project will connect standalone intersections on Ave B to the fiber backbone at 16th St and via branch connections on 8th St (Project 5) and 24th St (Project 4). See Section 2 for additional details.

Project 9 – Same scope as the Original Project List. See Section 2 for project description.

Project 9B – Same scope as the Original Project List. See Section 2 for project description.

Project 10 – Same scope as the Original Project List. See Section 2 for project description.

Project 11 – Same scope as the Original Project List. See Section 2 for project description.

Project 12 – Same scope as the Original Project List. See Section 2 for project description.

Project 13 – This project is located on 24th St from Araby Rd to Ave 7E, 1st St from 4th Ave to Penitentiary Ave Signal, 3rd St from 4th Ave to Redondo Center Dr, and Araby Rd from 24th St to 32nd St. It impacts a total of 6 signalized intersections, all owned by the City. This project will connect the 1st St corridor and Harold Giss Pkwy corridor to the fiber backbone via a branch connection on 4th Ave (Project 1). This project will also connect the east portion of the 24th St corridor to the fiber backbone via fiber connection to 32nd St (Project 6). A wireless connection will connect the signals along 24th St. This project includes approximately 3.2 miles of fiber optic and upgrades to new video detection, new EVP, new UPS devices, new ATCCs, and new signal controllers where needed.

Quantity assumptions for the new ITS infrastructure associated with each project are summarized **Table A1**. A comparison of quantities for Project 9 and the Project 9B Alternative is provided in **Table A2**.

Table A1: Estimated ITS Infrastructure Quantities

Corridor Project #	Corridor	Limits	Quantity of New ITS Infrastructure Needed								
			Miles of New Fiber	Miles of Conduit	No. of Signals in Project	Controller & Cabinet Equipment	EVP Units	Video Detection Units	No. 7 Pull Box with Extension	No. 9 Pull Box	Wireless Radio
Core Ring	4th Avenue, 16th Street, Avenue C, 32nd Street	Loop	11.7	10.8	21	15	35	31	52	21	0
1	4th Avenue	1st Street to 16th Street	2.3	2.1	5	2	0	0	10	5	0
2	32nd Street	4th Avenue to Avenue 3E	2.8	2.6	5	4	12	12	13	5	0
3	16th Street	1st Avenue to Avenue 3E	2.9	2.6	7	6	12	29	13	7	0
4	24th Street	Avenue B to Pacific Avenue	3.9	3.6	10	8	26	26	17	10	0
5	8th Street	Avenue C to Orange Avenue	3.2	2.9	6	6	23	19	14	6	0
6	32nd Street	Avenue 3E to Avenue 8E	3.5	3.2	7	7	28	28	16	5	4
7	Avenue 3E	24th Street to MCAS Main Gate	2.0	1.8	3	3	11	3	9	3	1
8	Avenue B	5th Street to 28th Street	2.3	2.1	4	4	12	16	11	4	0
9	US 95	Avenue G to 32nd Street	10.5	9.8	8	8	31	27	50	8	1
10	County 14th Street	US 95 to Avenue 5E	0.0	0.0	3	7	12	12	0	0	7
11	Avenue A	3rd Street to 32nd Street	1.3	1.2	3	2	11	11	6	3	0
12	Pacific Avenue	16th Street to 32nd Street	1.3	1.2	2	2	8	4	6	2	0
13	1st Street	4th Avenue to Ocean to Ocean Bridge	3.2	3.0	6	6	21	21	16	2	4
	Harold C Giss Parkway	4th Avenue to Redondo Center Drive									
	24th Street	Araby Road to Otondo Drive									
Total Infrastructure Once All ITS Projects Are Completed:			***50.8***	***47.1***	***90***	***80***	***242***	***239***	***233***	***81***	***17***
			Miles of New Fiber in New & Existing Conduit	***Miles of New Conduit***	***Locations Improved with ITS Infrastructure***	***All signals will have up-to-date Controller, EVP, and Video Detection Equipment***			***New No. 7 Pull Boxes***	***New No. 9 Pull Boxes***	***Wireless Radios***

Table A2: Estimated ITS Infrastructure Quantities (Project 9 vs Project 9B)

Corridor Project #	Corridor	Limits	Quantity of New ITS Infrastructure Needed								
			Miles of New Fiber	Miles of Conduit	No. of Signals in Project	Controller & Cabinet Equipment	EVP Units	Video Detection Units	No. 7 Pull Box with Extension	No. 9 Pull Box	Wireless Radio
9	US 95	Avenue G to 32nd Street	10.5	9.8	8	8	31	27	50	8	1
9B	US 95	Avenue G to 32nd Street	0.0	0.0	8	8	31	27	0	0	12

A.2 Modified Projects: Capital Costs

A cost estimate was developed for the Modified Projects List using the ITS Cost Estimator spreadsheet and revised quantities. A summary of estimated costs is provided in this section.

Modified Projects List

A breakdown of the combined total costs for all 13 projects plus the Fiber Backbone Ring is provided in **Table A3**, by agency. Due to the increased quantity of fiber optic cable and conduit required to construct the fiber backbone, the total project cost for the Modified Project List is higher than the Original Project List.

Table A3: Summary of Total Infrastructure Projects Costs by Agency (Modified Project List)

Agency	Current Cost (2021)	Future Cost (2026)
Total Yuma	$21,200,000	$27,100,000
Total Cocopah	$900,000	$1,100,000
Total Somerton	$2,200,000	$2,900,000
Total County	$4,000,000	$5,100,000
Total (All)	**$28,300,000**	**$36,200,000**

Table A4 summarizes the total project costs by project and per agency using present-day (2021) cost assumptions. As discussed in **Section 3.1**, present-day costs were projected out using a 5% growth rate per year for five years. **Table A5** summarizes the total project costs by project and per agency using future-year (2026) cost assumptions.

Table A4: Breakdown of Infrastructure Project Costs by Project (2021) (Modified Project List)

Current-Year Project Costs (2021)					
Project	Yuma Cost	County Cost	Cocopah Cost	Somerton Cost	Current Project Total
Core Ring	$5,900,000	N/A	N/A	N/A	$5,900,000
1	$1,000,000	N/A	N/A	N/A	$1,000,000
2	$1,400,000	$200,000	N/A	N/A	$1,600,000
3	$1,100,000	$800,000	N/A	N/A	$2,000,000
4	$2,500,000	N/A	N/A	N/A	$2,500,000
5	$1,400,000	$500,000	N/A	N/A	$2,000,000
6	$2,300,000	N/A	N/A	N/A	$2,300,000
7	$900,000	N/A	N/A	N/A	$900,000
8	$900,000	$400,000	N/A	N/A	$1,300,000
9	$0	$1,500,000	$900,000	$2,200,000	$4,600,000
10	$200,000	$500,000	N/A	N/A	$800,000
11	$800,000	N/A	N/A	N/A	$800,000
12	$700,000	N/A	N/A	N/A	$700,000
13	$1,900,000	N/A	N/A	N/A	$1,900,000
Total	$21,000,000	$3,900,000	$900,000	$2,200,000	$28,300,000

Table A5: Breakdown of Infrastructure Project Costs by Project (2026) (Modified Project List)

Project	Yuma Cost	County Cost	Cocopah Cost	Somerton Cost	Future Project Total
Core Ring	$7,500,000	N/A	N/A	N/A	$7,500,000
1	$1,300,000	N/A	N/A	N/A	$1,300,000
2	$1,800,000	$200,000	N/A	N/A	$2,000,000
3	$1,400,000	$1,100,000	N/A	N/A	$2,500,000
4	$3,200,000	N/A	N/A	N/A	$3,200,000
5	$1,800,000	$700,000	N/A	N/A	$2,500,000
6	$2,900,000	N/A	N/A	N/A	$2,900,000
7	$1,200,000	N/A	N/A	N/A	$1,200,000
8	$1,100,000	$500,000	N/A	N/A	$1,700,000
9	$0	$1,900,000	$1,100,000	$2,900,000	$5,900,000
10	$300,000	$700,000	N/A	N/A	$1,000,000
11	$1,100,000	N/A	N/A	N/A	$1,100,000
12	$900,000	N/A	N/A	N/A	$900,000
13	$2,500,000	N/A	N/A	N/A	$2,500,000
Total	$27,000,000	$5,100,000	$1,100,000	$2,900,000	$36,200,000

Modified Projects List: Alternative 9B

Because the scope of Project 9 and Project 9B is unchanged for the Modified Project List, the *relative* cost between the two alternatives is the same as it is for the original list. As discussed in **Section 3.1**, this difference is approximately 3 million dollars at present value and approximately 4 million dollars at future value. However, because Project 9 is not within the City's jurisdiction, there would be no cost savings for the City if Alternative 9B is chosen.

Table A6 displays the breakdown, by agency, for the combined cost of all 13 projects if Alternative 9B is used.

Table A6: Summary of Total Infrastructure Projects Costs by Agency – Project 9B (Modified Project List)

Agency	Current Cost (2021)	Future Cost (2026)
Total Yuma	$21,200,000	$27,100,000
Total Cocopah	$400,000	$400,000
Total Somerton	$600,000	$800,000
Total County	$2,900,000	$3,700,000
Total (All)	**$25,100,000**	**$32,000,000**

Appendix B – ITS Cost Estimator

CITY OF YUMA
ITS COST ESTIMATOR

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 1: 4th Avenue (32nd Street to 1st Street)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	3000	$120,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	1800	$72,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	4200	$252,000	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	6	$6,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	12	$60,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	12	$18,000	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	3000	$6,000	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	7500	$18,750	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	12	$30,000	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	12	$54,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	0	$0	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	0	$0	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	0	$0	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	0	$0	$0.00	$0
			Total Element Cost	**$685,350**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$68,535**		
			Unidentified Items (5%)	**$34,268**		
			Mobilization (5%)	**$34,268**		
			Construction Engineering Cost (10%)	**$68,535**		
			Design Cost (10%)	**$68,535**		
			TOTAL PROJECT COST	**$959,490**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,224,579**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 2: 32nd Street (Avenue C to Avenue 3E)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance					
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost	County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	2750	$110,000	$0.00	$0	250	$10,000	2500	$100,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	0	$0	$0.00	$0	0	$0	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	0	$0	$0.00	$0	0	$0	0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	0	$0	$0.00	$0	0	$0	0	$0
NO. 9 VAULT	$5,000	EACH	11	$55,000	$0.00	$0	1	$5,000	10	$50,000
NO. 9 VAULT (LID)	$1,500	EACH	11	$16,500	$0.00	$0	1	$1,500	10	$15,000
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	2750	$5,500	$0.00	$0	250	$500	2500	$5,000
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	1100	$2,750	$0.00	$0	100	$250	1000	$2,500
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	11	$27,500	$0.00	$0	1	$2,500	10	$25,000
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0				
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	11	$49,500	$0.00	$0	1	$4,500	10	$45,000
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	6	$42,000	$0.00	$0	1	$7,000	5	$35,000
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	5	$175,000	$0.00	$0	1	$35,000	4	$140,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	31	$310,000	$0.00	$0	4	$40,000	27	$270,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	5	$60,000	$0.00	$0	0	$0	5	$60,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	31	$155,000	$0.00	$0	4	$20,000	27	$135,000
			Total Element Cost	**$1,008,750**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$126,250**	**Cost (City of Yuma)**	**$882,500**
			Traffic Control (10%)	**$100,875**				**$12,625**		**$88,250**
			Unidentified Items (5%)	**$50,438**				**$6,313**		**$44,125**
			Mobilization (5%)	**$50,438**				**$6,313**		**$44,125**
			Construction Engineering Cost (10%)	**$100,875**				**$12,625**		**$88,250**
			Design Cost (10%)	**$100,875**				**$12,625**		**$88,250**
			TOTAL PROJECT COST	**$1,412,250**				**$176,750**		**$1,235,500**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$1,802,429**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 3: 16th Street (Avenue C to Avenue 3E)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	3250	$130,000	$0.00	$0	500	$20,000	2750	$110,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	4600	$184,000	$0.00	$0	0	$0	4600	$184,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	10200	$612,000	$0.00	$0	0	$0	10200	$612,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	15	$16,500	$0.00	$0	0	$0	15	$16,500
NO. 9 VAULT	$5,000	EACH	13	$65,000	$0.00	$0	2	$10,000	11	$55,000
NO. 9 VAULT (LID)	$1,500	EACH	13	$19,500	$0.00	$0	2	$3,000	11	$16,500
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	3250	$6,500	$0.00	$0	500	$1,000	2750	$5,500
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	16850	$42,125	$0.00	$0	200	$500	16650	$41,625
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	13	$32,500	$0.00	$0	2	$5,000	11	$27,500
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0				
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	13	$58,500	$0.00	$0	2	$9,000	11	$49,500
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	10	$70,000	$0.00	$0	2	$14,000	8	$56,000
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	3	$105,000	$0.00	$0	2	$70,000	1	$35,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	41	$410,000	$0.00	$0	8	$80,000	33	$330,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	8	$96,000	$0.00	$0	0	$0	8	$96,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	20	$100,000	$0.00	$0	8	$40,000	12	$60,000
			Total Element Cost	**$1,947,625**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$252,500**	**Cost (City of Yuma)**	**$1,695,125**
			Traffic Control (10%)	**$194,763**				**$25,250**		**$169,513**
			Unidentified Items (5%)	**$97,381**				**$12,625**		**$84,756**
			Mobilization (5%)	**$97,381**				**$12,625**		**$84,756**
			Construction Engineering Cost (10%)	**$194,763**				**$25,250**		**$169,513**
			Design Cost (10%)	**$194,763**				**$25,250**		**$169,513**
			TOTAL PROJECT COST	**$2,726,675**				**$353,500**		**$2,373,175**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$3,480,005**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 4: 24th Street (Avenue C to Pacific Avenue)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	2750	$110,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	6200	$248,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	7300	$438,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	14	$15,400	$0.00	$0
NO. 9 VAULT	$5,000	EACH	11	$55,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	11	$16,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	2750	$5,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	15300	$38,250	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	11	$27,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	11	$49,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	4	$28,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	5	$175,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	26	$260,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	30	$150,000	$0.00	$0
			Total Element Cost	**$1,664,650**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$166,465**		
			Unidentified Items (5%)	**$83,233**		
			Mobilization (5%)	**$83,233**		
			Construction Engineering Cost (10%)	**$166,465**		
			Design Cost (10%)	**$166,465**		
			TOTAL PROJECT COST	**$2,330,510**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$2,974,387**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 5: 8th Street (Avenue C to Orange Avenue)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1500	$60,000	$0.00	$0	250	$10,000	1250	$50,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	5800	$232,000	$0.00	$0	3100	$124,000	2700	$108,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	8200	$492,000	$0.00	$0	2500	$150,000	5700	$342,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	14	$15,400	$0.00	$0	6	$6,600	8	$8,800
NO. 9 VAULT	$5,000	EACH	6	$30,000	$0.00	$0	1	$5,000	5	$25,000
NO. 9 VAULT (LID)	$1,500	EACH	6	$9,000	$0.00	$0	1	$1,500	5	$7,500
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1500	$3,000	$0.00	$0	250	$500	1250	$2,500
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	15300	$38,250	$0.00	$0	6000	$15,000	9300	$23,250
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	6	$15,000	$0.00	$0	1	$2,500	5	$12,500
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH		$0	$0.00	$0				
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	6	$27,000	$0.00	$0	1	$4,500	5	$22,500
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	1	$7,000	$0.00	$0	1	$7,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	4	$140,000	$0.00	$0	1	$35,000	3	$105,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	19	$190,000	$0.00	$0	0	$0	19	$190,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	2	$24,000	$0.00	$0	0	$0	2	$24,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	23	$115,000	$0.00	$0	4	$20,000	19	$95,000
			Total Element Cost	**$1,397,650**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$381,600**	**Cost (City of Yuma)**	**$1,016,050**
			Traffic Control (10%)	**$139,765**				**$38,160**		**$101,605**
			Unidentified Items (5%)	**$69,883**				**$19,080**		**$50,803**
			Mobilization (5%)	**$69,883**				**$19,080**		**$50,803**
			Construction Engineering Cost (10%)	**$139,765**				**$38,160**		**$101,605**
			Design Cost (10%)	**$139,765**				**$38,160**		**$101,605**
			TOTAL PROJECT COST	**$1,956,710**				**$534,240**		**$1,422,470**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$2,497,313**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 6: 32nd Street (Avenue 3E to Avenue 8E)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1750	$70,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	0	$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	0	$0	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	0	$0	$0.00	$0
NO. 9 VAULT	$5,000	EACH	7	$35,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	7	$10,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1750	$3,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	700	$1,750	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	7	$17,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	7	$31,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	2	$14,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	3	$105,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	28	$280,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	28	$140,000	$0.00	$0
			Total Element Cost	**$756,750**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$75,675**		
			Unidentified Items (5%)	**$37,838**		
			Mobilization (5%)	**$37,838**		
			Construction Engineering Cost (10%)	**$75,675**		
			Design Cost (10%)	**$75,675**		
			TOTAL PROJECT COST	**$1,059,450**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,352,157**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 7: Avenue 3E (24th Street to MCAS Main Gate)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	750	$30,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	4300	$172,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	900	$54,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	6	$6,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	3	$15,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	3	$4,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	750	$1,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	5800	$14,500	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	3	$7,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	1	$4,500	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	3	$13,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	3	$21,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	3	$30,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	1	$12,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	11	$55,000	$0.00	$0
			Total Element Cost	**$511,600**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$51,160**		
			Unidentified Items (5%)	**$25,580**		
			Mobilization (5%)	**$25,580**		
			Construction Engineering Cost (10%)	**$51,160**		
			Design Cost (10%)	**$51,160**		
			TOTAL PROJECT COST	**$716,240**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$914,124**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	**Project 8: Avenue B (5th Street to 28th Street)**									
	Cost Estimates	**Unit**	**Project Quantities**		**Operations & Maintenance**		**County Qty**	**County Cost**	**City of Yuma Qty**	**City of Yuma Cost**
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	**Estimated Average Implementation Cost**	**Unit**	**Number of ITS Elements**	**Implementation Cost**	**O&M Annual Cost**	**Total O&M Cost**				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1000	$40,000	$0.00	$0	250	$10,000	750	$30,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	6400	$256,000	$0.00	$0	1600	$64,000	4800	$192,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	3800	$228,000	$0.00	$0	1600	$96,000	2200	$132,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	11	$12,100	$0.00	$0	4	$4,400	7	$7,700
NO. 9 VAULT	$5,000	EACH	4	$20,000	$0.00	$0	1	$5,000	3	$15,000
NO. 9 VAULT (LID)	$1,500	EACH	4	$6,000	$0.00	$0	1	$1,500	3	$4,500
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1000	$2,000	$0.00	$0	250	$500	750	$1,500
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	11150	$27,875	$0.00	$0	3500	$8,750	7650	$19,125
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	4	$10,000	$0.00	$0	1	$2,500	3	$7,500
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0	0	$0		
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	4	$18,000	$0.00	$0	1	$4,500	3	$13,500
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	1	$7,000	$0.00	$0	1	$7,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0	1	$35,000	1	$35,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	16	$160,000	$0.00	$0	4	$40,000	12	$120,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	2	$24,000	$0.00	$0	0	$0	2	$24,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	12	$60,000	$0.00	$0	4	$20,000	8	$40,000

Total Element Cost	**$940,975**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$299,150**	**Cost (City of Yuma)** **$641,825**
Traffic Control (10%)	**$94,098**				**$29,915**	**$64,183**
Unidentified Items (5%)	**$47,049**				**$14,958**	**$32,091**
Mobilization (5%)	**$47,049**				**$14,958**	**$32,091**
Construction Engineering Cost (10%)	**$94,098**				**$29,915**	**$64,183**
Design Cost (10%)	**$94,098**				**$29,915**	**$64,183**
TOTAL PROJECT COST	**$1,317,365**				**$418,810**	**$898,555**
Current Year	**2021**					
Year of Deployment Project	**2026**					
TOTAL PROJECT COST IN FUTURE YEAR	**$1,681,329**	*This cost assumes a 5% per year increase in unit costs.*				

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 9: US 95 (32nd Street to Avenue G)													
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance									
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost	County Qty	County Cost	Cocopah Qty	Cocopah Cost	Somerton Qty	Somerton Cost	City of Yuma Qty	City of Yuma Cost
COMMUNICATION														
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	2000	$80,000	$0.00	$0	500	$20,000	500	$20,000	1000	$40,000	0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0							0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	43500	$1,740,000	$0.00	$0	16600	$664,000	8300	$332,000	18600	$744,000	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	6500	$390,000	$0.00	$0	1500	$90,000	500	$30,000	4500	$270,000	0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0							0	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	50	$55,000	$0.00	$0	19	$20,900	9	$9,900	22	$24,200	0	$0
NO. 9 VAULT	$5,000	EACH	8	$40,000	$0.00	$0	2	$10,000	2	$10,000	4	$20,000	0	$0
NO. 9 VAULT (LID)	$1,500	EACH	8	$12,000	$0.00	$0	2	$3,000	2	$3,000	4	$6,000	0	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	2000	$4,000	$0.00	$0	500	$1,000	500	$1,000	1000	$2,000	0	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0							0	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	53300	$133,250	$0.00	$0	19250	$48,125	9450	$23,625	24600	$61,500	0	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	8	$20,000	$0.00	$0	2	$5,000	2	$5,000	4	$10,000	0	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0							0	$0
WIRELESS RADIO	$4,500	EACH	1	$4,500	$0.00	$0	1	$4,500	0	$0	0	$0	0	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	8	$36,000	$0.00	$0	2	$9,000	2	$9,000	4	$18,000	0	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0							0	
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	8	$56,000	$0.00	$0	2	$14,000	2	$14,000	4	$28,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	8	$280,000	$0.00	$0	2	$70,000	2	$70,000	4	$140,000	0	$0
DETECTION														
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	27	$270,000	$0.00	$0	4	$40,000	7	$70,000	16	$160,000	0	$0
TRAFFIC SIGNAL														
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	31	$155,000	$0.00	$0	8	$40,000	7	$35,000	16	$80,000	0	$0
			Total Element Cost	**$3,275,750**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$1,039,525**	**Cost (by others)**	**$632,525**	**Cost (by others)**	**$1,603,700**	**Cost (City of Yuma)**	**$0**
			Traffic Control (10%)	**$327,575**				**$103,953**		**$63,253**		**$160,370**		**$0**
			Unidentified Items (5%)	**$163,788**				**$51,976**		**$31,626**		**$80,185**		**$0**
			Mobilization (5%)	**$163,788**				**$51,976**		**$31,626**		**$80,185**		**$0**
			Construction Engineering Cost (10%)	**$327,575**				**$103,953**		**$63,253**		**$160,370**		**$0**
			Design Cost (10%)	**$327,575**				**$103,953**		**$63,253**		**$160,370**		**$0**
			TOTAL PROJECT COST	**$4,586,050**				**$1,455,335**		**$885,535**		**$2,245,180**		**$0**

Current Year	**2021**	
Year of Deployment Project	**2026**	
TOTAL PROJECT COST IN FUTURE YEAR	**$5,853,091**	*This cost assumes a 5% per year increase in unit costs.*

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 9B: Interstate 95 (32nd Street to Avenue G)													
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	Cocopah Qty	Cocopah Cost	Somerton Qty	Somerton Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost								
COMMUNICATION														
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF		$0	$0.00	$0		$0		$0		$0	0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0							0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF		$0	$0.00	$0		$0		$0	0	$0	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF		$0	$0.00	$0		$0		$0	0	$0	0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0							0	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
NO. 9 VAULT	$5,000	EACH		$0	$0.00	$0		$0		$0	0	$0	0	$0
NO. 9 VAULT (LID)	$1,500	EACH		$0	$0.00	$0		$0		$0	0	$0	0	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2	LF	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3	LF		$0	$0.00	$0							0	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$3	LF	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH		$0	$0.00	$0		$0		$0	0	$0	0	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0							0	$0
WIRELESS RADIO	$4,500	EACH	12	$54,000	$0.00	$0	4	$18,000	3	$13,500	5	$22,500	0	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	11	$49,500	$0.00	$0	4	$18,000	3	$13,500	4	$18,000	0	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0							0	$0
POLE	$5,000	EACH	3	$15,000	$0.00	$0	2	$10,000	1	$5,000			0	$0
POWER METER & ELECTRICAL SERVICE	$25,000	EACH	3	$75,000	$0.00	$0	2	$50,000	1	$25,000			0	$0
ITS CABINET & FOUNDATION	$5,000	EACH	3	$15,000	$0.00	$0	2	$10,000	1	$5,000			0	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	8	$56,000	$0.00	$0	2	$14,000	2	$14,000	4	$28,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	8	$280,000	$0.00	$0	2	$70,000	2	$70,000	4	$140,000	0	$0
DETECTION														
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	27	$270,000	$0.00	$0	4	$40,000	7	$70,000	16	$160,000	0	$0
TRAFFIC SIGNAL														
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	31	$155,000	$0.00	$0	8	$40,000	7	$35,000	16	$80,000	0	$0
			Total Element Cost	**$969,500**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$270,000**	**Cost (by others)**	**$251,000**	**Cost (by others)**	**$448,500**	**Cost (City of Yuma)**	**$0**
			Traffic Control (10%)	**$96,950**				**$27,000**		**$25,100**		**$44,850**		**$0**
			Unidentified Items (5%)	**$48,475**				**$13,500**		**$12,550**		**$22,425**		**$0**
			Mobilization (5%)	**$48,475**				**$13,500**		**$12,550**		**$22,425**		**$0**
			Construction Engineering Cost (10%)	**$96,950**				**$27,000**		**$25,100**		**$44,850**		**$0**
			Design Cost (10%)	**$96,950**				**$27,000**		**$25,100**		**$44,850**		**$0**
			TOTAL PROJECT COST	**$1,357,300**				**$378,000**		**$351,400**		**$627,900**		**$0**
			Current Year	**2021**										
			Year of Deployment Project	**2026**										
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,732,297**	*This cost assumes a 5% per year increase in unit costs.*									

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 10: County 14th Street (US 95 to Avenue 5E)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0			0	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	0	$0	$0.00	$0	0	$0	0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0			0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0			0	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	0	$0	$0.00	$0	0	$0	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	0	$0	$0.00	$0	0	$0	0	$0
TRENCH QUAD DUCT CONDUIT	$40	LF		$0	$0.00	$0			0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0			0	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	0	$0	$0.00	$0	0	$0	0	$0
NO. 9 VAULT	$5,000	EACH	0	$0	$0.00	$0	0	$0	0	$0
NO. 9 VAULT (LID)	$1,500	EACH	0	$0	$0.00	$0	0	$0	0	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	0	$0	$0.00	$0	0	$0	0	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0			0	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	0	$0	$0.00	$0	0	$0	0	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	0	$0	$0.00	$0	0	$0	0	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0			0	$0
WIRELESS RADIO	$4,500	EACH	7	$31,500	$0.00	$0	5	$22,500	2	$9,000
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	7	$31,500	$0.00	$0	5	$22,500	2	$9,000
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0			0	$0
POLE	$5,000	EACH	4	$20,000	$0.00	$0	3	$15,000	1	$5,000
POWER METER & ELECTRICAL SERVICE	$25,000	EACH	4	$100,000	$0.00	$0	3	$75,000	1	$25,000
ITS CABINET & FOUNDATION	$5,000	EACH	4	$20,000	$0.00	$0	3	$15,000	1	$5,000
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	3	$21,000	$0.00	$0	2	$14,000	1	$7,000
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	3	$105,000	$0.00	$0	2	$70,000	1	$35,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	12	$120,000	$0.00	$0	8	$80,000	4	$40,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0	3	$36,000	1	$12,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	12	$60,000	$0.00	$0	8	$40,000	4	$20,000
			Total Element Cost	**$557,000**	**TOTAL O&M**	**$0**		**$390,000**	**Cost (City of Yuma)**	**$167,000**
			Traffic Control (10%)	**$55,700**				**$39,000**		**$16,700**
			Unidentified Items (5%)	**$27,850**				**$19,500**		**$8,350**
			Mobilization (5%)	**$27,850**				**$19,500**		**$8,350**
			Construction Engineering Cost (10%)	**$55,700**				**$39,000**		**$16,700**
			Design Cost (10%)	**$55,700**				**$39,000**		**$16,700**
			TOTAL PROJECT COST	**$779,800**				**$546,000**		**$233,800**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$995,244**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 11: Avenue A (3rd Street to 32nd Street)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	750	$30,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	2000	$80,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	3400	$204,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	6	$6,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	3	$15,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	3	$4,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	750	$1,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	6000	$15,000	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	3	$7,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	3	$13,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	0	$0	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	1	$35,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	11	$110,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	1	$12,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	11	$55,000	$0.00	$0
			Total Element Cost	**$589,600**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$58,960**		
			Unidentified Items (5%)	**$29,480**		
			Mobilization (5%)	**$29,480**		
			Construction Engineering Cost (10%)	**$58,960**		
			Design Cost (10%)	**$58,960**		
			TOTAL PROJECT COST	**$825,440**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,053,494**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 12: Pacific Avenue (16th Street to 32nd Street)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	500	$20,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	2800	$112,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	3100	$186,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	6	$6,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	2	$10,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	2	$3,000	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	500	$1,000	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	6400	$16,000	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	2	$5,000	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	2	$9,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	0	$0	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	4	$40,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	0	$0	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	8	$40,000	$0.00	$0
			Total Element Cost	**$518,600**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$51,860**		
			Unidentified Items (5%)	**$25,930**		
			Mobilization (5%)	**$25,930**		
			Construction Engineering Cost (10%)	**$51,860**		
			Design Cost (10%)	**$51,860**		
			TOTAL PROJECT COST	**$726,040**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$926,631**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR

PROJECT LOCATION:	Project 13: 24th St (Araby Road to Otondo Drive), 1st Street (4th Avenue to Ocean to Ocean Bridge), Harold C Giss Parkway (4th Avenue to Redondo Center Drive)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1500	$60,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	2800	$112,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	4200	$252,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	7	$7,700	$0.00	$0
NO. 9 VAULT	$5,000	EACH	6	$30,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	6	$9,000	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1500	$3,000	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	7950	$19,875	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	6	$15,000	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	6	$27,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	6	$42,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	21	$210,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	21	$105,000	$0.00	$0
			Total Element Cost	**$1,010,575**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$101,058**		
			Unidentified Items (5%)	**$50,529**		
			Mobilization (5%)	**$50,529**		
			Construction Engineering Cost (10%)	**$101,058**		
			Design Cost (10%)	**$101,058**		
			TOTAL PROJECT COST	**$1,414,805**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,805,690**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Core Loop (4th Ave, 16th St, Avenue C, 32nd St)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	5250	$210,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	23100	$924,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	28800	$1,728,000	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	52	$57,200	$0.00	$0
NO. 9 VAULT	$5,000	EACH	21	$105,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	21	$31,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	5250	$10,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	56600	$141,500	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	21	$52,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	21	$94,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	7	$49,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	4	$140,000	$0.00	$0
L3 AGGREGATOR SWITCH	$25,000	EACH	2	$50,000	$0.00	$0
L3 AGGREGATOR CABINET	$5,000	EACH	2	$10,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	31	$310,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	11	$132,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	35	$175,000	$0.00	$0
			Total Element Cost	**$4,220,700**	**TOTAL O&M**	**$56,000**
			Traffic Control (10%)	**$422,070**		
			Unidentified Items (5%)	**$211,035**		
			Mobilization (5%)	**$211,035**		
			Construction Engineering Cost (10%)	**$422,070**		
			Design Cost (10%)	**$422,070**		
			TOTAL PROJECT COST	**$5,908,980**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$7,541,522**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 1: 4th Avenue (16th Street to 1st Street)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1250	$50,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	3300	$132,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	6600	$396,000	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	10	$11,000	$0.00	$0
NO. 9 VAULT	$5,000	EACH	5	$25,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	5	$7,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1250	$2,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	10900	$27,250	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	5	$12,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	5	$22,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	0	$0	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	0	$0	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	0	$0	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	2	$24,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	0	$0	$0.00	$0

Total Element Cost	**$710,250**
Traffic Control (10%)	**$71,025**
Unidentified Items (5%)	**$35,513**
Mobilization (5%)	**$35,513**
Construction Engineering Cost (10%)	**$71,025**
Design Cost (10%)	**$71,025**
TOTAL PROJECT COST	**$994,350**
Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$1,269,071**

TOTAL O&M **$0**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 2: 32nd Street (4th Avenue to Avenue 3E)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance					
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost	County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1250	$50,000	$0.00	$0	250	$10,000	1000	$40,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	4400	$176,000	$0.00	$0	0	$0	4400	$176,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	8000	$480,000	$0.00	$0	0	$0	8000	$480,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	13	$14,300	$0.00	$0	0	$0	13	$14,300
NO. 9 VAULT	$5,000	EACH	5	$25,000	$0.00	$0	1	$5,000	4	$20,000
NO. 9 VAULT (LID)	$1,500	EACH	5	$7,500	$0.00	$0	1	$1,500	4	$6,000
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1250	$2,500	$0.00	$0	250	$500	1000	$2,000
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	13550	$33,875	$0.00	$0	100	$250	13450	$33,625
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	5	$12,500	$0.00	$0	1	$2,500	4	$10,000
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH		$0	$0.00	$0				
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	5	$22,500	$0.00	$0	1	$4,500	4	$18,000
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	3	$21,000	$0.00	$0	1	$7,000	2	$14,000
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	3	$105,000	$0.00	$0	1	$35,000	2	$70,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	12	$120,000	$0.00	$0	4	$40,000	8	$80,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	1	$12,000	$0.00	$0	0	$0	1	$12,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	12	$60,000	$0.00	$0	4	$20,000	8	$40,000

	Project						
Total Element Cost	$1,142,175	TOTAL O&M	$0	Cost (by others)	$126,250	Cost (City of Yuma)	$1,015,925
Traffic Control (10%)	$114,218				$12,625		$101,593
Unidentified Items (5%)	$57,109				$6,313		$50,796
Mobilization (5%)	$57,109				$6,313		$50,796
Construction Engineering Cost (10%)	$114,218				$12,625		$101,593
Design Cost (10%)	$114,218				$12,625		$101,593
TOTAL PROJECT COST	**$1,599,045**				**$176,750**		**$1,422,295**

Current Year	2021
Year of Deployment Project	2026
TOTAL PROJECT COST IN FUTURE YEAR	**$2,040,832**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 3: 16th Street (1st Avenue to Avenue 3E)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	**Estimated Average Implementation Cost**	**Unit**	**Number of ITS Elements**	**Implementation Cost**	**O&M Annual Cost**	**Total O&M Cost**				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1750	$70,000	$0.00	$0	500	$20,000	1250	$50,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	2500	$100,000	$0.00	$0	0	$0	2500	$100,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	9600	$576,000	$0.00	$0	5500	$330,000	4100	$246,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	13	$14,300	$0.00	$0	6	$6,600	7	$7,700
NO. 9 VAULT	$5,000	EACH	7	$35,000	$0.00	$0	2	$10,000	5	$25,000
NO. 9 VAULT (LID)	$1,500	EACH	7	$10,500	$0.00	$0	2	$3,000	5	$7,500
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1750	$3,500	$0.00	$0	500	$1,000	1250	$2,500
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	13450	$33,625	$0.00	$0	6000	$15,000	7450	$18,625
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	7	$17,500	$0.00	$0	2	$5,000	5	$12,500
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0	0	$0		
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	7	$31,500	$0.00	$0	2	$9,000	5	$22,500
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	7	$49,000	$0.00	$0	2	$14,000	5	$35,000
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0	2	$70,000	0	$0
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	29	$290,000	$0.00	$0	8	$80,000	21	$210,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0	0	$0	4	$48,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	12	$60,000	$0.00	$0	8	$40,000	4	$20,000

Total Element Cost	**$1,408,925**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$603,600**	**Cost (City of Yuma)**	**$805,325**
Traffic Control (10%)	**$140,893**				**$60,360**		**$80,533**
Unidentified Items (5%)	**$70,446**				**$30,180**		**$40,266**
Mobilization (5%)	**$70,446**				**$30,180**		**$40,266**
Construction Engineering Cost (10%)	**$140,893**				**$60,360**		**$80,533**
Design Cost (10%)	**$140,893**				**$60,360**		**$80,533**
TOTAL PROJECT COST	**$1,972,495**				**$845,040**		**$1,127,455**
Current Year	**2021**						
Year of Deployment Project	**2026**						
TOTAL PROJECT COST IN FUTURE YEAR	**$2,517,459**	*This cost assumes a 5% per year increase in unit costs.*					

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 4: 24th Street (Avenue B to Pacific Avenue)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	2500	$100,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	4700	$188,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	11600	$696,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	17	$18,700	$0.00	$0
NO. 9 VAULT	$5,000	EACH	10	$50,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	10	$15,000	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	2500	$5,000	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	18150	$45,375	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	10	$25,000	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	10	$45,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	4	$28,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	5	$175,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	26	$260,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	3	$36,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	26	$130,000	$0.00	$0
			Total Element Cost	**$1,817,075**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$181,708**		
			Unidentified Items (5%)	**$90,854**		
			Mobilization (5%)	**$90,854**		
			Construction Engineering Cost (10%)	**$181,708**		
			Design Cost (10%)	**$181,708**		
			TOTAL PROJECT COST	**$2,543,905**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$3,246,739**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 5: 8th Street (Avenue C to Orange Avenue)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1500	$60,000	$0.00	$0	250	$10,000	1250	$50,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	5800	$232,000	$0.00	$0	3100	$124,000	2700	$108,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	8200	$492,000	$0.00	$0	2500	$150,000	5700	$342,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	14	$15,400	$0.00	$0	6	$6,600	8	$8,800
NO. 9 VAULT	$5,000	EACH	6	$30,000	$0.00	$0	1	$5,000	5	$25,000
NO. 9 VAULT (LID)	$1,500	EACH	6	$9,000	$0.00	$0	1	$1,500	5	$7,500
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1500	$3,000	$0.00	$0	250	$500	1250	$2,500
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	15300	$38,250	$0.00	$0	6000	$15,000	9300	$23,250
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	6	$15,000	$0.00	$0	1	$2,500	5	$12,500
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0	0	$0		
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	6	$27,000	$0.00	$0	1	$4,500	5	$22,500
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	1	$7,000	$0.00	$0	1	$7,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	4	$140,000	$0.00	$0	1	$35,000	3	$105,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	19	$190,000	$0.00	$0	0	$0	19	$190,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	2	$24,000	$0.00	$0	0	$0	2	$24,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	23	$115,000	$0.00	$0	4	$20,000	19	$95,000

Total Element Cost	**$1,397,650**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$381,600**	**Cost (City of Yuma)**	**$1,016,050**
Traffic Control (10%)	**$139,765**				**$38,160**		**$101,605**
Unidentified Items (5%)	**$69,883**				**$19,080**		**$50,803**
Mobilization (5%)	**$69,883**				**$19,080**		**$50,803**
Construction Engineering Cost (10%)	**$139,765**				**$38,160**		**$101,605**
Design Cost (10%)	**$139,765**				**$38,160**		**$101,605**
TOTAL PROJECT COST	**$1,956,710**				**$534,240**		**$1,422,470**

Current Year	**2021**	
Year of Deployment Project	**2026**	
TOTAL PROJECT COST IN FUTURE YEAR	**$2,497,313**	*This cost assumes a 5% per year increase in unit costs.*

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 6: 32nd Street (Avenue 3E to Avenue 8E)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1250	$50,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	9000	$360,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	6900	$414,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	16	$17,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	5	$25,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	5	$7,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1250	$2,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	17200	$43,000	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	5	$12,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	4	$18,000	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	8	$36,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
POLE	$5,000	EACH	1	$5,000	$0.00	$0
POWER METER & ELECTRICAL SERVICE	$25,000	EACH	1	$25,000	$0.00	$0
ITS CABINET & FOUNDATION	$5,000	EACH	1	$5,000	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	2	$14,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	3	$105,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	28	$280,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	28	$140,000	$0.00	$0
			Total Element Cost	**$1,608,100**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$160,810**		
			Unidentified Items (5%)	**$80,405**		
			Mobilization (5%)	**$80,405**		
			Construction Engineering Cost (10%)	**$160,810**		
			Design Cost (10%)	**$160,810**		
			TOTAL PROJECT COST	**$2,251,340**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$2,873,344**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 7: Avenue 3E (24th Street to MCAS Main Gate)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	750	$30,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	7800	$312,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	1100	$66,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	9	$9,900	$0.00	$0
NO. 9 VAULT	$5,000	EACH	3	$15,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	3	$4,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	750	$1,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	9650	$24,125	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	3	$7,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	1	$4,500	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	3	$13,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	3	$21,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	3	$30,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	1	$12,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	11	$55,000	$0.00	$0
			Total Element Cost	**$676,525**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$67,653**		
			Unidentified Items (5%)	**$33,826**		
			Mobilization (5%)	**$33,826**		
			Construction Engineering Cost (10%)	**$67,653**		
			Design Cost (10%)	**$67,653**		
			TOTAL PROJECT COST	**$947,135**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,208,811**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION: Project 8: Avenue B (5th Street to 28th Street)

ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Cost Estimates: Estimated Average Implementation Cost	Unit	Project Quantities: Number of ITS Elements	Project Quantities: Implementation Cost	Operations & Maintenance: O&M Annual Cost	Operations & Maintenance: Total O&M Cost	County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	1000	$40,000	$0.00	$0	250	$10,000	750	$30,000
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0				
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0				
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	6400	$256,000	$0.00	$0	1600	$64,000	4800	$192,000
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	3800	$228,000	$0.00	$0	1600	$96,000	2200	$132,000
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0				
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	11	$12,100	$0.00	$0	4	$4,400	7	$7,700
NO. 9 VAULT	$5,000	EACH	4	$20,000	$0.00	$0	1	$5,000	3	$15,000
NO. 9 VAULT (LID)	$1,500	EACH	4	$6,000	$0.00	$0	1	$1,500	3	$4,500
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	1000	$2,000	$0.00	$0	250	$500	750	$1,500
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0				
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	11150	$27,875	$0.00	$0	3500	$8,750	7650	$19,125
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	4	$10,000	$0.00	$0	1	$2,500	3	$7,500
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0				
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0	0	$0		
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	4	$18,000	$0.00	$0	1	$4,500	3	$13,500
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0				
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	1	$7,000	$0.00	$0	1	$7,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0	1	$35,000	1	$35,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	16	$160,000	$0.00	$0	4	$40,000	12	$120,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	2	$24,000	$0.00	$0	0	$0	2	$24,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	12	$60,000	$0.00	$0	4	$20,000	8	$40,000

	Project		County		City of Yuma
Total Element Cost	**$940,975**	**TOTAL O&M** **$0**	**Cost (by others)**	**$299,150**	**Cost (City of Yuma)** **$641,825**
Traffic Control (10%)	**$94,098**			**$29,915**	**$64,183**
Unidentified Items (5%)	**$47,049**			**$14,958**	**$32,091**
Mobilization (5%)	**$47,049**			**$14,958**	**$32,091**
Construction Engineering Cost (10%)	**$94,098**			**$29,915**	**$64,183**
Design Cost (10%)	**$94,098**			**$29,915**	**$64,183**
TOTAL PROJECT COST	**$1,317,365**			**$418,810**	**$898,555**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$1,681,329**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 9: US 95 (32nd Street to Avenue G)													
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	Cocopah Qty	Cocopah Cost	Somerton Qty	Somerton Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost								
COMMUNICATION														
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	2000	$80,000	$0.00	$0	500	$20,000	500	$20,000	1000	$40,000	0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0							0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	43500	$1,740,000	$0.00	$0	16600	$664,000	8300	$332,000	18600	$744,000	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	6500	$390,000	$0.00	$0	1500	$90,000	500	$30,000	4500	$270,000	0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0							0	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	50	$55,000	$0.00	$0	19	$20,900	9	$9,900	22	$24,200	0	$0
NO. 9 VAULT	$5,000	EACH	8	$40,000	$0.00	$0	2	$10,000	2	$10,000	4	$20,000	0	$0
NO. 9 VAULT (LID)	$1,500	EACH	8	$12,000	$0.00	$0	2	$3,000	2	$3,000	4	$6,000	0	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	2000	$4,000	$0.00	$0	500	$1,000	500	$1,000	1000	$2,000	0	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0							0	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	53300	$133,250	$0.00	$0	19250	$48,125	9450	$23,625	24600	$61,500	0	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	8	$20,000	$0.00	$0	2	$5,000	2	$5,000	4	$10,000	0	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0							0	$0
WIRELESS RADIO	$4,500	EACH	1	$4,500	$0.00	$0	1	$4,500	0	$0	0	$0	0	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	8	$36,000	$0.00	$0	2	$9,000	2	$9,000	4	$18,000	0	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0							0	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	8	$56,000	$0.00	$0	2	$14,000	2	$14,000	4	$28,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	8	$280,000	$0.00	$0	2	$70,000	2	$70,000	4	$140,000	0	$0
DETECTION														
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	27	$270,000	$0.00	$0	4	$40,000	7	$70,000	16	$160,000	0	$0
TRAFFIC SIGNAL														
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	31	$155,000	$0.00	$0	8	$40,000	7	$35,000	16	$80,000	0	$0
			Total Element Cost	**$3,275,750**	**TOTAL O&M**	**$0**	**Cost (by others)**	**$1,039,525**	**Cost (by others)**	**$632,525**	**Cost (by others)**	**$1,603,700**	**Cost (City of Yuma)**	**$0**
			Traffic Control (10%)	**$327,575**				**$103,953**		**$63,253**		**$160,370**		**$0**
			Unidentified Items (5%)	**$163,788**				**$51,976**		**$31,626**		**$80,185**		**$0**
			Mobilization (5%)	**$163,788**				**$51,976**		**$31,626**		**$80,185**		**$0**
			Construction Engineering Cost (10%)	**$327,575**				**$103,953**		**$63,253**		**$160,370**		**$0**
			Design Cost (10%)	**$327,575**				**$103,953**		**$63,253**		**$160,370**		**$0**
			TOTAL PROJECT COST	**$4,586,050**				**$1,455,335**		**$885,535**		**$2,245,180**		**$0**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$5,853,091**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 9B: US 95 (32nd Street to Avenue G)													
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance									
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost	County Qty	County Cost	Cocopah Qty	Cocopah Cost	Somerton Qty	Somerton Cost	City of Yuma Qty	City of Yuma Cost
COMMUNICATION														
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$35	LF	0	$0	$1.00	$0	0	$0	0	$0	0	$0	0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0							0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0							0	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0							0	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
NO. 9 VAULT	$5,000	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
NO. 9 VAULT (LID)	$1,500	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2	LF	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3	LF		$0	$0.00	$0							0	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$3	LF	0	$0	$1.00	$0	0	$0	0	$0	0	$0	0	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	0	$0	$0.00	$0	0	$0	0	$0	0	$0	0	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0							0	$0
WIRELESS RADIO	$4,500	EACH	12	$54,000	$500.00	$6,000	4	$18,000	3	$13,500	5	$22,500	0	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	11	$49,500	$0.00	$0	4	$18,000	3	$13,500	4	$18,000	0	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0							0	$0
POLE	$5,000	EACH	3	$15,000	$0.00	$0	2	$10,000	1	$5,000			0	$0
POWER METER & ELECTRICAL SERVICE	$25,000	EACH	3	$75,000	$0.00	$0	2	$50,000	1	$25,000			0	$0
ITS CABINET & FOUNDATION	$5,000	EACH	3	$15,000	$0.00	$0	2	$10,000	1	$5,000			0	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	8	$56,000	$0.00	$0	2	$14,000	2	$14,000	4	$28,000	0	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	8	$280,000	$0.00	$0	2	$70,000	2	$70,000	4	$140,000	0	$0
DETECTION														
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	27	$270,000	$1,000.00	$27,000	4	$40,000	7	$70,000	16	$160,000	0	$0
TRAFFIC SIGNAL														
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	0	$0	$1,200.00	$0	0	$0	0	$0	0	$0	0	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	31	$155,000	$0.00	$0	8	$40,000	7	$35,000	16	$80,000	0	$0
			Total Element Cost	**$969,500**	**TOTAL O&M**	**$33,000**	**Cost (by others)**	**$270,000**	**Cost (by others)**	**$251,000**	**Cost (by others)**	**$448,500**	**Cost (City of Yuma)**	**$0**
			Traffic Control (10%)	**$96,950**				**$27,000**		**$25,100**		**$44,850**		**$0**
			Unidentified Items (5%)	**$48,475**				**$13,500**		**$12,550**		**$22,425**		**$0**
			Mobilization (5%)	**$48,475**				**$13,500**		**$12,550**		**$22,425**		**$0**
			Construction Engineering Cost (10%)	**$96,950**				**$27,000**		**$25,100**		**$44,850**		**$0**
			Design Cost (10%)	**$96,950**				**$27,000**		**$25,100**		**$44,850**		**$0**
			TOTAL PROJECT COST	**$1,357,300**				**$378,000**		**$351,400**		**$627,900**		**$0**

Current Year	**2021**	
Year of Deployment Project	**2026**	
TOTAL PROJECT COST IN FUTURE YEAR	**$1,732,297**	*This cost assumes a 5% per year increase in unit costs.*

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 10: County 14th Street (US 95 to Avenue 5E)									
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance		County Qty	County Cost	City of Yuma Qty	City of Yuma Cost
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost				
COMMUNICATION										
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0			0	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	0	$0	$0.00	$0	0	$0	0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0			0	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0			0	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	0	$0	$0.00	$0	0	$0	0	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	0	$0	$0.00	$0	0	$0	0	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0			0	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	0	$0	$0.00	$0	0	$0	0	$0
NO. 9 VAULT	$5,000	EACH	0	$0	$0.00	$0	0	$0	0	$0
NO. 9 VAULT (LID)	$1,500	EACH	0	$0	$0.00	$0	0	$0	0	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	0	$0	$0.00	$0	0	$0	0	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0			0	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	0	$0	$0.00	$0	0	$0	0	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	0	$0	$0.00	$0	0	$0	0	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0			0	$0
WIRELESS RADIO	$4,500	EACH	7	$31,500	$0.00	$0	5	$22,500	2	$9,000
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	7	$31,500	$0.00	$0	5	$22,500	2	$9,000
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0			0	$0
POLE	$5,000	EACH	4	$20,000	$0.00	$0	3	$15,000	1	$5,000
POWER METER & ELECTRICAL SERVICE	$25,000	EACH	4	$100,000	$0.00	$0	3	$75,000	1	$25,000
ITS CABINET & FOUNDATION	$5,000	EACH	4	$20,000	$0.00	$0	3	$15,000	1	$5,000
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	3	$21,000	$0.00	$0	2	$14,000	1	$7,000
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	3	$105,000	$0.00	$0	2	$70,000	1	$35,000
DETECTION										
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	12	$120,000	$0.00	$0	8	$80,000	4	$40,000
TRAFFIC SIGNAL										
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0	3	$36,000	1	$12,000
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	12	$60,000	$0.00	$0	8	$40,000	4	$20,000
			Total Element Cost	**$557,000**	**TOTAL O&M**	**$0**		**$390,000**	**Cost (City of Yuma)**	**$167,000**
			Traffic Control (10%)	**$55,700**				**$39,000**		**$16,700**
			Unidentified Items (5%)	**$27,850**				**$19,500**		**$8,350**
			Mobilization (5%)	**$27,850**				**$19,500**		**$8,350**
			Construction Engineering Cost (10%)	**$55,700**				**$39,000**		**$16,700**
			Design Cost (10%)	**$55,700**				**$39,000**		**$16,700**
			TOTAL PROJECT COST	**$779,800**				**$546,000**		**$233,800**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$995,244**

This cost assumes a 5% per year increase in unit costs.

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 11: Avenue A (3rd Street to 32nd Street)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	750	$30,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	2000	$80,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	3400	$204,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	6	$6,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	3	$15,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	3	$4,500	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	750	$1,500	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	6000	$15,000	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	3	$7,500	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	3	$13,500	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	0	$0	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	1	$35,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	11	$110,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	1	$12,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	11	$55,000	$0.00	$0
			Total Element Cost	**$589,600**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$58,960**		
			Unidentified Items (5%)	**$29,480**		
			Mobilization (5%)	**$29,480**		
			Construction Engineering Cost (10%)	**$58,960**		
			Design Cost (10%)	**$58,960**		
			TOTAL PROJECT COST	**$825,440**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$1,053,494**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 12: Pacific Avenue (16th Street to 32nd Street)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	500	$20,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	2800	$112,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	3100	$186,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	6	$6,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	2	$10,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	2	$3,000	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	500	$1,000	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	6400	$16,000	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	2	$5,000	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	0	$0	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	2	$9,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	0	$0	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	4	$40,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	0	$0	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	8	$40,000	$0.00	$0
			Total Element Cost	**$518,600**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$51,860**		
			Unidentified Items (5%)	**$25,930**		
			Mobilization (5%)	**$25,930**		
			Construction Engineering Cost (10%)	**$51,860**		
			Design Cost (10%)	**$51,860**		
			TOTAL PROJECT COST	**$726,040**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$926,631**	*This cost assumes a 5% per year increase in unit costs.*	

CITY OF YUMA
ITS COST ESTIMATOR
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

PROJECT LOCATION:	Project 13: 24th St (Araby Road to Otando Drive), 1st Street (4th Avenue to Ocean to Ocean Bridge), Harold C Giss Parkway (4th Avenue to Redondo Center Drive)					
	Cost Estimates	Unit	Project Quantities		Operations & Maintenance	
ITS PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of ITS Elements	Implementation Cost	O&M Annual Cost	Total O&M Cost
COMMUNICATION						
1-2" ELECTRICAL CONDUIT (PVC)	$25	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT (PVC) (INTERSECTION BRANCH CABLE)	$40	LF	500	$20,000	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT	$40	LF		$0	$0.00	$0
ELECTRICAL CONDUIT (2-3") CONDUIT - DIRECTIONAL DRILL	$100	LF		$0	$0.00	$0
1-4" ELECTRICAL CONDUIT - TRENCH (CONNECTION TO BACKBONE)	$40	LF	7400	$296,000	$0.00	$0
1-4" ELECTRICAL CONDUIT - DIRECTIONAL DRILL (CONNECTION TO BACKBONE)	$60	LF	7900	$474,000	$0.00	$0
NO. 5 PULL BOX	$600	EACH		$0	$0.00	$0
NO. 7 PULL BOX (WITH EXTENSION)	$1,100	EACH	16	$17,600	$0.00	$0
NO. 9 VAULT	$5,000	EACH	2	$10,000	$0.00	$0
NO. 9 VAULT (LID)	$1,500	EACH	2	$3,000	$0.00	$0
SINGLE MODE 12-FIBER OPTIC CABLE	$2.00	LF	500	$1,000	$0.00	$0
SINGLE MODE 96-FIBER OPTIC CABLE	$3.00	LF		$0	$0.00	$0
SINGLE MODE 48-FIBER OPTIC CABLE	$2.50	LF	16300	$40,750	$0.00	$0
FIBER OPTIC SPLICE CLOSURE	$2,500	EACH	2	$5,000	$0.00	$0
FIBER TERMINATION PANEL	$950	EACH		$0	$0.00	$0
WIRELESS RADIO	$4,500	EACH	4	$18,000	$0.00	$0
FIELD HARDENED ETHERNET DISTRIBUTION SWITCH	$4,500	EACH	6	$27,000	$0.00	$0
RADIO FOR PUBLIC SAFETY/TMC/OTHER	$0	EACH		$0	$0.00	$0
UNINTERRUPTED POWER SUPPLY (UPS)	$7,000	EACH	6	$42,000	$0.00	$0
ADVANCED TRAFFIC CONTROL CABINET (ATCC), CONTROLLER, AND FOUNDATION	$35,000	EACH	2	$70,000	$0.00	$0
DETECTION						
VIDEO IMAGE DETECTION (PER UNIT)	$10,000	EACH	21	$210,000	$0.00	$0
TRAFFIC SIGNAL						
TRAFFIC SIGNAL CONTROLLER	$12,000	EACH	4	$48,000	$0.00	$0
SIGNAL PREEMPTION/PRIORITY RECEIVER	$5,000	EACH	21	$105,000	$0.00	$0
			Total Element Cost	**$1,387,350**	**TOTAL O&M**	**$0**
			Traffic Control (10%)	**$138,735**		
			Unidentified Items (5%)	**$69,368**		
			Mobilization (5%)	**$69,368**		
			Construction Engineering Cost (10%)	**$138,735**		
			Design Cost (10%)	**$138,735**		
			TOTAL PROJECT COST	**$1,942,290**		
			Current Year	**2021**		
			Year of Deployment Project	**2026**		
			TOTAL PROJECT COST IN FUTURE YEAR	**$2,478,909**	*This cost assumes a 5% per year increase in unit costs.*	

Appendix C – Project Intersection Lists

CITY OF YUMA
ITS PROJECT INTERSECTION LIST

Project Intersection List			
Project Number	**Intersection**	**Jurisdiction**	**Type**
1	4th Avenue and 1st Street	City of Yuma	Signalized
	4th Avenue and 3rd Street	City of Yuma	Signalized
	4th Avenue and 8th Street	City of Yuma	Signalized
	4th Avenue and 10th Street	City of Yuma	Signalized
	4th Avenue and 14th Street	City of Yuma	Signalized
	4th Avenue and 22nd Street	City of Yuma	Signalized
	4th Avenue and 24th Street	City of Yuma	Signalized
	4th Avenue and 28th Street	City of Yuma	Signalized
	4th Avenue and Catalina Drive	City of Yuma	Signalized
	4th Avenue and 32nd Street (Big Curve)	City of Yuma	Signalized
	32nd Street and 32nd Street Extension (Big Curve)	City of Yuma	Signalized
	4th Avenue and 16th Street	City of Yuma	Signalized
2	4th Avenue Extension and 32nd Street	City of Yuma	Signalized
	32nd Street and Pacific Avenue	City of Yuma	Signalized
	32nd Street and Arizona Avenue	City of Yuma	Signalized
	32nd Street and Catalina Drive	City of Yuma	Signalized
	32nd Street and 8th Avenue	City of Yuma	Signalized
	32nd Street and Avenue A	City of Yuma	Signalized
	32nd Street and 15th Avenue/Kofa driveway	City of Yuma	Signalized
	32nd Street and 21st Drive	City of Yuma	Signalized
	32nd Street and Avenue B	City of Yuma	Signalized
	32nd Street and Avenue C	City of Yuma	Signalized
	32nd Street & Avenue 3E	Yuma County	Signalized
3	16th Street and Pacific Avenue	City of Yuma	Signalized
	16th Street and Sunridge Drive	City of Yuma	Signalized
	16th Street and Interstate 8	City of Yuma	Signalized
	16th Street and Redondo Center Drive	City of Yuma	Signalized
	16th Street and Arizona Avenue	City of Yuma	Signalized
	16th Street and 1st Avenue	City of Yuma	Signalized
	16th Street and Avenue A	City of Yuma	Signalized
	16th Street and 14th Avenue	City of Yuma	Signalized
	16th Street and Avenue B	City of Yuma	Signalized
	16th Street and 31st Drive	City of Yuma	Signalized
	16th Street and Avenue C	City of Yuma	Signalized
	16th Street & S Engler Avenue	Yuma County	Signalized
	16th Street & Avenue 3E	Yuma County	Signalized
4	24th Street and Pacific Avenue	City of Yuma	Signalized
	24th Street and Kennedy Lane	City of Yuma	Signalized
	24th Street and Arizona Avenue	City of Yuma	Signalized
	24th Street and 1st Avenue	City of Yuma	Signalized
	24th Street and 8th Avenue	City of Yuma	Signalized
	24th Street and Avenue A	City of Yuma	Signalized
	24th Street and Yuma Regional Medical Center	City of Yuma	Signalized
	24th Street and Camino Alemeda	City of Yuma	Signalized
	24th Street and 22nd Drive	City of Yuma	Signalized
	24th Street and Avenue B	City of Yuma	Signalized
	24th Street and Avenue C	City of Yuma	Signalized
5	8th Street and Orange Avenue	City of Yuma	Signalized
	8th Street and Avenue A	City of Yuma	Signalized
	8th Street and 14th Avenue	City of Yuma	Signalized
	8th Street and Magnolia Avenue	City of Yuma	Signalized
	8th Street and Avenue B	City of Yuma	Signalized
	8th Street & Avenue C	Yuma County	Signalized
	8th St West of 21st Avenue	City of Yuma	HAWK - Not included in Project
6	32nd Street and Avenue 8E	City of Yuma	Signalized
	32nd Street and Avenue 7E	City of Yuma	Signalized
	32nd Street and Avenue 6E	City of Yuma	Signalized
	32nd Street and Avenue 5.5E	City of Yuma	Signalized
	32nd Street and Avenue 5E	City of Yuma	Signalized
	32nd Street and Avenue 4E	City of Yuma	Signalized
	32nd Street and Avenue 3.5E	City of Yuma	Signalized

Project Intersection List			
Project Number	**Intersection**	**Jurisdiction**	**Type**
7	24th Street and Avenue 3E	City of Yuma	Signalized
	Avenue 3E and MCAS North Gate	City of Yuma	Signalized
	Avenue 3E and MCAS Main Gate	City of Yuma	Signalized
8	12th Street and Avenue B	City of Yuma	Signalized
	20th Street and Avenue B	City of Yuma	Signalized
	26th Street and Avenue B	Yuma County	Signalized
	28th Street and Avenue B	City of Yuma	Signalized
	5th St & Avenue B	Yuma County	HAWK - Not included in Project
9	County 16th Street & Avenue G	Yuma County	Signalized
	Main Street & Avenue F	City of Somerton	Signalized
	Main Street & Somerton Avenue	City of Somerton	Signalized
	Main Street & Bingham Avenue	City of Somerton	Signalized
	Main Street & Avenue D	City of Somerton	Signalized
	Main Street & Cocopah Casino	Cocopah Tribe	Signalized
	Avenue B & County 15th Street	Cocopah Tribe	Signalized
	County 14th Street & Avenue B	Yuma County	Signalized
9B	County 16th Street & Avenue G	Yuma County	Signalized
	Main Street & Avenue F	City of Somerton	Signalized
	Main Street & Somerton Avenue	City of Somerton	Signalized
	Main Street & Bingham Avenue	City of Somerton	Signalized
	Main Street & Avenue D	City of Somerton	Signalized
	Main Street & Cocopah Casino	Cocopah Tribe	Signalized
	Avenue B & County 15th Street	Cocopah Tribe	Signalized
	County 14th Street & Avenue B	Yuma County	Signalized
	County 13th Street & Avenue B	Yuma County	Unsignalized (New Wireless Pole Only)
	County 12th Street & Avenue B	Cocopah Tribe	Unsignalized (New Wireless Pole Only)
	Main Street & County 16th Street	Yuma County	Unsignalized (New Wireless Pole Only)
10	County 14th Street and Avenue 3E	City of Yuma	Signalized
	County 14th Street & Avenue A	Yuma County	Signalized
	County 14th Street & Avenue 5E	Yuma County	Signalized
	County 14th Street & Avenue 1E	Yuma County	Unsignalized (New Wireless Pole Only)
	County 14th Street & Avenue 2E	Yuma County	Unsignalized (New Wireless Pole Only)
	County 14th Street & Avenue 4E	Yuma County	Unsignalized (New Wireless Pole Only)
	County 13th Street & Avenue 3E	City of Yuma	Unsignalized (New Wireless Pole Only)
11	Parkview Loop and Avenue A	City of Yuma	Signalized
	3rd Street and Avenue A	City of Yuma	Signalized
	Palmcroft Drive and Avenue A	City of Yuma	Signalized
12	Palo Verde Street and Pacific Avenue	City of Yuma	Signalized
	Gila Ridge Road and Pacific Avenue	City of Yuma	Signalized
13	24th Street and Otondo Drive	City of Yuma	Signalized
	24th Street and Avenue 7.5E	City of Yuma	Signalized
	24th Street and Avenue 7E	City of Yuma	Signalized
	24th Street and Araby Road	City of Yuma	Signalized
	Giss Parkway and Redondo Center Drive	City of Yuma	Signalized
	Ocean to Ocean Bridge	City of Yuma	Signalized
Future Signals	North Frontage Road and Avenue 9E		Signalized - Not included in Project
	18th Street and Avenue C		Signalized - Not included in Project
	32nd Street and East Main Canal Linear Park		HAWK - Not included in Project
	4th Avenue and Court Street		HAWK - Not included in Project
	4th Avenue and 4th/5th Street		HAWK - Not included in Project
	4th Avenue and 12th/13th Street		HAWK - Not included in Project
	24th Street and 6th Avenue		HAWK - Not included in Project
	Giss Parkway and City Hall Pedestrian Crossing		HAWK - Not included in Project

CITY OF YUMA
ITS PROJECT INTERSECTION LIST
(ALTERNATIVE FOR NO EXISTING FIBER BACKBONE)

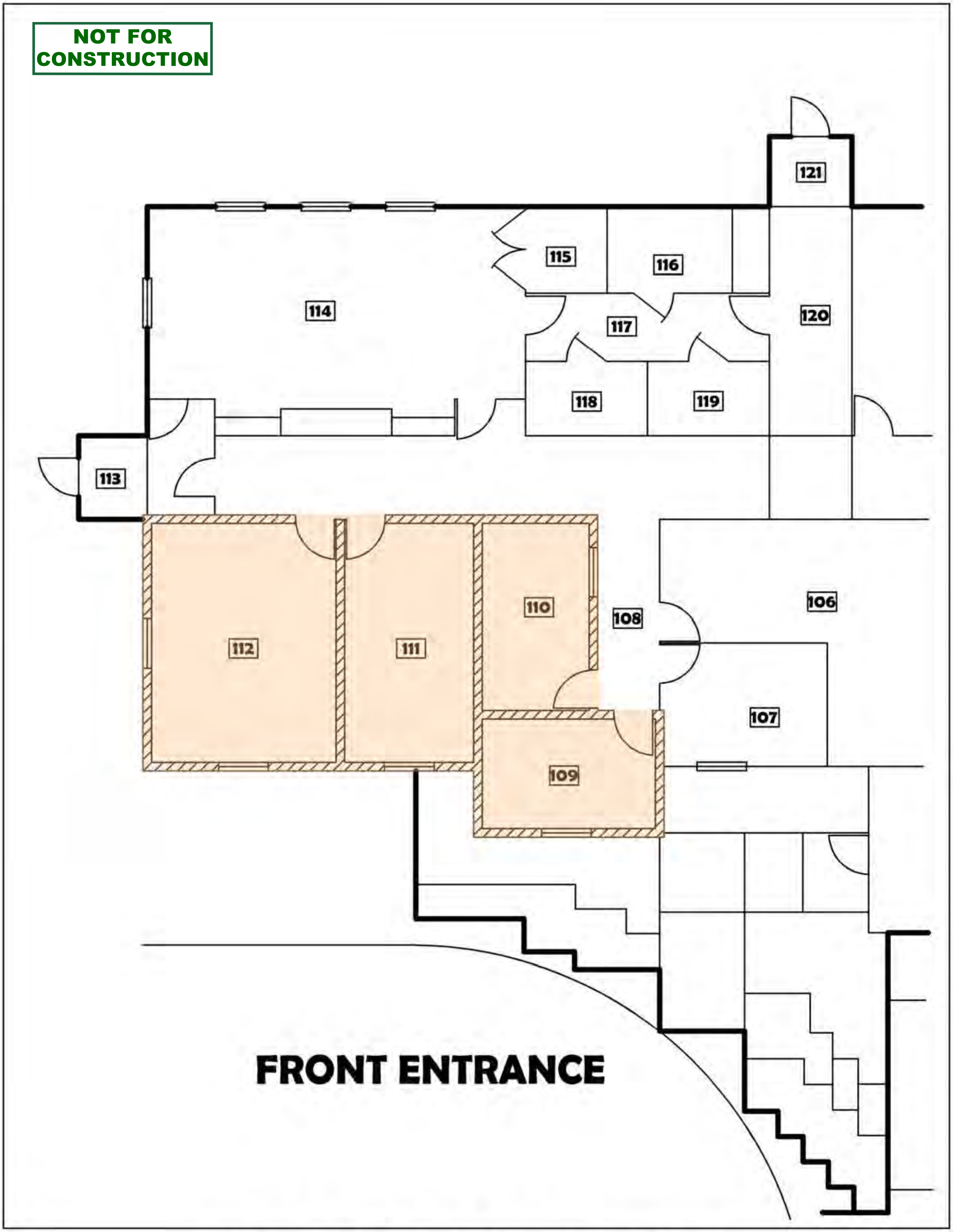
Project Intersection List - No Backbone Alternative			
Project Number	**Intersection**	**Jurisdiction**	**Type**
Core Ring	4th Avenue and 16th Street	City of Yuma	Signalized
	4th Avenue and 22nd Street	City of Yuma	Signalized
	4th Avenue and 24th Street	City of Yuma	Signalized
	4th Avenue and 28th Street	City of Yuma	Signalized
	4th Avenue and Catalina Drive	City of Yuma	Signalized
	4th Avenue and 32nd Street (Big Curve)	City of Yuma	Signalized
	16th Street and Avenue C	City of Yuma	Signalized
	16th Street and 31st Drive	City of Yuma	Signalized
	16th Street and Avenue B	City of Yuma	Signalized
	16th Street and 14th Avenue	City of Yuma	Signalized
	16th Street and Avenue A	City of Yuma	Signalized
	16th Street and 1st Avenue	City of Yuma	Signalized
	24th Street and Avenue C	City of Yuma	Signalized
	20th Street and Avenue C	City of Yuma	Signalized
	32nd Street and Avenue C	City of Yuma	Signalized
	32nd Street and Avenue B	City of Yuma	Signalized
	32nd Street and 21st Drive	City of Yuma	Signalized
	32nd Street and 15th Avenue/Kofa driveway	City of Yuma	Signalized
	32nd Street and Avenue A	City of Yuma	Signalized
	32nd Street and 8th Avenue	City of Yuma	Signalized
	4th Avenue Extension and 32nd Street	City of Yuma	Signalized
1	4th Avenue and 1st Street	City of Yuma	Signalized
	4th Avenue and 3rd Street	City of Yuma	Signalized
	4th Avenue and 8th Street	City of Yuma	Signalized
	4th Avenue and 10th Street	City of Yuma	Signalized
	4th Avenue and 14th Street	City of Yuma	Signalized
2	32nd Street and Pacific Avenue	City of Yuma	Signalized
	32nd Street and Arizona Avenue	City of Yuma	Signalized
	32nd Street and Catalina Drive	City of Yuma	Signalized
	32nd Street and 32nd Street Extension (Big Curve)	City of Yuma	Signalized
	32nd Street & Avenue 3E	Yuma County	Signalized
3	16th Street and Pacific Avenue	City of Yuma	Signalized
	16th Street and Sunridge Drive	City of Yuma	Signalized
	16th Street and Interstate 8	City of Yuma	Signalized
	16th Street and Redondo Center Drive	City of Yuma	Signalized
	16th Street and Arizona Avenue	City of Yuma	Signalized
	16th Street & S Engler Avenue	Yuma County	Signalized
	16th Street & Avenue 3E	Yuma County	Signalized
4	24th Street and Pacific Avenue	City of Yuma	Signalized
	24th Street and Kennedy Lane	City of Yuma	Signalized
	24th Street and Arizona Avenue	City of Yuma	Signalized
	24th Street and 1st Avenue	City of Yuma	Signalized
	24th Street and 8th Avenue	City of Yuma	Signalized
	24th Street and Avenue A	City of Yuma	Signalized
	24th Street and Yuma Regional Medical Center	City of Yuma	Signalized
	24th Street and Camino Alemeda	City of Yuma	Signalized
	24th Street and 22nd Drive	City of Yuma	Signalized
	24th Street and Avenue B	City of Yuma	Signalized
5	8th Street and Orange Avenue	City of Yuma	Signalized
	8th Street and Avenue A	City of Yuma	Signalized
	8th Street and 14th Avenue	City of Yuma	Signalized
	8th Street and Magnolia Avenue	City of Yuma	Signalized
	8th Street and Avenue B	City of Yuma	Signalized
	8th Street & Avenue C	Yuma County	Signalized
	8th St West of 21st Avenue	City of Yuma	HAWK - Not included in Project

Project Intersection List - No Backbone Alternative

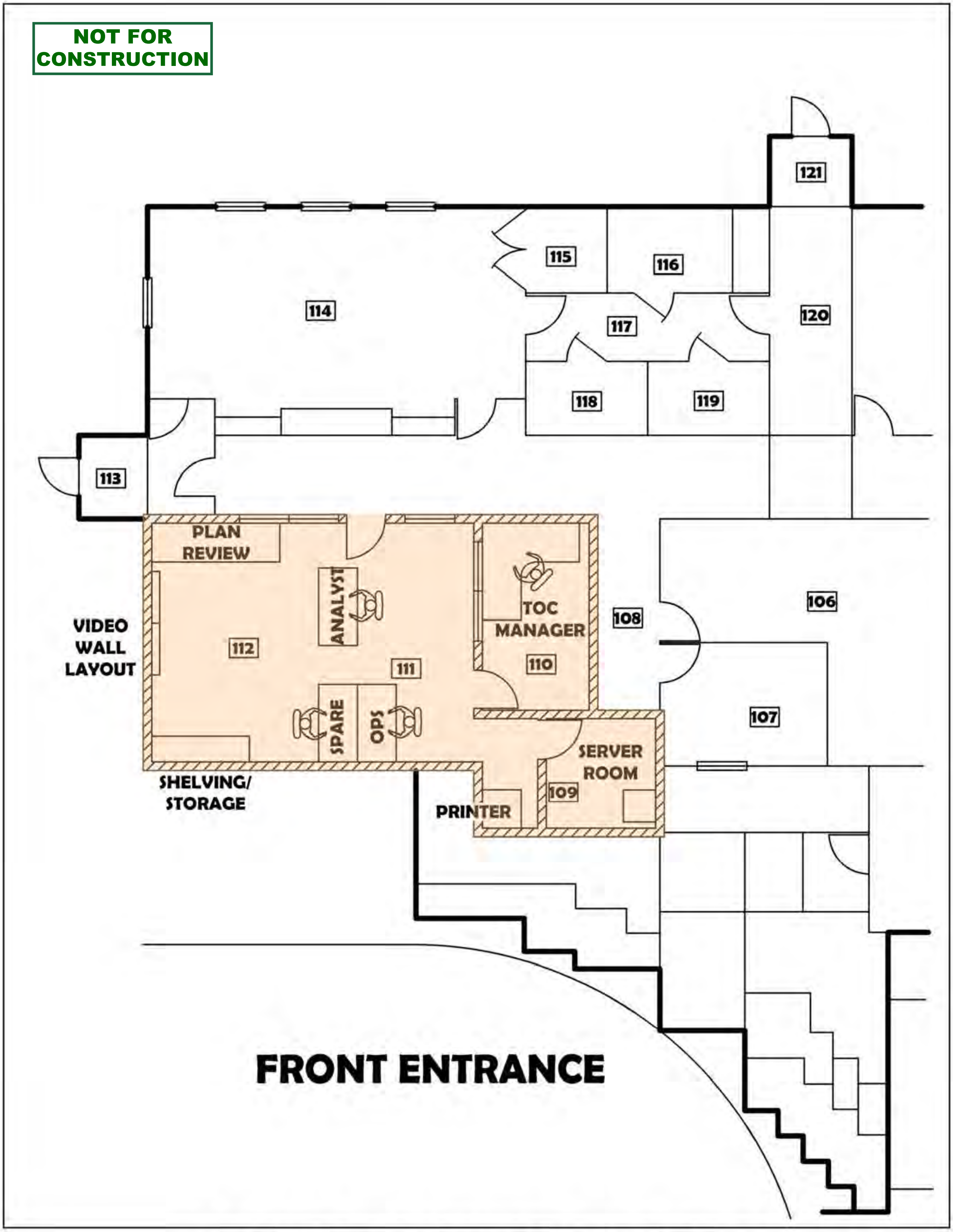
Project Number	Intersection	Jurisdiction	Type
6	32nd Street and Avenue 8E	City of Yuma	Signalized
	32nd Street and Avenue 7E	City of Yuma	Signalized
	32nd Street and Avenue 6E	City of Yuma	Signalized
	32nd Street and Avenue 5.5E	City of Yuma	Signalized
	32nd Street and Avenue 5E	City of Yuma	Signalized
	32nd Street and Avenue 4E	City of Yuma	Signalized
	32nd Street and Avenue 3.5E	City of Yuma	Signalized
7	24th Street and Avenue 3E	City of Yuma	Signalized
	Avenue 3E and MCAS North Gate	City of Yuma	Signalized
	Avenue 3E and MCAS Main Gate	City of Yuma	Signalized
8	12th Street and Avenue B	City of Yuma	Signalized
	20th Street and Avenue B	City of Yuma	Signalized
	26th Street and Avenue B	Yuma County	Signalized
	28th Street and Avenue B	City of Yuma	Signalized
	5th St & Avenue B	Yuma County	HAWK - Not included in Project
9	County 16th Street & Avenue G	Yuma County	Signalized
	Main Street & Avenue F	City of Somerton	Signalized
	Main Street & Somerton Ave	City of Somerton	Signalized
	Main Street & Bingham Ave	City of Somerton	Signalized
	Main Street & Avenue D	City of Somerton	Signalized
	Main Street & Cocopah Casino	Cocopah Tribe	Signalized
	Avenue B & County 15th Street	Cocopah Tribe	Signalized
	County 14th Street & Avenue B	Yuma County	Signalized
9B	County 16th Street & Avenue G	Yuma County	Signalized
	Main Street & Avenue F	City of Somerton	Signalized
	Main Street & Somerton Avenue	City of Somerton	Signalized
	Main Street & Bingham Avenue	City of Somerton	Signalized
	Main Street & Avenue D	City of Somerton	Signalized
	Main Street & Cocopah Casino	Cocopah Tribe	Signalized
	Avenue B & County 15th Street	Cocopah Tribe	Signalized
	County 14th Street & Avenue B	Yuma County	Signalized
	County 13th Street & Avenue B	Yuma County	Unsignalized (New Wireless Pole Only)
	County 12th Street & Avenue B	Cocopah Tribe	Unsignalized (New Wireless Pole Only)
	Main Street & County 16th Street	Yuma County	Unsignalized (New Wireless Pole Only)
10	County 14th Street and Avenue 3E	City of Yuma	Signalized
	County 14th Street & Avenue A	Yuma County	Signalized
	County 14th Street & Avenue 5E	Yuma County	Signalized
	County 14th Street & Avenue 1E	Yuma County	Unsignalized (New Wireless Pole Only)
	County 14th Street & Avenue 2E	Yuma County	Unsignalized (New Wireless Pole Only)
	County 14th Street & Avenue 4E	Yuma County	Unsignalized (New Wireless Pole Only)
	County 13th Street & Avenue 3E	City of Yuma	Unsignalized (New Wireless Pole Only)
11	Parkview Loop and Avenue A	City of Yuma	Signalized
	3rd Street and Avenue A	City of Yuma	Signalized
	Palmcroft Drive and Avenue A	City of Yuma	Signalized
12	Palo Verde Street and Pacific Avenue	City of Yuma	Signalized
	Gila Ridge Road and Pacific Avenue	City of Yuma	Signalized
13	24th Street and Otondo Drive	City of Yuma	Signalized
	24th Street and Avenue 7.5E	City of Yuma	Signalized
	24th Street and Avenue 7E	City of Yuma	Signalized
	24th Street and Araby Road	City of Yuma	Signalized
	Giss Parkway and Redondo Center Drive	City of Yuma	Signalized
	Ocean to Ocean Bridge	City of Yuma	Signalized

Project Intersection List - No Backbone Alternative			
Project Number	Intersection	Jurisdiction	Type
Future Signals	North Frontage Road and Avenue 9E		Signalized - Not included in Project
	18th Street and Avenue C		Signalized - Not included in Project
	32nd Street and East Main Canal Linear Park		HAWK - Not included in Project
	4th Avenue and Court Street		HAWK - Not included in Project
	4th Avenue and 4th/5th Street		HAWK - Not included in Project
	4th Avenue and 12th/13th Street		HAWK - Not included in Project
	24th Street and 6th Avenue		HAWK - Not included in Project
	Giss Parkway and City Hall Pedestrian Crossing		HAWK - Not included in Project

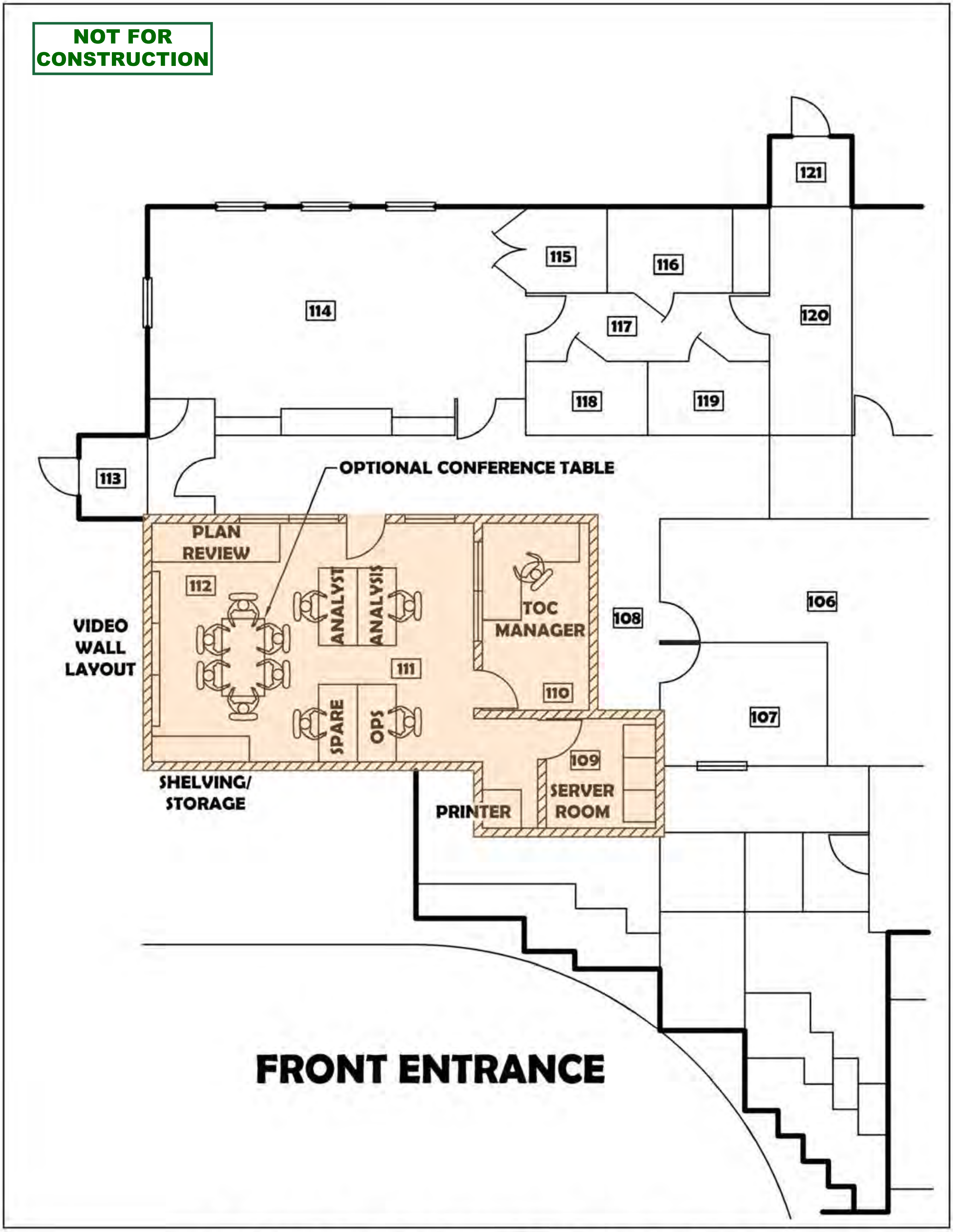
Appendix D – TOC Layout & Cost Estimate



EXAMPLE TOC LAYOUT: EXISTING CONDITIONS



EXAMPLE TOC LAYOUT: PHASE 1 (INITIAL BUILDOUT)



EXAMPLE TOC LAYOUT: PHASE 2 (EXPANSION)

CITY OF YUMA
TOC COST ESTIMATOR

PROJECT LOCATION:	Yuma Traffic Operations Center (TOC) INITIAL BUILDOUT			
	Cost Estimates	Unit	Project Quantities	
TOC PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	Estimated Average Implementation Cost	Unit	Number of TOC Elements	Implementation Cost
OPERATIONS FLOOR WORKSTATIONS				
WORKSTATION EQUIPMENT				
29" MONITOR WITH STAND	$300	EA	9	$2,700
KEYBOARD (INCLUDES KVM SWITCH AND MOUSE)	$800	EA	3	$2,400
COMPUTER SPEAKERS (1 UNIT)	$50	EA	3	$150
MINI-PC	$500	EA	3	$1,500
MICROSOFT WINDOWS SERVER SOFTWARE	$1,000	EA	3	$3,000
HARD DRIVE	$100	EA	3	$300
MAINTENANCE AND VENDOR SUPPORT PER YR AFTER FACTORY WARRANTY	$250	EA	3	$750
PHONE	$150	EA	3	$450
UNITERRUPTED POWER SUPPLY AND POWER STRIP	$150	EA	3	$450
WORKSTATION FURNITURE				
ADJUSTABLE HEIGHT WORKSTATION WITH CABLE MANAGEMENT	$8,500	EA	3	$25,500
CHAIR	$200	EA	3	$600
VERTICAL STORAGE	$500	EA	3	$1,500
			Subtotal	**$39,300**
OFFICE SPACE				
MANAGEMENT WORKSTATION EQUIPMENT				
29" MONITOR WITH STAND	$300	EA	3	$900
KEYBOARD (INCLUDES KVM SWITCH AND MOUSE)	$800	EA	1	$800
COMPUTER SPEAKERS (1 UNIT)	$50	EA	1	$50
MINI-PC	$500	EA	1	$500
MICROSOFT WINDOWS SERVER SOFTWARE	$1,000	EA	1	$1,000
HARD DRIVE	$100	EA	1	$100
MAINTENANCE AND VENDOR SUPPORT PER YR AFTER FACTORY WARRANTY	$250	EA	1	$250
PHONE	$150	EA	1	$150
UNITERRUPTED POWER SUPPLY AND POWER STRIP	$250	EA	1	$250
MANAGEMENT WORKSTATION FURNITURE				
ADJUSTABLE HEIGHT WORKSTATION WITH CABLE MANAGEMENT	$8,500	EA	1	$8,500
CHAIR	$200	EA	1	$200
VERTICAL STORAGE	$500	EA	1	$500
			Subtotal	**$13,200**
VIDEO WALL				
LCD FLAT PANEL DISPLAY (55" MAX)	$5,000	EA	4	$20,000
WALL MOUNTING HARDWARE	$200	EA	4	$800
CABLES	$50	EA	4	$200
MAINTENANCE AND VENDOR SUPPORT PER YR AFTER FACTORY WARRANTY	$3,500	EA	1	$3,500
			Subtotal	**$24,500**
COMMON AREA (CONTROL ROOM)				
SHELVING UNITS	$5,000	EA	1	$5,000
COUNTER OR REVIEW SPACE	$2,500	EA	1	$2,500
PRINTER/SCANNER	$3,000	EA	1	$3,000
LOCKING STORAGE (FOR STAFF PERSONAL ITEMS)	$1,000	EA	1	$1,000
TOC PHONE	$150	EA	1	$150
COAT RACK	$150	EA	1	$150
			Subtotal	**$11,800**
COMMUNICATIONS / SERVER ROOM				
DEDICATED HVAC SYSTEM	$10,000.00	EA	1	$10,000
FIREWALL	$20,000.00	LS	1	$20,000
SECURITY SUBSCRIPTION FOR FIREWALL	$8,500.00	EA	1	$8,500
SWITCHES	$12,500.00	LS	3	$37,500
SSL VPN DEVICE	$1,800.00	EA	1	$1,800
ROUTER	$6,000.00	EA	2	$12,000
WIRELESS ACCESS POINT	$1,000.00	EA	1	$1,000
MAINTENANCE AND VENDOR SUPPORT PER YR AFTER FACTORY WARRANTY	$28,000.00	EA	1	$28,000
SERVER EQUIPMENT AND RACKS	$8,500.00	EA	1	$8,500
			Subtotal	**$127,300**
BUILDING				
SECURITY SYSTEM - TOC MAIN DOOR	$5,000	EA	1	$5,000
WINDOWS	$1,500	EA	5	$7,500
MISCELLANEOUS BUILDING REMODEL (INITIAL BUILDOUT PHASE)	$35,000	LS	1	$35,000
SECURITY SYSTEM - COMMUNICATIONS / SERVER ROOM	$10,000	EA	1	$10,000
			Subtotal	**$57,500**
ATMS SYSTEM				
INITIAL ATMS SYSTEM & SUPPORT	$250,000	LS	1	$250,000
			Subtotal	**$250,000**
			Total Element Cost	**$523,600**
			Contingency (15%)	**$80,000**
			Integration and Professional Services (7%)	**$40,000**
			TOTAL PROJECT COST	**$643,600**

Current Year	**2021**
Year of Deployment Project	**2026**
TOTAL PROJECT COST IN FUTURE YEAR	**$820,000**

CITY OF YUMA
TOC COST ESTIMATOR

PROJECT LOCATION:	Yuma Traffic Operations Center (TOC) EXPANSION PHASE			
	Cost Estimates	Unit	Project Quantities	
TOC PROJECT COMPONENTS (PER UNIT UNLESS OTHERWISE SPECIFIED)	**Estimated Average Implementation Cost**	**Unit**	**Number of TOC Elements**	**Implementation Cost**
OPERATIONS FLOOR WORKSTATIONS				
EXISTING WORKSPACE UPGRADES				
ADDITIONAL MONITOR - EXPANSION	$300	EA	2	$600
NEW WORKSTATION EQUIPMENT (ANALYSIS STAFF)				
29" MONITOR WITH STAND	$300	EA	3	$900
KEYBOARD (INCLUDES KVM SWITCH AND MOUSE)	$800	EA	1	$800
COMPUTER SPEAKERS (1 UNIT)	$50	EA	1	$50
MINI-PC	$500	EA	1	$500
MICROSOFT WINDOWS SERVER SOFTWARE	$1,000	EA	1	$1,000
HARD DRIVE	$100	EA	1	$100
MAINTENANCE AND VENDOR SUPPORT PER YR AFTER FACTORY WARRANTY	$250	EA	1	$250
PHONE	$150	EA	1	$150
UNITERRUPTED POWER SUPPLY AND POWER STRIP	$150	EA	1	$150
WORKSTATION FURNITURE				
ADJUSTABLE HEIGHT WORKSTATION WITH CABLE MANAGEMENT	$8,500	EA	1	$8,500
CHAIR	$200	EA	1	$200
VERTICAL STORAGE	$500	EA	1	$500
			Subtotal	**$13,700**
VIDEO WALL				
LCD FLAT PANEL DISPLAY (55" MAX) - EXPANSION	$5,000	EA	5	$25,000
WALL MOUNTING HARDWARE	$200	EA	5	$1,000
CABLES	$50	EA	5	$250
MAINTENANCE AND VENDOR SUPPORT PER YR AFTER FACTORY WARRANTY	$3,500	EA	1	$3,500
			Subtotal	**$29,750**
COMMON AREA (CONTROL ROOM)				
CONFERENCE TABLE AND CHAIRS	$5,000	LS	1	$5,000
			Subtotal	**$5,000**
COMMUNICATIONS / SERVER ROOM				
SERVER EQUIPMENT AND RACKS - EXPANSION	$8,500.00	EA	2	$17,000
			Subtotal	**$17,000**
BUILDING				
MISCELLANEOUS BUILDING REMODEL (EXPANSION PHASE)	$5,000	LS	1	$5,000
BACKUP GENERATOR - EXPANSION	$50,000	EA	1	$50,000
			Subtotal	**$55,000**
			Total Element Cost	**$120,450**
			Contingency (15%)	**$20,000**
			Integration and Professional Services (7%)	**$10,000**
			TOTAL PROJECT COST	**$150,450**
			Current Year	**2021**
			Year of Deployment Project	**2026**
			TOTAL PROJECT COST IN FUTURE YEAR	**$190,000**