Closed-Circuit Television System Deployment with Future Data-Sharing with Houston TranStar

Concept of Operations – Version 1.X

Prepared for:

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Anyplace County

CSJ XXX-XX-XXXX

MPO Project ID: XXXXX

Concept of Operations [Template]

## Closed Circuit Television (CCTV) Deployment with Future Data Sharing with Houston TranStar

The Concept of Operations (ConOps) document defines the operational mission of the [project name] project and states the operational requirements necessary to achieve that mission. The ConOps defines: 1) the goals, objectives, and capabilities of each system included in the project; and 2) the roles and responsibilities of the [agency], other agencies, and associated project stakeholders.

# Concept of Operations Scope

This section provides an overview of the ConOps document and the proposed CCTV system to which it applies.

* + 1. Identification of System

This project will deploy, operate and maintain a CCTV system on/in [describe roadway segment or area]. This project is referenced as CSJ ###-##-#### on the H-GAC Transportation Improvement Plan (TIP) and referenced by [city/county] documents as ITS Project ###.

* + 1. Document Overview

This project is motivated by three main needs:

1. First, the project will enable monitoring traffic conditions in real-time on the facility to identify abnormal travel conditions;
2. The second need is to provide the capability to identify incidents and dispatch appropriate emergency response to the scene; and
3. The third need is providing traveler information through dissemination of images to the public and to the broadcast media.

The purpose of this ConOps document is to:

* To ensure that the city (and other stakeholder) needs and expectations have been documented early in the project development process;
* To ensure that the project deployment is linked to the agency mission, goals, and objectives;
* To identify and document existing operations, and where gaps may exist;
* To identify where the proposed system could supplement existing operations;
* To define the envisioned operational environment with the [project] in operation;
* To establish a list of operational requirements; and
* To begin the traceability of the systems engineering process.
	+ 1. System Overview

[Blind Note: Briefly state the purpose of the proposed system. Describe the general nature of the system, and identify the project sponsors, user agencies, support agencies, and the operating centers that will run the system. Mention other documents relevant to the present or proposed system. A graphical overview of the system is strongly recommended. This can be any type of diagram that depicts the system and its environment.]

A CCTV system can be used to monitor conditions along a roadway or, more commonly, at arterial intersections. The purpose of this type of system is to all traffic management center operators to monitor traffic conditions and react to incidents or abnormal conditions, often in conjunction with emergency services. In addition, CCTV images (either snapshots or full motion video) can be transmitted to media partners or published via websites for further dissemination to the traveling public.

The project will be sponsored by [agency]. Other users of the data generated by the system will include [other users/agencies]. The travel time monitoring system will be run through the [local center OR Houston TranStar OR other].

[Blind Note: include high-level system operational graphic here – show representations of physical equipment and connections indicating high-level data elements to be transmitted AND calculations completed – DO NOT show technologies to be used in this graphic as the ConOps should be technology-neutral. Technologies are selected in the market studies/pre-design or design phases]

# Referenced Documents

[Blind Note: List the document number, title, revision, and date of all documents referenced in the ConOps document here. If references are not in the public domain, list the owning agency or source.]

1. U.S. Department of Transportation, California Division. Systems Engineering Guidebook for ITS. [Online] [Cited: Date] <http://www.fhwa.dot.gov/cadiv/segb/>

Additional Local References:

* Houston-Galveston Area Regional ITS Architecture
* National ITS Architecture
* Houston TranStar IS Requirements
* Houston TranStar Policy and Procedures Manual

Houstontranstar.org:

* CCTV: <https://traffic.houstontranstar.org/cctv/transtar/>
* CCTV Map: <https://traffic.houstontranstar.org/layers/layers.aspx?cam=True>

# Current System or Situation

[Blind Note: In this section, describe the system or situation as it currently exists. If there is no current system on which to base changes, describe the situation that motivates the proposed system.]

This section describes the current operational situation and summarizes the rationale for deployment of a CCTV system in the [corridor].

* + 1. Background, objectives and scope

The [city] currently operates and maintains ### traffic signals on a street system of nearly #,### center lane miles. Currently, most real-time operations are reactive in nature (responding to outages or responding to major arterial incidents with police, fire and EMS staff). There is some real-time signal control capability but little real-time modification of signal timing to current operational conditions because of the lack of operational awareness. However, the [city] has identified enhanced arterial operations as a priority initiative in its mission and part of the solution identified is the deployment of CCTV at key intersections and along problematic sections of the arterial network.

* + 1. Operational policies and constraints

City Council has determined that city streets should operate with higher level of service than currently experienced. The council desires to provide traffic engineering staff with the capability to monitor traffic for unusual conditions, and to enable fire, police and EMS to remotely monitor and react to incidents or other operational issues. The constraint placed upon the system by the council is that the CCTV system comply with all city ordinances, address public privacy concerns, and to operate the system in a secure manner per city IT and Engineering Department policies. The Engineering Department will be in charge of the CCTV system, with support from IT and input from public safety.

* + 1. Description of current system or situation

[Blind Note: The purpose of this section is to describe the current system and how it operates. This description should be simple enough and clear enough that all intended readers of the document can fully understand it using the users' terminology. Graphics should be used wherever possible. If parts of the descriptions are large or overly complicated, they can be included in an appendix or incorporated by reference. When the proposed system is new, discussion should focus on the current situation.]

Currently, the city has no method to visually monitor traffic conditions at key intersection of problematic sections or arterial roadways. While CCTV images and video are available on nearby highways (operated by TxDOT and tolling authorities), they are not available on the major arterial network in the city. Having CCTV images available on the city system will give the city visibility to problems on the network and the ability to react and adjust operations accordingly or respond to incidents with the appropriate level of resources.

A system which in the future provides CCTV data sharing between Houston TranStar and the local system will also give travelers outside of the city/county knowledge of current conditions, and to be able to adjust routes accordingly. The Houston TranStar website is also used by broadcast media to alert travelers of adverse travel conditions, and the new CCTV system, when connected to TranStar in the future, will give media the ability to give more local information.

Currently a communications connection with the ability to carry CCTV full-motion video does not exist between the city network and state communications network. However, this project will plan for the eventuality of CCTV data sharing between the two government agencies for mutual benefit.

* + 1. Modes of operation for the current system or situation

The city does not currently have a CCTV system. Feedback on real-time operations comes from city staff on-scene (either engineering staff or first-responders) with radio or cellphone communications person-to-person, or person-to-dispatch center.

* + 1. User classes and other involved staff/personnel for the current system or situation

As the city does not currently have a CCTV system, there is limited impact on user classes and staff.

* + 1. Support environment for the current system or situation

As the city does not currently have any CCTV system, there is little impact on the support requirements for a monitoring system. The impact to the city currently is the delay in response from engineering or first responders to situations on the roadway network or at intersections.

# Justification for and Nature of Changes

In this section, shortcomings of the current situation that causes the need for development of a new system is described. This section provides justification for features of the new travel time monitoring system.

* + 1. Justification for changes

The city has realized that in response to citizen concerns about traffic congestion in the area, that a real-time capability to assess traffic conditions was needed. There was also an opportunity with a CCTV system to provide traveler information data to the region through a data sharing agreement with Houston TranStar, enabling non-local travelers to see what was happening in the city at the point in time when communications is achieved with the state communications network.

* + 1. Description of desired changes

The new CCTV, at a high level, should provide the following capabilities, functions, processes, and interfaces:

* The system should provide real-time video images, in HD or better resolution, of key intersections or problematic arterial sections in the city, with a focus on areas which experience more frequent incidents;
* The system should enable city engineering staff to visually confirm the effectiveness of traffic signal operations and to assess the response to real-time changes in signal operation from the city’s traffic management center;
* The system should enable emergency services to react to incidents with the appropriate level of response to 1) clear incidents faster, and 2) reduce un-needed trips for emergency vehicles;
* The CCTV system should provide an internet-based interface to view the CCTV images in snapshot and/or moving-image form.
	+ 1. Priorities among desired changes and new features

Priorities among the new features are shown in Table 1 below. Each feature is classified as essential, desirable, or optional. Classifying the new features is important to guide the decision-making process during the life cycle of the proposed system. This information is also helpful in cases of budget or schedule cuts or overruns, since it permits determination of which features must be finished, and which ones can be delayed or omitted. Desirable priority does not mean that a requirement should not be met, but may be met at a level lower than stated if schedule or budget constraints preclude reaching stated performance thresholds.

Table . High-Level Requirements and Priority.

|  |  |
| --- | --- |
| High-Level Requirement | Priority (Essential, Desirable, Optional) |
| * The system should provide real-time video images, in HD or better resolution, of key intersections or problematic arterial sections in the city, with a focus on areas which experience more frequent incidents;
 | Essential |
| * The system should enable city engineering staff to visually confirm the effectiveness of traffic signal operations and to assess the response to real-time changes in signal operation from the city’s traffic management center;
 | Essential |
| * The system should enable emergency services to react to incidents with the appropriate level of response to 1) clear incidents faster, and 2) reduce un-needed trips for emergency vehicles;
 | Essential |
| * The CCTV system should provide an internet-based interface to view the CCTV images in snapshot and/or moving-image form.
 | Desirable |

There are no optional items listed in the high-level requirements.

* + 1. Changes considered but not included

The only CCTV system feature that was considered for this project was the addition of a communications link to connect to the TxDOT fiber optic communications hub at the IH-69 at Cross-Street interchange. The distance between the nearest system node and the interchange is nearly three miles, and the project will not bear that cost at this time. This feature will be considered later as additional funding becomes available.

* + 1. Assumptions and constraints

The following assumptions were made to enable deployment of the system:

* To reduce project cost, most CCTV will be co-located with traffic signal infrastructure;
* Communications between CCTV and traffic management center will be via existing fiber optic cable network and supplemented with wireless or cellular as needed;
* Adequate city resources will be dedicated to system operation and maintenance;
* There shall be no less than 25 CCTV deployed as part of the project.

The following constraints will be placed on the system:

* The CCTV system must produce images via protocols that can be accepted by the Houston TranStar CCTV system;
* The system must comply with city IT department and/or Engineering Department security protocols and TranStar IS protocols for shared data elements;

# Concepts for the Proposed System

In this section, the proposed system is described in a high-level manner, indicating the operational features that are to be provided without specifying design details. This section explains how the proposed CCTV system is envisioned to operate in fulfilling user needs. This discussion does not contain design specifications, but it does have examples of design strategies.

* + 1. Background, objectives, and scope of the new or modified system

The city has identified enhanced arterial operations as a priority initiative in its mission. Proactive ITS elements are needed to extend the capability for enhanced signal operations, arterial traveler information, incident response, and arterial monitoring on key city roadway corridors.

The goals (high-level needs) of the proposed CCTV system are:

* Provide real-time images of traffic signal operation on key city arterials (Need 1);
* Provide real-time ability to confirm incidents for first responder response (Need 2); and
* Provide a means to provide traveler information (CCTV images and/or video) on the arterial network (Need 3).

The scope of the system is as follows:

* [Roadways (and extents) upon which the system will be installed]
* [Which portals will be required for traveler information (city/county website or app, houstontranstar.org, or by other means)]

The objectives of the system are:

* Provide quality images for traffic engineering staff to assess traffic signal operations at key locations;
* Provide quality images for emergency services to assess the most appropriate response to incidents, or to avoid congestion routes in incident response;
* Provide traveler information through ##,### website and/or mobile app views of city/county CCTV images.
	+ 1. Operational policies and constraints that apply to the proposed system

The city Engineering Department has been tasked to deliver the CCTV system and has set the goals listed in Section 1.5.1 as minimum for the system. The City Council stated that the CCTV system should be available to residents using a map interface and that a report should be provided at least once per year on the CCTV system operational status.

The engineering department has determined that the system (including cameras, communications, and the interface) should be operational 99.5% of the hours over a year, allowing time for system maintenance as needed. City Council has set aside additional operational funds for the system once installed at an annual amount of $XX,XXX, provided through the Engineering Department. City Council also specified that data from the system be shared with partner stakeholders (including TxDOT and other cities and counties), and with private-data providers who execute data sharing agreements through either the city attorney’s office or (in the future) with Houston TranStar.

* + 1. Description of proposed system

This section contains a description of the proposed system.

* + - 1. The operational environment and its characteristics

The CCTV system will operate in two environments: 1) field; and 2) server located in a city facility or in the future at Houston TranStar with associated terminals.

In the field, it is planned that CCTV cameras will be deployed at signalized intersections where existing traffic signal cabinets, and most often communications connections, are located. The CCTV units should have requirements regarding environmental specifications including temperature, humidity, and electrical power.

The CCTV control system and associated server would need to comply with City IT requirements, including physical specifications and cooling functions. For future connectivity with Houston TranStar, the CCTV equipment should be compliant with TxDOT/LoneStar specifications or compatible through NTCIP protocols.

* + - 1. Major system elements and the interconnections among these elements

Figure 1 shows the system elements and connections between elements (with high-level data types noted). The system components can be separated into four primary elements:

1. CCTV assembly (camera and housing)
2. Communications
3. CCTV processing software
4. Human interface (PC-type computer)

The figure below shows the proposed system configuration.



Figure 1. System Elements and Connections.

* + - 1. Interfaces to external systems or procedures

The primary system data interface to external systems is out via an IP-based image output from the system. The system interface is internet browser-based to outward facing clients (image streams).

* + - 1. Capabilities or functions of the proposed system

The capabilities and functions of the proposed CCTV system include:

* IP-based video;
* Support for up to 1000 simultaneous video streams;
* Compatible with multiple camera vendors;
* Full pan/tilt/zoom support;
* Ability to set camera pre-sets;
* Ability to take snapshots from cameras
* Ability to temporarily block CCTV views from outside of the control center;
* Support for multicast streaming;
* Ability to record video for training and review purposes;
* Ability to publish to internet;
* Ability to display video on workstations and on a video wall; and
* Ability to allow external users to view video without access to control client.
	+ - 1. Charts/descriptions depicting inputs, outputs, dataflow

Figure 2 shows the high-level system inputs, outputs and data flows between field elements, host processing elements (at the city and in the future at Houston TranStar) and the interfaces. Images are read by the CCTV cameras and transmitted to the control center for monitoring and viewing. Once at the control center, images can be transmitted to other users. In the future, a communications connection to Houston TranStar will provide data sharing between TxDOT and the city.



Figure 2. High-Level System Inputs, Outputs and Dataflows

The system inputs include the following:

* CCTV Field devices:
	+ Configuration parameters (including logical name, IP address)
	+ Streaming Images
* Central Software/Server:
	+ Configuration parameters
	+ Video streams
* Human interface:
	+ Camera views
	+ Camera selection
	+ Camera control

System outputs include:

* Retrieve traffic data, traffic video
	+ - 1. Cost of systems operations, including manpower requirements

It is estimated that the cost of CCTV system operations and maintenance will require funding in the amount of $##,### per year, including an additional 0.5 man-year of effort for field maintenance. If current workload increases, or priorities changed, additional cost to operate and maintaining the CCTV system may be required.

The monetary value of CCTV system operations and maintenance cost is estimated to be approximately $45,000 per year ($45/hour x 4 man-hours/day x 250 days/year) for internal city labor, $60,000 per year for contracted maintenance and $40,000 per year for communications cost and supplemental equipment.

* + - 1. Operational risk factors

The primary operational risk factor of the CCTV system is with protection of public privacy. To mitigate this risk, the CCTV system shall have the capability to encrypt transmission between the field and control center. The other operational risk factors include failure of the communications system or central control software. Operational factors could also include inadequately trained maintenance staff, operating staff, and inadequate funding for system operation and maintenance.

* + - 1. Performance characteristics, such as speed, throughput, volume, frequency

The CCTV system shall be able to manage up to 1,000 simultaneous video streams at HD resolution at minimum of 30 frames per second. The control software should accommodate up to 50 concurrent users through the browser interface. Video servers should be able to accommodate 1000 concurrent sessions, but may use cloud computing and/or multicast techniques to satisfy this function.

* + - 1. Quality attributes, including: reliability and availability, others as needed

The CCTV system shall be available 99.5% of hours of the year.

* + - 1. Provisions for safety, security, privacy, integrity, and continuity of operations in emergencies

There are no additional provisions for safety, security, or privacy in emergency operations versus normal operations. The city’s backup power systems at the signalized intersections where this system is deployed will provide power in the event that grid-power is lost.

* + - 1. Logistics requirements to support system

Other than providing communications to CCTV units, a standard inventory control of replacement parts (including confirming lead times with suppliers) and regular software updates of server operating system, there are no other significant logistics requirements to support the system.

* + 1. Modes of operation

The CCTV system will have only one mode of operation: normal. With a future connection to Houston TranStar as secondary/backup, the CCTV operation can operate as concurrent so that if one system is unavailable, the other system is still processing images for viewing.

* + 1. User classes and other involved staff/personnel

This section discusses the user classes and how they interact with the system

* + - 1. Organizational structure

The organizational structure of user groups and classes that will be involved with the proposed system are shown in the figure below. This shows the relationship of city administration in relation to the various user classes listed in Section 1.5.5.2.



Figure 3. System/Organizational Structure of User Classes

* + - 1. Profiles of user classes

User classes for the system include:

* System Operator – individuals (likely Engineering Department staff) that manage system configuration and use the CCTV system for real-time operations. These users require the highest levels of system authentication and are trained in the use of the system. This class of user should be trained in the operation and configuration of the system and are responsible for its daily operation and function. The interface with the system will be primarily on workstations.
* System Maintainer – individuals (likely Engineering Department staff) or contractors with primary responsibility to maintain the function of field equipment and communications links between field equipment and CCTV central processing system. These users should be skilled in electronics installation, troubleshooting and repair, and are likely the same staff that deal with traffic signal and telecommunications issues for the agency.
* City/County User – Administrator/Executive – this class of user desires CCTV images occasionally. This class might include city council members and city management staff (e.g., department/division heads).
* City/County User – Engineering/Planning – this class of user desires more detail on traffic operations at intersections or those conducting studies (turning movement counts, etc.) where the use of video is advantageous.
* Public User – this class of user is a member of the traveling public with a desire to know more about roadway movement. They interface with the system by viewing a moving video or snapshots on the city website.
	+ - 1. Interactions with system among user classes

The various user classes interface with the proposed system as described below. Most of the interface will be through internet browser-based screens via PC and mobile devices, but some users will have access to field equipment interfaces and will need to connect via laptop computer or over mobile internet connections.

* System Operator – interaction with the CCTV system will be primarily on the central software CCTV module. Operators will monitor the CCTV system to detect abnormal conditions and react to incidents.
* System Maintainer – interaction with the system will be through the CCTV system status page, which shows communications status, IP/network address, and charts including communications status and reliability. Their interaction will also be in the field where they will interface with the CCTV hardware and communication interfaces.
* City/County User – Administrator/Executive – this class of user will interface the system through the browser-based interface, primarily using the CCTV images/snapshot page to view camera images.
* City/County User – Engineering/Planning – this class of user will interface the system through the browser-based interface, viewing images or video streams.
* Public User –The public will interface with the system largely by viewing snapshot images from a layer on the color-coded map of arterial conditions. Selected cameras may be viewed by the public via streaming video.
	+ - 1. Other involved personnel

Other agency executives and staff members may not directly interact with the CCTV system but will influence it use and operational status. The city/county manager may not directly use the system but will use reports from the system to prioritize initiatives to improve mobility. City Council members may also not directly use the system but will use reports and input from staff derived from the CCTV system to make decisions on budgeting and priorities for investment in transportation systems in the community. Consultants may also be asked to use video data generated by the system for analyses and reports on behalf of the city, but they may do so using exported video provided through city staff, and not by directly using the system.

* + 1. Support Environment

The CCTV system is envisioned as one that does not require significant resources to maintain and operate. Aside from ensuring power and communications remain in operation, the continuous operation of the CCTV system is relatively free of maintenance requirements.

Preventative maintenance is recommended but is mainly limited to checks of the field equipment and associated antennas and cables and ensuring communications with the camera units is continuous. The materials used in these systems are relatively small and spares can typically be stored on shelves in climate or non climate-controlled facilities.

Support for the system can be under the direction of the Engineering or Public Works Department, with additional support by contractors as needed. Typical levels of spare parts should be kept on hand (5-15% replacement in inventory). In some cases, bucket trucks or other heavy equipment may be needed to properly attach cameras to supports or connect communications – those activities may be completed with in-house equipment or as contracted services.

The software interface should be used to identify cameras which malfunction, either to the units themselves or from communications interruptions. This interface should identify CCTV that experience communications uptime below acceptable levels, or which have reliability below acceptable levels.

# Operational Scenarios

Below are step-by-step descriptions of how the proposed CCTV system should operate and interact with its users and external interfaces under certain circumstances.

## Normal Operations

Under normal operations, the CCTV system is sending images to the control center for viewing by system operators and at the same time sending snapshots or limited streaming video to the internet for viewing by the public. CCTV is communicating over existing city-owned fiber optic cables, over city-owned wireless communications links, and over leased cellular connections.

City Engineering Department staff, primarily system operators, monitor the CCTV system via their workstations or video wall to observe the map for real-time operations. If intersections are operating abnormally they can use the CCTV system to examine for incidents. If an incident is found, the system operator can notify the emergency services for a response.

City Engineering Department staff assist City Planning staff to access the interface and download video data used for planning studies.

For public users, interaction with the system will primarily be trough viewing the traffic map interface on the city’s website. Broadcast media could be considered public users for this purpose and will view the city’s website to report traffic information on radio, internet and TV.

## Incident Operations

If an incident is detected via the CCTV system, either by automated alerts (using an optional video analytics tool) or using human observation, the traffic management center operators will alert emergency services personnel (dispatchers) via phone. Fire/EMS/Police dispatchers will have access to the CCTV interface at their consoles and can view images to assist first responders in responding with the correct assets.

# Summary of Impacts

This section describes the operational impacts of the proposed CCTV system on the users and the operations and maintenance organizations involved and describes how those users can prepare for the changes that will be brought about by the new system.

* + 1. Operational impacts

The anticipated operational impacts of the system on users, support, and operations and maintenance staff during the operations of the travel time monitoring system include:

* Users
	+ System Operator – operators will spend time interacting with the CCTV system, particularly in peak periods as they monitor traffic. Operators will monitor the cameras and view cameras as requested by emergency services or engineering staff to view the impacts of special events or incidents. The anticipated man-hours per week spent by one operator on this system could be 20-30 hours per week. New procedures may need to be developed to guide operators on their responsibilities with the system and their priorities related to it versus other duties. The operators may also need to have a policy about notification on incidents and data sharing and permissions and procedures to provide data to third parties.
	+ System Maintainer – system maintenance may require interpretation of CCTV status reports and interaction in the field where they will interface with the CCTV hardware and communication interfaces. System maintenance may require less than 2 hours per week per 10 cameras. The maintenance staff will need to understand where in the repair priority the CCTV system is in relation to other equipment and maintenance responsibilities. Departmental budgets will need adjustment to include the additional manhours and materials needed to maintenance the system.
	+ City User (internal) – Administrator/Executive – this class of user will interface the CCTV system through the browser-based interface. These users need to be made aware of privacy policies and any limitations on the publication or use of the data.
	+ City User (internal) – Engineering/Planning – this class of user will interface the system through the browser-based interface, viewing images and video. Similar to administrator/executive users, these users need to be made aware of privacy policies and any limitations on the publication or use of the data. Administrators within the engineering and/or planning departments may spend additional hours overseeing operations and maintenance of the CCTV system, but much of that responsibility is seen being delegated to operators and maintenance staff.
	+ Public User –The public will interface with the system largely by viewing snapshots or video via layers on a map of the arterial network via the city’s website. There would be no direct cost for the public user for this service. However, users would be made aware that all content is copyright of the owning agency (a disclaimer should be put on every page viewed claiming copyright and no responsibility for use or misuse of the data).
* Support Staff – there will likely be a need for city IT staff to assist with obtaining network addresses for CCTV equipment initially, and to assist Engineering Department with ongoing maintenance issues. The level of support could be expected to be about 4 hours per 5 CCTV deployed initially, and less than 2 man-hours per week thereafter for normal operations and maintenance. City IT may also need to supply computerized archive space on the city server where the CCTV module will be housed, and in the future work with Houston TranStar IS staff on data exchange policy and protocol. City IT and Houston TranStar IS will have to mitigate any security risks associated with the new system and ensure that security updates are applied to applicable servers.
	+ 1. Organizational impacts

At this point, it is not envisioned that this system would require additional staff to monitor and maintain the system. Existing operations staff will add CCTV monitoring to their normal duties and advise administration if additional resources are ultimately needed. Regarding maintenance, existing staff and/or contracted services can accommodate needs. Aside from the time to train on the system, additional staff resources are not necessary.

The City Council will have to provide funding to deploy and maintain the system, and incrementally fund expansion as desired.

Where existing communications links are not available at CCTV deployment sites, cellular or wireless communications links will need to be provided and paid for using allocated operations funds. City Council and Engineering Department administrators will need to determine if those funds come from existing operations allocations or will need supplemental funds added.

* + 1. Impacts during development

During development of the system, staff members at various level of the agency may be needed to provide input or be involved in meetings to discuss requirements, high-level design, and detailed design. In addition, key staff may be needed to be involved in verification and validation efforts to document compliance with system requirements once deployment begins. Designated staff members may need to take time from normal duties for training activities and support staff may be required to escort contractors during field installation and work in the right-of-way. Since this CCTV system is new, no parallel operations and no retirement of existing systems will be required. Coordination with Houston TranStar IS and TranStar agency partners will be required in the future to setup protocols and procedures for data sharing.

# Analysis of proposed system

*Provide an analysis of the benefits, limitations, disadvantages, and alternatives considered for the proposed system. These benefits can be quantitative (preferred) or qualitative.*

* + 1. Benefits

The benefits of the proposed CCTV system are that it provides a method to remotely monitor traffic conditions at key intersections and problematic sections within the city’s transportation network. The CCTV system allows for the reduction of dispatched trips to the field and can be used to optimize response to incidents (eliminating unnecessary deployment of emergency assets). The system allows traveler information on city arterials and does so at a reasonable initial capital cost and reasonable ongoing operations and maintenance costs.

* + 1. Disadvantages and limitations

The CCTV system will not provide coverage to all intersections or continuous coverage on the city street network. Unless a video analytics software is utilized, the CCTV will not automatically alert operations staff of incidents.

* + 1. Alternatives considered

No alternatives to a CCTV system were considered that would meet the same needs and functional requirements.

# Appendices

[Blind note: Some information may be placed in appendices to the document. Each appendix should be referenced in the main body of the document where that information would normally have been provided. This can include proposed system coverage maps, locations of readers, communications links (existing and proposed) and graphics regarding the system.]

# Glossary

[Blind note: A glossary should be maintained and updated during the processes of concept analysis and development of the ConOps document. Include an alphabetical listing of all acronyms and abbreviations, along with their meanings as used in this document, and a list of any terms and definitions needed to understand the document. ]