PARTNERS FOR ADVANCED TRANSPORTATION TECHNOLOGY
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

Connected Corridors: I-210 Pilot Integrated Corridor Management System

Project Management Plan

February 10, 2017

Partners for Advanced Transportation Technology works with researchers, practitioners, and industry to implement transportation research and innovation, including products and services that improve the efficiency, safety, and security of the transportation system.

This page left blank intentionally

Primary Author

Francois Dion, PhD, PE (Michigan)
Senior Development Engineer
California PATH
University of California, Berkeley

Contributing Authors

Hari Hirani
Senior Development Engineer
California PATH
University of California, Berkeley

Ashkan Sharafsaleh, PE (California)
Senior Research and Development Engineer
California PATH
University of California, Berkeley

Lisa Hammon
Project/Policy Analyst
California PATH
University of California, Berkeley

Fred Winik
Technical Writer
California PATH
University of California, Berkeley

Joe Butler
Project Manager
California PATH
University of California, Berkeley

This page left blank intentionally

REVISION HISTORY

Date	Sections	Change Description
03/18/2014	All	Initial document
04/21/2015	All	Various revisions to provide conformity with SEMP
06/19/2015	Schedule Management Plan	Updated project schedule
09/25/2015	Schedule Management Plan; Appendix B; Appendix C	Updated project schedule; Caltrans personnel change
06/15/2016	Schedule Management Plan; Appendix B; Appendix C	Updated project schedule; Caltrans personnel change
02/10/2017	Project Management Approach, Schedule Management Plan; Appendix B; Appendix C; Appendix D; Appendix E	Updated project schedule; organizational chart, personnel directory; risk registry

This page left blank intentionally

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

This page left blank intentionally

1. INTRODUCTION

This document describes the project management principles and procedures that will be applied to the design, development, and implementation of a pilot Integrated Corridor Management (ICM) system on a section of the I-210 freeway in Southern California. This pilot implementation, referred to as the "I-210 Pilot" hereafter, is being conducted as part of the Connected Corridors program administered by the California Department of Transportation (Caltrans) and the Partners for Advanced Transportation Technology (PATH) at the University of California, Berkeley.

The Project Management Plan (PMP) is an important deliverable of the systems engineering process, as this document captures various activities and processes that will be followed, from project initiation through planning, execution, and closure, to ensure the successful completion of the pilot project. Given the complexity of the project, it is essential that the best project management practices be applied. Agreement, and adherence, to the procedures presented here are viewed as an important key to successful project delivery.

Elements presented in this section include:

- Purpose of Project Management Plan
- Intended audience of document
- Relation to the systems engineering process
- Project motivation and purpose
- Project definition
- Description of the I-210 Pilot corridor
- Project goals and objectives
- Primary problems to be addressed
- Map of user issues to corridor management needs
- Individual plans developed within the Project Management Plan

1.1. PURPOSE OF THE PROJECT MANAGEMENT PLAN

The Project Management Plan (PMP) is the primary planning document of a project. Elements captured in the PMP normally cover all phases of a project, from initiation through planning, execution, and closure. The PMP provides a comprehensive baseline of what has to be achieved by the project, how it is to be achieved, who will be involved, how it will be reported and measured, and how information will be communicated. Specific elements addressed by the PMP typically include the following:

- **Overview:** Why the project is being conducted and its primary objectives
- **Scope:** Business needs, requirements, deliverables, constraints, and work breakdown structure
- **Project team:** The people working on the project, their roles and responsibilities
- **Schedules:** Activities schedule and project milestones
- **Communications:** Communication type, channels, and the reporting approach
- **Costs:** Project budget and its funding approach
- **Quality Control:** Quality measurement and control approach
- **Risks**: Risk index, methods to identify and evaluate risks, risk mitigation, and contingency planning
- **Procurements:** Required procurements and purchase processes

- **Closure:** Closure approach, including protocols for handing-off deliverables
- **Changes:** Procedures used to track changes in the project
- **Baselines:** Scope, schedule, and budget baselines
- **Project Evaluation:** Methods to assess project activities and outcomes

1.2. INTENDED AUDIENCE

The primary intended audience for this document includes individuals from Caltrans and the University of California, Berkeley, tasked with project management duties. However, it is also expected that the document will be distributed to other project partners to guide and facilitate the coordination of activities.

1.3. RELATION TO SYSTEMS ENGINEERING PROCESS

Systems engineering is a methodical interdisciplinary approach for the planning, design, implementation, technical management, operations, and retirement of a system. This approach focuses on defining customer needs and required functionality early in the development cycle, as well as adequately documenting requirements, before proceeding with the design, synthesis, and validation of a system. The purpose of the process is to plan up-front for the life cycle of the project in order to minimize risks to budget, scope, and schedule.

As a comprehensive planning approach, the systems engineering process relies heavily on traceability and documentation, as well as on the use of “decision gates” to determine when to pass to the next step of the process. For each "decision gate," three issues are assessed: the quality of execution of the last step, the business rationale for moving to the next step, and resource availability to execute the next step. The systems engineering process further attempts to take into account all elements that may affect the development of a solution to a particular problem, such as system operational needs, cost and schedule requirements, system performance needs, training and support needs, system testing and validation needs, and, if required, system retirement needs. The process also aims to integrate all the disciplines and specialty groups involved in the development of a system into a team effort, forming a structured development process considering both the business and the technical needs of all customers, with an end goal of providing a quality product meeting the established user needs.

The overall trajectory of the systems engineering process, as outlined in the Federal Highway Administration's *Systems Engineering Guidebook for ITS, Version 3.0,* is often represented by the “Vee Diagram” shown in Figure 1-1. The left side of the diagram focuses on the definition and decomposition of the system to be built, the base on the building of the system components, and the right side on the integration and testing of system components, as well as acceptance and operation of the system. There are significant interactions between the two sides of the diagram, as verification and validation plans developed during the decomposition of the system on the left side of the process are used on the right side to make sure that the resulting components and integrated system meets the needs and requirements of the stakeholders. Throughout the process, “decision gates” are used as decision points to determine if a particular step has been completed to the satisfaction of the initially established criteria.

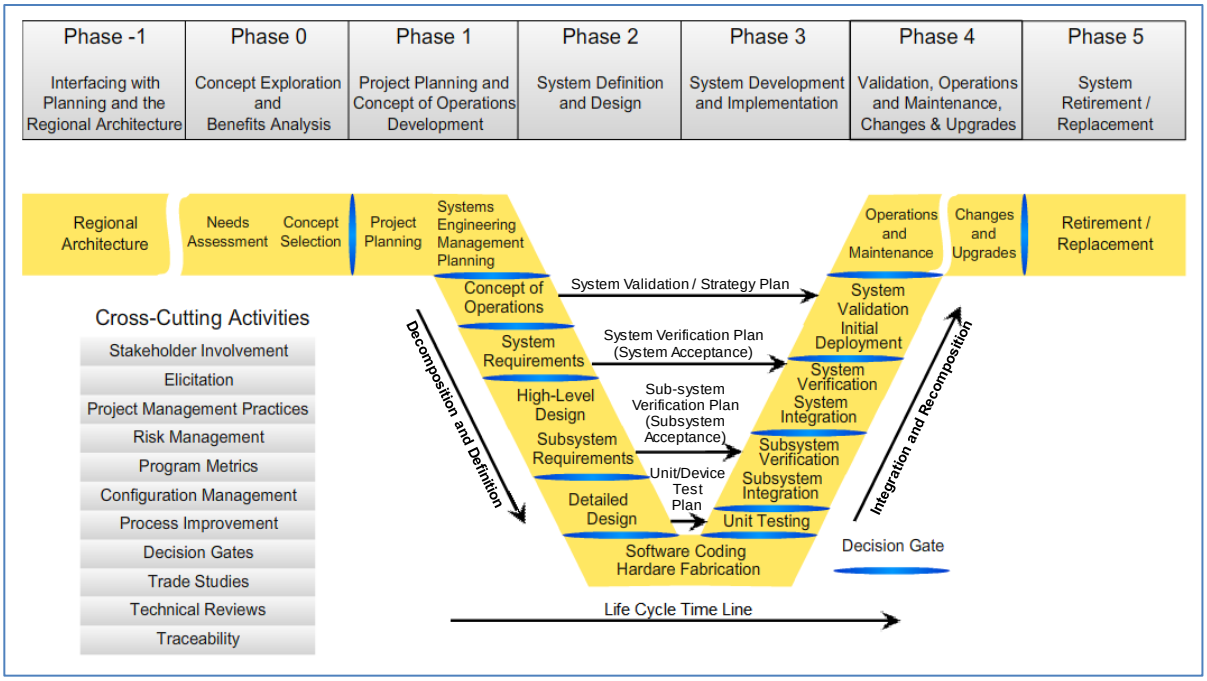

Figure 1-1 – Systems Engineering Process

A closely related companion document, the Systems Engineering Management Plan (SEMP), is also developed in the early phase of the systems engineering process, as illustrated in Figure 1-2. The SEMP is usually the second forma document to be developed, often immediately after the Project Management Plan (PMP). It uses the foundation laid by the Project Management Plan to build the framework for implementing the technical tasks of the project. As further shown in Figure 1-2, while the SEMP is developed early, it is meant to be a living document to be updated as necessary as the project progresses, typically until the end of the detailed system design phase.

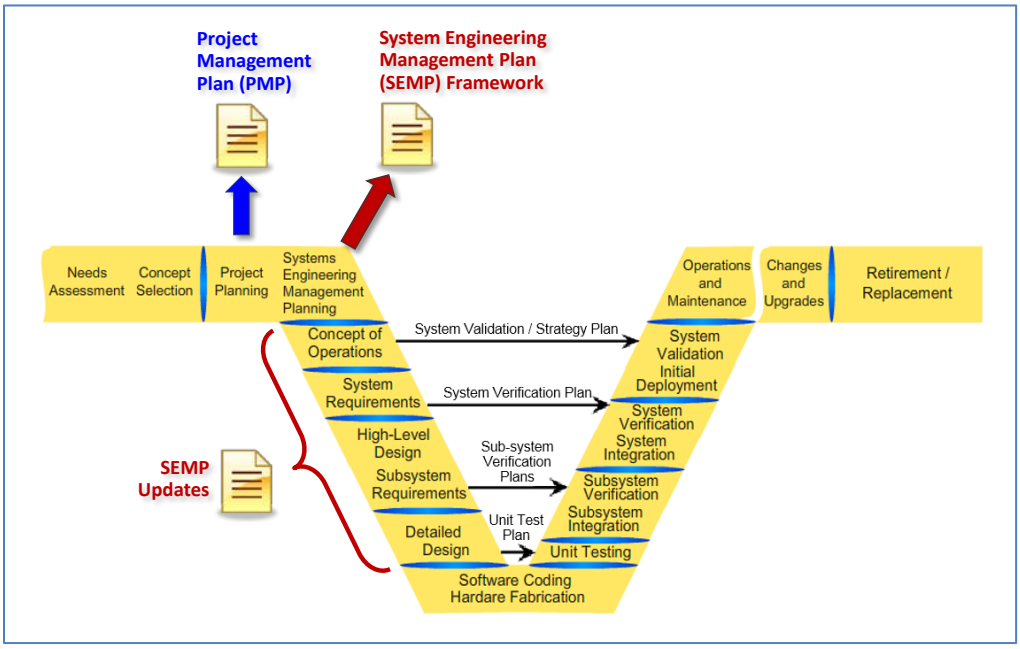

Figure 1-2 – SEMP Development within Systems Engineering Process

1.4. PROJECT MOTIVATION

Southern California has the second-worst traffic in the country, behind Washington, D.C. Recent statistics compiled by the Texas Transportation Institute indicate that commuters in the Los Angeles area spent on average 61 hours per year stuck in traffic in 2012, compared to 37 hours in 1982. This time is estimated to carry a cost of about $1,300 in both wasted time and wasted fuel. The region is also second behind Washington, D.C. in the unreliability of its freeways. Incidents often have significant impacts on the time that travelers may need to travel to a given destination. As population and car ownership continue to grow, more time is spent in gridlock, more money is lost on wasted energy, and more air pollution is generated. This trend is expected to continue if nothing is done to address the problem.

In the past, government agencies across the country would have addressed the problem of urban congestion by widening highways; building new roads, tunnels, and bridges; and providing multimodal options where feasible, particularly for shorter urban trips. However, due to both financial and space constraints the emphasis has now shifted from building new infrastructure to efficiently using what has already been built.

Except in very select situations, safety, mobility, and environmental improvements can no longer be achieved through expensive capital improvements alone. Nor do they need to be, as new technologies and improved organizational cooperation can deliver a better traveler experience with minimal infrastructure modifications. Similar to the same way the manufacturing sector has raised efficiency through better software, hardware, and supply integration, the transportation sector can use technology to improve the performance of existing infrastructure. Several studies have indicated that technological advances may be used to improve the operations of freeways, arterials, and other transportation systems at a much lower cost than the traditional infrastructure-based approach. While it can be expected that notable gains can be obtained regarding the operations of specific roadway facilities or transportation systems, the greatest potential gains in operational performance, and travelers' quality of life, are likely associated with multi-facility, multi-modal, and multi-jurisdiction solutions considering the overall transportation needs of a corridor rather than the needs of specific elements.

1.5. PROJECT DEFINITION

The general objective of the I-210 Pilot is to reduce congestion and improve mobility within a section of the I-210 corridor in the San Gabriel Valley north of Los Angeles through the coordinated management of the I-210 freeway, key surrounding arterials, supporting local transit services, and other relevant transportation components. Operational improvements within the corridor will be achieved through the design, development, implementation, and evaluation of a prototype Integrated Corridor Management (ICM) system designed to assist transportation system managers in their decision-making tasks. The overall goal of this system is to achieve performance gains by enabling transportation systems managers, transportation control systems, vehicles, and travelers within a corridor to work together in a highly-coordinated manner.

At the heart of the proposed ICM system is a Decision Support System (DSS) that will use information gathered from monitoring systems to estimate the current operational performance of systems being managed, simulation and analytical tools to forecast near-future operational conditions under alternative scenarios, and imbedded decision algorithms to recommend courses of action to address specific problems being observed. It is expected that the deployed system will more specifically:

- Improve real-time monitoring of travel conditions within the corridor
- Enable operators to better characterize travel patterns within the corridor and across systems
- Provide predictive traffic and system performance capabilities
- Evaluate alternative system management strategies and recommend desired courses of action in response to incidents, events, and even daily recurring congestion
- Improve decision-making from transportation system managers
- Improve collaboration among agencies operating transportation systems within the corridor
- Improve the utilization of existing infrastructure and systems
- Provide corridor capacity increases through operational improvements
- Reduce delays and travel times along freeways and arterials
- Improve travel time reliability
- Help reduce the number of accidents occurring along the corridor
- Reduce greenhouse gas emissions
- Generate higher traveler satisfaction rates
- Increase the overall livability of communities in and around the I-210 corridor

The preliminary project scope for the I-210 Pilot includes the design, development, installation, testing, and operation of components of the proposed ICM system, including the development of interfaces with existing monitoring systems. However, given the experimental nature of the project, the system will not be permitted to interact directly with existing traffic management systems operated by Caltrans. Interactions with such systems will be done through manual interventions by system operators.

While development of the proposed ICM system is under the sponsorship of Caltrans Headquarters and Caltrans District 7, the system will be developed in collaboration with local transportation agencies and other stakeholders. In addition to considering the needs of individual stakeholders, the system will also be based on the experiences and lessons learned identified through other recent successful ICM projects, both in the United States and abroad. It is expected that the deployed system will be an important element of Caltrans' strategic response to the State of California's objectives of improving the performance of transportation systems and enhancing the livability, sustainability, and economic performance of the state.

1.6. CORRIDOR BOUNDARIES

The area of interest for the I-210 Pilot project is illustrated in Figure 1-3. Along the I-210 freeway, this area roughly extends from the Mountain Avenue interchange, just north of the SR-134 interchange near downtown Pasadena, to the Foothill Boulevard interchange in La Verne, east of the SR-57 freeway interchange. This is the portion of the freeway typically carrying the highest traffic volumes and experiencing the highest levels of congestion.

Ultimately, an ICM system covering the I-210 freeway from Mountain Avenue to Foothill Boulevard will be deployed. This deployment is expected to occur in two phases, with the first phase focusing on a deployment between Mountain Avenue and the I-605 interchange at the east end of Duarte, and a second phase extending system coverage from the I-605 interchange to the Foothill Boulevard interchange.

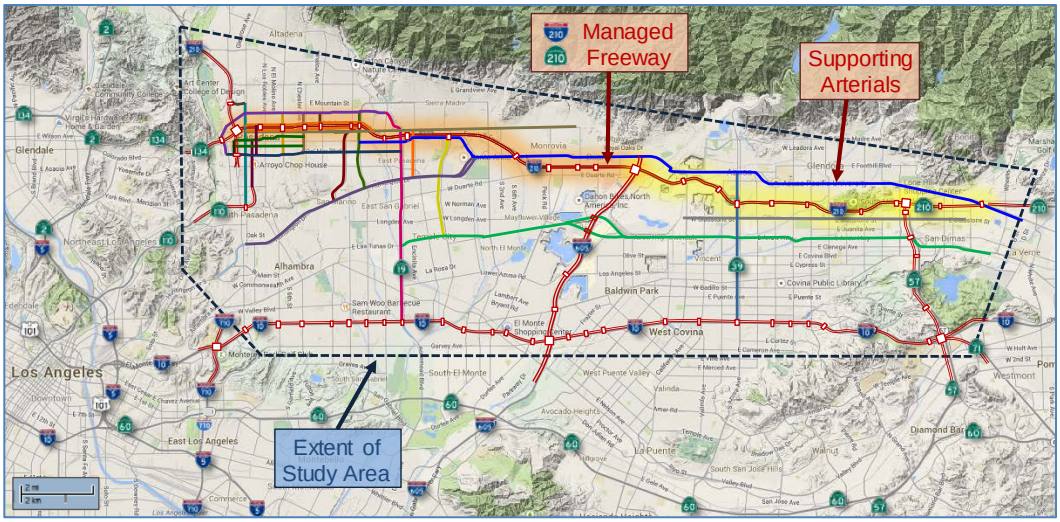

Figure 1-3 – I-210 Pilot Corridor

South of the I-210, the area of interest to the project extends to the I-10 freeway. While the aim is to improve operations along the I-210 corridor, the close proximity of the I-10 freeway, located only four to five miles south of the I-210, creates some operational interdependencies between the two freeways. Incidents or events significantly affecting operations along the I-10 are frequently observed affecting operations along the I-210, and vice versa.

1.7. TRANSPORTATION SYSTEMS UNDER CONSIDERATION

Figure 1-4 identifies the arterials surrounding the I-210 freeway that may be part of the deployed ICM system. These arterials are bolded and labeled in the figure. Figure 1-5 further indicates the key supporting transit systems that are being considered. These systems include the Gold light-rail line operated by Metro and the San Bernardino commuter rail line operated by Metrolink. While not shown in the figure, various express bus routes and park-and-ride lots may also be considered.

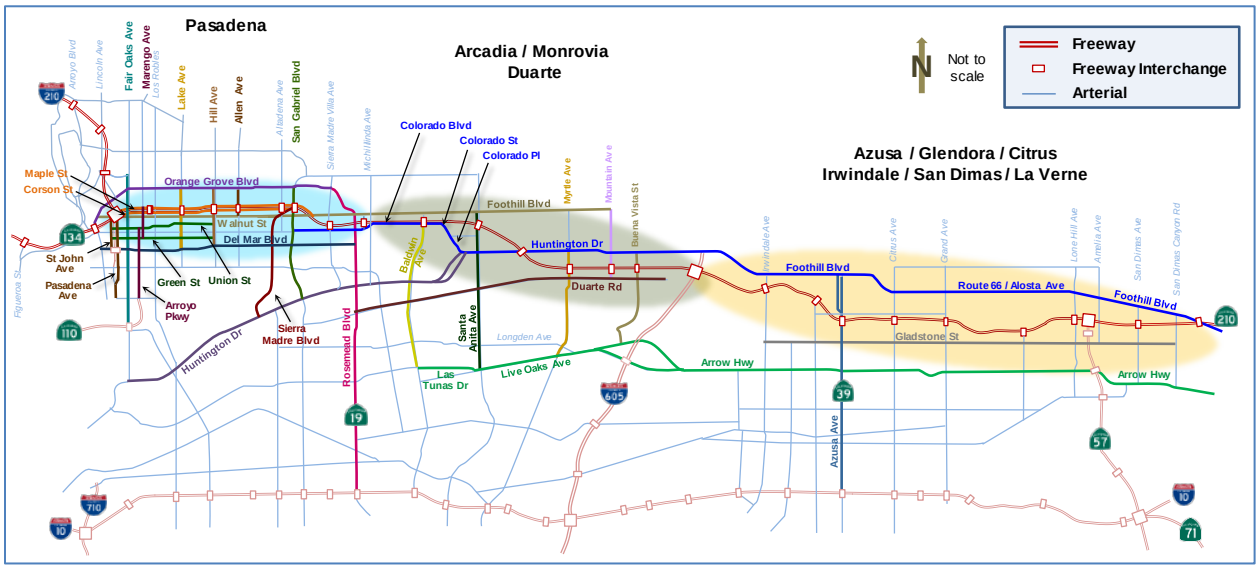

Figure 1-4 – Candidate I-210 Pilot Roadways

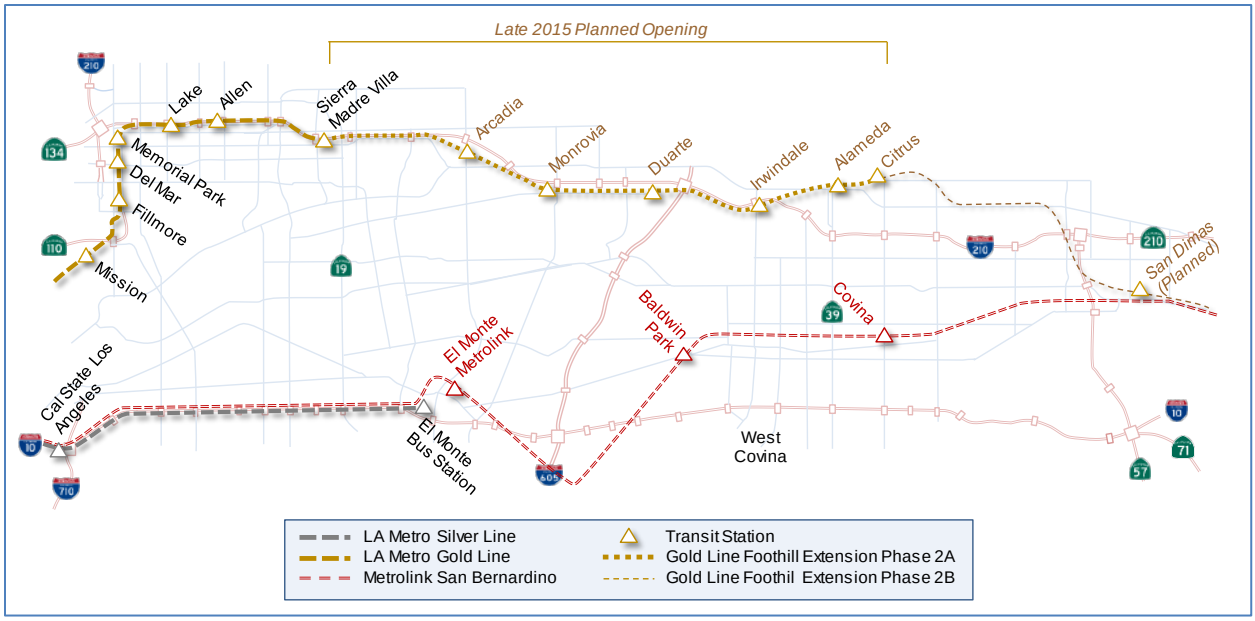

Figure 1-5 – Key Transit Systems Considered

1.8. PROBLEMS TO BE ADDRESSED

The management of multi-jurisdiction, multi-modal corridors for the efficient transportation of people and goods presents a unique set of technical, procedural, and organizational challenges. The intent of this project is to coordinate the various transportation networks and control systems in use within the I-210 corridor to enable them to operate as a cohesive and integrated system. To do so, the project team, in collaboration with project stakeholders, will investigate tools and technologies and develop processes, that will help Caltrans and corridor partner agencies enhance their real-time collaborative decision-making capabilities.

Key user-related issues to be addressed by the project include:

1. Freeway and arterial congestion management
2. Coordinated transit and roadway operations
3. Enhanced situational and operational awareness
4. Development of coordinated strategy management
5. Enhanced communication with system users
6. Management and monitoring of deployed system

Specific problems associated with each of these issues are identified in the "mind map" of Figure 1-6 and the subsections that follow. A mind map is a type of diagram used to organize information visually. Mind maps are often created to illustrate various notions surrounding a central idea or element, in this case the development of an improved multi-modal, multi-jurisdictional active traffic management system.

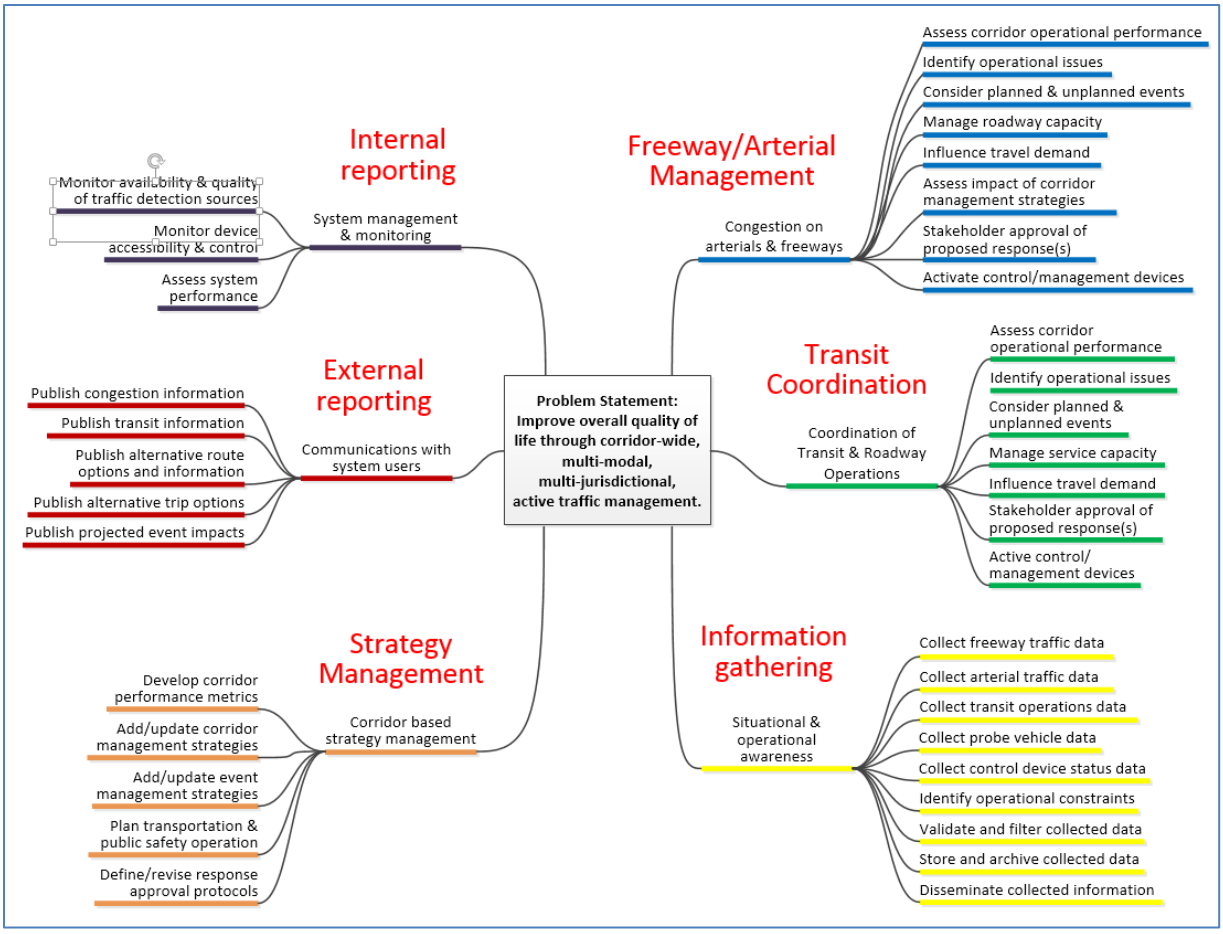

Figure 1-6 – Mapping of User Issues to General Corridor Management Needs

1.8.1. MANAGEMENT OF CONGESTION SPANNING FREEWAY AND ARTERIALS

Traffic congestion across the I-210 freeway and surrounding arterials is the primary problem to be addressed. Congestion occurs when demand for travel along a roadway segment exceeds the capacity of the existing infrastructure. Congestion can happen on a recurring basis, such as during peak travel periods on weekdays; during anticipated events, such as the Rose Bowl or other significant special event; or because of unanticipated events causing roadway capacity reductions in an unplanned and unexpected manner, such as traffic accidents, wildfires, or other events.

While many transportation system operators already dedicate significant efforts to addressing the congestion that affects the transportation system, these efforts often remain confined to the specific network. For instance, Caltrans typically tries to resolve congestion issues along freeways, while cities along the I-210 corridor typically focus only on what happens on surface streets. However, congestion often spreads across networks. Congestion on the freeway often spreads onto local streets. On local street networks, congestion also often spreads across jurisdictional boundaries.

The problem of efficiently addressing congestion has multiple facets. It first involves identifying the extent and potential cause of the problem based on the results of performance assessments of individual field elements. This evaluation must also consider planned and unplanned events that may influence system operations. Once operational issues have been identified, actions may then be taken to adjust the

capacity of roadway elements and influence, travel demand within the corridor to maximize system performance. The actions to be taken will depend on the previously identified and approved response strategies, and the ability to activate the related control devices, either automatically or manually.

1.8.2. COORDINATION OF TRANSIT AND ROADWAY OPERATIONS

While local and regional transit operators have already devoted significant efforts to providing efficient transit services to the I-210 corridor, further improvements could be achieved by coordinating transit and roadway operations. For instance, transit agencies could alter bus routes or offer additional rides in response to major roadway incidents. Another strategy may be to provide comprehensive information to travelers about available transit options, such as comparative travel times on changeable message signs to key destinations using car or transit.

The major value proposition of the I-210 Pilot for transit agencies is improved travel time reliability and increased transit ridership within the corridor through the coordinated use of existing assets and infrastructure. Indeed, one of the pivotal effects of congestion along the corridor is that transit agencies cannot provide transit services to the public with the travel time reliability riders want. This has a significant effect on customer service, as travel time reliability is a major factor in how travelers select a particular mode of transportation.

Using transit service effectively to support corridor operations will depend on the ability to:

- Provide adequate parking near transit stations
- Use existing transit vehicles to accommodate additional passengers
- Put additional transit vehicles into service
- Monitor transit operations in real time
- Coordinate operations among transit operators
- Communicate information to motorists and transit riders effectively

1.8.3. ENHANCEMENT OF SITUATIONAL AND OPERATIONAL AWARENESS

The need for adequate monitoring is influenced by the fact that both the capacity of transportation systems and the travel demand placed on transportation networks are somewhat dynamic. Arterial capacity, for instance, is dependent on the operation of traffic signals at intersections. Roadway capacity can be further influenced by incidents, construction and maintenance activities, inclement weather, and driver behavior. Transit capacity is a function of service frequency and vehicle type. Moreover, while travel demand is somewhat repetitive on a day-to-day basis, variations can occur over time. While there are obvious differences between weekdays and weekends, travel demand may fluctuate on a month-by-month basis and be affected by business cycles. In this context, up- to-date measurements of corridor performance and travel demand will allow agency operators to determine appropriate pre-approved corridor management strategies designed to meet specific, agreed-upon corridor performance metrics.

The challenge of achieving adequate situational and operational awareness is associated with the deployment of comprehensive supportive monitoring systems. A lack of appropriate monitoring can significantly impede the ability of transportation system operators to devise optimal response strategies to address observed operational issues. While many agencies have devoted significant efforts to deploying real-time monitoring systems in the operation of their transportation networks, significant gaps remain to support adequately the corridor-based performance and operational objectives associated with

this project. For instance, while extensive real-time monitoring capabilities already exist along the I-210 freeway, current real-time traffic data collection capabilities along arterials are somewhat limited, with large variations from one operating agency to the next. Real-time information sharing between agencies is also only partially available.

To develop a suitable real-time monitoring system, the type of data that could be collected from freeway, arterial, transit, and other monitoring systems must first be determined. Then, the frequency with which data can be retrieved must be assessed, as well as the need to validate and filter the collected information to remove erroneous data. In turn, the problem of how to store and disseminate the collected information to facilitate use by corridor systems and stakeholders must be considered, as well as the problem of how best to visualize the collected information to facilitate interpretation.

1.8.4. DEVELOPMENT OF COORDINATED STRATEGY MANAGEMENT

Once the situational awareness issues have been addressed, the problem of defining what to do under different operational environments arises. This is crucial, as a lack of coordination among corridor stakeholders can result in the implementation of less effective solutions than what might be achievable through coordinated control. In some cases, a lack of coordinated control may also be responsible for degrading corridor operations.

The I-210 Pilot partners need to have an ability to define, select, communicate, and implement strategies that support jointly developed corridor management objectives and performance metrics. Effective coordination of different operational systems will require the establishment of agreed-upon processes and corridor performance metrics based on common operational philosophies and corridor management objectives. A need for such coordination exists as current corridor operations are typically fragmented. Each transportation system is typically managed as an independent system, with only occasional considerations given to cross-system or cross-jurisdictional issues. This prevents implementation of synergistic strategies through a coordinated ICM system.

1.8.5. ENHANCEMENT OF COMMUNICATION WITH SYSTEM USERS

The leading part of the problem statement in Figure 1-6 is to improve overall quality of life, and a key part of doing that involves consistently setting and meeting system users' reasonable expectations. This involves both meeting corridor performance metrics and communicating reliable information to travelers. Depending on the operational goals of the traffic management system developed, the information provided to travelers may include the location and severity of congestion hotspots, data for transit services, routing options around congestion hotspots or problem areas, and data for alternate trip options. The last option, for instance, may include providing comparative statistics for trips made by car or using transit, or for trips delayed by a certain amount of time. Information about the projected impacts of incidents or events may also be published to appropriate traveler information sites to provide travelers with advance information about future traffic conditions and enable them to adjust their travel plans well ahead of the time they are planning to reach affected areas.

1.8.6. MANAGEMENT AND MONITORING OF DEPLOYED SYSTEM

The effectiveness of any traffic management system is highly dependent on the quality and completeness of the information used to monitor its operations and performance, as well as to implement desired

control actions. While suitable field equipment may be deployed to enable adequate information gathering and system control, these devices can degrade over time due to exposure to weather elements or traffic. Equipment operation may also be affected by construction activities or vandalism. In this context, it is imperative to continuously monitor deployed equipment and advise system operators about equipment health to maintain an appropriate level of operations. This may require developing methods and metrics for assessing equipment and system health based on the equipment status and the monitoring information.

1.9. PROJECT GOALS AND OBJECTIVES

The specific goals and objectives of the I-210 Pilot are summarized in Table 1-1. In addition to improving system performance through enhanced system monitoring, agency collaboration, and the use of decision-support tools, a key aspect of the project is to demonstrate the viability and effectiveness of ICM strategies and develop a roadmap for future system deployments in fifty corridor segments within California.

Table 1-1 – Project Goals and Objectives

Goal	Objectives
Bring together corridor stakeholders to create an environment for cooperation, including sharing knowledge, developing working pilots, and researching and resolving key issues.	• Develop a collective understanding and acceptance among all participating agencies and stakeholders of the I-210 Pilot's planning, development, and deployment. • Foster positive, collaborative, and ongoing joint system management practices among participating agencies.
Develop and deploy an integrated, advanced decision support system for use by the stakeholders as they actively manage the corridor.	• Integrate planning processes and transportation management procedures used by state, regional, and local agencies. • Develop and deploy tools supporting proactive system management. • Develop an initial set of proactive system management protocols, standard operating procedures, and action plans.
Measure institutional and pilot performance outcomes and indicators to help inform future transportation performance-based decision-making.	• Develop a set of performance measures to quantify the successes and performance impacts of the I-210 Pilot program and Connected Corridors program in general.
Formulate a roadmap for the cost-effective implementation of future innovations.	• Develop a pilot system that can be replicated on other corridors and be a model for other corridors in the state and country to improve transportation system performance and implement performance-based decision-making. • Use the project to demonstrate the effectiveness of ICM strategies. • Develop lessons learned and best practices to guide the development and deployment of future ICM systems within California. • Use demonstrated system effectiveness to secure commitments and funding for system expansion, deployment of new systems, or development of more advanced tools and capabilities.
Improve corridor performance.	• Improve traveler information, mobility, and safety. • Reduce congestion and increase freeway-arterial corridor performance. • Encourage, facilitate, and incorporate transit and multimodal travel in the corridor.

1.10. SPECIFIC PLANS DEVELOPED WITHIN THE DOCUMENT

The following sections are detailed in the Project Management Plan:

- **Section 2** – **Project Management Approach**: Describes general principles that will be followed for managing the project.
- **Section 3** – **Work Breakdown Structure:** Division of the project into tasks and subtasks; identification of key milestones and deliverables.
- **Section 4** – **Change Management Plan**: Describes the principles and processes that will be used to review and track project changes to ensure that the project direction does not depart from the stated goals.
- **Section 5** – **Scope Management Plan**: Identifies the roles and responsibilities of the project partners regarding project scope, the control measures to verify that the scope is maintained, and the processes by which changes and the project scope may be reviewed and adopted.
- **Section 6** – **Schedule Management Plan**: Describes the processes used to create a baseline schedule, monitor the project schedule, and manage necessary changes to the schedule.
- **Section 7** – **Communication Management Plan**: Outlines the framework for effective communications among the project partners throughout the life of the project.
- **Section 8** – **Cost Management Plan**: Identifies the processes that will be used to manage project expenditures and produce expense reports.
- **Section 9** – **Staffing Management Plan**: Indicates how the project manager will manage staff resources throughout the project.
- **Section 10** – **Quality Management Plan**: Identifies the activities that will be carried out to ensure that the project is satisfying the needs and maintaining the quality standards for which it was undertaken.
- **Section 11** – **Risk Management Plan**: Addresses the processes for identifying, assessing, mitigating, and monitoring the risks expected or encountered during the project's life cycle.
- **Section 12** – **Procurement Management Plan**: Identifies the processes that will be used for managing procurements throughout the duration of the project. This includes identifying the items that may be procured, the types of contracts that may be used, the approval process, and the decision criteria.

2. PROJECT MANAGEMENT APPROACH

This section presents key elements of the project management approach that will be followed for the I-210 Connected Corridors Pilot. As outlined in the Introduction, the selected project management approach reflects the desire to apply current systems engineering principles to the process that will be used to design, develop, implement, and evaluate the proposed I-210 Pilot.

Specific elements described in this section include:

- Application of project management standards
- Organizational chart
- Division of responsibilities across team members and groups
- Collaboration tools to be used throughout the project

2.1. APPLICATION OF PROJECT MANAGEMENT STANDARDS

The development of the PMP is based on the project management standards described in the *Project Management Body of Knowledge (PMBOK Guide)* published by the Project Management Institute [1]. The PMBOK Guide represents a comprehensive collection of theory, learning, and experience in project management best practices. The format and content of the document reflects the guidance provided in the PMBOK Guide and explanatory guides. The document thus conforms to current best practice in project management, while being tailored to the needs the I-210 Pilot.

The PMBOK Guide provides both the structure and the content to guide the development and delivery of a successful project. This is done through the definition of 42 specific management processes categorized within five process groups and nine general knowledge areas. The 42 management processes represent essential activities for successful project management, while the process groups and knowledge areas provide a means to structure the management activities coherently according to the life-cycle phases of a project. For the I-210 Pilot, the application of the standards and processes outlined in the PMBOK Guide is accomplished through the development of the various plans that are outlined in this document.

For reference purposes, the five general management process groups defined within the PMBOK Guide are briefly described below, and their relationship illustrated in Figure 2-1:

- **Initiating Processes** – Processes performed to define a new project or a new phase of an existing project. This includes selecting a project manager if not already done, defining the initial scope of a project or phase, committing initial financial resources, identifying internal and external stakeholders who will interact and influence the overall outcome of the project, and developing a project charter.
- **Planning Processes** – Processes performed to establish the scope of the project, define and refine the objectives, and develop a course of action to attain the stated objectives. The Project Management Plan and other project documents that will be used to carry out a project are normally developed during this phase.

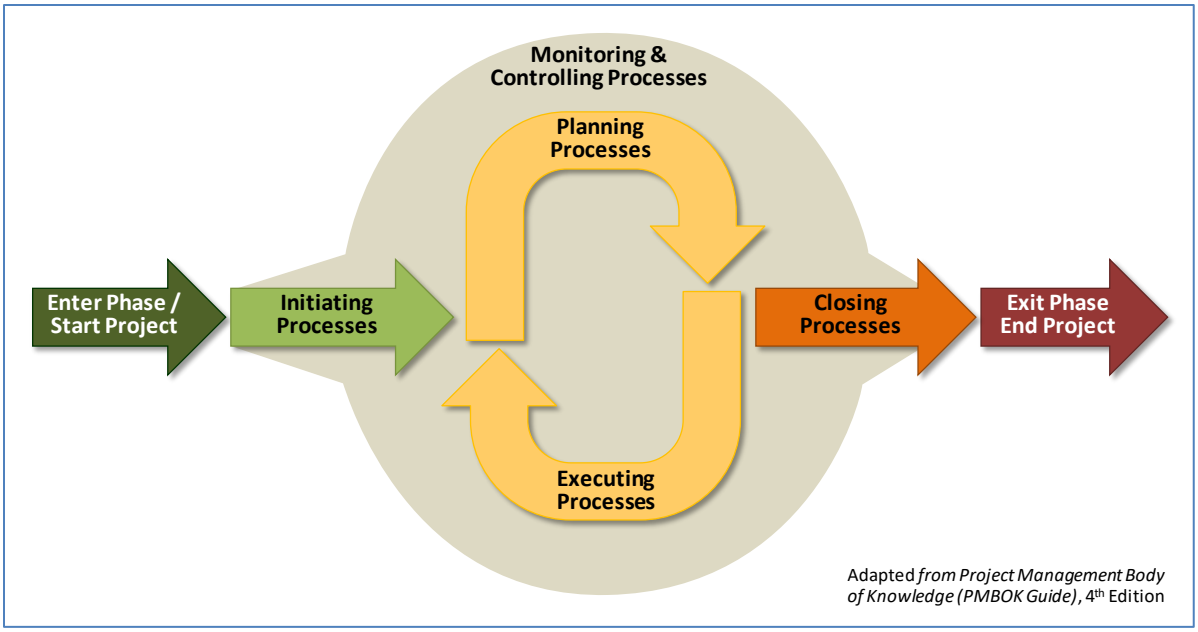

Figure 2-1 – Project Management Work Flow Process

- **Executing Processes** – Processes performed to complete the work defined in the Project Management Plan to satisfy the project specifications. These processes involve coordinating people and resources, as well as integrating and performing the activities of the project in accordance with the developed management plan.
- **Monitoring and Control Processes** – Processes required to track, review, and regulate the progress and performance of a project; identify any area in which changes to the plan are required, and initiate the corresponding changes. Other processes included in this group include controlling changes and recommending preventive action in anticipation of possible problems, monitoring ongoing project activities against the Project Management Plan and performance baseline, influencing the factors that could circumvent integrated change control so only approved changes are implemented.
- **Closing Processes** – Processes performed to finalize all activities associated with a project or phase of the project. These processes verify that all stages of the work have been completed satisfactorily and that documentation is complete. For the I-210 Pilot, this stage of the work will also include processes to evaluate the performance of the developed system and to identify lessons learned and any other relevant information to communicate to other potential deployment sites and practitioners.

Table 2-1, reproduced from the PMBOK Guide, further maps how the 42 defined management processes relate to the process groups and knowledge area to which they are more commonly associated.

Table 2-1 – Mapping of Activities to Project Management Process Groups

Knowledge Area	Project Management Process Groups				
	Initiating Processes	**Planning Processes**	**Executing Processes**	**Monitoring & Control Processes**	**Closing Processes**
Integration management	• Develop project charter	• Develop Project Management Plan	• Direct and manage project execution	• Monitor and control project work • Perform integrated change control	• Close project or phase
Scope management		• Collect requirements • Define scope • Create Work Breakdown Structure (WBS)		• Verify scope • Control scope	
Time management		• Define activities • Sequence activities • Estimate activity resources • Estimate activity durations • Develop schedule		• Control schedule	
Cost management		• Estimate costs • Determine budget		• Control costs	
Quality management		• Plan quality	• Perform quality assurance	• Perform quality control	
Human resource management		• Develop Human Resource Plan	• Acquire, develop, and manage project team		
Communication management		• Plan communications	• Distribute information • Manage stakeholder expectations	• Report performance	
Risk management		• Plan risk management • Identify risks • Perform qualitative and quantitative risk analysis • Plan risk responses		• Monitor and control risks	
Procurement management		• Plan procurements	• Conduct procurements	• Administer procurements	• Close procurements

2.2. ORGANIZATIONAL CHART

Figure 2-2 presents the project management organizational chart. This chart was developed through careful consideration of the positions that would most appropriately be staffed by Caltrans personnel, staff from PATH, and hired consultants.

In the figure, no specific names are associated with the Caltrans Support Staff positions, as these have not yet been formally filled. While Caltrans staff has been assigned to perform some project tasks, the Support Staff positions are not currently explicitly budgeted in Caltrans' funding projections. The recommendation for their formal creation was made by taking into account the existing organizational proficiencies of Caltrans and the goal of ensuring that Caltrans is well positioned to lead additional future Connected Corridors efforts.

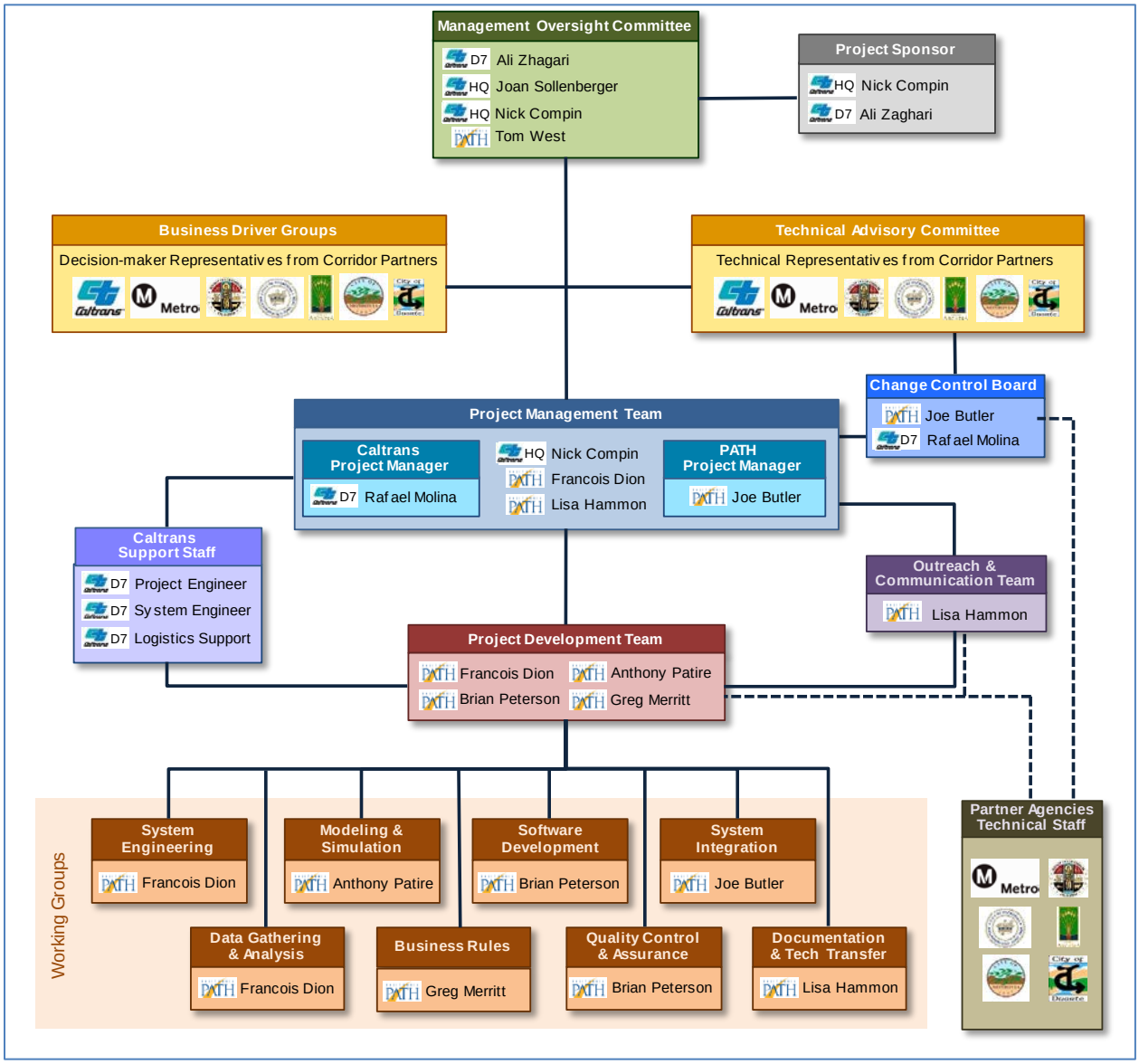

Figure 2-2 – Project Management Organization Chart

2.3. RESPONSIBILITY ASSIGNMENTS

This section summarizes the roles and responsibilities assigned to the various positions or groups shown in Figure 2-2. Information is more specifically provided for the following items:

- Project Sponsor
- Caltrans Project Manager
- PATH Project Manager
- Project Management Team
- Management Oversight Committee
- Technical Advisory Committee
- Business Drivers Group
- Communication & Outreach Team
- Project Development Team
- Individual working groups
- Caltrans District 7 support staff

2.3.1. PROJECT SPONSOR

The Division of Traffic Operations at Caltrans Headquarters in Sacramento and the Division of Traffic Operations at Caltrans District 7 are the official sponsors of the I-210 Pilot. The Division of Traffic Operations at Caltrans Headquarters will be officially represented on the project by **Dr. Nick Compin**, the Chief of Office of Strategic Development at Caltrans Headquarters, while Caltrans District 7 will be represented by **Ali Zaghari**, the Deputy District Director of Operations.

In their sponsorship capacity, these individuals will be responsible for addressing contractual and budgetary issues brought forward by the Caltrans Project Manager, PATH Project Manager, Oversight Management Committee, or project partners, and, in particular, for ensuring that contracted deliverables are delivered on time and according to the contracted obligations. These individuals may also provide guidance on project risks and approaches to pursue regarding the development of an ICM solution that could be easily replicated on other corridors within the state. They will further act as the primary point of contact for handling project issues that may require the involvement of other state agencies or the legislature.

2.3.2. CALTRANS PROJECT MANAGER

Rafael Molina, Chief, Office of Corridor Management (A), Division of Traffic Operations at Caltrans District 7, acts as the Caltrans Project Manager. He is tasked with reviewing and managing all project activities that do not involve the development of generic system components, i.e., components that may be used without major modifications to deploy ICM systems on other corridors. Examples of such components include the frameworks governing the use of simulation to conduct corridor evaluations and the engine used to develop corridor management strategies. Key responsibilities assigned to the Caltrans Project Manager include:

- Coordination of project activities across corridor partners, in collaboration with the PATH Project Manager
- Monitoring of project schedule and status of deliverables

- Review and acceptance of project deliverables
- Management of tasks assigned to Caltrans District 7
- Management of District 7 personnel assigned to the project
- Management of project funds to be expended by Caltrans District 7
- Participation in outreach meetings with corridor partners

2.3.3. PATH PROJECT MANAGER

Joe Butler, from PATH, acts as the PATH Project Manager for the I-210 Pilot. He is responsible for the overall management of the project budget and resources, including the management of subcontractors that may be hired to help with project activities. Specific responsibilities assigned to this individual include:

- Management of the overall project schedule, budget, and PATH resources
- Development of overall vision for the I-210 Pilot
- Coordination of activities to be executed by the various corridor partners
- Communication of project status to the project sponsor
- Management of the design, development, and implementation of generic components of the proposed ICM system that are to be developed by PATH
- Management of PATH staff assigned to the project
- Management of subcontractors hired by PATH to assist with project activities
- Monitoring and reporting of project metrics
- Monitoring, controlling, and communicating project risks

2.3.4. PROJECT MANAGEMENT TEAM

The Project Management Team is tasked with assisting the Caltrans Project Manager and PATH Project Manager in addressing complex or overarching project issues. This team is composed of the following individuals from Caltrans District 7, Caltrans Headquarters, and PATH:

- **Rafael Molina** – Caltrans Project Manager (Caltrans District 7)
- **Dr. Nick Compin** – Connected Corridors Project Manager (Caltrans Headquarters)
- **Joe Butler** – PATH Program Manager
- **Dr. Francois Dion** – PATH Systems Engineer
- **Lisa Hammon** – PATH Communications and Outreach Coordinator

The Project Management Team is expected to meet once a week to discuss project scheduling and budgetary issues, contractual issues, coordination of activities among project partners, planned outreach and communications activities, as well as the status of upcoming deliverables. As this group is expected to maintain a clear understanding of the work to be completed and the framework in which the project is to be executed, its members will be responsible for communicating the project expectations to the various project partners and to direct the project activities to meet the project objectives.

2.3.5. MANAGEMENT OVERSIGHT COMMITTEE

The Management Oversight Committee is tasked with providing executive-level guidance on project direction, administrative and management issues, and contract compliance. This committee may also be

involved, upon request, in resolving issues that cannot be addressed by the Caltrans Project Manager, PATH Project Manager, Project Management Team, and/or Technical Advisory Committee. This committee is currently composed of the following high-level individuals within Caltrans District 7, Caltrans Headquarters, and PATH:

- **Ali Zaghari** – Deputy District Director of Operations at Caltrans District 7
- **Dr. Nick Compin** –Chief, Office of Strategic Development; Statewide Connected Corridors Project Manager for Division of Traffic Operations
- **Tom West** – Co-Director of PATH

2.3.6. TECHNICAL ADVISORY COMMITTEE

The primary role of the Technical Advisory Committee is to provide guidance on the development of a suitable ICM solution to help project partners make collective technical decisions. This committee will most commonly be asked to provide opinions or assessments on proposed technical system components and processes. The specific roles and responsibilities of the Technical Advisory Committee are to:

- Provide leadership and direction
- Review progress, risks, and issues and recommend resolution
- Make recommendations to Caltrans regarding how to address specific project issues

The exact composition of the Technical Advisory Committee will be determined after all project stakeholders have been engaged. It is expected that this committee will include at its core technical representatives from Caltrans District 7, Metro, Los Angeles County, and the cities participating in the project (Pasadena, Arcadia, Monrovia, and Duarte). Representatives from the San Gabriel Valley Council of Governments (SGVCOG), local transit agencies, or other agencies having an interest in how the corridor is managed may also be included in the committee.

2.3.7. BUSINESS DRIVERS GROUP

The Business Drivers Group (BDG) is similar to the Technical Advisory Committee, except that its focus is on addressing business impact issues rather than technical issues. This group, which will be convened on an as-needed basis, will be comprised of key technical or policy decision-maker representatives from Caltrans, Metro, Los Angeles County, and the cities. It will be involved in providing assessment and decisions on project activities that have potential business impacts and that cannot be addressed by the Project management team or Technical Advisory Committee. This group is intended to form part of the overall effort to support an effective engagement of corridor partners throughout the project and at critical milestones.

The active participation of regional transportation partners in the Business Drivers Group will be encouraged and supported through the delivery of "executive-level" communications. For example, the briefings delivered to the BDG will be succinct and to the point, explaining the background and context, the need for their consideration/action, and an explanation of the actions required or options available.

2.3.8. COMMUNICATIONS AND OUTREACH TEAM

The Communications and Outreach Team is responsible for engaging corridor partners and involving them in the planning, implementation, and rollout of the I-210 Pilot. This group is also responsible for

coordinating communication between various team members and generating various types of documents and presentation materials. Lisa Hammon from PATH currently leads this group, with assistance from a number of Los Angeles-based consultants and partner agency Public Information Officers.

2.3.9. PROJECT DEVELOPMENT TEAM

The Project Development Team is tasked with overseeing and coordinating the various development activities to be carried out by PATH. The purpose of this team is to ensure that changes within the project are effected in such a way that it benefits the project as a whole. A key task of the Project Development Team will be to coordinate activities from the various working groups that are defined in the next section and to act as the liaison between the working groups and the Project Management Team.

It is expected that the Project Development Team will be comprised, at a minimum, of the leaders of the eight Working Groups identified in the organization chart of Figure 2-2. The group leaders are listed in Table 2-2 in Section 2.3.10.

2.3.10. WORKING GROUPS

Working groups are subcommittees that will be assembled by PATH on a need basis to address specific project topics. These groups, which may not all be active at the same time, will be tasked with analyzing specific topics and developing recommended courses of action to achieve the desired outcomes. Eight working groups are currently defined:

- **Systems Engineering** – Group responsible for the application of systems engineering principles to the I-210 Pilot activities.
- **Data Gathering & Analysis** – Group responsible for inventorying existing systems in operation along the I-210 corridor, collecting data that may be used to characterize current corridor operations, and determining what data may be available to support the development of dynamic and corridor-wide traffic management strategies.
- **Modeling & Simulation** – Group responsible for the development of analytical and simulation models that will be used to conduct corridor operational evaluations and assess the performance of alternate traffic management strategies.
- **Business Rules** – Group responsible for the development of the framework governing the operations of the Decision Support System and business rules that will govern the identification of suitable response strategies to identified incidents and events.
- **Software Development** – Group responsible for the development, testing, and implementation of software for the various components of the proposed ICM system.
- **System Integration** – Group responsible for the development of suitable interfaces between developed system components, as well as with external systems.
- **Quality Control and Quality Assurance (QC/QA)** – Group responsible for ensuring that the project satisfies the needs of I-210 corridor customers. This group will be responsible for implementing the Quality Management Plan defined in Section 0.
- **Documentation & Technology Transfer** – Group responsible for the implementation of project deliverables and the documentation of project efforts.

While it is anticipated that most of these groups will be led by team members from PATH, their activities will involve frequent interactions with Caltrans staff and members of partner agencies. The currently assigned leaders for the various groups are indicated in Table 2-2. Two groups, the System Integration Group and Quality Control / Quality Assurance Group, do not currently have an assigned leader as their activities are expected to begin later in the project. For each of these two groups, a leader will be named in due time and may not necessarily be someone within PATH.

Table 2-2 – Assigned Working Group Leads

Group	Group Leader
System Engineering	Dr. Francois Dion (PATH)
Data Gathering & Analysis	Dr. Francois Dion (PATH)
Modeling & Simulation	Dr. Anthony Patire (PATH)
Business Rules	Greg Merritt (PATH)
Software Development	Brian Peterson (PATH)
Quality Control/Quality Assurance	Brian Peterson (PATH)
System Integration	Joe Butler (PATH)
Documentation & Technology Transfer	Lisa Hammon (PATH)

2.3.11. CALTRANS DISTRICT 7 SUPPORT STAFF

Three recommended positions will be created by Caltrans District 7 to support the I-210 Pilot:

- **Caltrans Policy and Communications Coordinator** – Ensures that technical action items resulting from outreach activities are effectively communicated and carried out within the organization and assists with ongoing preparation for and coordination of outreach activities. This coordinator will also research and resolve specific issues raised during stakeholder meetings.
- **Caltrans Systems Engineering Coordinator** – Responsible for the delivery, quality control, and application of all systems engineering deliverables. The coordinator will become a resource within Caltrans for questions and insights related to the systems engineering process.
- **Caltrans Logistics Support** – Assists the Caltrans Project Manager, the Policy and Communications Coordinator, and the Systems Engineering Coordinator with meeting details, document preparation, organizational assistance, fieldwork, financial analysis, webinars and conferences, research investigations, and educational tasks.

2.4. COLLABORATION TOOLS

This section describes tools that will be used during the course of the project to facilitate communication among project partners, the sharing of documents and information, and the creation of a project management environment supporting the transfer of knowledge.

Tools currently available for use by some or all project team members include:

- **University of California, Berkeley's Connected Corridors Project Documentation Website (http://ccdocs.berkeley.edu/)** – Website developed and maintained by project staff from UC

Berkeley to serve as a repository of information regarding the I-210 Pilot. Screenshots of the website landing page and document library page are shown in Figure 2-3 and Figure 2-4.

- **University of California, Berkeley's Connected Corridors Website (http://connected-corridors.berkeley.edu/)** – Website developed as a "go to" site for ICM and the Connected Corridors program in general.
- **Box.com** – Cloud-hosted platform sponsored by the University of California, Berkeley, which allows its users to store and share documents. A screenshot of the application in shown in Figure 2-5. This service provides university users with 50 GB of free file storage on their personal accounts, with the possibility to increase storage space if necessary. Users can also determine who can view the files or folders they create on their account, and can make selected files viewable by anyone on the internet. Another application further allows saving data stored on Box in a special synchronization folder on a desktop computer or mobile devices. Changes made to the content of the sync folder are then automatically propagated back up to the cloud-based Box account, thus enabling users to work on documents from different devices or to groups of users to work collaboratively on the development of documents.
- **Dropbox** – Free file-hosting service operated by Dropbox offering 3 GB of free cloud storage, a file synchronization application, and personal cloud management tools. Similar to Box.com, this service allows its users to create a special folder on each of their computers that is then synchronized by Dropbox. This synchronization then allows individual users or groups of users to access the same folder, with the same content, regarding of which device they used to view the folder.

In the context of the I-210 Pilot, the primary applications that will be used for sharing information across stakeholders will be the ICM Documentation website and the Connected Corridors website. Documents posted on these websites will primarily consist of final documents or near-final draft documents released for review by stakeholders, as well as information about Integrated Corridor Management and corridor projects. The Box.com application will also be used to store and share work-in-progress documents, as well as various technical documents collected by the project team, such as signal timing sheets, detector layout documents, reports on traffic studies, etc. Primary users of the Box.com application will likely be PATH-based project members, as participating public agencies may not allow their employees to access the website from their work computers, as is the case with Caltrans.

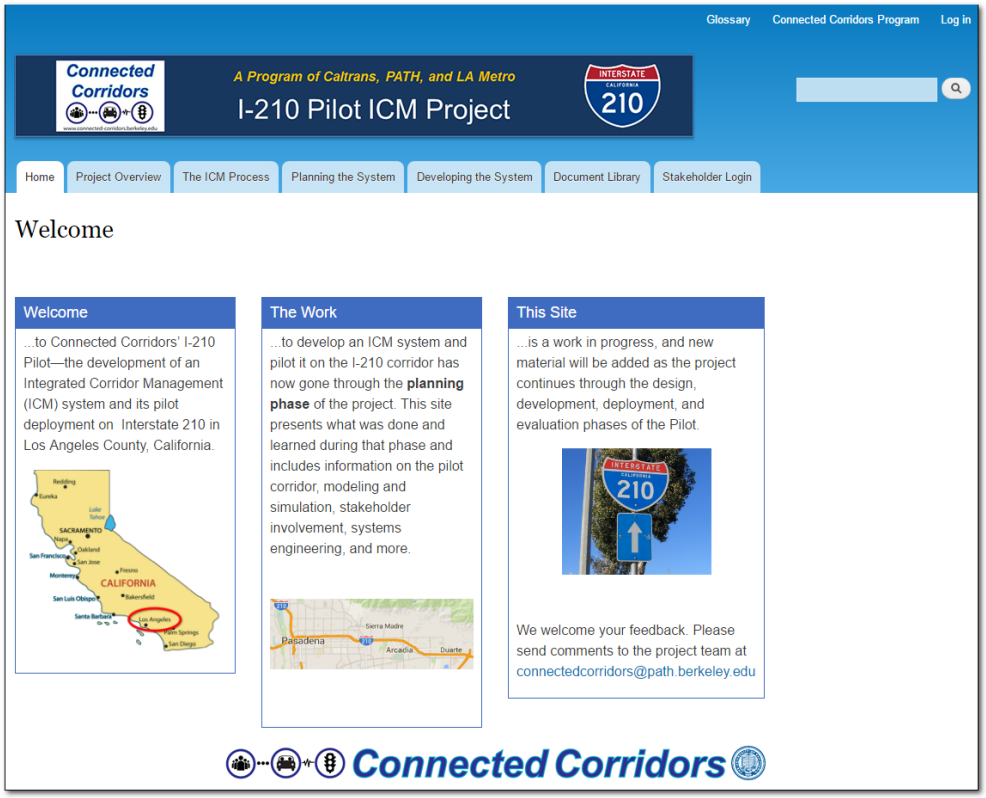

Figure 2-3 – UC Berkeley's I-210 Pilot ICM Project Website Landing Page

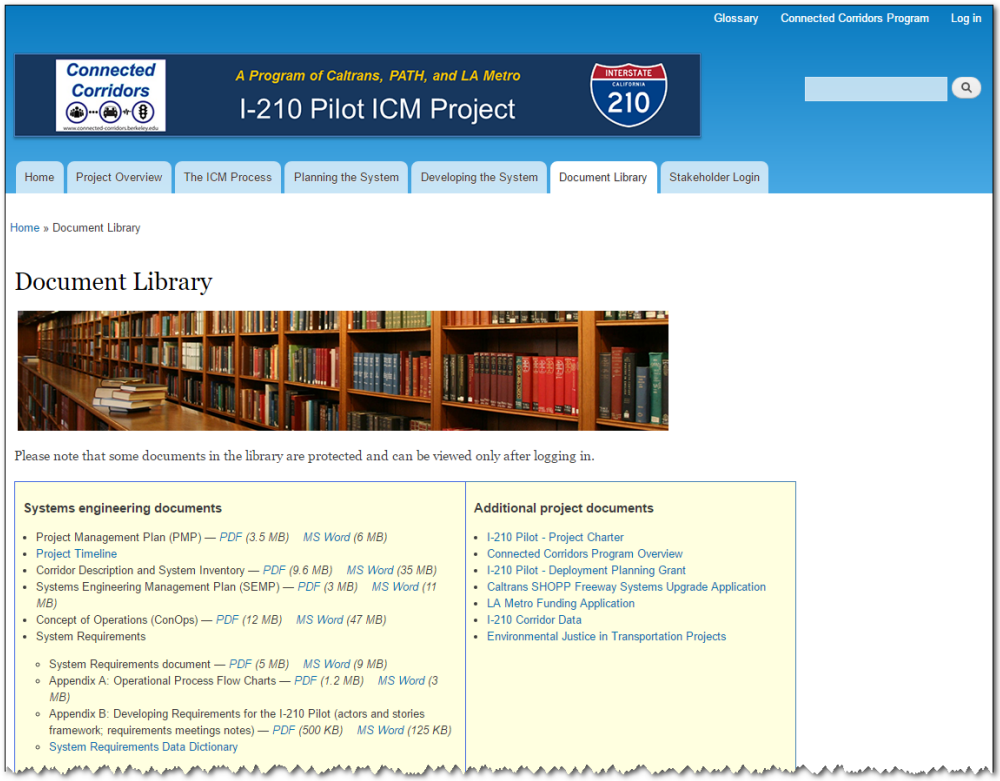

Figure 2-4 – UC Berkeley's I-210 Pilot ICM Project Documentation Webpage

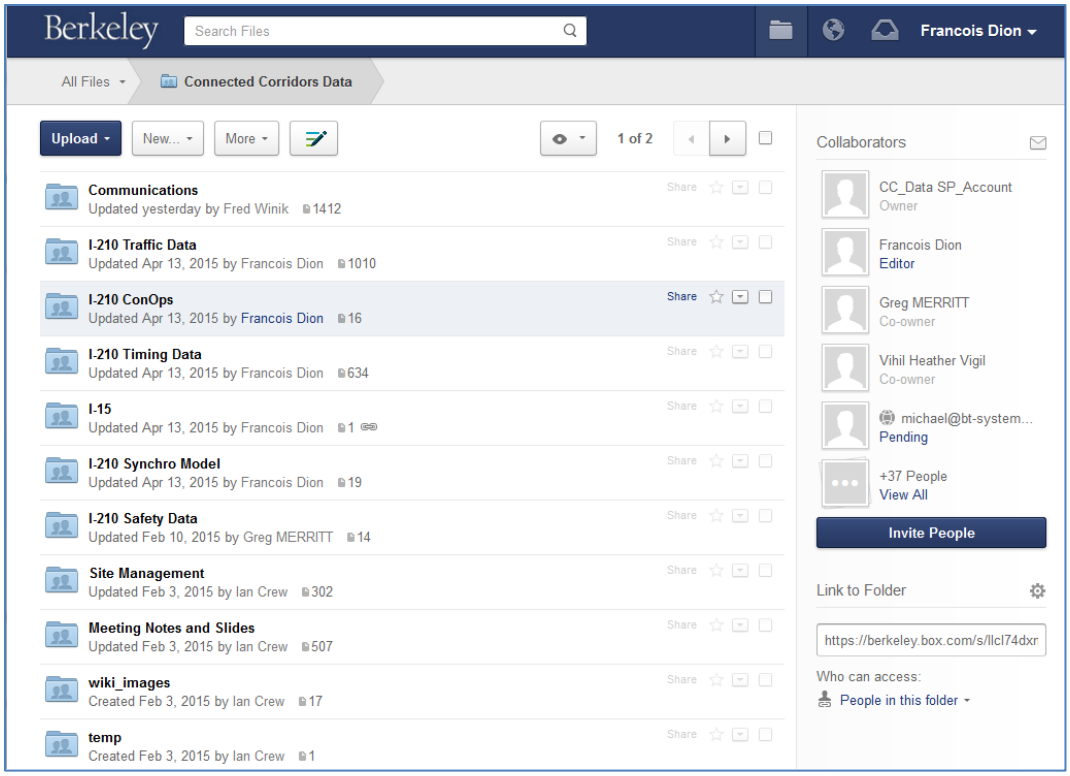

Figure 2-5 – UC Berkeley's Box.com File Sharing Service

3. PRELIMINARY WORK BREAKDOWN STRUCTURE

This section presents the established preliminary Work Breakdown Structure (WBS) for the project. It is anticipated that this structure will be reviewed once all project stakeholders have been engaged. The complete WBS that was developed is shown in Appendix B. The following summary elements are presented in this section:

- Main project tasks
- Key project milestones
- List of key deliverables

3.1. MAIN PROJECT TASKS

Table 3-1 presents the key project tasks identified for the successful completion of the I-210 Pilot project. The table identifies 19 broad tasks covering system planning, design, development, implementation, and evaluation, as well as project management, outreach, and training activities.

Table 3-1 – Main Project Tasks

Task	Title	Description
1	Project Initiation & Management	General project management activities, such as staffing, budgeting, contracting issues.
2	Outreach & Communication	Corridor stakeholder engagement, coordination of activities among stakeholders, release of information to the public, etc.
3	Preliminary Concept Exploration & User Needs	Evaluation of current corridor operations (travel demand, observed speeds and travel times, status of detectors, etc.); identification of high-level user needs; and identification of operational gaps.
4	Corridor Preparation	Activities to ensure that the monitoring and control systems currently in place along the corridor are operating adequately; management of equipment upgrade requests prior to ICM system deployment.
5	Analysis, Modeling, & Simulation	Use of analytical and simulation tools to evaluate the potential improvements that may be provided by various candidate strategies.
6	SEMP	Identification of systems engineering activities that will guide the development of the proposed ICM system.
7	Concept of Operations	Development of the Concept of Operations for the I-210 Pilot.
8	System Requirements and Verification & Validation Plan	Development of system requirements and preliminary systems verification & validation plans for the I-210 Pilot.
9	Organizational & Procedural Design	Identification of organizational changes that may be implemented to enhance corridor-based operations.
10	Technical Design	Design of system architecture and technical components of the I-210 Pilot.
11	Component Development	Development of technical components of the I-210 Pilot.
12	System Integration	Integration of developed technical components into a coherent integrated corridor-based traffic management system.
13	Institutional Deployment	Implementation of approved identified organizational and procedural changes.
14	Technical Deployment	Field deployment of the developed I-210 Pilot.
15	User Training	Training of operators and administrators of the proposed I-210 Pilot.
16	System Validation & Acceptance	Validation of the deployed I-210 Pilot and acceptance by corridor stakeholders.
17	System Operations	Operations of the deployed I-210 Pilot.
18	System Evaluation	Evaluation of the benefits provided by the deployed I-210 Pilot, both pre-deployment and post-deployment
19	Migration to Production	Conversion of pilot system into production system
20	Lessons Learned & Best Practices	Identification and documentation of lessons learned and best practices.

A table with more detailed activities is in Appendix C. Where relevant, each major task is broken down to the second level and third level.

3.2. KEY MILESTONES

Project milestones define significant points in the project that can be used to track adherence to the established schedule. Many of the milestones, but not all, are also project deliverables. Key milestones for the I-210 pilot are:

- **Project Planning:**
    - Development of initial work plan
    - Development of Project Management Plan (PMP)
    - Development of initial Systems Engineering Management Plan (SEMP)
- **Development of I-210 Pilot Team:**
    - Engagement of all key corridor stakeholders
    - Executed Project Charter with all key corridor stakeholders
    - Executed Memorandum of Understanding (MOU) with all key corridor stakeholders
- **Development of I-210 Pilot Concept:**
    - Development of user needs
    - Development of preliminary system concept
    - Completion of analysis of operational alternatives
    - Completion of I-210 Pilot Concept of Operations
- **Development of I-210 Pilot System – Organizational and Procedural Elements:**
    - Identification of potential organizational and procedural changes within each agency to improve coordinated response to incidents and event management, as well as normal day-to-day operations
    - Implementation of approved organizational and procedural changes by corridor stakeholders
- **Development of I-210 Pilot System – Technical Elements:**
    - Development of system requirements
    - Development of general system validation plan
    - Development of system/subsystem verification and acceptance plans
    - Completion of system design
    - Completion of component development and testing
    - Completion of system integration, verification, and validation
    - Completion of system deployment
    - Completion of system acceptance tests
    - Completion of user training
- **Evaluation of I-210 Pilot System:**
    - Delivery of report documenting system evaluation results
    - Delivery of document outlining lessons learned and best practices

3.3. KEY DELIVERABLES

Key project deliverables from the systems engineering process include the following:

- Project Management Plan (PMP)
- Systems Engineering Management Plan (SEMP)
- Analysis, Modeling, and Simulation: Alternatives Analysis Report
- Concept of Operations (ConOps)
- System Requirements
- Recommended organizational and procedural changes, if needed
- System Design Diagrams
- System Deployment Plan
- System/Subsystem Verification Plans
- System Validation Plan
- System Acceptance Plan
- System Validation and Acceptance Report
- Operations and Maintenance Plan
- Training Plan
- Training materials
- Operations manuals
- System Evaluation Plan
- System Evaluation Report
- Lessons Learned and Best Practice Document

This page left blank intentionally

4. CHANGE MANAGEMENT PLAN

This section defines the processes that will be used to manage effectively how proposed changes to the project would be submitted and reviewed for approval. These elements include:

- Change management approach
- Composition and role of Change Control Board
- Change control phases
- Change management log

4.1. CHANGE MANAGEMENT APPROACH

Project changes can have a significant impact on project scope, budget, and/or schedule. Without proper review and control, the uncontrolled execution of proposed changes can inadvertently change the direction of a project and push it away from its stated goals. To avoid such consequences, all proposed changes of certain significance to the project ought to be reviewed and approved by a Change Control Board residing within the Project Management Team prior to their implementation.

While not officially part of the Change Control Board, it is expected that both the Management Oversight Committee and Technical Advisory Committee may play an important advisory role. While the Change Control Board is the key body tasked with making decisions on the submitted project change requests, the Management Oversight Committee will have the final authority on this matter and will have the ability to override any decision made by the Change Control Board if deemed appropriate.

4.2. COMPOSITION AND ROLE OF CHANGE CONTROL BOARD

The Change Control Board for the I-210 Pilot will be made up of members of the Project Management Team who will be tasked with reviewing project changes submitted by project partners or PATH team members. At a minimum, the Change Control Board will consist of the following two individuals:

- Caltrans Project Manager
- PATH Project Manager

Additional Project Team Members may be invited to join the Board as needed, either on a permanent or temporary basis as determined by the existing Change Control Board. Unanimity among board members, and approval from the Management Oversight Committee, will be required for the addition of a new member to the Change Control Board.

It is anticipated that the Change Control Board will meet on an as-needed basis, typically after a change request has been received. If change requests are frequently submitted, the number and complexity of the requests being made will likely determine the frequency with which the meetings will be scheduled. It is not anticipated that the Change Control Board will meet more than once a month on a regular basis.

4.3. CHANGE CONTROL PHASES

Figure 4-1 details the Change Control Process. It consists of the five following phases:

- Submission of change request
- Initial review of change request
- Initial impact analysis
- Executive review of proposed change
- Recommendation

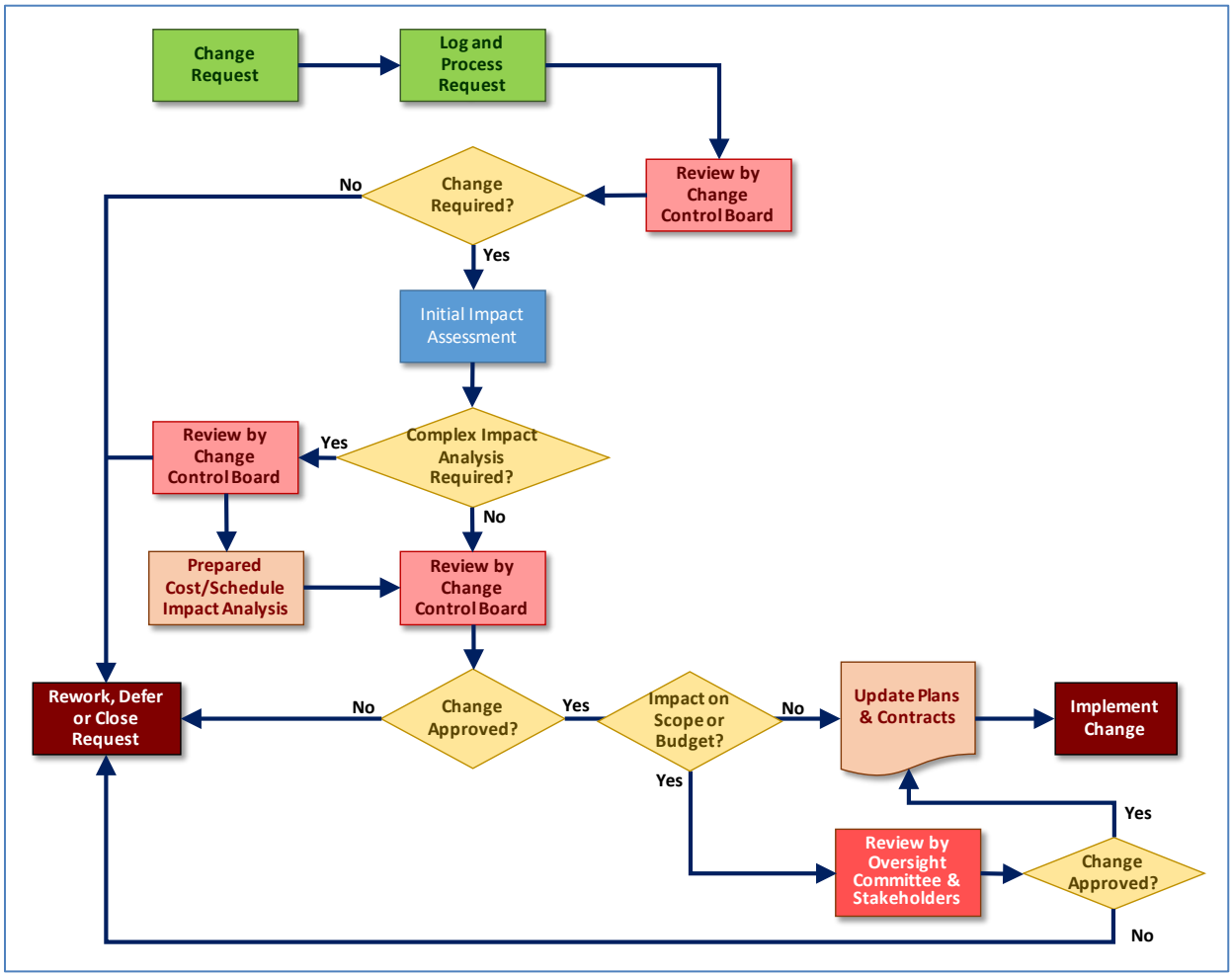

Figure 4-1 – Change Control Process Flowchart

4.3.1. SUBMISSION OF CHANGE REQUEST

Anyone within the project team, user community, stakeholders, or contractors can submit a change request. This is to be done in writing using the template shown in Table 4-1. Key information to be provided with the submitted change request shall include:

- **Change Identification** - Identifies the change request title, which will be used in subsequent communication, the date submitted, and the person and organization submitting the request.

Table 4-1 – Project Change Request Template

Element	Description
Change Identification	
Date	The date the change request was created
Change Control #	Unique tracking number assigned by the individual in charge of tracking and logging change requests
Title	A brief description of the change request
Individual Submitting Change Request	
Submitter	Name of the person submitting the suggested change and who can answer questions regarding its purpose and justification
Phone	Phone number of the submitter
E-Mail	Email of the submitter
Description of Proposed Change	
Description	Description of the desired change
Product	The product the suggested change applies to
Version	The product version the suggested change applies to
Affected Tasks	The tasks primarily affected by the proposed change
Priority	Categorization of the urgency of the requested change (High, Medium, Low)
Change Justification	
Justification	Brief explanation of the need to implement the proposed change
Impact Statement	Brief explanation of the potential impacts on project activities if the change is not implemented

- **Person Submitting the Change Request** – Name of person submitting the change request, with contact information.
- **Description of Proposed Change** – Describes the change being proposed and clearly identifies whether the change is technical, system, organizational, financial, or procedural in nature. Any reference material that will assist the reviewers should be identified and attached.
- **Justification** – A discussion of why the change is being proposed. This may include a cost/benefit analysis for proposed changes that may have a significant impact on project activities or outcomes. This justification is to identify clearly how system users or system operations will benefit from the change. The justification is also to include a statement indicating how system users or operations will be adversely affected if the proposed change is not implemented.

The person submitting the Change Request shall attach any supporting documentation that helps to clarify the proposed change. Change Requests will be submitted to a centralized repository where they will be logged and tracked through a unique Change Request control, such as a unique identifying number, from submittal to completion. An assigned individual from the Documentation & Technology Transfer Group within PATH will be responsible for logging and tracking the submitted change requests.

4.3.2. INITIAL REVIEW OF CHANGE REQUEST

After receiving a change request, the Change Control Board will first conduct a high-level review of the request and determine whether to proceed, reject, or defer it.

If a decision is made to proceed with the request, the Change Control Board will then assign an individual within one of the project's Working Groups to conduct an initial impact assessment of the requested

change. The selection of a reviewer will be based on the evaluation needs associated with each change request. If needed, members of the Project Management Team may also be selected to conduct some preliminary assessments.

4.3.3. INITIAL IMPACT ASSESSMENT

After the Change Control Board assigns someone to review the change request, that person will make an initial assessment of the cost, schedule, and resources needed to implement the proposed change.

If an initial assessment cannot be made within two days due to the complexity of the submitted request, a full Cost/Schedule Impact Analysis will be requested instead. In this case, the person assigned to the review will be required to determine the need for the analysis and to estimate the cost, schedule, and resources needed for an appropriate analysis to be performed.

Based on the results of the review, and the estimated resources needed to complete a recommended Cost/Schedule Impact Analysis, the Change Control Board will accept or reject the request, or defer its decision to a later time.

4.3.4. EXECUTIVE REVIEW OF PROPOSED CHANGE

While the Change Control Board is formally tasked with reviewing and approving any submitted Change Requests, the board may also ask for guidance from the Technical Advisory Committee and/or Oversight Management Committee on whether a change should be approved or rejected. However, it is likely that this would occur only in cases where acceptance or denial of a proposed change is expected to have significant impacts on project activities, budget, resource allocation, or scope.

4.3.5. FINAL RECOMMENDATION

After the effects of a requested change on project scope, budget, and schedule will have been identified, the Change Control Board will review the findings and either recommend or reject implementation of the proposed change. Approved changes that are expected to have only minor impacts on project scope, schedule, or budget will then be communicated to the appropriate project partners or team members responsible for their implementation. On the other hand, changes assessed as having significant impact on project scope, schedule, or budget will be submitted to the Caltrans Oversight Committee and affected stakeholders for approval. If such a referral occurs, implementation of a suggested change will then only move forward if both the Caltrans Oversight Committee and affected stakeholders approve it.

With recommendation and approval of a project change, the appropriate processes will be followed with regard to project contracts and baseline documentation.

4.4. CHANGE MANAGEMENT LOG

All Change Requests submitted to the Change Control Board shall be logged in a Change Management Log that is to be maintained by an assigned individual from the Documentation & Technology Transfer Group. This log will include the initial Change Request and information indicating whether the change was approved or rejected. For rejected requests, the log shall also include information indicating why the request was denied.

5. SCOPE MANAGEMENT PLAN

Scope management includes all the processes leading to the definition of a specific scope for a project. The objective of the Scope Management Plan is to describe how the scope will be defined, developed, monitored, controlled, and verified. The Scope Management Plan documented herein outlines the processes that will be used to ensure that I-210 Pilot includes all the activities required, and only the required activities, to complete the project successfully. Key elements and processes that are detailed in the following subsections include:

- Scope management approach
- Roles and responsibilities regarding scope management
- Scope definition process
- Work Breakdown Structure (WBS) development process
- Scope verification process
- Scope control process
- Management of proposed scope changes

5.1. SCOPE MANAGEMENT APPROACH

For the I-210 Pilot, the PATH Project Manager and Caltrans Project Manager will jointly be the responsible for managing the scope of the project. All activities related to the definition of an initial project scope, and subsequently to address potential changes in scope, will be coordinated by these two individuals, in close collaboration with the project stakeholders and project sponsors.

The initial scope for this project will be defined by the following elements:

- **Scope Statement** – Document detailing the major objectives and deliverables of the project. Information presented in the Scope Statement will include the project owner, sponsor, and stakeholders; the problem to be address; the defined goals and objectives of the project; key project requirements; key project deliverables; and items specifically considered to be outside the scope of the project.
- **Work Breakdown Structure (WBS)** – Decomposition of the project into phases, deliverables, and work packages.
- **WBS Dictionary** – Document briefly defining for each WBS component the scope or statement of the associated work, the deliverable to be produced, a list of associated activities, and a list of recognized milestones to gauge progress.

After the development of these elements, scope management will focus on ensuring that the project scope is respected and assessing, if required, potential changes to the scope. These activities will still be under the joint responsibility of the PATH Project Manager and Caltrans Project Manager, with help from various members of the project team. Ensuring that the project scope is respected will consist of comparing work being done to the activities identified in the Scope Statement, WBS, and WBS Dictionary to ensure that only work described in the project's original scope is completed. If changes to the project scope become necessary, the processes described in the Change Management Plan will then be followed.

5.2. ROLES AND RESPONSIBILITIES

Table 5-1 lists the responsibilities assigned to specific individuals regarding project scope management. For the I-210 Pilot, scope management will be the joint responsibility of the Caltrans Project Manager and PATH Project Manager. While the Caltrans Project Manager will have higher authority, it is expected that the PATH Project Manager will play a significant advisory and support role. While the Caltrans Project Manager may be authorized to approve minor changes in scope on his own, the Change Control Board will generally be tasked with reviewing and accepting or rejecting the proposed changes. Changes that have a potentially significant impact on project activities will require final acceptance by the Management Oversight Committee.

Table 5-1 – Roles and Responsibilities for Scope Management

Individual/Group	Responsibilities
Caltrans Project Manager	• Individual to whom scope change requests are be submitted • Manages the scope change process • Reviews the need for the proposed scope change • Reviews the impacts of the proposed scope change on project deliverables and resources • Facilitates the execution of the change review process within Caltrans and with project partners • Key point of contact for individuals or agencies seeking information about a submitted scope change request • Communicates the outcome of scope change requests to Caltrans staff and local corridor partners
PATH Project Manager	• Individual to whom scope change requests are submitted • Receives scope change requests on behalf of Caltrans Project Manager • Assists the Caltrans Project Manager in reviewing the need for the proposed change in scope • Assists the Caltrans Project Manager in reviewing the impacts of the proposed scope change request on project deliverables and resources • Facilitates the execution of the change review process within PATH • Communicates the outcomes of scope change requests to development teams
Change Control Board	• Final acceptance of proposed changes in project scope
Management Oversight Committee	• Reviews recommendations for change in project scope made by the Caltrans Project Manager and/or PATH Project Manager • Approves/rejects proposed scope changes
Technical Advisory Committee	• Provides advice on the desirability or feasibility of proposed changes in project scope
PATH System Engineer	• Assists the Caltrans Project Manager in evaluating proposed changes on project activities • Implements changes to project documents to reflect adopted changes in scope • Communicates project scope changes to stakeholders and development team members
Project Stakeholders	• Advisory role
Project Development Team Members	• Advisory role

5.3. SCOPE DEFINITION PROCESS

The scope definition process will start with a review of project documents that may have been drafted following preliminary discussions and explorations with potential project stakeholders. This may include a review of identified stakeholders, draft project charter, memoranda of understanding with specific agencies, and identified preliminary user needs and system requirements. If needed to clarify uncertainties, interviews with specific project team members or facilitated workshops may also be conducted.

Following the conclusion of the data collection phase, a draft Scope Statement will be developed by the PATH project team in collaboration with Caltrans. This draft statement will then be submitted for review and refinement to all the corridor stakeholders. The review process will be continued until a general agreement is obtained from all stakeholders. After its approval by all project stakeholders, the Scope Statement will then define the scope baseline for the project that will be subject to scope verification and control.

5.4. DEVELOPMENT OF WORK BREAKDOWN STRUCTURE

The Work Breakdown Structure (WBS) and its corresponding Dictionary present a hierarchical decomposition of the work to be accomplished, typically based on deliverables. The purpose of the WBS is to allow a Project Manager to manage effectively the scope of a project while presenting the work in small packages to facilitate stakeholder understanding of the tasks that must be done to complete the project. Once adequately defined, the work packages become the basis for developing schedules, estimating resources, and sequencing work.

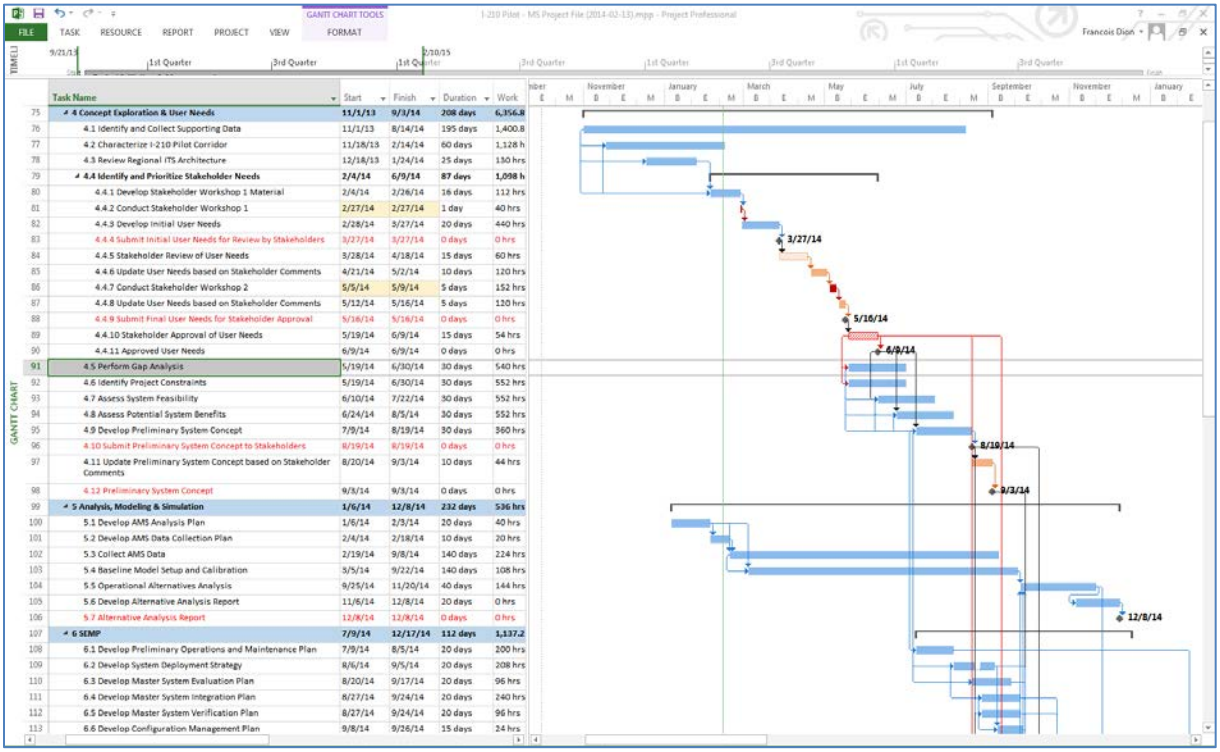

Figure 5-1 – Microsoft Project Task Management Environment

The WBS for the I-210 Pilot will be developed using Microsoft Project 2013. While use of this tool is based on its availability to the PATH project members, utilization of another tool is not precluded if so requested by Caltrans. Figure 5-1 shows a section of the task breakdown that was developed for the WBS in Microsoft Project.

Development of the preliminary WBS followed an iterative process. Early in the project, a draft initial WBS was developed jointly by the PATH System Engineer and the PATH Project Manager. This draft was then circulated among PATH's project team members for assessment and refinement, a process that included several iterations. The resulting draft WBS was then submitted to the Caltrans Project Manager for further review, before being forwarded to the Management Oversight Committee for final review and approval.

A second round of review and approval will occur after all local agencies have been engaged. This round will occur after the user needs and the Concept of Operations are drafted and completed. Once this milestone has been reached, the draft WBS will be circulated among all corridor stakeholders for final review and approval.

Following the acceptance of the WBS by all participating agencies, it is anticipated that periodic revisions will be necessary to account for changes in scheduled activities or other project elements caused by unanticipated factors. When necessary, proposed changes to the WBS will first be assessed by the project's Change Control Board, with the assistance of the PATH System Engineer. The board will have full authority to approve minor changes in work activities. Proposed changes expected to have a significant impact on the project's schedule, budget, or resource utilization will be further submitted for review to the Management Oversight Committee, which will have the final decision in such cases.

More detailed information on the preliminary task breakdown, key milestones, and key deliverables that had been identified at the time this management plan was developed is presented in Appendix B and Appendix C.

5.5. SCOPE VERIFICATION PROCESS

Scope verification is the process of determining how deliverables will be tracked to the original project scope and how they will be formally accepted. This will occur throughout the project through the following activities:

- Periodic review of project deliverables being developed against the baselined project scope and WBS
- Review and acceptance of submitted deliverables

Project deliverables should be verified against the project scope and formally accepted by the appropriate stakeholders throughout the life of the project. As the project progresses, the PATH Project Manager and Caltrans Project Manager will verify that interim deliverables correspond to deliverables originally specified in the project's scope statement, and the WBS. The Caltrans Project Manager will only sign off on the deliverables once they have been deemed correct and within the project scope.

Depending on the deliverable, acceptance may be determined solely by the Caltrans Project Manager or may require input from the Management Oversight Committee and stakeholders. Minor or interim deliverables may be accepted by the Caltrans Project Management alone. However, acceptance of key

major deliverables will require review and approval by the Management Oversight Committee and stakeholders.

To facilitate the tracking of deliverables, a Deliverable Verification Matrix will be maintained by the PATH Project Manager. A sample matrix is shown in Table 5-2. This matrix will identify for each WBS element the planned deliverables and the products that were actually submitted. Explanations will also be provided for deliverables with significant variance between what was planned and delivered.

Table 5-2 – Sample Deliverable Verification Matrix

I-210 Connected Corridors Pilot				**Project Number XXXX**	
WBS Code	**WBS Element Name**	**Planned Deliverable**	**Deliverable Submitted**	**Variance**	**Comments**

5.6. SCOPE CONTROL PROCESS

Scope control involves monitoring scope elements and drivers over the course of the project for possible changes that can affect approved project scope baselines. The Caltrans Project Manager and PATH Project Manager, with the assistance of the leaders of the various Working Groups, will be responsible for monitoring and addressing any unplanned deviation from the baselined scope, as well as resolving scope change issues before they become critical. A key aspect of this review will be to ensure that the project team performs only the work described in the WBS and generates the deliverables defined for each WBS element. This review is to be conducted quarterly, or as soon as potential deviations are brought to attention.

5.7. MANAGEMENT OF PROPOSED SCOPE CHANGES

Proposed changes in project scope may be initiated by any member of the project team. However, determining whether a proposed change should be approved or rejected will be the responsibility of the project's Change Control Board. If a change to the project scope is needed, a formal process for recommending changes to the scope of the project will be carried out following the processes outlined in the Change Management Plan described in Section 0.

Upon approval of a change request by the Change Control Board, the PATH Systems Engineer will record the change in the project Change Control Document and subsequently update all relevant systems engineering project documents to reflect the change. This individual will further be responsible for communicating the change to all project stakeholders. The PATH System Engineer will also inform the leader of the Document and Technology Transfer Working Group of the approved change to ensure that the initial change request and the resulting decisions are properly archived in the project's repository.

This page left blank intentionally

6. SCHEDULE MANAGEMENT PLAN

The project schedule is the roadmap for how the project will be executed. Schedules are an important part of the I-210 ICM Project, as they provide the project team, Caltrans, and corridor stakeholders a picture of the project's status at any given time. The purpose of the Schedule Management Plan is to define the approach the project team will use in creating the project schedule. This plan defines how the team will monitor the project schedule and manage changes after a baseline schedule has been approved. This includes identifying, analyzing, documenting, prioritizing, approving or rejecting, and publishing all schedule-related changes.

Elements detailed in this plan include:

- Schedule management approach
- Roles and responsibilities regarding schedule management
- Schedule development process
- Current project schedule
- Key project milestones by date
- Schedule control process
- Management of proposed schedule changes
- Consideration of related changes in project scope

6.1. SCHEDULE MANAGEMENT APPROACH

Project schedules will be created using Microsoft Project, starting with the deliverables identified in the project's Work Breakdown Structure (WBS). Activity definition will identify the specific work packages that must be performed to complete each deliverable. Activity sequencing will then be used to determine the order of work packages and assign relationships between project activities. Activity duration estimates will finally be used to calculate the number of work periods required to complete work packages and to allow resource estimates to be assigned to specific work packages.

PATH will have the responsibility of developing and maintaining the project schedule. Once a preliminary schedule will have been developed, it will be submitted for review to Caltrans and, if necessary, other relevant project stakeholders. A baseline schedule will be established once an agreement is reached among all relevant stakeholders regarding the proposed schedule of activities. The resulting schedule will then be subject to control, requiring that any proposed major change be submitted for formal review and approval.

6.2. ROLES AND RESPONSIBILITIES

Table 6-1 lists the responsibilities assigned to specific individuals or groups regarding schedule management. Schedule management will be the joint responsibility of the Caltrans Project Manager and PATH Project Manager. Both individuals will have the authority to approve changes that do not affect scheduled project deliverable dates. However, all proposed changes potentially affecting project deliverables will need to be formally reviewed by the Change Control Board, who will then have authority to accept or reject the change or escalate it to a higher authority. All proposed changes resulting in a

delay of more than two weeks in the scheduled date of a deliverable will require a formal review and acceptance by the project's Management Oversight Committee.

Table 6-1 – Roles and Responsibilities for Schedule Management

Individual/Group	Responsibilities
Caltrans Project Manager	• Review the project schedules • Coordinate review of proposed initial schedule and subsequent schedule change requests with corridor stakeholders
PATH Project Manager	• Review the project schedules • Coordinate development/review of project schedules with Caltrans • Participate in monthly schedule reviews
Change Control Board	• Formal review/acceptance of schedule changes
Management Oversight Committee	• Review recommendations for project schedule changes submitted by the Change Control Board
PATH System Engineer	• Facilitate the definition of work packages, the sequencing of activities, and the determination of time and resource requirements for each activity • Validate developed schedules with the PATH Project Manager • Implement the developed project schedule in Microsoft Project 2013 • Baseline the schedule • Participate in monthly schedule reviews
Technical Advisory Committee	• Provide technical advice on the desirability or feasibility of proposed schedule items
Business Drivers Group	• Provide advice on the desirability or feasibility of proposed schedule items
Project Stakeholders	• Provide input on the development or revision of project schedules • Approval or rejection of requests for major schedule changes
Project development team members	• Advisory role in the definition of work packages, the sequencing of activities, and the determination of time and resource requirements for each activity • Participate in monthly schedule reviews • Review proposed schedule changes to determine impacts on project activities

6.3. SCHEDULE DEVELOPMENT PROCESS

Project schedules will be created using Microsoft Project 2013. Development of an initial project schedule will start with the activities, milestones, and deliverables defined in the project's Work Breakdown Structure (WBS). Each activity listed in the WBS will then be further defined to identify the specific work that must be performed within it to complete each deliverable. Once all activities are defined, activity sequencing will be used to determine the order of work packages and assign relationships between the various project activities. After completing the sequencing of activities, the time and resources needed to complete each deliverable will be estimated. To the extent possible, the duration and resource estimates for individual tasks will be determined by comparing the needs of each activity to similar activities conducted in past projects. Where such comparison will not be possible, estimates will be made based on an analysis of the work to be executed within the activity.

The initial project schedule will be drafted the PATH Project Manager, the PATH System Engineer, and the development teams. After an internal consensus is reached on a tentative project schedule, the resulting preliminary schedule will be submitted to the Caltrans Project Manager for review and comment. Based on the comments received from the Caltrans Project Manager, the tentative project schedule may then be modified and resubmitted for review. This process will continue until there is agreement between the

PATH Project Manager and Caltrans Project Manager on the definition of each task, the sequencing of activities, the nature and magnitude of work to be conducted within each task, the time required for completing each activity, and the resources needed for each task. Once an agreement is reached, the Caltrans Project Manager will forward the tentative project schedule to Caltrans Oversight Management Committee for approval. Upon approval, the developed schedule will then be baselined and subject to the control and change processes defined in the Change Management Plan.

The following will be designated as milestones for the project schedule:

- Completion of scope statement and WBS
- Baselined project schedule
- Approval of final project budget
- Project kick-off
- Approval of roles and responsibilities
- Requirements definition approval
- Completion of data mapping/inventory
- Project implementation
- Acceptance of final deliverables

6.4. CURRENT PROJECT SCHEDULE

In order to track successful completion of project tasks, a baseline project schedule has been developed and aligned with the WBS of the project. This baseline schedule is shown in Figure 6-1. It presents a high-level overview of the tentative schedule of activities planned from the project. This schedule was initially developed in January 2014 and was periodically updated as the project moved forward. From an official start date of October 1, 2013, the illustrated timeline currently indicates a target end date of June 29, 2018.

It should be noted that the end date is a general estimate of when all project activities would be concluded. This estimate is based on currently available and projected resources, the assessed time that will be needed to develop appropriate agreements with corridor stakeholders, and the time anticipated to design, develop, implement, and evaluate a complex, multi-jurisdiction prototype traffic management system along the I-210 corridor. It must be understood that the implementation of the corridor management system can be influenced by ongoing changes in working relationships, gradual improvement of corridor ITS elements, and uncertainties associated with the use of new, less-tested technologies. The illustrated schedule shows an overall estimated timeline for the completion of a complex effort based on reasonable assumptions.

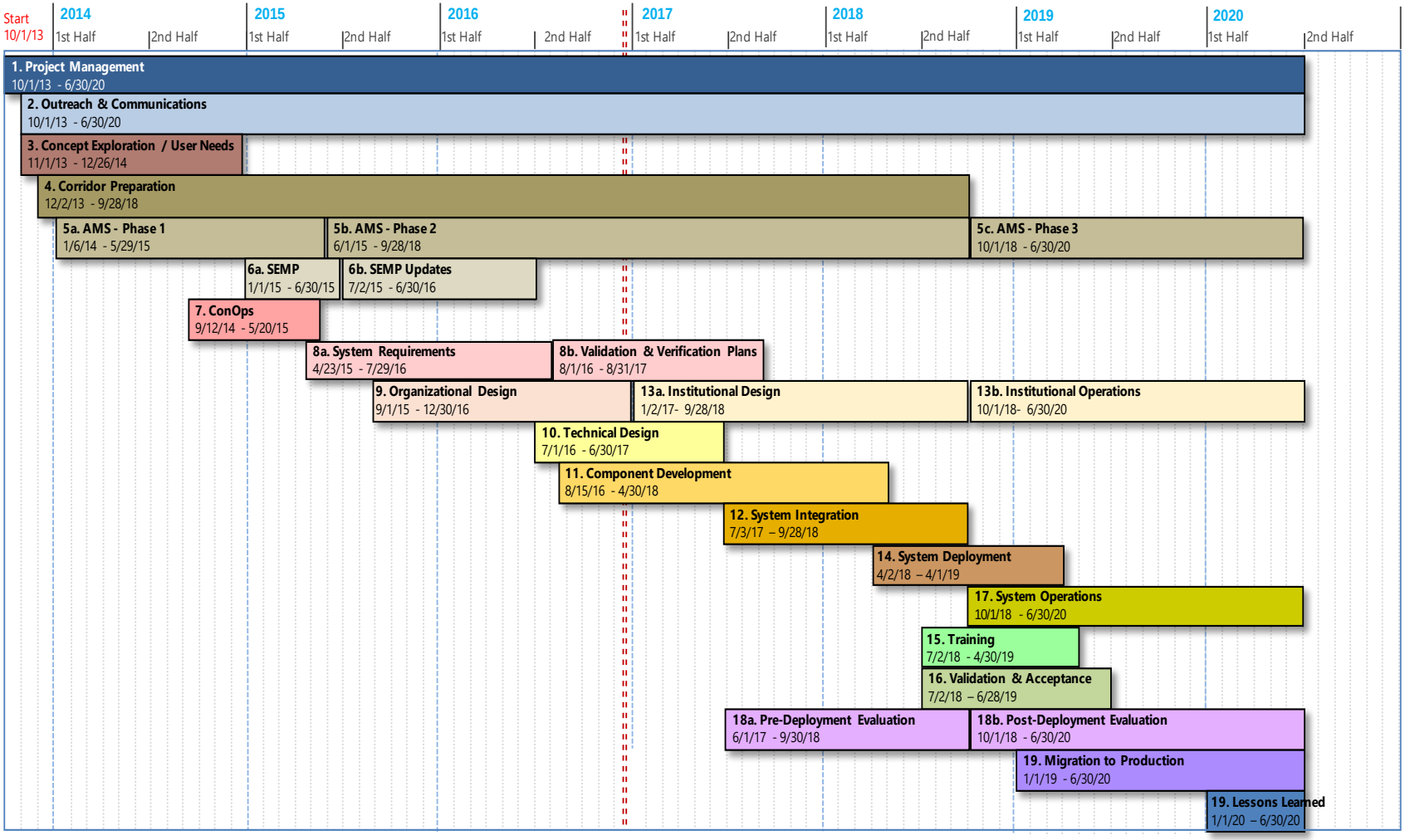

Figure 6-1 – Project Timeline

6.5. KEY MILESTONES

Project milestones define significant points in the project that can be used to track schedule adherence. Many of the milestones are also project deliverables. The following identifies the anticipated dates at which key project milestones will be reached:

- **November 2013:** Delivery of draft work plan to Caltrans
- **June 2014:** Delivery of draft Project Management Plan (PMP) to Caltrans
- **July 2014**: Submission of developed user needs to corridor stakeholders for approval
- **December 2014:** Completion of preliminary system concept
- **May 2015:** Submission of SEMP to corridor stakeholders for approval
  Submission of I-210 Pilot ConOps to corridor stakeholders for approval
- **June 2015:** Project Charter signed by all corridor stakeholders
  Completion of Phase 1 of AMS operational alternative analysis
- **September 2016:** Submission of system requirements to corridor stakeholders for final approval
- **August 2017:** Submission of system verification and acceptance plans for approval
- **June 2017:** Final technical system design and system deployment plan
- **April 2018:** Executed Memorandum of Understanding (MOU) with all corridor stakeholders
- **September2018:** End of implementation of organizational and operational changes
- **September 2018:** Completion of component development and testing activities
- **April 2019:** Completion of system integration, verification, and validation activities
- **May-June 2019:** System acceptance tests
- **October 2018:** System launch
- **April 2019:** Completion of training activities
- **June 2020:** Delivery of draft system evaluation report
  Delivery of lessons learned and best practice document

It should be kept in mind that the dates listed above are target dates subject to change. Slippage could occur because of various factors, such as unexpected technical difficulties or delays in obtaining specific agreements. Every effort will be made to ensure adherence to the listed target dates. Should a schedule slippage occur, the target dates of affected deliverables will then be adjusted.

6.6. SCHEDULE CONTROL PROCESS

Following the establishment of a baseline, the PATH Project Manager in collaboration with the Caltrans Project Manager and PATH System Engineer will review on a quarterly basis the status of project activities to identify whether any slippage has occurred with respect to the baseline schedule. This process will involve obtaining input on the actual/expected start and end dates of active as well as near-future tasks from the individuals, working groups, or agencies responsible for the execution of these tasks.

The definition of a significant schedule slippage will depend on the nature of the task. For a subtask, this may be a two-week delay in the production of the deliverable. For a major task, this may be defined as a percentage deviation from the total time or resources allocated to a task, such as a 20% increase in the time or resources needed to complete a task. The specific threshold to use for each type of task and subtask will be determined jointly by the PATH Project Manager and Caltrans Project Manager, with possible assistance from the Project Development Team, Technical Advisory Committee, Business Drivers Group, and Management Oversight Committee.

Following the identification of a significant schedule slippage or increase in resource needs, the PATH Project Manager will be responsible for tasking an individual, or group of individuals, to conduct a review of the slippage. This review will assess the cause of the slippage, determine whether it can be recovered and how this recovery can be done, and evaluate its potential impacts on future project activities and resources. Following this evaluation, an assessment will then be made as to whether the slippage may be recovered through simple adjustments that can be authorized by the PATH Project Manager or Caltrans Project Manager, or whether it will require the submission of a formal Change Request to the Change Control Board.

6.7. MANAGEMENT OF PROPOSED SCHEDULE CHANGES

Individuals estimating that a change in the project schedule is necessary will first need to discuss the matter with the leader of their Working Group, who will then bring it to the attention of either the Caltrans Project Manager or PATH Project Manager. The Group Leader and Project Manager will then collaborate to determine whether the suggested change can be implemented without significant impacts on other project activities or resource allocations. Minor changes in project schedule that do not affect the delivery date of project products or significantly affect resource utilization may be directly approved at the discretion of the PATH Project Manager or Caltrans Project Manager. However, suggested changes having the potential to affect significantly product delivery dates or resource allocations will need to be formally reviewed and approved by the Change Control Board, and possibly the Caltrans Oversight Committee and relevant corridor stakeholders. These changes will require the submission of a formal Change Request according to the processes outlined in the Change Management Plan (Section 4).

After a change request will have been reviewed and approved, the PATH System Engineer will be responsible for adjusting the baseline project schedule and communicating the results and impacts of this change to the various team members or groups affected by it. The PATH System Engineer will also inform the leader of the Document and Technology Transfer Working Group of the approved change to ensure that the initial change request and the resulting decisions are properly archived in the project's repository.

6.8. CONSIDERATION OF CHANGES IN PROJECT SCOPE

Any approved changes in the project scope will require the Caltrans Project Manager and PATH Project Manager to evaluate the effect of the scope change on the current schedule. If it is determined that the scope change will significantly affect the current project schedule, the Caltrans Project Manager or PATH Project Manager may request that a new schedule baseline be developed to take into consideration changes that need to be made as part of the new project scope. Regardless of who requests the new baseline, the Caltrans Project Manager will be responsible for its approval. However, if the new baseline differs significantly from the current one, the Caltrans Project Manager will need to seek additional approval from the Management Oversight Committee before accepting the change of schedule baseline.

This page left blank intentionally

7. COMMUNICATION MANAGEMENT PLAN

This section describes the framework that will be used to ensure that efficient communication occurs among all project participants, as well as to manage the production, distribution, and storage of project-related information. Elements presented in this section include:

- Communication Management Plan audience
- Stakeholder directory
- Stakeholder roles and responsibilities related to project communications
- Communication vehicles to be used
- Website to be used to disseminate project information to the public
- General guidelines for conducting meetings

7.1. INTENDED AUDIENCE

The intended audience of the I-210 Pilot Communication Management Plan includes the Caltrans Project Manager, the PATH Project Manager and Project Development Team members, stakeholder agencies, and contracted entities responsible for communicating information to specific individuals or groups of individuals.

7.2. STAKEHOLDER DIRECTORY

Key stakeholders for the I-210 Pilot project are as follows:

- Caltrans District 7
- Caltrans Headquarters
- University of California PATH
- Metro
- Los Angeles County Department of Public Works
- City of Pasadena
- City of Arcadia
- City of Monrovia
- City of Duarte
- Consultants (System Metrics Group, Iteris)

For each of the stakeholders listed above, Table 7-1 identifies key contact individuals. The table also identifies individuals from consulting firms who have been contracted to participate in the project. The individuals listed in the directory are those expected to attend project meetings or to have significant involvement in the project activities. They will be responsible for providing information to other stakeholders and for communicating project-related information to their agencies.

The stakeholder directory will be periodically reviewed and updated. It is possible that the directory may increase in size as the project advances and additional agencies or entities are invited to participate in the project.

Table 7-1 – Project Stakeholder Directory

Organization	Name	Title	Phone	E-Mail
Caltrans District 7	Rafael Molina	Caltrans Project Manager	213-897-9776	rafael.molina@dot.ca.gov
	Samson Teshome	Corridor Manager	213-276-8454	samson.teshome@dot.ca.gov
	Ali Zaghari	Deputy District Director, Traffic Operations, District 7	213-897-0362	ali.zaghari@dot.ca.gov
Caltrans Headquarters	Nick Compin	Connected Corridors Statewide Project Manager	916-651-1247	nicholas.compin@dot.ca.gov
University of California PATH	Joe Butler	PATH Program Manager	510-213-5560	joebutler@path.berkeley.edu
	Francois Dion	Sr. Research Engineer	408-892-0433	fdion@path.berkeley.edu
	Lisa Hammon	Outreach & Communications Manager	510-642-5923	lisahammon@berkeley.edu
Metro	Steve Gota	Director, Highway Program	213-922-3043	gotas@metro.net
	Ed Alegre	SeniorManager, Highway Program	213-922.7902	alegree@metro.net
LA County Department of Public Works	Jane White	Sr. Civil Engineer, Section Head, Traffic & Lighting Division's Traffic Section	626-300-2020	jwhite@dpw.lacounty.gov
	Marty Amundson	Sr. Civil Engineer, Section Head for Traffic & Lighting Division's Traffic Systems Section	626-300-4774	mamund@dpw.lacounty.gov
City of Pasadena	Fred Dock	Transportation Director	626-744-6450	fdock@cityofpasadena.net
	Norman Baculinao	Traffic Engineering Manager	626-244-4263	nbaculinao@cityofpasadena.net
	Joaquin Siques	Associate Traffic Engineer	626-744-6900	jsiques@cityofpasadena.net
	Bahman Janka	Transportation Administrator	626-744-4610	bjanka@cityofpasadena.net
City of Arcadia	Phil Wray	City Engineer	626-574-5488	pwray@ci.arcadia.ca.us
	Kevin Merrill	Associate Civil Engineer	626-574-5481	kmerrill@ci.arcadia.ca.us
City of Monrovia	Tina Cherry	Public Services Director	626-256-8226	tcherry@ci.monrovia.ca.us
City of Duarte	Rafael Casillas	Public Works Manager	626-357-7931	rcasillas@accessduarte.com
System Metrics Group	Tom Choe	Principal	213-382-6875	tom_choe@sysmetgroup.com
Iteris	Allan Clellan	Senior Vice President, Transportation Systems	949-270-9577	axc@iteris.com

7.3. ROLES AND RESPONSIBILITIES

Figure 7-1 illustrates the communication structure between the various working and management groups defined within the I-210 Pilot. At the bottom of the structure are the various working groups, which all report to the Project Development Team. In turn, the Project Development Team reports to the Project Management Team, which includes both the Caltrans Project Manager and PATH Project Manager. The Project Management Team is further responsible for communicating with the Technical Advisory Committee, Business Drivers Group, Management Oversight Committee, and Project Sponsor.

The specific roles and responsibilities associated with the various entities shown in Figure 7-1 are identified in Table 7-2.

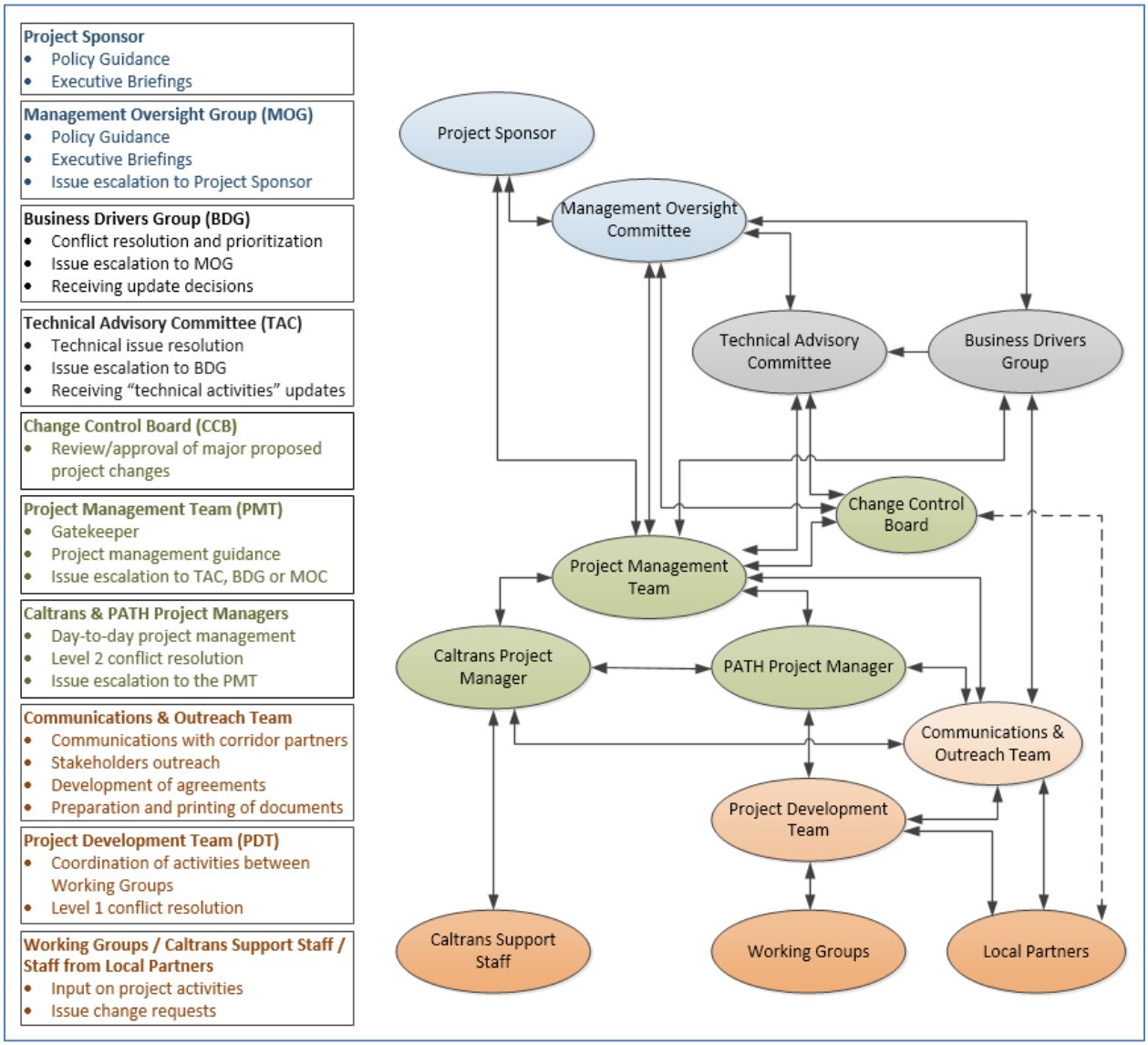

Figure 7-1 – Group Communication Structure

Table 7-2 – Communication Roles and Responsibilities

Project Entity	Responsibilities
Project sponsors	• Interact with the Caltrans Project Manager and PATH Project Manager to track the progress of the project to address contractual, staffing, and/or budgetary issues; help mitigate project risks; and ensure that contracted deliverables are produced • Provide guidance to the Management Oversight Committee when the latter is asked to weigh-in on project issues that could not be resolved by the Caltrans Project Manager or PATH Project Manager • Point of contact with other state agencies and the state legislature • Recipient of monthly project status reports produced by PATH • Recipient of formal project reports to be produced by PATH
Management Oversight Committee	• Interact with the Caltrans Project Manager to resolve or provide guidance on project management issues that cannot be addressed at lower management levels • Seek guidance, upon request, from the Technical Advisory Committee and Business Development Group
Business Drivers Group	• Provide guidance on business-related, legal, or approval issues submitted by the Project Management Team or Technical Advisory Committee • May interact with the Management Oversight Committee to help resolve specific issues that have been submitted to the Committee • Interact with the Communications & Outreach Team to reach project members
Technical Advisory Committee	• Provide guidance on technical project issues submitted by the Project Management Team or Business Development Group • May interact with the Management Oversight Committee to help resolve specific issues that have been submitted to the Committee • Interact with the Communications & Outreach Team to reach project members
Change Control Board	• Review and approval of major proposed project changes • Composed of members of the Project Management Team • May interact with the Technical Advisory Committee, Management Oversight Committee and local partners to make decisions on proposed changes.
Project Management Team	• Weekly project management discussion • Interact with the Caltrans Project Manager, PATH Project Manager, Communications & Outreach Team, Technical Advisory Committee, Business Development Group, and Management Oversight Committee to address project issues brought to the attention of the team • Provide project direction to corridor partners and project team members • Review and approve project change requests
Caltrans Project Manager	• Communicate on a regular basis with the PATH Project Manager to discuss project management issues and coordinate project activities • Interact with the Project Sponsor to address funding, staffing, and/ or resource issues • Interact with Caltrans District 7 staff to coordinate, manage, and review tasks assigned to the agency • Interact with the PATH System Engineer and other PATH staff to address technical issues • Participate in all project management meetings • Participate in all corridor outreach efforts • Receive project change requests and communicate results to the issuer • Receive and review project deliverables • Primary liaison between PATH and the senior Caltrans executives • Primary liaison for PATH and corridor partners with the Management Oversight Committee, the Technical Advisory Committee, and other Caltrans divisions or offices

Table 7-2 – Communication Roles and Responsibilities (cont'd)

Project Entity	Responsibilities
PATH Project Manager	• Communicate on a regular basis with the Caltrans Project Manager to discuss project management issues and coordinate project activities • Interact with the Project Sponsor to address funding, staffing, and/ or resource issues • Interact with PATH staff to coordinate, manage and review tasks to be performed by PATH • Participate in all project management meetings • Participate in all corridor outreach efforts • Review and approve all documents to be distributed to the project sponsor, Caltrans, and corridor partners • Submit monthly project status and other formal reports to the project sponsor • Receive project change requests and communicate results to the issuer • Escalate decisions to the Management Oversight Committee, the Technical Advisory Committee, and other Caltrans divisions or offices
Communication & Outreach Team	• Develop and implement the Communications and Outreach Plan • Primary liaison between project partners • Outreach to project stakeholders within the I-210 corridor • Develop materials and presentations supporting outreach activities • Review project documents and agreements
Project Development Team	• Forum where issues overarching several work groups can be discussed and resolved • Liaison between the Working Groups and Project Management Team
Working Groups	• Key participants in project development meetings • Produce technical project documents • Review general concept documents
Caltrans Support Staff	• Key participants in project development meetings • Review general concept documents
Partner Agencies	• Key participants in project development meetings • Review project documents

7.4. COMMUNICATION VEHICLES

Table 7-3 identifies the various types of communications that will be used to foster the exchange of ideas and information dissemination among project stakeholders as well as with entities external to the project that will support project activities. For each type of communication, the table identifies its general purpose, the intended audience, the primary communication method(s) to be used, the anticipated frequency of the activity, and the individual expected to be in charge.

Table 7-3 – Communication Matrix

Communication Type	Purpose	Medium(s)	Frequency	Audience	Primary Coordinator
Project kickoff	Introduce the project team and project; review project objectives and management approach.	• Face-to-face meeting	Once, at start of project	• Caltrans District 7 • Caltrans Headquarters • Metro • PATH	Caltrans Project Manager
Project management meetings	Review status of the project with the project management team.	• Face-to-face meetings • Conference calls	Weekly	• Caltrans District 7 • Caltrans Headquarters • Metro • PATH	PATH Project Manager

Table 7-3 – Communication Matrix (cont'd)

Communication Type	Purpose	Medium(s)	Frequency	Audience	Primary Coordinator
Project progress meetings	Review and discuss project progress with the whole project team; provide recommendations, guidance, and consensus building	• Face-to-face	Monthly	• Caltrans District 7 • Caltrans Headquarters • Metro • LA County • Participating cities • PATH	Caltrans Project Manager
Monthly project report to sponsor	Monthly update on project activities and accomplishments; delivery of well-documented and annotated invoice	• Printed document • Face-to-face meeting	Monthly	• Caltrans Headquarters • PATH	PATH Project Manager
Project deliverable reports	Reports documenting specific project deliverables	• Printed documents • Information posted on project website	As needed	• Caltrans Headquarters • PATH	PATH Project Manager
Technical design discussions	Discuss and develop technical design solutions for the project.	• Face-to-face meetings • Conference calls	As needed	• Technical staff from project participants	PATH Project Manager
Issue resolution	Determination of best course of action to resolve project management or technical issues.	• Face-to-face	As needed	• Management Oversight Committee	Caltrans Project Manager
Connected Corridors website	Provision of information to the professional and research communities on the Connected Corridors program, the I-210 Pilot project, and other ICM projects in the United States and abroad.	• Website	Monthly updates	• PATH	PATH Outreach & Communications Coordinator
Connected Corridors Digest	Compilation of links to articles, research papers, conference information, and newsletters related to ICM, the I-210 corridor, and other closely related topics.	• Connected Corridors website	Bi-weekly updates	• PATH	PATH Outreach & Communications Coordinator
Fact Sheets	One-page fliers describing the Connected Corridors program and activities associated with the I-210 Pilot	• Printed documents	As needed	• PATH	PATH Outreach & Communications Coordinator
Newsletters	Provide Connected Corridors information to the project partners and the general public	• Printed newsletter	Quarterly or bi-monthly	• CC stakeholders • General public	PATH Outreach & Communications Coordinator
Public Announcements	Official launch of I-210 Pilot project; official launch of I-210 Pilot	• Public event • Printed documents • Social media	As needed	• Caltrans District 7 • Caltrans Headquarters • PATH • Metro • LA County • Participating cities	PATH Outreach & Communications Coordinator
Conference and Journal Articles	Dissemination of key findings from I-210 Pilot project	• Conference presentation • Conference/ journal article	As needed	• PATH	PATH Outreach & Communications Coordinator

7.5. CONNECTED CORRIDORS WEBSITE

To support the dissemination of information related to the I-210 Pilot and the more general Connected Corridors program, PATH has developed a website to be used as a repository of useful information on the I-210 Pilot project and other notable integrated corridor management projects within the United States and abroad. This website was launched in June 2013 and can be accessed at the following address: http://connected-corridors.berkeley.edu/. A screenshot of the website's home page is shown in Figure 7-2.

Figure 7-2 – Connected Corridors Website

Information to be posted on the website will include the following:

- General information about integrated corridor management principles
- General information about Caltrans' Connected Corridors program
- Monthly Connected Corridors Digests
- News items relevant to the I-210 Pilot Project and Connected Corridors Program
- Information about the USDOT ICM Initiative, ICM projects within the United States, and ICM projects abroad
- Links to documents summarizing past and present ICM-related research activities by faculty and staff from PATH faculty members, researchers, and students
- Identification of key individuals behind the Connected Corridors Program
- Contact information

7.6. GUIDELINES FOR MEETINGS

This section presents general guidelines that will be followed when organizing and conducting formal project meetings. Topics addressed in this section include:

- Responsibility of Meeting Coordinator
- Responsibility of Note Taker
- Production and distribution of meeting agendas
- Meeting structure
- Handling of off-agenda discussion topics
- Processing of action items
- Distribution of meeting minutes

7.6.1. RESPONSIBILITY OF MEETING COORDINATOR

Each meeting shall be assigned a Meeting Coordinator. This individual will be responsible for developing and distributing the meeting agenda, facilitating the meeting, and distributing the meeting minutes. In addition to ensuring that the meetings start and end on time, this person will also be responsible for ensuring that all scheduled presenters adhere to their allocated discussion time when presiding over time-constrained meetings.

For teleconference meetings, the Meeting Coordinator will also be responsible for ensuring that a valid teleconference phone number or web link is provided to the participants. The Meeting Coordinator will also ensure that the teleconferencing equipment or web application is operating properly before the start of a meeting, and for operating the teleconferencing equipment during the meeting.

7.6.2. RESPONSIBILITY OF NOTE TAKER

During each meeting, a Note Taker will document the status of all meeting items, recording action items, maintaining a "meeting parking lot" item list (see Section 7.6.5), and taking notes of important issues and discussion items. At the end of the meeting, the notes will be forwarded to the Meeting Coordinator, who will then use them to develop the meeting minutes and subsequently distribute the minutes to the meeting participants. Typically, note takers will be individuals from either Caltrans or PATH.

7.6.3. PRODUCTION AND DISTRIBUTION OF AGENDAS

Meeting agendas will be distributed to the participants via email two business days ahead of a meeting. The agendas will identify the topics to be discussed, the order of the discussion, and the presenter of each topic. Where appropriate, the agendas will also indicate which discussion items will require decisions to be made by the meeting participants.

7.6.4. MEETING STRUCTURE

Most meetings will follow this template:

1. Introductions
2. Review meeting goals and agenda items
3. Review action items from previous meeting
4. Main meeting topics
5. Review action items and key decisions made
6. If time permits, consider discussion topics not listed on the agenda
7. Follow up items, including action items
8. Time and location of next meeting, if any

7.6.5. HANDLING OF OFF-AGENDA ISSUES BROUGHT FORWARD DURING A MEETING

Parking lot issues refer to topics or questions that come up during a meeting and that are not on the distributed agenda. All discussion topics moved to the parking lot will be recorded in the minutes. These records will briefly describe the topic brought forward and who brought it up, as this person will be responsible for ensuring follow-up.

7.6.6. ACTION ITEMS

All action items identified during a meeting will be recorded in the meeting minutes. This record will include both a brief description of the action item and the individual or agency responsible for follow-up. Follow-up action items will be reviewed at the end of the meeting. At the next meeting, the discussion will start with a review of action items from the previous meeting.

7.6.7. DISTRIBUTION OF MEETING MINUTES

Meeting minutes will be distributed within two business days following the event. The minutes will describe discussion topics, decisions that were made, and any action items that have been tasked to specific individuals. Upon distribution of the meeting minutes, meeting participants will be offered a window to comment on the accuracy of the meeting minutes and to provide corrections. After adjusting the minutes based on the comments received, the meeting coordinator will redistribute a final version to all meeting attendees.

This page left blank intentionally

8. COST MANAGEMENT PLAN

This section describes the framework that will be used to ensure the efficient management of project costs and budget. This section includes:

- Cost management approach
- Cost management roles and responsibilities
- Measurement of project costs
- Cost reporting format
- Cost variance response format
- Change control process

8.1. COST MANAGEMENT APPROACH

Costs for the project will be managed at the second level of the Work Breakdown Structure (WBS). Cost variances of 10% or more of a specific cost item relative to the established baseline will result in a cautionary flag being assigned to the item. Cost variances of 20% or more will result in an alert status being assigned to the item.

The development of a corrective action plan to bring the project budget below the warning or alert level will be required for any cost deviation of 20% or more and will require review and approval by the Project Management Team. Corrective action plans for cost deviations of less than 20% may be approved by the PATH or Caltrans Project Manager. All proposed corrective actions significantly altering project activities will require the issuance of a Change Request that must be approved by the Change Control Board before it can become part of the scope of the project. Approval from the Oversight Management Committee will also be required for proposed changes deemed to have a potentially significant impact on project activities, resource allocation, or scope.

8.2. ROLES AND RESPONSIBILITIES

Table 8-1 summarizes the roles and responsibilities related to cost management. At both Caltrans and PATH, project accounting will be performed by individuals responsible for project account management. At both Caltrans and PATH, these functions will be performed by individuals normally responsible from handling budgets. In this context, the primary responsibility of the Caltrans and PATH Project Managers will be to review the accounting summary and to identify any unexpected cost deviations. They will also be responsible for informing the Project Management Team, Project Oversight Committee, and Project Sponsors of any significant budget deviation. With the help of the Project Management Team, the Project Managers will further be responsible for developing strategies to bring the project back within budget while maintaining the project scope. Depending on the magnitude, the proposed corrective actions may need approval of the Project Management Team or may require approval of the Oversight Management Committee and Project Sponsors. In addition to general fund tracking, the PATH Project Manager will also be responsible for submitting monthly expense reports to Caltrans Headquarters.

Table 8-1 – Cost Management Roles and Responsibilities

Project Entity	Responsibilities
PATH Project Manager	• Track expenses from PATH and PATH's subcontractors • Submit monthly expense report to Caltrans Headquarters • Identify cost deviations and their cause(s) • Develop strategies to address cost deviations
Caltrans Project Manager	• Track project expenses from Caltrans District 7 • Identify cost deviations and their cause(s) • Develop strategies to address minor cost deviations
Project Management Team	• Assist the PATH Project Manager and Caltrans Project Manager in developing strategies to address major cost deviations • Review modifications proposed by the PATH Project Manager or Caltrans Project Manager • Escalation, if necessary, of cost management issues to the Change Control Board or Oversight Management Committee
Change Control Board	• Review Project Change Requests triggered by cost issues • Escalation, if necessary, of change requests deemed by the Board to have potentially significant impacts on project costs to the Oversight Management Committee
Oversight Management Committee	• Review changes requests forwarded by the Change Control Board • Evaluate project budgetary needs
Project Partners	• Review and approve proposed changes impacting partners
Caltrans Headquarters	• Track overall project expenditures

8.3. COST MEASUREMENT

Project performance with respect to costs will be measured using the following four metrics:

- **Schedule Variance** – Difference between the value of work performed to date (Earned Value) for a Work Breakdown Structure element and the authorized budget assigned to the work to be accomplished (Planned Value) for the activity or element.
- **Cost Variance** – Difference between the value of work performed to date (Earned Value) for an activity of Work Breakdown Structure element and the actual project costs of the corresponding work.
- **Schedule Performance Index -** Ratio of Earned Value to the Planned Value.
- **Cost Performance Index -** Ratio of Earned Value to Actual Costs.

Table 8-2 – Cost Management Performance Measurement

Performance Measure	Warning Level	Alert Level
Schedule Performance Index	Value between 1.2 and 1.3	Value equal to or greater than 1.3
Cost Performance Index	Value between 1.2 and 1.3	Value equal to or greater than 1.3

Table 8-2 indicates the general threshold levels that will be considered for the Schedule Performance Index and Cost Performance Index. If an index is found to have a value greater than 1.20, indicating a cost

overrun of 20% or more, the manager of the budget item will then be required to report the reason for the deviance to the PATH Project Manager or Caltrans Project Manager. The PATH Project Manager or Caltrans Project Manager will then assess whether the deviance may be accepted or if a corrective action should be undertaken. If they cannot address the issue by themselves, they may bring it to the attention of the Project Management Team, who will then be responsible for overseeing the development of an acceptance corrective plan. If there is a cost overrun of 30% or more, the Project Management Team will further be required to provide a report to the Management Oversight Committee explaining the deviance, and providing a detailed corrective plan to bring the project performance back to acceptable levels.

8.4. REPORTING FORMAT

Cost management reporting will be included in the Monthly Project Status Report that PATH will deliver to Caltrans Headquarters every month. Each report will include the following information:

- Total amount invoiced to Caltrans for activities conducted during the previous month
- Summary of project expenditures since the contract start date
- Summary of expenditures incurred during the previous month
- Detail of project expenditures

Project expenditures will be compiled by staff from the University of California and will be reported using the following general expense categories:

- Salaries
- Other employee compensation
- Employee benefits
- Supplies and expenses
- Travel expenses
- Indirect costs

In addition to the expense summary outlined above, the Monthly Project Status Report will indicate whether the incurred project costs are in line with expectations. If significant deviations from the initial budget are observed, the reason(s) for such deviation will be provided, as well as a description of any planned corrective actions to address the issue. Change Requests that have been submitted to the Change Control Board for consideration due to cost deviations will be also be identified and tracked.

8.5. COST VARIANCE RESPONSE PROCESS

The development of a Cost Variance Corrective Action Plan will be required each time the control thresholds identified in Table 8-2 are reached or exceeded. This plan is to detail the actions necessary to bring the project back within budget and the means by which the effectiveness of the actions in the plan will be measured.

The development of a Cost Variance Corrective Action Plan is to be initiated as soon as a significant cost deviance is reported. After a cost deviance is reported, individuals designated by the PATH Project Manager or Caltrans Project Manager will have five business days to present options for corrective actions to the Project Management Team. For large cost deviations, an additional five business days may be allotted. After a suitable option is selected by the Project Management Team, the designated individuals

will have an additional five to ten days to develop a formal Cost Variance Corrective Action Plan and present it to the Project Management Team. During this process, guidance may be sought from the Technical Advisory Committee, Business Drivers Group, and Management Oversight Committee. Upon its acceptance by the Project Management Team, the Cost Variance Corrective Action Plan will become part of the project plan. Acceptance of the plan will then result in an update of scheduled project activities and project documents to reflect the adopted corrective actions.

8.6. PROJECT BUDGET

The overall budget for the project will be tracked and maintained by Caltrans Headquarters.

9. HUMAN RESOURCES MANAGEMENT PLAN

This section details how human resources will be identified, acquired, and managed to ensure that the project has sufficient staff with the correct skill sets and experience to ensure successful project completion. Specific elements include:

- Staff resources
- Staff management approach
- Resource management structure
- Resource need estimation approach

9.1. STAFF RESOURCES

At its core, the project will include staff from the following entities:

- University of California, Berkeley PATH
- Division of Operations at Caltrans District 7
- Consultants hired by PATH or Caltrans District 7 to support project activities

In addition to staff from PATH and Caltrans District 7, the following agencies are expected to provide project support by assigning existing staff members to assist Caltrans District 7 and PATH with project tasks:

- Caltrans Headquarters
- Metro
- Los Angeles County Department of Public Works
- City of Pasadena
- City of Arcadia
- City of Duarte
- City of Monrovia

9.2. STAFF MANAGEMENT APPROACH

The staff management process for the project consists of the following five elements:

- **Staff planning** – Staffing needs estimate for each phase of the project.
- **Staff acquisition** – Staff assigned to the project or hiring of new individuals to support project activities
- **Staff training** – Project training to ensure that staff have an adequate understanding of the project goals and objectives and their assigned duties
- **Staff tracking** – Staff performance monitoring
- **Staff transition** – Processes to address the staff transition between groups when needed, as well as the appropriate replacement of departing staff

Each of the above elements is described in more detail in the following subsections.

9.2.1. STAFF PLANNING

Estimated staff requirements will be analyzed for each phase of the project at a high level using the Work Breakdown Structure defined in Section 5.4. For each task, initial staffing needs will be determined based on an analysis of required activities and the expected task duration. To ensure that no individual is over-assigned, detailed staffing analyses may be conducted. To ensure that current and scheduled staffing assignments remain adequate, a project needs analysis will further be conducted every quarter. Based on the results of this analysis, appropriate staff adjustments will then be made to ensure that committed deliverables will be met.

9.2.2. STAFF ACQUISITION

Staffing needs that cannot be addressed using existing resources may create a need for PATH or Caltrans to hire new staff members or contract with consultants to support specific project activities.

Should new individuals be hired, hiring processes already in place at the University of California and Caltrans will be followed. This will require developing position descriptions and minimum qualifications, posting job descriptions for a certain amount of time, and evaluating the suitability of the respondents.

Consultants will be utilized when agency staff does not possess the necessary qualifications for specific focus areas, when agency staff is not available due to existing assignments, or when the services are of an urgent or temporary nature. When needed, consulting services will be procured by Caltrans or PATH using the corresponding agency's approved hiring process. In this process, it is anticipated that the Caltrans Project Manager or PATH Project Manager will coordinate with the agency staff responsible for the procurement to determine the appropriate contract vehicle, set up the proposal evaluation criteria, potentially participate in vendor interviews, and help make a final vendor selection. For each procurement, the type of contract vehicle chosen will depend on the specific needs of the procurement.

9.2.3. STAFF TRAINING

When new staff joins the project, the Project Manager or group leader will provide an orientation to the project. This orientation will include the following topics:

- Project background
- Project status
- Specific job duties and expectations
- Introduction to the project team
- Facility and available resource overview
- Project process overview
- Confidentiality, conflict of interest, and/or sexual harassment policy review

In addition to the project orientation, the manager of each new staff member will review the skill sets of the hired individual against the assigned responsibilities to determine whether additional training is needed to enable the individual to fulfill his duties adequately. Should training be required, a plan will be drafted to allow the individual to acquire the desired additional knowledge and skill sets.

In addition to the initial review, at the start of each phase, managers will review the skill sets of their staff to assess whether training may be required to ensure adequate completion of the new work being assigned.

9.2.4. STAFF TRACKING

Within PATH, day-to-day management of the project staff will be the responsibility of the PATH Project Manager and designated functional managers. The PATH Project Manager will also be responsible for conducting performance evaluations and addressing performance issues related to the project. Promotions and disciplinary actions, if required, will follow U.C. Berkeley's procedures.

Within Caltrans, day-to-day management of the Caltrans staff assigned to the project is the responsibility of the Caltrans Project Manager. Performance evaluations, performance issues and recognition, promotions, and disciplinary actions will follow Caltrans' approved processes.

9.2.5. STAFF TRANSITION

In the event that a staff member leaves the project team, the manager will transfer/assign the tasks to a remaining staff member or a new hire in a timely manner. If appropriate, the staff member receiving the additional work will be provided with additional training to support his new responsibilities.

These processes will be facilitated by the PATH Project Manager or the Caltrans Project Manager.

This page left blank intentionally

10. QUALITY MANAGEMENT PLAN

The purpose of the Quality Management Plan is to provide a roadmap for ensuring that the project satisfies the customers' needs. This plan is based on the premise that quality is achieved when the project meets and exceeds stakeholder expectations. The plan addresses both the definition of quality objectives and the verification of quality compliance. Defining quality objectives involves outlining the needs of the customers of the proposed system and identifying standards that should be applied to its development, while quality compliance verification involves confirming the proposed solution complies with the established quality objectives throughout the life cycle of the project.

Elements of the plan described in more detail below include:

- Quality management approach
- Roles and responsibilities of individuals and entities with regard to quality management
- Quality objectives definition
- Quality metrics identification
- Quality compliance verification
- Quality improvement process
- Quality management tools and activities

10.1. QUALITY MANAGEMENT APPROACH

The approach for ensuring that appropriate quality management activities are conducted within the project is derived from the Project Management Institute's (PMI) Standard as described in the Project Management Book of Knowledge (PMBOK) [1]. This approach focuses on defining and implementing the desired quality objectives of a project through quality planning, quality assurance, and quality control processes. More information about these processes is provided in the subsections below.

10.1.1. QUALITY PLANNING

Quality planning defines quality objectives, identifies activities for verifying quality compliance, and assigns resources to carry out the desired quality management activities. During quality planning, the Quality Assurance / Quality Control (QA/QC) Lead (individual yet to be determined), with assistance from members of the QA/QC Working Group and other relevant project members, will identify relevant quality standards for the project and determine how to satisfy them through the development of a Requirements Traceability Matrix (defined in Section 10.3). Quality planning standards that will be considered include, but are not restricted to, the following:

- Documentation standards
- Design and coding standards
- Testing standards and practices
- Best practices for quality control and quality assurance reviews

In addition to identifying quality standards to follow, quality planning will involve determining how to satisfy each identified standard through the scheduling of project activities, the allocation of project resources, and the utilization of internal procedures. How these quality standards will be implemented, inspected, controlled, and reported will also be addressed.

10.1.2. QUALITY ASSURANCE

Quality assurance involves a periodical review and evaluation of the overall project performance to provide confidence that the project will satisfy the relevant quality standards. This includes evaluating, identifying, and recommending adjustments to project activities and assigned resources that must be performed to provide confidence that the project will meet the defined quality objectives.

For the I-210 Pilot, quality assurance will primarily be executed through a bi-monthly executive review of project activities by the QA/QC Lead. Through these reviews, the QA/QC Lead will be responsible for periodically verifying that the Quality Management Plan and defined project plans, standards, processes, and tasks fit the project's needs, add value to the overall project, and reduce risks. This group will also be responsible for ascertaining that the plan will be usable for performing quality reviews and inspections, and uncovering quality problems throughout the life cycle of the project.

10.1.3. QUALITY CONTROL

Quality control involves monitoring specific project results and deliverables to determine if they comply with identified quality standards. Quality control assesses project deliverables as they are being defined, designed, built, and used, as well as identifies ways to mitigate risks or eliminate causes of unsatisfactory results, to ensure that the project products and deliverables meet defined quality standards and variance tolerances.

Throughout the life of the project, the QA/QC Lead will periodically review project activities and inspect specified deliverables to verify compliance against the defined Requirements Traceability Matrix (see Table 10-2). Results of this review will then be provided to the PATH Project Manager and Caltrans Project Manager to inform them as to whether the project is adhering to its established quality objectives. In addition to identifying deviations, the QA/QC Lead will also track how deviations are resolved and verify that appropriate corrections have been made. This information will also be brought to the attention of the PATH Project Manager and Caltrans Project Manager.

10.2. ROLES AND RESPONSBILITIES

This section summarizes the roles and responsibilities of project team members regarding quality management. In the context of the I-210 Pilot, implementation of the Quality Management Plan will rest primarily with the QA/QC Lead and the members of the QA/QC Working Group. Significant oversight duties will also be assigned to the Caltrans Project Manager and PATH Project Manager.

Issues that cannot be resolved by the above-mentioned individuals may be brought to the attention of the Project Management Team. Issues that cannot be resolved at the Project Management Team level could further be escalated by the PATH Project Manager or Caltrans Project Manager for review by the Technical Advisory Committee and/or Management Oversight Committee.

Table 10-1 – Roles and Responsibilities for QA/QC

Project Entity	Responsibilities
QA/QC Lead	• Responsible for the implementation and monitoring of the Quality Management Plan • Develop and direct Quality Control and Quality Assurance reviews • Monitors selected performance metrics relative to Quality Assurance and Quality Control • Tracks the resolution of identified quality issues • Develop and submit Quality Assurance Status and Improvement Reports to the PATH Project Manager and Caltrans Project Manager • When required, submit Change Requests to the Change Control Board according to the process outline in the Change Management Plan (Section 0) and track the results of the review to be conducted by the Change Control Board • Inform project team members of any corrective actions to be implemented because of the Quality Control and Quality Assurance reviews
PATH Project Manager	• Review results of quality audits performed by the QA/QC Lead • Review the Quality Assurance Status and Improvement Reports submitted by the QA/QC Lead • When necessary, escalate Quality Control and Quality Assurance issues to the Project Management Team, Technical Advisory Committee, or Oversight Management Committee
Caltrans Project Manager	• Review results of quality audits performed by the QA/QC Lead • Review the Quality Assurance Status and Improvement Reports submitted by the QA/QC Lead • When necessary, escalate Quality Control and Quality Assurance issues to the Project Management Team, Technical Advisory Committee, or Management Oversight Committee

10.3. DEFINITION OF QUALITY OBJECTIVES

The definition of quality objectives involves defining the needs of the customers of the proposed systems. To define suitable quality objectives, the issues and needs associated with each identified group of customers will be cataloged and used to create a Requirements Traceability Matrix similar to the one shown in Table 10-2. The matrix will couple each system requirement with one or more user needs and, where applicable, one or more test cases. Once completed, this matrix will be used to support quality compliance activities during all phases of the project's life cycle.

Table 10-2 – Requirements Traceability Matrix

System Requirement ID	System Requirement Description	Related Sub-system(s)	Related User Need(s)	Related Test Case(s)

10.4. MEASUREMENT OF QUALITY

Measuring quality ensures that the project's processes, products, and procedures adhere to the contract terms and conditions, relevant standards, and the Project Management Body of Knowledge (PMBOK®). To achieve this goal, the project team will identify, collect, analyze, and report on metrics throughout the project's life. The use of metrics will help reduce subjectivity in the assessment and control of project

quality by providing a quantitative basis for making decisions. However, this use of metrics does not eliminate the need for human judgment in the evaluation.

The selection of metrics and data items to consider during the quality assessments will focus on specific areas including:

- Schedule and progress
- Resource and cost
- Process performance
- Conformance to requirements

10.5. VERIFICATION OF QUALITY COMPLIANCE

Verification of quality compliance will involve confirming quality through rigorous compliance testing against the developed Requirements Traceability Matrix. This verification will be done throughout the project lifecycle under the responsibility of the QA/QC Lead. While all project elements will be subject to quality compliance verification, a particular emphasis will be put on verifying quality compliance for the following project tasks:

- Design specifications review
- Sub-component verification
- Component verification
- System (integrated system) verification
- Solution (hardware, software, documentation, and delivery) validation

The ongoing compliance effort will ensure that the defined quality objectives are built into the project. This is a cost-effective approach when compared to approaches only verifying satisfaction of system requirements and user needs during final system tests.

10.6. QUALITY IMPROVEMENT PROCESS

Following the identification of quality issues, the QA/QC Lead will develop and submit written recommendations for improvements. Following the submission of a recommendation, the QA/QC lead will then track approval of the recommendation, indicate to the relevant project teams what corrective actions are to be implemented, verify that the approved corrections have been made, and document the results of the activities.

Recommendations for improvements are to be submitted following the processes defined in the Change Management Plan in Section 4. The Change Request will define the requested change and analyze the impacts of the proposed change on project activities, resource allocation, schedule, and/or budget. Change requests pertaining to processes or products under Caltrans responsibility are to be submitted first to the Caltrans Project Manager, while requests pertaining to processes or products under PATH's responsibility are to be submitted to the PATH Project Manager. Both Project Managers will have the authority to approve changes that would not affect the scope of the project, the schedule, or allocated resources. Other requests will require at a minimum a review by the Project Management Team. It will be the responsibility of the Project Management Team to determine whether approval of a change

request should further require a review by the Technical Advisory Committee, the Management Oversight Committee, or project stakeholders.

Once a request will have been formally approved, the PATH System Engineer will update the project plans to reflect the change and assign, in collaboration with the QA/QC Lead, implementation responsibility to a specific individual or project group. The QA/QC Lead will then follow-up to verify that the change or correction was made and indicate status and closure on the finding.

10.7. QUALITY IMPROVEMENT TOOLS AND ACTIVITIES

The Quality Management Plan will be implemented using the following tools and activities:

- Quality checklists
- Quality control reviews
- Change requests
- Quality assurance activities
- Quality assurance reports

10.7.1. QUALITY CHECKLISTS

The checklist is the project tool to ensure that the quality standards are being met on the project. As part of the quality planning process, the QA/QC Lead will guide the monitoring and measurement of quality standards with Quality Checklists. These checklists will combine selected quality standards with the expected monitoring activities to be used by the quality control process. Each checklist will include, at a minimum, the following information:

- Schedule for review
- Who is responsible for performing the review tasks and reviewing the results
- Specific review procedure to be followed, (e.g., a procedure for schedule analysis, code walk-through, peer review, lessons learned, test methodology)
- Methodology to verify and record that a set of required inspections have been performed
- Whether the minimum quality standard has or has not been met
- Recorded measurements
- Expected risk trigger or measurement
- Expected acceptability or tolerance
- Rank of only the quality standards where risk was found unacceptable
- Change in risk rank since previous review
- A reference, which will describe what was reviewed, who it was reviewed with, and the information or reasoning indicating that this quality standard causes risk

10.7.2. QUALITY CONTROL REVIEWS

Quality control will be achieved by tasking the QA/QC Lead with conducting periodic quality control reviews of project activities and products being developed. These reviews will typically occur at the end of a main task or major project milestone, when key decisions are expected. However, depending on project activities, such reviews may also be scheduled to occur at periodic intervals, such as every quarter or every month.

While the exact schedule for reviews will be specified in the Project Schedule, the following is a preliminary list of quality reviews that the project team is expected to conduct:

- **System Requirements Specifications Review** – Verification of the adequacy of the requirements stated in the System Requirements Specification. This review may not be necessary if the system requirements do not change significantly.
- **Architecture Design Review** – Evaluation of the technical adequacy of the preliminary design (also known as top-level design) for the project's components, sub-components, software, and services depicted in the contractor's preliminary design description.
- **Detailed Design Review** – Determination of the acceptability of the detailed designs as depicted in the contractor's Detailed Design Document in satisfying the requirements specified in the system requirements.
- **Functional Audit** – Verification that all requirements specified in the System Requirements Specification have been met. Also, includes successful testing of the requirements.
- **Physical Audit** – Verification of the internal consistency of the software and its documentation, as well as its readiness for release.
- **In-process Audits** – Verification of the consistency of the system design. These audits will be conducted on an as-needed basis. They will cover the following elements: code versus design documentation, interface specifications (hardware and software), design implementations versus functional requirements, functional requirements versus test descriptions.
- **Configuration Management Plan Review** – Evaluates the adequacy and completeness of the configuration management methods defined in the Project Management Plan.

During scheduled project reviews, a work product or set of work products will be presented to managerial staff, technical staff, end users, or other key stakeholders for their comment or approval. The deliverable of these reviews will be a checklist indicating what items have been measured, ranked, and reported by the reviewer(s). The completed checklist will subsequently be reviewed with the Project Management Team and used as input to Quality Status and Improvement Reports.

10.7.3. QUALITY ASSURANCE REVIEWS

Under supervision of the QA/QC Lead, project staff will assess project activities at planned intervals to determine whether the applied processes conform to the plans, are being executed as defined, and are being effectively implemented and maintained.

In addition to the quality assurance reviews, the QA/QC Lead will participate in lessons-learned sessions facilitated by the Project Management Team. These sessions will be part of the Risk Registry reviews and will be held as needed during the scheduled Project Management Team meetings. They will be facilitated by the PATH Systems Engineer and will be an open discussion of practical experiences and lessons learned to date. They will further be conducted in a manner to encourage open discussions on items to consider for future projects.

10.7.4. QUALITY ASSURANCE STATUS AND IMPROVEMENT REPORTS

Monthly, the QA/QC lead will create and deliver a Quality Assurance Status and Improvement Report that contains the following elements:

- Executive summary of the entire report, containing the following information:
  - A brief description the primary achievements in the last period
  - A brief description of the highest ranked quality risks covered in the report details
  - A brief description of the impact or consequence of the risk if left unresolved
- Summary of the Current Progress Tasks and Deliverables followed by major milestones.
- Brief status on all the high-level activities. Activities where no risks were identified should simply be indicated in one line (for example, "Decision Drivers – no risks currently identified") or not evaluated at this time.
- Risks Resolved Since Last Period. Provide the previous risk rank, and brief status or the actions taken on risks and results.

The QA Status and Improvements Report will be submitted to the Project Management Team for review and determination of completeness and accuracy of facts before presentation or delivery to others within the project and approval by the Project Sponsors.

This page left blank intentionally

11. RISK MANAGEMENT PLAN

This section presents the Risk Management Plan for the I-210 Pilot. The purpose of this plan is to document the policies and procedures that will be used for identifying, analyzing, handling, monitoring, and ultimately retiring uncommon causes of project variation. A risk is an event or condition that could have a positive or negative effect on the project objectives if it occurs. Elements presented in this plan include:

- Risk management plan intended audience
- Risk management approach
- Risk management roles and responsibilities
- Processes for identifying risks
- Processes for analyzing risks
- Risk response planning
- Risk monitoring and control

11.1. INTENDED AUDIENCE

The primary audience for the Risk Management Plan includes the following project entities:

- Project Management Team
- Project Development Team
- Consulting/Contractor Teams
- Business Drivers Group
- Management Oversight Committee

11.2. RISK MANAGEMENT APPROACH

The overall risk management approach follows the standard risk management model shown in Figure 11-1. This approach includes the following four steps:

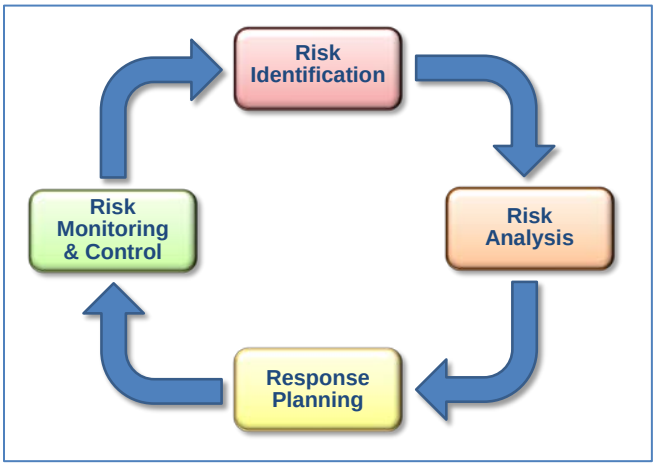

Figure 11-1 – Risk Management Approach

- **Risk Identification** – Identification of the risks that may potentially affect the project and documentation of the characteristics.
- **Risk Analysis** – Assessment of the potential outcomes on project activities of each identified risk based on qualitative and quantitative evaluations, and prioritization of risks based on anticipated outcomes.
- **Response Planning** – Development of options and actions to enhance opportunities to manage identified risks and to reduce threats to project objectives.
- **Risk Monitoring and Control** – Processes to implement developed risk response plans, track risks, monitor residual risks, identify new risks, and evaluate risk process effectiveness.

11.3. ROLES AND RESPONSIBILITIES

Table 11-1 summarizes the roles and responsibilities of project team members regarding risk management. For the I-210 Pilot, risk management primarily falls under the responsibility of the PATH Project Manager, with significant management support from the Caltrans Project Manager and Project Management Team. To help address significant or complex risks, guidance may also be sought from the Technical Advisory Committee, Business Drivers Group, and Management Oversight Committee.

Table 11-1 – Roles and Responsibilities for Risk Management

Project Entity	Responsibilities
PATH Project Manager	• Co-lead the risk management process with the Caltrans Project Manager, in collaboration with the Project Management Team • Lead the overall identification of project risks • Oversee the mitigation of PATH-related risks
Caltrans Project Manager	• Co-lead the risk management process with the PATH Project Manager, in collaboration with the Project Management Team • Support the PATH Project Manager in the identification of project risks • Oversee the mitigation of Caltrans-related risks
Project Management Team	• Participate in the risk identification process • Discuss risk monitoring and mitigation strategies at monthly meetings • Escalate risk management to the Technical Advisory Committee and Management Oversight Committee, if necessary
QA/QC Lead	• Ensure identified risks are being managed according to the Risk Management Plan • Assist in identifying new risks • Assist in proposing mitigation strategies and contingency plans • Assist in proposing improvements to the risk management plan and processes
Risk Manager	• Responsible for the execution of the mitigation plan for a specific risk • Identify appropriate mitigation plans for assigned risks
PATH System Engineer	• Participate in the risk identification process • Participate in the identification of risk mitigation strategies • Assist in monitoring risk action effectiveness • Maintain the Risk Registry
Project Development Team	• Participate in the risk identification process • Participate in risk escalation, as necessary • Assist in monitoring risk action effectiveness
Local Partners	• Help identify project risks • Provide inputs in the development of risk mitigation strategies

11.4. RISK REGISTRY

The Risk Registry is the repository of information regarding identified project risks and mitigation strategies. This registry, developed as a Microsoft Excel spreadsheet based on the Caltrans Risk Registry format (note a change to this format was made in 2015), is to be maintained by the PATH System Engineer. A partial screenshot is shown as an example in Figure 11-2. The full registry can be found in Appendix E.

Key information fields of the Risk Registry include the following:

- **Status** – Status of the risk: "monitoring" for risks being tracked, "active" for risks that have occurred, and "retired" for risks that have been closed
- **ID No** – Unique risk identification number
- **Risk Type** – Opportunity or Threat
- **Organization** – Major functional area where the risk originates
- **Title** – Short Title
- **Risk Statement** – Description of Risk
- **Current Status/Assumptions** – Not used
- **Priority Rating** – Anticipated impact on project activities if the risk triggered ("low", "medium", "high", or "very high"), as determined by the risk analysis
- **Rational for Rating -** Description of Risk
- **Strategy** – Avoid, Transfer, Mitigate, Accept, Exploit, Share, Enhance, Accept
- **Response Actions** - Activities that were undertaken to mitigate the risk and that are planned to be undertaken to address the risk if triggered in the future
- **Risk Owner** - Person responsible for monitoring the risk and mitigating it if triggered
- **Updated** – Date of last update

LEVEL 1 - RISK REGISTER				Project Name:	Connecte Corridors Pilot		D7/HQ		Project Manager	Nick, Allen, Joe		
Risk Identification							Risk Rating		Risk Response			
Status	ID #	Type	Organizational	Title	Risk Statement	Current status /assumptio	Priority Rating	Rationale for Rating	Strategy	Response Actions	Risk Owner	Updated
Active Dormant Retired		Opportunity Threat Threat	Organizational Organizational Organizational				Very High High Moderate Low Very Low		Mitigate Transfer Transfer			
		Threat	Organizational	Caltrans Personnel	As a result of Caltrans personnel not being available to fill critial roles in the CC pilot, the pilot will fail		High	Current experiences indicate that personnel are explicitly stating that they will not fulfill the personnel requirements.	Mitigate	Clearly identify the foles and the personnel who will fill them. Ensure those personnel agree to the roles. PATH to provide backup where roles are not filled.	PATH/Caltrans D7/Caltrans HQ (Lisa, ??, Nick)	
Active		Threat	Organizational	Education, Training and Culture	As a result of Caltrans personnel not having the proper technical and cultural education and training the CC pilot will fail		Medium	As the people who will fill certain roles are not identified there is a real risk that they will not have the proper education and training	Mitigate	Provide education and training to personnel. PATH to provide back up expertise.	PATH/Caltrans D7/Caltrans HQ (Lisa, ??, Nick)	
		Threat	Organizational	SHOPP Funding	As a result of the possible need for SHOPP funding for a number of software items there is a risk of those not being funded in time		Medium	SHOPP funding is difficult to get quickly	Mitigate	Determine where funding is coming from	Caltrans D7/Caltrans HQ (Ali, Nick)	

Figure 11-2 – Risk Registry Implementation in Microsoft Excel

11.5. RISK IDENTIFICATION

Risk identification is the first step in the risk management process. This step identifies potential project risks before they become problems. Under leadership from the QA/QC Lead, all project team members will be invited to identify areas of concern with respect to the project scope, budget, schedule, and planned activities. Information regarding potential risks will further be collected through a review of project plans and technical documents, brainstorming sessions with key project team members and/or stakeholders, and the execution of various high-level analyses. In this effort, careful attention will be given to potential issues associated with the following items:

- Project deliverables
- Project assumptions
- Identified project constraints
- Activities defined in the Work Breakdown Structure
- Scheduling of activities
- Cost/effort estimates
- Resource planning
- Quality assurance audits and reviews
- Submitted project change requests
- Lessons learned from other recent ICM projects

Because existing risks may evolve or new risks become known as the project progresses through its life cycle, the identification of project risks will be an iterative process. The frequency of iterations, and who participates in each cycle, will vary depending on the situation. To ensure consistency across iterations and facilitate risk comparisons, the format of the risk statements developed during each iteration will be consistent and follow the format described later in this plan.

Figure 11-3 illustrates a preliminary mapping of the various categories of risks that will be considered throughout the project. The figure identifies 14 high-level categories of project risks that are further decomposed into subcategories. The subcategories are color-coded based on their assessed probability of occurrence, and further tagged by a circle indicating the anticipated impact level of each risk category.

The development and maintenance of a Risk Registry (see Section 11.4) will be a key output of the Risk Identification step. This registry is to be maintained by the PATH System Engineer. It will be developed in Microsoft Excel and updated as needed throughout the project. All the identified risks will be entered in the registry and documented with the following information:

- Unique identification number
- Project stage(s) to which the risk applies
- Risk category
- Description of risk

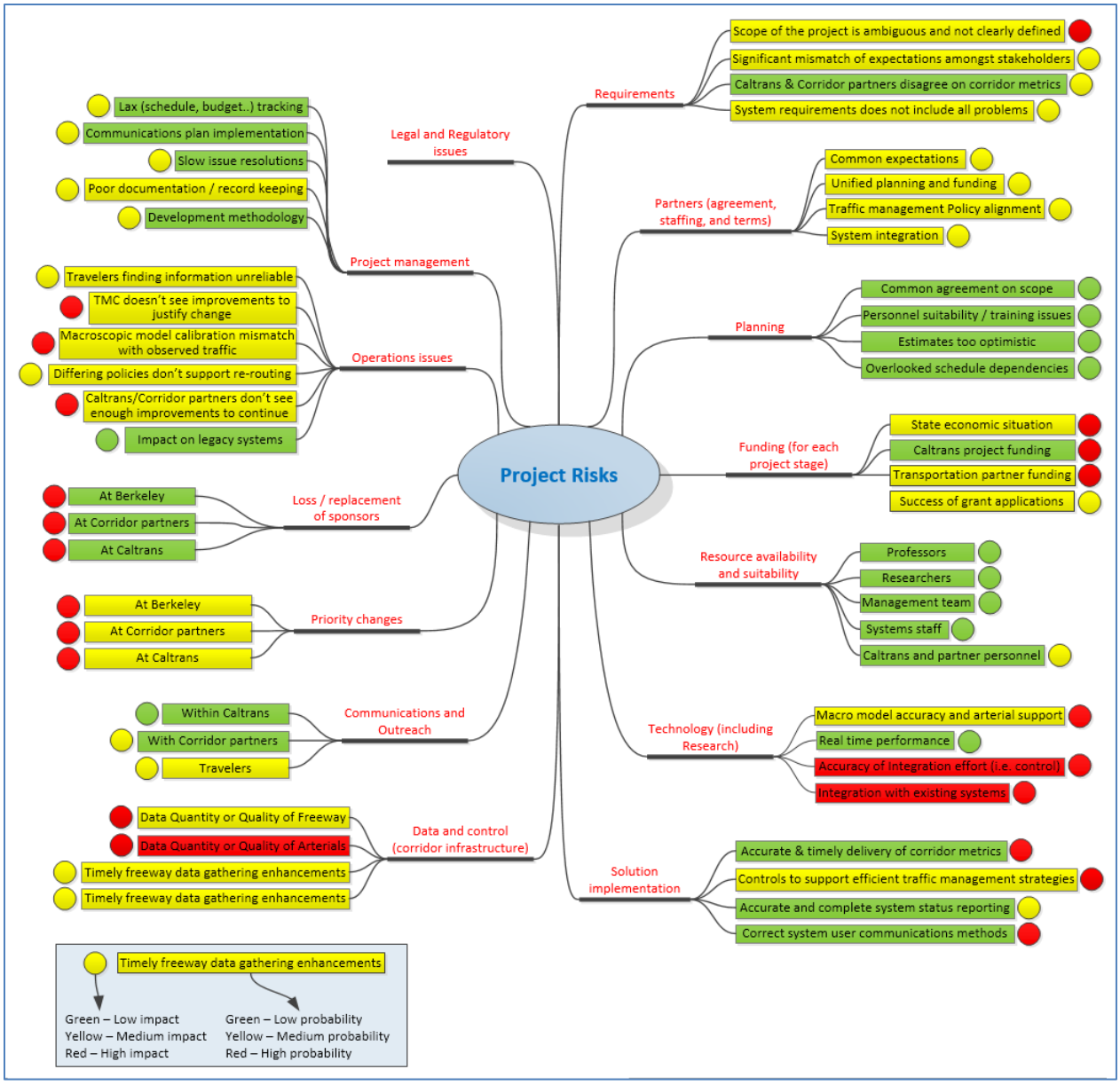

Figure 11-3 – Potential Risks Associated with the I-210 Pilot

11.6. RISK ANALYSIS

Each identified risk will be assessed to determine the probability of its occurrence and the probable effect on the project. The purpose of this analysis will be to assess which risks are most important to consider and which risks can be tabled. This will be done by defining the two following dimensions for each identified risk:

- **Probability of occurrence** – The likelihood that an identified risk will occur during the course of the project
- **Potential impact** – Assessment of the consequences the risk would have on the project if it were to occur

The criteria shown in Table 11-2 and Table 11-3 will be used to determine the probability of occurrence of a risk and its potential impacts on project activities. Since most of the risks attempt to address future events that may or may not occur, specific metrics cannot easily be used to determine when a risk may be triggered. For this reason, determination of the probability of occurrence is highly subjective and qualitative in nature. This subjectivity will call for a periodic review of the risk probabilities. Should the need arise, more refined criteria may also be developed in the course of the project to adjust the probabilities to the maturing knowledge of project needs and activities.

Table 11-2 – Criteria for Risk Probability

Probability Level	Criteria
Very Low	Less than 9% confidence that the risk will occur.
Low	Between 10% and 19% confidence that the risk will occur.
Medium	Between 20% and 39% confidence that the risk will occur.
High	Between 40% and 59% confidence that the risk will occur.
Very High	60% or higher confidence that the risk will occur.

Table 11-3 – Criteria for Risk Impact

Impact Level	Criteria
Very Low	Impact confined to a single project activity that does not require external intervention for resolution.
Low	Team-level impact than can be addressed by the leader of the team to which the risk applies without involving other teams.
Medium	Multi-team or inter-team impact that may require intervention or assistance from the PATH Project Manager or Caltrans Project Manager.
High	Project-level impact that may require the intervention or assistance of the project's executive management.
Very High	Risk involving rethinking the proposed solution or resulting in major delays and/or cost overruns.

The results of the analysis will primarily be used to prioritize project risks, i.e., to identify which risks should be monitored closely and for which a response plan should be drafted, and which risks could be tabled until they pose a greater threat.

11.7. RESPONSE PLANNING

During the course of the project, mitigation strategies and response plans will be developed to minimize the anticipated impacts of identified risks to a point where they can be controlled and managed. Response planning will not be considered for all identified risks but only for the risks assigned both a high or very high probability of occurrence and a high or very high impact level. Response planning for other risks will be addressed on an as-needed basis, if the probability of occurrence and/or impact level of the risk are raised.

For each major risk, one of the following approaches will typically be considered to address it:

- **Avoid** – Risk avoidance involves changing aspects of the overall Project Management Plan to eliminate the threat, isolating the project's objective from the risk's impact, or relaxing the objectives that are in threatened (e.g., extending the schedule or reducing the scope). Risks that

are identified early in the project can often be avoided by clarifying requirements, obtaining more information, improving communications, or obtaining expertise.

- **Mitigate** – Risk mitigation involves reducing the probability and/or the impact of risk threat to an acceptable level. Taking early and proactive action against a risk is often more effective than attempting to repair the damage a realized risk has caused. Developing contingency plans are examples of risk mitigation.
- **Transfer** – Risk transference involves shifting the negative impact of a threat to a third party. Risk transference does not eliminate a threat; it simply makes another party responsible for managing it. An example of risk transference includes situations in which development of a system component is outsourced to a third party who may be better qualified to execute the work than the project team.
- **Accept** – Acceptance is often taken as a risk strategy since it is very difficult to plan responses for every identified risk. Risk acceptance occurs when a project team has decided not to change the project management to deal with a risk, or is unable to identify any other suitable strategies. For these reasons, risk acceptance should normally only be considered for low-priority risks. Risk acceptance can be passive, where no action is taken at all, or active. The most common active approach to risk acceptance is to develop a cost and/or schedule reserve to accommodate known (or unknown) threats.

For each risk subject to response planning, the QA/QC Lead, in collaboration with project team members responsible for activities potentially impacted by the risk if triggered, will be tasked with identifying ways to prevent the risk from occurring or reduce its probability of occurring. Potential ways to reduce the impacts of the risk on project activities should the risk not be avoided altogether may also be identified. Results of this response planning will be documented in the Risk Registry by adding a summary description of the proposed mitigation strategy to the risk's description.

During the course of the project, should an identified risk be triggered, the PATH Project Manager or Caltrans Project Manager will then record the date the risk became active and assign the task of implementing a suitable mitigation of the risk to a specific individual. This Risk Manager may be the QA/QC Lead or any other project team member having the competence to address the issue at hand. The PATH System Engineer will in turn record the nomination of the Risk Manager for the triggered risk in the Risk Registry. The Risk Manager will then have the responsibility of refining, if necessary, the initially drafted mitigation strategy and developing a suitable course of action to eliminate the risk or reduce its impact on project activities.

Upon approval of a final mitigation strategy by the Caltrans Project Manager or PATH Project Manager, the Risk Manager will be responsible for implementing the proposed changes and monitoring whether risk is mitigated according to plan. The Risk Manager will also inform the PATH System Engineer of the details of the adopted mitigation strategy so that the Risk Registry can be updated accordingly.

11.8. RISK MONITORING AND CONTROL

During the course of the project, the PATH and Caltrans Project Managers, in collaboration with the Project Management Team, will diligently monitor all risks defined in the Risk Registry to determine whether these risks materialize. A natural focus of this monitoring will be on risks that have been assigned a high or very high probability of occurring or impact level. Monitoring activities will also seek to determine whether an existing

risk is changing or whether new risks have appeared due to project activities. Should a risk materialize, the PATH and Caltrans Project Managers will also be responsible for overseeing the execution of the mitigation or contingency plan for the triggered risk by the assigned risk manager.

Specific activities that may be conducted by the project team throughout the project to monitor and control risks include:

- Re-analyze existing risks to see if the probability, impact, or response plan has changed
- Identify, analyze, and plan for new risks
- Track risk mitigation
- Review and analyze the effectiveness of developed risk response strategies
- Ensure that the proper risk management policies and procedures are being utilized
- Update the Risk Registry to account for any changes in risk management

A risk will be closed when the risk event actually occurs or when the likelihood of the risk is reduced to such an extent that it is not worth expending additional resources to track it. At this time, all defined action plans will be halted and closed. If the risk could possibly arise again, the risk may be reduced to a watch status and evaluated periodically.

The manager of a risk may also recommend a risk for retirement. In such cases, final decision as to whether a risk should be retired will rest in the hands of the Project Management Team. In some cases, the project sponsor may also be involved in the decision to retire a risk.

Once a risk is approved for closure, the PATH System Engineer will enter the risk resolution data in the Risk Registry and will mark the risk as “retired.”

12. PROCUREMENT MANAGEMENT PLAN

The Procurement Management Plan describes the framework that will be followed for the procurement of hardware, software, materials, and services that will be acquired for the project. This plan will serve as a guide for managing procurement throughout the life of the project. It identifies:

- The general approach adopted for managing the procurement of products and services
- The roles and responsibilities of team members regarding procurement
- The definition of items expected to be subject to procurement
- The method for selecting the products and services to be produced
- The types of contracts to be used in support of the project
- The contract approval process to be followed
- The decision criteria to be used
- The process by which contracted consultants and vendors will be kept informed of project developments

The importance of coordinating procurement activities, establishing firm contract deliverables, and measuring procurement activities is included.

12.1. PROCUREMENT MANAGEMENT APPROACH

For the I-210 Pilot, individual project partners are expected to follow their established procurement processes. For instance, Caltrans will manage the procurement of products and services affecting existing freeway traffic monitoring and management systems, as well as Caltrans-operated intersections. Local partners will manage the procurement of products and services affecting monitoring and control systems under their jurisdiction. PATH will manage procurement activities related to the development of generic system components, such as the Decision Support System.

Within each agency, the individual normally responsible for procurements will be responsible for overseeing and managing the procurement being executed by the agency. The Procurement Manager will first work with project team members to identify the items that need to be procured for the successful completion of the project. Once this identification is complete, the Procurement Manager will identify suitable vendors and will initiate the procurement process with the appropriate department.

While each agency will be responsible for managing their specific procurement efforts, the Project Management Team will be tasked with overseeing the procurement effort.

12.2. ROLES AND RESPONSIBILITIES

Table 12-1 summarizes the roles and responsibilities of project team members regarding procurement management. As indicated in the previous section, each partner agency will be responsible for managing the procurement activities to be conducted by them. Within each agency, the person tasked with managing the procurement will be responsible for overseeing and managing the effort. Within Caltrans, the Procurement Manager will be the Caltrans Project Manager or an individual tasked with this duty by the Caltrans Project Manager. A similar setup will be used within PATH, with the PATH Project Manager or his designee acting as the Procurement Manager. Within partner agencies, the Procurement Manager

will be a staff member who normally handles procurements. To ensure adequate coordination of procurement efforts, one person will further be tasked with inventorying and tracking all procurement efforts. Depending on the procurement being managed, this task may be directly fulfilled by a member of the Project Management Team or be delegated to a specific individual within the project team.

Table 12-1 – Roles and Responsibilities for Procurement Management

Project Entity	Responsibilities
PATH Project Manager	• Management of procurement efforts related to PATH's activities.
Caltrans Project Manager	• Management of procurement efforts related to Caltrans systems and activities.
Local Partners	• Management of procurement efforts related to each agency's systems and activities.
Project Management Team	• Inventory and tracking of all active procurement efforts.

12.3. PROCUREMENT DEFINITION

Procurement needs will be defined based on the needs of each project task, as well as the resources and expertise available within the project team to execute the task. The following are examples of project elements that may be the subject of procurement activities:

- Purchase of computer equipment to support project activities.
- Purchase of system components, such as traffic signal controllers, traffic sensors, computer equipment.
- Purchase of licenses supporting the use of traffic simulation software.
- Purchase of licenses for software supporting the design and development of system components.
- Contracting with engineering firm(s) for the field installation of system components, such as installation of traffic signal controllers and traffic sensors in the field.
- Contracting services from engineering firm(s) to support the design, development, and evaluation of system components.
- Contracting services from public research or marketing firm(s) to support outreach activities.

12.4. TYPE OF CONTRACT TO BE USED

All items and services to be procured for this project will be solicited under firm fixed-price contracts. For each procurement effort, the relevant Procurement Manager will work with relevant project team members and the appropriate contracts and purchasing department(s) to define the required item types, quantities, services, and delivery dates. The contracts and purchasing department will then solicit bids from various vendors in order to procure the items within the required timeframe and at a reasonable cost under the firm fixed-price contract once the vendor is selected.

12.5. CONTRACT APPROVAL PROCESS

The first step in the contract approval process will be to determine what items or services will require procurement from outside vendors or consultants. This will be determined by comparing products or

services that can be provided internally with products and services that can be provided by vendors or consultants. Once this analysis is complete and the list of items and services to be procured externally is finalized, the purchasing and contracts department of the agency requesting the product or services will send out solicitations to outside vendors.

The approval process will begin once the solicitation window has closed. The first step of this process will consist of a review of all received vendor proposals to determine which meet the criteria established by the project team, as well as the purchasing and contracts department of the procuring agency. Purchases below a certain amount, to be determined by each agency, may only require the approval of the Procurement Manager, whereas purchases greater than the given amount may require the approval of a higher authority and possible review by the Project Management Team and other project partners.

All vendor and consultant procurements for the project must adhere to the same level of procurement pre-award scrutiny that Caltrans and PATH maintain.

12.6. DECISION CRITERIA

The selection and award of contracts under this project will be based on the following criteria:

- Ability of the vendor to provide all items by the required delivery date
- Ability to satisfy all procurement requirements
- Cost of proposed product of services
- Expected delivery date
- Comparison of outsourced cost versus in-sourcing costs, if applicable
- Past performance/experience of consultant or vendor

The degree to which the above criteria are met will be measured by the agency responsible for the procurement, with possible participation from the Project Management Team. The ultimate decision will be made based on these criteria as well as available resources.

12.7. MANAGEMENT OF CONTRACTED CONSULTANTS AND VENDORS

The Procurement Manager assigned by each agency is ultimately responsible for managing the consultants or vendors that have been contracted by the agency. To ensure the timely delivery and high quality of products and services to be provided, the Procurement Manager will meet periodically (at the discretion of the Procurement Manager) with each vendor or consultant to discuss the progress of each procured item. The purpose of these meetings will be to review documented specifications for each product, the status of the work being performed, and the findings of quality tests that may have been performed. This forum will provide an opportunity to review each item's development or the service provided to ensure its compliance with the specified requirements. It will also serve as an opportunity to ask questions or modify contracts or requirements ahead of time in order to prevent delays in delivery and schedule. The Procurement Manager will be responsible for scheduling such meetings until all contracted items are delivered and are determined to be acceptable.

12.8. INFORMATION DISSEMINATION TO CONSULTANTS AND VENDORS

In order to ensure that consultants and contractors have access to the most current and relevant information about the I-210 ICM project, a website will be used as a repository of important project information. This website will be developed and maintained by members of the Documentation and Technology Transfer Group at PATH. All contracted consultants and vendors will be provided with login and access arrangements to the website. This access will allow them to view relevant work products and project information.

In addition to access to the document repository, periodic meetings will be conducted with the contracted consultants and vendors to inform them of relevant project developments they should be aware of.

13. REFERENCES

[1] A guide to the Project Management Body of Knowledge (PMBOK Guide), 4th Edition. Project Management Institute, Inc., Newtown Square, Pennsylvania, 2008.

[2] I-15 ICM Stage II Concept of Operations, USDOT.

[3] I-15 ICM Project Management Plan, Final Report, June 2011.

APPENDIX A - ACRONYMS

The following acronyms and abbreviations are used in this document.

BDG	Business Drivers Group
Caltrans	California Department of Transportation
ConOps	Concept of Operations
DSS	Decision Support System
ICM	Integrated Corridor Management
ITS	Intelligent Transportation System
Metro	Los Angeles County Metropolitan Transportation Authority
MOU	Memorandum of Understanding
PATH	Partners for Advanced Transportation Technology
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMP	Project Management Plan
QA	Quality Assurance
QC	Quality Control
SCAG	Southern California Association of Governments
SEMP	Systems Engineering Management Plan
SGVCOG	San Gabriel Valley Council of Governments
USDOT	United States Department of Transportation
WBS	Work Breakdown Structure

APPENDIX B – DETAILED TASK BREAKDOWN

Table B.1 – Project Task Breakdown

Main Task	Subtask	Specific Activity
1. Project Initiation & Management	1.1. Define Project Goals and Objectives	
	1.2. Define Scope of Work	
	1.3. Develop Work Plan	1.3.1. Identify Project Tasks 1.3.2. Identify Key Milestones 1.3.3. Identify Project Deliverables 1.3.4. Develop Project Schedule 1.3.5. Deliver Work Plan to Caltrans 1.3.6. Work Plan Approval by Caltrans 1.3.7. Approved Work Plan
	1.4. Develop Project Management Plan	1.4.1. Develop Project Management Approach 1.4.2. Develop Scope Management Plan 1.4.3. Develop Staffing Management Plan 1.4.4. Develop Schedule Management Plan 1.4.5. Develop Cost Management Plan 1.4.6. Develop Quality Management Plan 1.4.7. Develop Procurement Management Plan 1.4.8. Develop Risk Management Plan 1.4.9. Write Project Management Plan 1.4.10. Submit Draft Project Management Plan to Caltrans 1.4.11. Project Management Plan Approval by Caltrans 1.4.12. Approved Project Management Plan
	1.5. Manage Project Resources	1.5.1. Manage Project Staff 1.5.2. Manage Budget 1.5.3. Manage Requests for Proposals/Subcontract Awards 1.5.4. Manage Procurement Requests
	1.6. Seek Supporting Funding for Project Activities	
	1.7. Manage Meetings and Communications	
	1.8. Manage Project Documentation	
2. Outreach Activities	2.1. Coordination with Key Partners and Staff	2.1.1. Weekly Conference Calls 2.1.2. Monthly Team Meetings
	2.2. Organize Working Groups	
	2.3. Develop Connected Corridors One-page Fliers	
	2.4 Develop and Maintain Connected Corridors Website	
	2.5 Publish Connected Corridors Digest	
	2.6. Stakeholder Meetings	2.6.1. Meetings with Metro 2.6.2. Meetings with LA County

Main Task	Subtask	Specific Activity
		2.6.3 Meetings with City of Pasadena 2.6.4. Meetings with City of Arcadia 2.6.5. Meetings with City of Monrovia 2.6.6. Meetings with City of Duarte 2.6.7. Meetings with SGVCOG Subcommittees and Board 2.6.8. Meetings with SCAG Subcommittees and Regional Council 2.6.9. Meeting with CHP and Local Enforcement Agencies 2.6.10. Meetings with Local Transit Agencies 2.6.11. Prepare Supplemental Fact Sheets 2.6.12. Support for Stakeholder Workshop 1 (Visioning, User Needs) 2.6.13. Support for Stakeholder Workshop 2 (Refined User Needs) 2.6.14. Identify and Engage Additional Stakeholders/Partners
	2.7. Develop Stakeholder Agreements	2.7.1. Develop Project Charter 2.7.2. Develop Memorandum of Understanding (MOU)
	2.8. Develop I-210 Logo and Brand	
	2.9. Additional Connected Corridors Publications & Outreach Materials	2.9.1. I-210 Pilot Announcement 2.9.2. I-210 Tab on Connected Corridors Website 2.9.3. Quarterly Connected Corridors Newsletter 2.9.4. Social Media 2.9.5. I-210 Connected Corridors Brochure 2.9.6. Press Events 2.9.7. Articles to Industry/Trade Publications 2.9.8. Speaker's Bureau 2.9.9. Participation at ICM/ITS Conferences 2.9.10. Public Service Announcements
	2.10. Develop ICM California	2.10.1. Organize ICM California Webinars 2.10.2. Organize Annual ICM California Conferences
3. Concept Exploration & User Needs	3.1. Identify and Collect Supporting Data	
	3.2. Characterize I-210 Connected Corridors Pilot Corridor	
	3.3. Review Regional ITS Architecture	
	3.4. Identify and Prioritize Stakeholder Needs	3.4.1. Develop Stakeholder Workshop 1 Material 3.4.2. Conduct Stakeholder Workshop (General User Needs) 3.4.3. Develop Initial User Needs 3.4.4. Submit Initial User Needs for Review by Stakeholders 3.4.5. Stakeholder Review of User Needs 3.4.6. Update User Needs based on Stakeholder Comments 3.4.7. Develop Stakeholder Workshop 2 Material 3.4.8. Conduct Stakeholder Workshop 2 (Transit) 3.4.9. Update User Needs based on Stakeholder Comments 3.4.10. Submit Final User Needs for Stakeholder Approval 3.4.11. Stakeholder Approval of User Needs 3.4.12. Approved User Needs
	3.5. Perform Gap Analysis	
	3.6. Identify Project Constraints	
	3.7. Assess System Feasibility	

Main Task	Subtask	Specific Activity
	3.8. Assess Potential System Benefits	
	3.9. Develop Preliminary System Concept	
	3.10. Preliminary System Concept	
4. Corridor Preparation	4.1. Assess Existing Infrastructure Repair/Upgrade Needs	
	4.2. Identify Needed Funding	
	4.3. Secure Funding for Corridor Improvements	
	4.4. Implement Identified Infrastructure Repairs/Upgrades	
5. Analysis, Modeling & Simulation	5.1. Develop AMS Analysis Plan	
	5.2. Develop AMS Data Collection Plan	
	5.3. Collect AMS Data	
	5.4. Baseline Model Setup and Calibration	
	5.5. Operational Alternatives Analysis	
	5.6. Develop Alternative Analysis Report	
	5.7. Submit Alternative Analysis Report	
6. SEMP	6.1. Develop Project Management Approach	
	6.2. Develop Schedule Management Plan	
	6.3. Develop Communications Management Plan	
	6.4. Develop Cost Management Plan	
	6.5. Develop Human Resources Management Plan	
	6.6. Develop Quality Management Plan	
	6.7. Develop Risk Management Plan	
	6.8. Develop Procurement Management Plan	
	6.9. Prepare Draft SEMP	
	6.10. Submit Draft SEMP to Stakeholders	
	6.11. Stakeholder Review of Draft SEMP	
	6.12. Update Draft SEMP based on Stakeholder Comments	
	6.13. Submit Revised SEMP to Stakeholders for Approval	
	6.14. Stakeholder Approval of Revised SEMP	
	6.15. Initial SEMP	
	6.16. SEMP Updates	
7. ConOps	7.1. Develop Operational Scenarios	
	7.2. Identify Relevant Performance Measures	
	7.3. Develop Draft ConOps	
	7.4. Submit Draft ConOps to Stakeholders	
	7.5. Stakeholder Review of Draft ConOps	
	7.6. Revise ConOps based on Stakeholder Input	
	7.7. Submit Revised ConOps for Stakeholder Approval	
	7.8. Stakeholder Approval of ConOps	
	7.9. Approved ConOps	
8a. System Requirements	8.1. Develop Preliminary Institutional Requirements	
	8.2. Develop Preliminary System Requirements	

Main Task	Subtask	Specific Activity
	8.3. Submit Preliminary System Requirements to Caltrans for Review	
	8.4. Core Stakeholder Review of Preliminary System Requirements	
	8.5. Update Preliminary System Requirements based on Core Stakeholder Comments	
	8.6. Submit Revised System Requirements to All Stakeholders for Second Review	
	8.7. Stakeholder Review of Preliminary System Requirements	
	8.8. Update Preliminary System Requirements based on Stakeholder Comments	
	8.9. Submit Revised System Requirements to All Stakeholders for Second Round Review	
	8.10. Stakeholder Review of Revised System Requirements	
	8.11. Update System Requirements based on Stakeholder Comments	
	8.12. Submit Final System Requirements to Stakeholders for Approval	
	8.13. Stakeholder Approval of Final System Requirements	
	8.14. Approved System Requirements	
8b. System Verification & Validation Plans	8.15. Develop Draft Validation Plan	
	8.16. Submit Draft Validation Plan to Stakeholders	
	8.17. Stakeholder Review of Draft Validation Plan	
	8.18. Update Draft Validation Plan based on Stakeholder Comments	
	8.19. Submit Validation Plan to Stakeholders for Approval	
	8.20. Stakeholder Approval of Validation Plan	
	8.21. Approved System Validation Plan	
	8.22. Develop Draft Verification Plan	
	8.23. Submit Draft Verification Plan to Stakeholders	
	8.24. Stakeholder Review of Draft Verification Plan	
	8.25. Update Draft Verification Plan based on Stakeholder Comments	
	8.26. Submit Verification Plan to Stakeholders for Approval	
	8.27. Stakeholder Approval of Verification Plan	
	8.28. Approved System Verification Plan	
9. Organizational Design	9.1. Identify Organizational Changes with Stakeholder Agencies	
	9.2. Identify Desired Procedural Changes within Stakeholder Agency Practices	
	9.3. Submit Identified Changes for Approval by Corridor Stakeholders	
	9.4. Approval of Submitted Changes by Stakeholders	
	9.5. Approved Organizational and Procedural Changes	
10. Technical Design	10.1. Develop System Architecture	
	10.2. Identify Internal and External Interfaces	

Main Task	Subtask	Specific Activity
	10.3. Identify Relevant Standards	
	10.4. Identify Candidate Off-the-Shelf Products	
	10.5. Identify Data Collection Needs	10.5.1. Identify Data Needs for Component Development 10.5.2. Identify Data Needs for Component/System Testing
	10.6. Design Subsystem Components	10.6.1. Design Probe Data Capture and Processing 10.6.2. Design Input Data Processing 10.6.3. Design Estimation Module 10.6.4. Design Prediction Module 10.6.5. Design Control Rules 10.6.6. Design Performance Evaluator 10.6.7. Design Data Visualizations 10.6.8. Design Administrative Functions 10.6.9. Design User Interfaces 10.6.10. Design System Interfaces
	10.7. Develop System Deployment Plan	
	10.8. Update System/Subsystem Requirements	
	10.9. Update System/Subsystem Integration Plans	
	10.10. Update System/Subsystem Verification Plans	
	10.11. Update Operations and Maintenance Plan	
	10.12. Update SEMP	
11. Component Development	11.1. Collect Supporting Data	
	11.2. Develop System Components	11.2.1. Develop Probe Data Capture and Processing 11.2.2. Develop Input Data Processing 11.2.3. Develop Estimation Module 11.2.4. Develop Prediction Module 11.2.5. Develop Control Rules 11.2.6. Develop Performance Evaluator 11.2.7. Develop Data Visualizations 11.2.8. Develop Administrative Functions 11.2.9. Develop User Interfaces 11.2.10. Develop System Interfaces
	11.3. Develop Unit Verification Procedures	
	11.4. Perform Unit Tests	
	11.5. Update Operations and Maintenance Plan	
12. System Integration	12.1. Develop System/Subsystem Verification Procedures	
	12.2. Conduct Subsystem Integration	
	12.3. Perform Subsystem Verifications	
	12.4. Conduct System Integration	
	12.5. Perform System Verifications	
	12.6. Document System Verification Results	
	12.7. Update Operations and Maintenance Plan	

Main Task	Subtask	Specific Activity
13. Institutional Deployment	13.1. Implement Organization Changes within Stakeholder Agencies	
	13.2. Implement Procedural Changes within Stakeholder Agencies	
14. Technical Deployment	14.1. Update System Deployment Strategy	
	14.2. Update System Deployment Plan	
	14.3. Deploy I-210 Pilot	
	14.4. Finalize Operations and Maintenance Plan	
	14.5. Develop Operations Manual	
	14.6. Update System Acceptance Plan	
15. Training	15.1. Develop Training Plan	
	15.2. Develop Training Material	
	15.3. Conduct Training Activities	
16. System Validation & Acceptance	16.1. Develop System Validation Procedures	
	16.2. Perform System Validation	
	16.3. Develop System Acceptance Procedures	
	16.4. Conduct System Acceptance	
	16.5. Prepare System Validation and Acceptance Report	
	16.6. Submit System Validation and Acceptance Report to Stakeholders	
	16.7. Stakeholder review of System Validation and Acceptance Report	
	16.8. System Acceptance	
17. System Operations	17.1. System Launch	
	17.2. System Operations	
18. System Evaluation	18.1. Develop System Evaluation Approach	
	18.2. Develop Pre-Implementation Data Collection Plan	
	18.3. Perform Pre-Implementation Corridor Evaluation	18.3.1. Pre-Implementation Data Collection 18.3.2. Pre-Implementation Data Analysis 18.3.3. Write Pre-Implementation Evaluation Report
	18.4. Develop Post-Implementation Data Collection Plan	
	18.5. Perform Post-Implementation Corridor Evaluation	18.5.1. Post-Implementation Data Collection 18.5.2. Post-Implementation Data Analysis 18.5.3. Write Post-Implementation Evaluation Report
	18.6. Develop Evaluation Report	
	18.7. Submit evaluation report to stakeholders	
	18.8. Stakeholder Review of Evaluation Report	
	18.9. Approved Evaluation Report	
19. Migration to Production	19.1. Migration to Production	
20. Lessons Learned	20.1. Summarize Lessons Learned	
	20.2. Identify Best Practices	
	20.3. Develop Lessons Learned and Best Practice Document	

Main Task	Subtask	Specific Activity
	20.4. Submit Identified Lessons Learned and Best Practices to Stakeholders	
	20.5. Stakeholder Review of Lessons Learned and Best Practices	
	20.6. Lessons Learned and Best Practice Document	

APPENDIX C – TASK DESCRIPTIONS

Table C.1 – Short Task Descriptions

Task Number	Task Name	Description
1	**Project Initiation & Management**	**General project management activities, such as staffing, budgeting, contracting issues.**
1.1	Define Project Goals and Objectives	Identification of the general goals and objectives of the project.
1.2	Define Scope of Work	Identification of the scope of the project, including corridor boundaries, systems to be developed and implemented.
1.3	Develop Work Plan	Development of project work plan.
1.3.1	Identify Project Tasks	Identification of key project activities throughout the duration of the project.
1.3.2	Identify Key Milestones	Identification of milestones.
1.3.3	Identify Project Deliverables	Identification of key project deliverables.
1.3.4	Develop Project Schedule	Development of a schedule for the execution of the identified tasks and production of the identified deliverables.
1.3.5	Deliver Work Plan to Caltrans	Project milestone.
1.3.6	Work Plan Approval by Caltrans	Approval of submitted work plan by Caltrans staff.
1.3.7	Approved Work Plan	Project deliverable.
1.4	Develop Project Management Plan	Development of project management approaches.
1.4.1	Develop Project Management Approach	Development of the general approach to be used to manage the project, including team organization, project collaboration tools, communication framework between team members, and other project management items.
1.4.2	Develop Scope Management Plan	Identification of the roles and responsibilities of project partners regarding project scope, control measures used to verify that project scope is maintained, and processes by which changes and project scope may be reviewed and adopted.
1.4.3	Develop Staffing Management Plan	Description of how the project manager will manage staff resources throughout the project.
1.4.4	Develop Schedule Management Plan	Definition of the approach that will be used to create a baseline schedule, to monitor the project schedule, and to manage necessary changes to the baseline schedule.
1.4.5	Develop Cost Management Plan	Develop the approach used to manage project expenditures and produce expense reports.
1.4.6	Develop Quality Management Plan	Identification of activities that will be carried to ensure that the project is satisfying the needs for which it was undertaken.
1.4.7	Develop Procurement Management Plan	Develop the processes that will be used for managing procurements throughout the duration of the project. This includes identifying the items that may be procured, the types of contracts that may be used, the process used for approving contract, and the decision criteria that may be used.
1.4.8.	Develop Risk Management Plan	Documentation of policies and procedures for identifying and handling uncommon causes of project variations.
1.4.9	Write Project Management Plan	Development of document describing the project management plan.
1.4.10	Submit Draft Project Management Plan to Caltrans	Project milestone.
1.4.11	Project Management Plan Approval by Caltrans	Approval of submitted project management plan by Caltrans staff.
1.4.12	Approved Project Management Plan	Project deliverable.
1.5	Manage Project Resources	Activities related to the management of project resources.
1.5.1	Manage Project Staff	Activities related to the hiring and management of individuals working on the project.
1.5.2	Manage Budget	Activities related to the tracking and reporting of project expenditures.

Task Number	Task Name	Description
1.5.3	Manage Requests for Proposals/Subcontract Awards	Activities related to the development of requests for proposals for the hiring of subcontractors, review of candidates, selection of winning bids, and management of activities executed by the hired subcontractor(s).
1.5.4	Manage Procurement Requests	Activities related to the selection and purchase of equipment and software for the project.
1.6	Seek Supporting Funding	Activities conducted by project team members to identify and secure funding for corridor improvements or to support various project activities.
1.7	Manage Meetings and Communications	Activities related to the organization and execution of project meetings.
1.8	Manage Project Documentation	Activities related to the writing, editing, review, publication, and dissemination of project reports and technical documents.
2	**Outreach & Communications**	**Engagement of corridor stakeholders, coordination of activities among stakeholders, release of information to the public, etc.**
2.1	Coordination with Key Partners and Staff	Activities to promote the coordination of activities among project partners.
2.1.1	Weekly Conference Calls	Determine day/time for weekly conference call; prepare agenda; prepare meeting notes and follow-up items.
2.1.2	Monthly Team Meetings	Determine day/time for monthly in-person meeting at Caltrans D7 in Los Angeles; prepare agenda; prepare meeting notes and follow-up items; facilitate meeting.
2.2	Organize Working Groups	Form working groups responsible for identifying data collection needs, performance metrics, and outreach activities. These groups are expected meet on a regular or “as needed” basis and provide reports at the monthly team meetings.
2.3	Develop Connected Corridors One-page Fliers	Development of one-page fliers describing the Connected Corridors program for distribution at meetings with corridor stakeholders and at conferences.
2.4	Develop and Maintain Connected Corridors Website	Development and launching of a website dedicated to the Connected Corridors program and I-210 Pilot deployment.
2.5	Publish Connected Corridors Digest	Develop and publish a compilation of links to articles, research papers, conference information, and newsletters related to ICM efforts nationwide and internationally, as well as the I-210 corridor.
2.6	Stakeholder Meetings	Organize and conduct meetings with corridor stakeholders.
2.6.1	Meetings with Metro	Organize and conduct meetings with representatives from the Los Angeles Metropolitan Transportation Authority (Metro)
2.6.2	Meetings with LA County	Organize and conduct meetings with representative from LA County
2.6.3	Meetings with City of Pasadena	Organize and conduct meetings with representatives from the City of Pasadena.
2.6.4	Meetings with City of Arcadia	Organize and conduct meetings with representatives from the City of Arcadia.
2.6.5	Meetings with City of Monrovia	Organize and conduct meetings with representatives from the City of Monrovia.
2.6.6	Meetings with City of Duarte	Organize and conduct meetings with representatives from the City of Duarte.
2.6.7	Meetings with SGVCOG	Organize briefings with the Board and relevant subcommittees of the San Gabriel Valley Council of Governments.
2.6.8	Meetings with SCAG	Organize briefings with the Regional Council and relevant subcommittees of the Southern California Association of Governments.
2.6.9	Meeting with CHP and Local Enforcement Agencies	Organize meetings with the California Highway Patrol and other local enforcement agencies.
2.6.10	Meeting with Local Transit Agencies	Organize meetings with Metro Rail, Metro Bus, Metrolink, Foothill Transit, and other relevant transit agencies operating in the I-210 corridor.
2.6.11	Prepare Supplemental Fact Sheets	Prepare fact sheets outlining corridor selection and project phasing criteria.
2.6.12	Support for Stakeholder Workshop 1 (Visioning & User Needs)	Plan and conduct a “Visioning Workshop” with all corridor stakeholders to develop a vision and goals for the I-210 Connected Corridors Pilot.

Task Number	Task Name	Description
2.6.13	Support for Stakeholder Workshop 2 (Refined User Needs)	Plan and conduct a "User Needs Workshop" with all corridor stakeholders to determine the needs of the cities and agencies along the I-210 corridor.
2.6.14	Identify and Engage Additional Stakeholders/Partners	Identify additional government agencies, as well as community and non-profit associations, educational institutions, Chambers of Commerce, interest groups, news stations, that may have some interest in the deployment of the I-210 Connected Corridors Pilot.
2.7	Develop Stakeholder Agreements	Draft, circulate for review/comment, and finalize User Agreements/MOUs with project partners. Plan and implement an annual ICM California Conference; determine the length of the conference, participants (speakers and attendees), sponsors, venue, etc.
2.7.1	Develop and Approve Project Charter	Develop a project charter; approval of charter by all project stakeholders.
2.7.2	Develop and Approve MOUs	Develop Memorandum of Understanding to be signed by individual stakeholders.
2.8	Develop I-210 Logo and Brand	Develop an I-210 logo and brand for use in print and media material related to the project.
2.9	Additional Connected Corridors Publications & Outreach Materials	Activities associated with the preparation and distribution of various outreach material related to the Connected Corridors program and I-210 Pilot.
2.9.1	I-210 Pilot Announcement	Preparation of materials and events to announce the I-210 Connected Corridors Pilot.
2.9.2	I-210 Tab on Connected Corridors Website	Development of an I-210 tab on the Connected Corridors website; uploading of information for the public and maintenance of posted information to keep it up to date.
2.9.3	Quarterly Connected Corridors Newsletter	Publication and distribution of a quarterly newsletter on Connected Corridors activities, including the I-210 Pilot deployment.
2.9.4	Social Media	Development of Connected Corridors material for publication on Facebook and Twitter accounts.
2.9.5	I-210 Connected Corridors Brochure	Development and distribution of an I-210 Connected Corridors brochure to outline key projects elements.
2.9.6	Press Events	Identification and preparation of press events for the I-210 Connected Corridors Pilot.
2.9.7	Articles to Industry/Trade Publications	Development and submission of articles to industry/trade publications.
2.9.8	Speaker's Bureau	Identification of availability of senior team members to speak on behalf of the I-210 Connected Corridors Pilot on panels, at trade shows and/or industry events); preparation of speaking points and other relevant material.
2.9.9	Participation at ICM/ITS Conferences	Participation of team members at conferences on ICM and Intelligent Transportation System topics.
2.9.10	Public Service Announcements	Identification of situations in which public service announcements are required/important for the I-210 Connected Corridors Pilot; preparation of supporting material.
2.10	Develop ICM California	Informational activities to increase awareness to the ICM California Program.
2.10.1	Organize ICM California Webinars	Preparation and hosting of quarterly webinars on topics of interest to ICM/ITS project managers, public agencies, research institutions, etc.
2.10.2	Organize Annual ICM California Conferences	Planning and hosting an annual conference on ICM California.
3	**Preliminary Concept Exploration & User Needs**	**Evaluation of current corridor operations and problems to resolve.**
3.1	Identify and Collect Supporting Data	Identification of data needed for corridor analyses and concept development and activities related to the collection of identified data needs.
3.2	Characterize I-210 Connected Corridors Pilot Corridor	Inventory and characterization of transportation networks and transportation management systems within the I-210 corridor; assessment of current operational conditions on the I-210 freeway, surrounding arterials, and relevant transit systems.

Task Number	Task Name	Description
3.3	Review Regional ITS Architecture	Review of elements defined in the Regional ITS architecture to identify support elements and potential gaps in the architecture.
3.4	Identify and Prioritize Stakeholder Needs	Identification and prioritization of user needs associated with the I-210 Connected Corridors Pilot.
3.4.1	Develop Stakeholder Workshop 1 Material	Development of materials to be used during the first user's needs workshop (general user needs).
3.4.2	Conduct Stakeholder Workshop 1	Planning and execution of the first user's needs workshop.
3.4.3	Develop Initial User Needs	Identification of a preliminary set of system user needs based on input from stakeholders gathered during the user's needs workshop.
3.4.4	Submit Initial User Needs for Review by Stakeholders	Project milestone.
3.4.5	Stakeholder Review of User Needs	Review of proposed preliminary set of user needs by corridor stakeholders.
3.4.6	Update User Needs based on Stakeholder Comments	Revision of identified user needs to reflect comments made by corridor stakeholders.
3.4.7	Develop Stakeholder Workshop 2 Material	Development of materials to be used during the second user's needs workshop (transit user needs).
3.4.8	Conduct Stakeholder Workshop 2	Planning and execution of the second user's needs workshop.
3.4.9	Update User Needs based on Stakeholder Comments	Update of user needs based on comments received during the second stakeholder workshop.
3.4.10	Submit Final User Needs for Stakeholder Approval	Project milestone.
3.4.11	Stakeholder Approval of User Needs	Approval of proposed system user needs by corridor stakeholders.
3.4.12	Approved User Needs	Project milestone and deliverable.
3.5	Perform Gap Analysis	Review of current corridor operations to identify how stated user needs are not currently being met.
3.6	Identify Project Constraints	Identification of organizational, technical, and financial constraints that affect or restrict the development of corridor-wide transportation management strategies.
3.7	Assess System Feasibility	Evaluation of the technical, institutional, and financial capability of implementing an ICM system within the I-210 corridor.
3.8	Assess Potential System Benefits	Summary identification of the potential benefits that could be obtained from an ICM system.
3.9	Develop Preliminary System Concept	Development of a preliminary system concept based on the results of the gap analysis, identification of constraints, and system feasibility assessment.
3.10	Preliminary System Concept	Project milestone.
4	**Corridor Preparation**	**Activities to ensure that the monitoring and control systems currently in place along the corridor are operating adequately; management of equipment upgrade requests prior to ICM system deployment.**
4.1	Assess Existing Infrastructure Repair/Upgrade Needs	Identification of existing traffic sensors, signal controllers, and other corridor assets that may need to be repaired or upgraded to support the development and deployment of ICM strategies.
4.2	Identify Needed Funding	Identification of potential funding opportunities that may be tapped to obtain funding required for the repairing and upgrading of corridor assets.
4.3	Secure Funding	Activities leading to securing funding supporting corridor preparation activities.
4.4	Implement Identified Infrastructure Repairs/Upgrades	Activities by which existing corridor assets are repaired or upgraded.
5	**Analysis, Modeling & Simulation**	**Use of analytical and simulation tools to evaluate the potential improvements that may be provided by various candidate strategies.**
5.1	Develop AMS Plan	Identification of how analytical and simulation tools will be used to conduct corridor operational assessments and evaluate the potential benefits of candidate ICM strategies.
5.2	Develop AMS Data Collection Plan	Identification of data to be collected and data collection methods to support the development and the use of analytical and simulation tools.

Task Number	Task Name	Description
5.3	Collect AMS Data	Execution of the data collection activities outlined in the AMS Data Collection Plan.
5.4	Baseline Model Setup and Calibration	Development of calibrated analytical and simulation models of the I-210 corridor.
5.5	Operational Alternative Analysis	Analysis of corridor operations and potential impacts of candidate ICM strategies using the analytical and simulation models developed in Task 5.4.
5.6	Develop Alternative Analysis Report	Compilation of results of analysis of corridor operations and of impacts of candidate ICM strategies
5.7	Operational Alternative Analysis	Project milestone
6	**SEMP**	**Identification of systems engineering activities that will guide the development of the proposed ICM system.**
6.1	Develop Project Management Approach	Development of key elements of the project management approach that will be followed for the I-210 Connected Corridors Pilot, including Work Breakdown Structure (WBS), project scope management approach, and project change management approach.
6.2.	Develop Schedule Management Plan	Development of the process that will be followed by the project team to monitor the project schedule and manage schedule changes.
6.3	Develop Communications Management Plan	Development of the framework that will be used to ensure that efficient communication occurs among all project participants, as well as to manage the production, distribution, and storage of project-related information.
6.4	Develop Cost Management Plan	Development of the framework that will be used to ensure the efficient management of project costs and budget.
6.5	Develop Human Resources Management Plan	Development of the framework that will be used to identify, acquire, and manage the human resources needed for the execution of the project.
6.6	Develop Quality Management Plan	Development of the framework that will be used to ensure that the project satisfies the needs of its customers.
6.7	Develop Risk Management Plan	Development of the framework that will be used to identify, analyze, handle, monitor, and ultimately retire uncommon causes of project variation.
6.8	Develop Procurement Management Plan	Development of the framework that will be followed for the procurement of hardware, software, materials, and services that will be acquired for the project.
6.9	Prepare Draft SEMP	Development of a draft Systems Engineering Management Plan including the preliminary operations and maintenance plan, system deployment strategy, system evaluation plan, system integration plan, system verification plan, and configuration management plan developed in tasks 6.1 through 6.6.
6.10	Submit Draft SEMP to Stakeholders	Project milestone.
6.11	Stakeholder Review of Draft SEMP	Review of draft SEMP by corridor stakeholders.
6.12	Update Draft SEMP based on Stakeholder Comments	Revision of content of SEMP based on comments received from corridor stakeholders.
6.13	Submit Revised SEMP to Stakeholders for Approval	Project milestone.
6.14	Stakeholder Approval of Revised SEMP	Approval of the revised SEMP by corridor stakeholders.
6.15	Initial SEMP	Project deliverable.
6.16	SEMP Updates	Periodic updated to the SEMP as the project progresses
7	**Concept of Operations**	**Development of the concept of operations for the I-210 Pilot ICM system.**
7.1	Develop Operational Scenarios	Development of a set of operational scenarios outlining how an ICM system may respond to various incidents and situations.
7.2	Identify Relevant Performance Measures	Identification of ley performance measures that will be used to assess the performance of the deployed ICM system.
7.3	Develop Draft ConOps	Development of a draft concept of operations based on the preliminary system concept developed in Task 4.12, operational scenarios of Task 6.1 and desired performance measures identified in Task 6.2.

Task Number	Task Name	Description
7.4	Submit Draft ConOps to Stakeholders	Project milestone.
7.5	Stakeholder Review of Draft ConOps	Review of draft ConOps by corridor stakeholders.
7.6	Revise ConOps based on Stakeholder Input	Revision of content of draft ConOps based on comments received from corridor stakeholders during the ConOps walkthrough.
7.7	Submit Revised ConOps for Stakeholder Approval	Project milestone.
7.8	Stakeholder Approval of ConOps	Approval of revised ConOps by each corridor stakeholder.
7.9	Approved ConOps	Project deliverable.
8a	**System Requirements**	**Development of system requirements for the I-210 Pilot ICM system.**
8.1	Develop Preliminary Institutional Requirements	Development of a preliminary set of system requirements regarding the organizational setting of each participating agency.
8.2	Develop Preliminary System Requirements	Development of a preliminary set of system requirements identifying what specific ICM system and/or subsystem should do.
8.3	Submit Preliminary System Requirements to Core Stakeholders for Review	Project milestone.
8.4	Core Stakeholder Review of Preliminary System Requirements	Review of preliminary system requirements by Caltrans, Metro and other core system stakeholders.
8.5	Update System Requirements, based on Core Stakeholder Comments	Update of preliminary system requirements based on comments received from core stakeholders.
8.6	Submit Preliminary System Requirements to All Stakeholders	Project milestone.
8.7	Stakeholder Review of Preliminary System Requirements	Review of preliminary system requirements by Caltrans, Metro, Los Angeles County, cities, and all other system stakeholders.
8.8	Update System Requirements, based on Stakeholder Comments	Update of system requirements based on comments received from stakeholders.
8.9	Submit Revised System Requirements to Stakeholders for Second Round Review	Project milestone.
8.10	Stakeholder Review of Revised System Requirements	Review of revised system and subsystem requirements by all system stakeholders.
8.11	Update System Requirements based on Stakeholder Comments	Update of system and subsystem requirements based on comments received from all system stakeholders.
8.12	Submit Final System Requirements, Verification and Acceptance Plans to Stakeholders	Project milestone.
8.13	Stakeholder Approval of Final System Requirements	Approval of System Requirements and Verification Plan by individual stakeholders.
8.14	Approved System Requirements	Project deliverable.
8b	**Preliminary Verification & Validation Plans**	**Development of preliminary versions of the system verification and system validation plans**
8.15	Develop Draft Validation Plan	Development of a preliminary set of criteria that will be used by system developers to verify that the user needs at the base of the project are met by the final delivered system.
8.16	Submit Draft Validation Plan to Stakeholders	Project milestone.
8.17	Stakeholder Review of Draft Validation Plan	Review of preliminary system validation plan by project stakeholders.
8.18	Update Draft Validation Plan based on Stakeholder Comments	Review of preliminary system validation plan based on comments received from project stakeholders.
8.19	Submit Validation Plans to Stakeholders for Approval	Project milestone.

Task Number	Task Name	Description
8.20	Stakeholder Approval of Validation Plan	Review and approval by project stakeholders of the final version of the system validation plan.
8.21	Approved System Validation Plan	Project deliverable.
8.22	Develop Draft Verification Plan	Development of a preliminary set of criteria that will be used by system developers to verify that the user needs at the base of the project are met by the final delivered system.
8.23	Submit Draft Verification Plan to Stakeholders	Project milestone.
8.24	Stakeholder Review of Draft Verification Plan	Review of preliminary system verification plan by project stakeholders.
8.25	Update Draft Verification Plan based on Stakeholder Comments	Review of preliminary system verification plan based on comments received from project stakeholders.
8.26	Submit Verification Plans to Stakeholders for Approval	Project milestone.
8.27	Stakeholder Approval of Verification Plan	Review and approval by project stakeholders of the final version of the system verification plan.
8.28	Approved System Verification Plan	Project deliverable.
9	**Organizational Design**	**Identification of organizational and institutional changes that may be implemented to enhance corridor-based operations.**
9.1	Identify Organizational Changes with Stakeholder Agencies	Identification of organizational changes (staffing, organizational structure) that may be implemented by each agency to improve coordinated corridor operations.
9.2	Identify Desired Procedural Changes within Stakeholder Agency Practices	Identification of procedural changes that may be implemented by each agency to improve coordinated corridor operations.
9.3	Submit Identified changes for Approval by Corridor Stakeholders	Project milestone.
9.4	Approval of Submitted Changes by Stakeholders	Approval by individual agencies of the identified organizational and procedural changes that may be implemented by each agency to improve coordinated corridor operations.
9.5	Approved Organizational and Procedural Changes	Project deliverable.
10	**Technical Design**	**Design of system architecture and technical components of the proposed I-210 Pilot ICM system.**
10.1	Develop System Architecture	Develop the conceptual model defining the structure and components of the I-210 Pilot ICM system.
10.2	Identify Internal and External Interfaces	Identify the various interfaces that will need to be developed between system components and with external systems.
10.3	Identify Relevant Standards	Identify the various relevant standards that will need to be considered for the development of the I-210 Pilot ICM system.
10.4	Identify Candidate Off-the-shelf Products	Identify existing commercial off-the-self software and hardware that could be used for the development of the I-210 Pilot ICM system.
10.5	Identify Data Collection Needs	Identify the data that will need to be collected to support the development of the I-210 Pilot ICM system.
10.5.1	Identify Data Needs for Component Development	Identify the data that will need to be collected to support the development of various system components.
10.5.2	Identify Data Needs for Component/System Testing	Identify the data that will need to be collected to support the testing of system components and the overall ICM system.
10.6	Design Subsystem Components	Design of various system components.
10.6.1	Design Probe Data Capture and Processing	Design of the module that will be used to capture and process probe vehicle data.
10.6.2	Design Input Data Processing	Design of the module that will be used to validate and filter input data received from various sources.

Task Number	Task Name	Description
10.6.3	Design Estimation Module	Design of the module that will be used to estimate the current operational performance of the I-210 freeway, surrounding arterials, supporting transit services, and supporting parking systems.
10.6.4	Design Prediction Module	Design of the module that will be used to predict corridor performance in the near future under alternative transportation management strategies.
10.6.5	Design Control Rules	Development of the rules that will be used by the Decision Support System to develop appropriate response strategies to address various observed operational issues.
10.6.6	Design Performance Evaluator	Design of the module that will be used by the Decision Support System to quantify performance of specific corridor elements (freeway, arterials, transit service, etc.) and the entire corridor.
10.6.7	Design Data Visualizations	Design of how collected and processed data will be presented to system users.
10.6.8	Design Administrative Functions	Design of rules governing who can access the system, who can modify system elements, and what elements can be modified by each user.
10.6.9	Design User Interfaces	Design of the various interfaces by which system users will interact with the ICM system.
10.6.10	Design System Interfaces	Design of data communication protocols between the various ICM system modules, as well as between the ICM system and external systems.
10.7	Develop System Deployment Plan	Develop strategy that will be used to deploy the ICM system along the I-210 corridor.
10.8	Update System/Subsystem Requirements	Update of the previously developed system and subsystem requirements based on the results of the design activities.
10.9	Update System/Subsystem Integration Plans	Update of the previously developed system and subsystem integration plans based on the results of the design activities.
10.10	Update System/Subsystem Verification Plans	Update of the previously developed system and subsystem verification plans based on the results of the design activities.
11	**Component Development**	**Development of technical components of the I-210 Pilot ICM system.**
11.1	Collect Supporting Data	Collect data identified as required for the development of system components.
11.2	Develop System Components	Building of various system components.
11.2.1	Develop Probe Data Capture and Processing	Building of the module that will be used to capture and process probe vehicle data.
11.2.2	Develop Input Data Processing	Building of the module that will be used to validate and filter input data received from various sources.
11.2.3	Develop Estimation Module	Building of the module that will be used to estimate the current operational performance of the I-210 freeway, surrounding arterials, supporting transit services, and supporting parking systems.
11.2.4	Develop Prediction Module	Building of the module that will be used to predict corridor performance in the near future under alternative transportation management strategies.
11.2.5	Develop Control Rules	Codification of the rules that will be used by the Decision Support System to develop appropriate response strategies to address various observed operational issues.
11.2.6	Develop Performance Evaluator	Building of the module that will be used by the Decision Support System to quantify performance of specific corridor elements (freeway, arterials, transit service, etc.) and the entire corridor.
11.2.7	Develop Data Visualizations	Development of algorithms implementing data visualization functions.
11.2.8	Develop Administrative Functions	Codification of rules governing who can access the system, who can modify system elements, and what elements can be modified by each user.
11.2.9	Develop User Interfaces	Development of the various interfaces by which system users will interact with the ICM system.
11.2.10	Develop System Interfaces	Codification of data communication protocols enabling data exchange between the various ICM system modules, as well as between the ICM system and external systems.

Task Number	Task Name	Description
11.3	Develop Unit Verification Procedures	Develop the procedures that will be used to verify that individual system components meet their identified requirements.
11.4	Perform Unit Tests	Conduct tests to verify that individual system components meet their identified requirements.
11.5	Update Operations and Maintenance Plan	Update of the preliminary operations and maintenance plan based on the results of the component development activities.
12	**System Integration**	**Integration of developed technical components into a coherent integrated corridor-based traffic management system.**
12.1	Develop System/Subsystem Verification Procedures	Develop the procedures that will be followed to integrate various modules into functional subsystems, and finally integrate various subsystems into the final ICM system.
12.2	Conduct Subsystem Integration	Perform tasks associated with the integration of various modules into functional subsystems.
12.3	Perform Subsystem Verifications	Perform tests to verify that each of the developed subsystems meet its associated system requirements.
12.4	Conduct System Integration	Develop the final ICM system.
12.5	Perform System Verifications	Perform tasks associated with the integration of various subsystems into the final ICM system.
12.6	Document System Verification Results	Perform tests to verify that the final ICM system meets the overall requirements that have been identified for the system.
12.7	Update Operations and Maintenance Plan	Update of the preliminary operations and maintenance plan based on the results of the system integration.
13	**Institutional Deployment**	**Implementation of the approved identified organizational and procedural changes.**
13.1	Implement Organization Changes within Stakeholder Agencies	Implement within each stakeholder agency the organization changes that have been identified and approved in Task 9.
13.2	Implement Procedural Changes within Stakeholder Agencies	Implement within each stakeholder agency the procedural changes that have been identified and approved in Task 9.
14	**Technical Deployment**	**Field deployment of the developed ICM system.**
14.1	Update System Deployment Strategy	Update, if necessary, the previously developed system deployment strategy to account for modifications that may have been incorporated into the ICM system during the design and development phases.
14.2	Update System Deployment Plan	Update, if necessary, the previously developed system deployment plan to account for modifications that may have been incorporated into the ICM system during the design and development phases.
14.3	Deploy ICM System	Deploy the developed ICM system along the I-210 corridor.
14.4	Finalize Operations and Maintenance Plan	Finalize the ICM system operations and maintenance plan.
14.5	Develop Operations Manual	Develop the user manual for the deployed ICM system.
14.6	Update System Acceptance Plan	Update, if necessary, the previously developed system acceptance plan to account for potential modifications that may have been incorporated into the ICM system to address issues encountered during the deployment activities.
15	**User Training**	**Training of operators and administrators of the proposed ICM system.**
15.1	Develop Training Plan	Identify activities that will be carried out to train adequately system operators and administrators.
15.2	Develop Training Material	Develop materials that will be used to support the training of system operators and administrators.
15.3	Conduct Training Activities	Conduct the training of system operators and administrators.
16	**System Validation and Acceptance**	**Validation of the deployed ICM system and acceptance by corridor stakeholders.**
16.1	Develop System Validation Procedures	Develop the procedures that will be used to verify that the deployed ICM system meets the stated user needs.
16.2	Perform System Validation	Conduct tests to verify that the deployed ICM system meets the stated user needs.

Task Number	Task Name	Description
16.3	Develop System Acceptance Procedures	Develop the procedures that will be used by system stakeholders to perform final acceptance tests on the deployed ICM system.
16.4	Conduct System Acceptance	Conduct final system acceptance tests.
16.5	Prepare System Validation and Acceptance Report	Write report documenting the results of the system validation and acceptance tests.
16.6	Submit System Validation and Acceptance Report to Stakeholders	Project milestone.
16.7	Stakeholder review of System Validation and Acceptance Report	Review by corridor stakeholders of report documenting the results of the system validation and acceptance tests.
16.8	System Acceptance	Project deliverable.
17	**System Operations**	**Operations of the deployed ICM system.**
17.1	System Launch	Project milestone.
18.1	System Operations	Day-to-day operations of the fully deployed ICM system.
18	**System Evaluation**	**Evaluation of the benefits provided by the deployed ICM system.**
18.1	Develop System Evaluation Approach	Develop the approach that will be used to evaluate the potential benefits provided by the deployed ICM system.
18.2	Develop Pre-Implementation Data Collection Plan	Develop the strategy by which data supporting the evaluation of operational conditions along the I-210 corridor prior to the deployment of the ICM system will be collected.
18.3	Perform Pre-Implementation Corridor Evaluation	Evaluation of transportation system operations within the I-210 corridor prior to the deployment of the ICM system.
18.3.1	Pre-Implementation Data Collection	Collect data supporting the evaluation of the operational conditions along the I-210 corridor prior to the launch of the ICM system.
18.3.2	Pre-Implementation Data Analysis	Analyze collected pre-launch data to evaluate operational conditions along the I-210 corridor prior to the deployment of the ICM system.
18.3.3	Write Pre-Implementation Evaluation Report	Write report summarizing the results of the pre-launch operational evaluation.
18.4	Develop Post-Implementation Data Collection Plan	Develop the strategy by which data supporting the evaluation of operational conditions along the I-210 corridor after the deployment of the ICM system will be collected.
18.5	Perform Post-Implementation Corridor Evaluation	Evaluation of transportation system operations within the I-210 corridor after the deployment of the ICM system.
18.5.1	Post-Implementation Data Collection	Collect data supporting the evaluation of the operational conditions along the I-210 corridor after the launch of the ICM system.
18.5.2	Post-Implementation Data Analysis	Analyze collected post-launch data to evaluate operational conditions along the I-210 corridor after the deployment of the ICM system; evaluate operational benefits by comparing the pre-launch and post-launch evaluation results.
18.5.3	Write Post-Implementation Evaluation Report	Write report summarizing the results of the post-launch operational evaluation.
18.6	Develop Evaluation Report	Write report summarizing the operational benefits provided by the deployed ICM system.
18.7	Submit Evaluation Report to Stakeholders	Project milestone.
18.8	Stakeholder Review of Evaluation Report	Review of developed evaluation report by the corridor stakeholders.
18.9	Approved Evaluation Report	Project deliverable.
19	**Migration to Production**	**Transition of system operations from pilot to standard operations**
19.1	Migration to Production	Transition of system operations from pilot system to standard production system
20	**Lessons Learned**	**Identification and documentation of lessons learned and best practices.**
20.1	Summarize Lessons Learned	Identify the lessons learned regarding the development and deployment of ICM systems from the various project activities.
20.2	Identify Best Practices	Identify the best practices to consider in future system deployments.

Task Number	Task Name	Description
20.3	Develop Lessons Learned and Best Practice Document	Develop a practice guide summarizing the identified lessons learned and best practices.
20.4	Submit Identified Lessons Learned and Best Practices to Stakeholders	Project milestone.
20.5	Stakeholder Review of Lessons Learned and Best Practices	Review of the document summarizing the identified lessons learned and best practices by the corridor stakeholders.
20.6	Approved Lessons Learned and Best Practice Document	Project deliverable.

APPENDIX D – PROJECT TEAM DIRECTORY

Table D.1 – Team Directory

Name	Title	Organization	Phone	E-Mail
Rafael Molina	Project Manager	Caltrans	213-897-9776	rafael.molina@dot.ca.gov
Samson Teshome	Corridor Manager	Caltrans	213-276-8454	samson.teshome@dot.ca.gov
Joe Butler	Program Manager	PATH	510-213-5560	joebutler@path.berkeley.edu
Francois Dion	Sr. Research Engineer	PATH	408-892-0433	fdion@path.berkeley.edu
Lisa Hammon	Outreach & Communications Manager	PATH	510-642-5923	lisahammon@berkeley.edu
Nick Compin	Connected Corridors Statewide Project Manager	Caltrans	916-651-1247	nicholas.compin@dot.ca.gov
Ali Zaghari	Deputy District Director, Traffic Operations, District 7	Caltrans	213-897-0362	ali.zaghari@dot.ca.gov
Steve Gota	Director, Highway Program	Metro	213-922-3043	gotas@metro.net
Ed Alegre	Senior Manager, Highway Program	Metro	213-922.7902	alegree@metro.net
Tom Choe	Principal	System Metrics Group	213-382-6875	tom_choe@sysmetgroup.com
Fred Dock	Transportation Director	City of Pasadena	626-744-6450	fdock@cityofpasadena.net
Norman Baculinao	Traffic Engineering Manager	City of Pasadena	626-244-4263	nbaculinao@cityofpasadena.net
Joaquin Siques	Associate Traffic Engineer	City of Pasadena	626-744-6900	jsiques@cityofpasadena.net
Bahman Janka	Transportation Administrator	City of Pasadena	626-744-4610	bjanka@cityofpasadena.net
Jane White	Sr. Civil Engineer, Section Head, Traffic & Lighting Division's TRAFFIC Section	LA County, DPW	626-300-2020	jwhite@dpw.lacounty.gov
Marty Amundson	Sr. Civil Engineer, Section Head for Traffic & Lighting Division's Traffic Systems Section	LA County, DPW	626-300-4774	mamund@dpw.lacounty.gov
Phil Wray	City Engineer	City of Arcadia	626-574-5488	pwray@ci.arcadia.ca.us
Kevin Merrill	Associate Civil Engineer	City of Arcadia	626-574-5481	kmerrill@ci.arcadia.ca.us
Tina Cherry	Public Services Director	City of Monrovia	626-256-8226	tcherry@ci.monrovia.ca.us
Rafael Casillas	Public Works Manager	City of Duarte	626-357-7931	rcasillas@accessduarte.com

APPENDIX E – RISK REGISTRY

LEVEL 1 - RISK REGISTER		Project Name:	Connected Corridors Pilot		D7/HQ		Project Manager	Nick, Allen, Joe		
Risk Identification							Risk Rating		Risk Response			
Status	**ID #**	**Type**	**Organizational**	**Title**	**Risk Statement**	**Current status / assumptions**	**Priority Rating**	**Rationale for Rating**	**Strategy**	**Response Actions**	**Risk Owner**	**Updated**
	1	Threat	Organizational	Caltrans Personnel	As a result of Caltrans personnel not being available to fill critical roles in the CC pilot, the pilot will fail		High	Current experiences indicate that personnel are explicitly stating that they will not fulfill the personnel requirements.	Mitigate	Clearly identify the foles and the personnel who will fill them. Ensure those personnel agree to the roles. PATH to provide backup where roles are not filled.	PATH/Caltrans D7/Caltrans HQ (Lisa, ??, Nick)	
Active	2	Threat	Organizational	Education, Training and Culture	As a result of Caltrans personnel not having the proper technical and cultural education and training the CC pilot will fail		Medium	As the people who will fill certain roles are not identified there is a real risk that they will not have the proper education and training	Mitigate	Provide education and training to personnel. PATH to provide backup expertise.	PATH/Caltrans D7/Caltrans HQ (Lisa, ??, Nick)	
	3	Threat	Organizational	SHOPP Funding	As a result of the possible need for SHOPP funding for a number of software items there is a risk of those not being funded in time		Medium	SHOPP funding is difficult to get quickly	Mitigate	Funding allocated for ATMS. Still needed for PEMS.	Caltrans D7/Caltrans HQ (Ali, Nick)	2/9/2017
	4	Threat	Organizational	ICM 3 Funding	As a result of the next PATH contract not being funded personnel will not be available for the pilot launch and the pilot will fail		Medium	There is always some risk with new contracts and the funding of these contracts. No contract has great impact and cannot be easily mitigated.	Accept	Allocate funding, ensure executive support and follow through on process	PATH/Caltrans D7/Caltrans HQ (Joe, Nick)	

	5	Threat	Organizational	Turn over	As a result of the loss of champions or experienced personnel the project will either fail or be delayed		High	New personnel in multiple management positions	Mitigate	Ali and others to assist with ensuring importance of I-210 to interim and new positions at HQ	Caltrans and PATH	12/5/2016
	6	Threat	Organizational	POC Partners unwilling	As a result of a lack of a clear path to potential revenue our partners will not be willing to participate in our POC		Medium	This is what they are telling us and it makes business sense	Mitigate	Really plan out how these systems will be used state wide	Caltrans(Nick)	
	7	Threat	Construction	I-210 Construction	The I-210 will be under construction and this could heavily disrupt sensing and normal traffic patterns		High	Construction is likely to occur and difficult to mitigate	Mitigate	Temporary sensing and good planning	Caltrans D7 (Raphael)	
	8	Threat	Hardware	Call for Projects Hardware	As a result of the Call for Projects hardware portion not being delivered on time the CC launch date will slip		High	There is not a solid resourced plan in place	Mitigate	Management focus	Caltrans D7 (Allen)	
	9	Threat	Hardware	I-210 SHOPP project	As a result of the I-210 SHOPP project not being delivered on time the CC launch date will slip		Medium	Not possible to obtain a schedule showing delivery dates of required hardware	Mitigate	Management focus to help obtain a schedule	Caltrans D7 (Rafael)	
	10	Threat	Data	City Data Quality	As a result of poor data quality for city data the DSS will not function correctly and the goals of the project will not be met		Medium	This is unknow but current numbers need to improve.	Mitigate	Ensure there is focus on this by stakeholders	PATH/D7/Cities/County (Anthony, Shafique)	
	11	Threat	Data	I-210 Data Quality	As a result of poor data quality for the I-210 loop data the DSS will not function correctly and the goals of the project will not be met		Medium	It has been a difficult task requiring continuous senior management focus to make small incremental progress	Mitigate	Ensure management stays heavily involved	PATH/D7 (Anthony, Shafiquel)	

	12	Threat	System Integration	System Integration Conflicts	As a result of the complexity of the integration requirements the 210 system will not be completed on time		Medium	Years of experience have taught us that complex integration projects often have unexpected occurrences	Accept	Ensure proper resources and focus are placed on the project by management at all stakeholders	PATH (Joe)	
	13	Threat	System Integration	System Integration Timing	As a result of the timing requirements for integration the 210 system will not be completed on time		High	There are two challenges here. 1) Data will arrive so late it is difficult to integrate it correctly. 2) The data hub may hit some challenges that mean we cannot load it with data early enough to integrate the data correctly	Accept	Ensure proper resources and focus are placed on the project by management at all stakeholders	PATH (Joe)	
	14	Threat	AMS	Rules Engine	As a result of inadequate coordination, the rules engine will not be shared across programs and may not work correctly resulting in improper response plans or the need to delay the launch		Low	There is risk when two programs need to work together and there is little communication. There is also risk due to future procurements	Mitigate	We have decided to not merge the DSS/Rules Engines of the two programs	PATH/D7/Parsons (Joe, Allen, Dan)	2/9/2017
	15	Threat	AMS	Code Sharing	As a result of inadequate sharing of code among Caltrans systems and vendors the system may not work correctly resulting in improper response plans or the need to delay the launch		Low	Current experience	Mitigate	PATH has received the needed code.	PATH/D7/HQ (Joe, Allen, Mike J)	2/9/2017
	16	Threat	AMS	Routing	As a result of inadequate or ineffective signage and messaging motorists do not follow our recommendations		Medium	Unknown risks with a high potential for disrupting our success. Would like more signs on freeway.	Accept	Commission a study on this and look at the recommendations	PATH (Joe)	

	17	Threat	AMS	Routing	As a result of inadequate partnerships with 3rd party information providers, motorists do not follow our recommendations		Medium	Current problems exist already in the corridor	Mitigate	Start discussions with 3rd Party providers	Caltrans (??)	
	18	Threat	AMS	Signal Timing Plans	As a result of inability to agree or generate signal timing plans the launch date of the pilot may slip.		Medium	This has been a point of contention in the past	Accept	Continue to work this	PATH and all core stakeholders (Francois)	
	19	Threat	Software	IEN - Signal Control	As a result of delivery dates for the IEN, signal lights will not be able to be controlled and we will slip the launch date		Medium	We have decided to not use the IEN.	Mitigate	We have decided to not use the IEN for the pilot. Now the risk moves to obtaining an alternative.	PATH/D7/County (Joe, Allen, Jane)	2/9/2017
	20	Threat	Software	IEN - CMS Control	As a result of delivery dates for the IEN, local wayfinding signs will not be able to be controlled and we will slip the launch date		High	We have decided to not use the IEN but still need to determine a solution for wayfinding signs.	Mitigate	Strong management focus	PATH/D7/County (Joe, Allen, Jane)	
	21	Threat	Software	Call for Projects Software	As a result of the Call for Projects software portion not being delivered on time the CC launch date will slip		Medium	There is not a solid resourced plan in place	Mitigate	Management focus	Caltrans D7 (Allen)	
	22	Threat	Software	Data Hub	As a result of the data hub not working the launch will be delayed		High	High because of critical component, timing requirements, small funding risk and normal software risks.	Mitigate	We are highly focused on delivering this on time.	PATH (Brian)	
	23	Threat	Software	PEMS	As a result of PEMS not being updated the project will not be able to properly measure or visualize results		Medium	There seems to be some questions at HQ regarding the general way in which these requirements should be met.	Mitigate	Caltrans to answer	Caltrans HQ (Raj)	

	24	Threat	Software	Purple Box	As a result of the Purple Box functionality not being delivered the launch date will need to slip		High	Criticality, complexity, potential contract issues.	Mitigate	Meet with vendors and work out an acceptable strategy	PATH (Joe)	
	25	Threat	Software	Resources	As a result of turnover, inability to hire critical resources and the general competitiveness of the market the project may slip		Medium	Experience	Mitigate	Continue good management, line up small consulting contracts that can be expanded in an emergency.	PATH (Brian)	