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Connected Corridors: I-210 Pilot Verification Plan

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1. Introduction

The “I-210 Integrated Corridor Management (ICM) System Pilot” project, 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. This document provides a verification guideline for the I-210 Pilot project systems development.

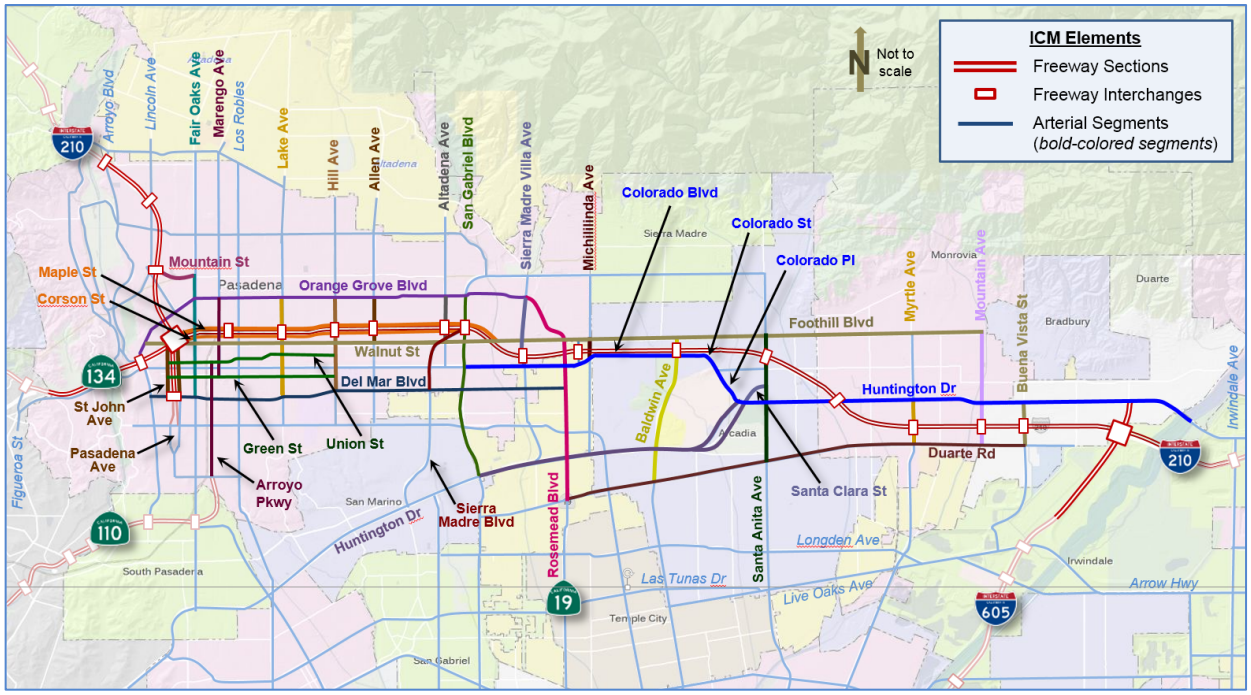

Figure 1-1 I-210 Pilot Map

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2. Purpose of Document

The verification plan specifies the methods of verification to be used for testing the ICM system operations. This including test strategies, definitions of what will be tested, the levels to which different system elements will be tested, and a test matrix with detailed mapping connecting the testing performed to the system requirements. This verification plan ensures that all requirements specified in the System Requirements document have been met and reviewed. The test strategies presented ensure that the testing defined for each system component and the integration of these components shall meet the system requirements.

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3. Scope

3.1 Scope of this document

This is the verification plan for the release of the "I-210 Pilot." This document defines the scope, approach, resources, schedule, and risks/mitigations for testing this project. The test cases as outlined in Section 8 have been reviewed and approved to ensure completeness of the testing, as well as determine the testing schedule. The test cases can be managed using this document or within a test case management system. Detailed test cases are not included in this document, but will be maintained within a test case management system. Any major changes to testing will be documented and approved through the verification plan and new or revised test cases shall also be reviewed and approved.

3.2 System requirements scope

The purpose of the I-210 Pilot is to reduce congestion and improve overall corridor performance along a section of I-210 corridor in Los Angeles County. The improvements will be achieved by developing and deploying the ICM system. At the heart of the proposed system will be a Decision Support System (DSS) designed to help corridor system operators manage incidents, unscheduled events, and planned events more effectively. This system will use information gathered from monitoring systems and provided by predictive analytical tools to estimate current and near-future operational performance. The information will be used to develop recommended courses of action to address problems caused by identified incidents and events. More specifically, this system is expected to:

- 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
- Be able to evaluate alternative system management strategies and recommend desired courses of action in response to planned events, unscheduled events, and incidents
- Improve decision-making by transportation system managers
- Improve collaboration among agencies operating transportation systems in the corridor
- Improve the utilization of existing infrastructures and systems
- More efficiently use spare capacity to address non-recurring congestion
- Reduce delays and travel times along freeways and arterials
- Improve travel time reliability
- Help reduce the number of accidents occurring along the corridor
- Reduce the period during which the congestion resulting from an incident or event affects corridor operations

- Reduce greenhouse gas emissions
- Generate higher traveler satisfaction rates
- Increase the overall livability of communities in and around the I-210 corridor

Refer to “I-210 Pilot -High-Level Design “ and “I-210 Pilot-System Requirements” documents for further details.

3.2.1 In Scope

In general, the scope of the requirements is to improve corridor-wide traffic conditions particularly during an incident, unscheduled event, or planned event. This means the requirements are focused on:

- Providing better information to transportation operators and travelers regarding incidents and events—This includes the creation and deployment of “incident response plans.” It is not focused on managing the incident or event itself, however, better data could potentially enable a faster response and reduce the impact an incident or event has on corridor conditions.
- Operations at the corridor level—Rather than focusing on freeways alone, the requirements define a system that uses freeways, arterials, and alternative modes of travel in a coordinated way to assist with traffic/traveler management around an incident or event.
- Improving communications and data flow between the transportation operators within the I-210 corridor.

3.2.2 Out of Scope

The requirements are not focused on:

- Managing normal daily traffic— The system shall not be used to improve normal day-to-day traffic on an ongoing basis.
- Managing the scene of an incident/event—While the system will divert travelers around an incident or event, it is not intended to manage what happens at the incident/event itself. That remains under the control of emergency responders. For example, the proposed system:
    - Does not expect first responders to change their processes or priorities at the incident scene or event location. It will request communication from first responders as part of the ICM process, but it will not alter responders’ internal methods already in place for incident/event management.
    - Does not suggest road or lane closures. Safety officers on the scene will determine which lanes to close and for how long. The ICM system only requires input on which lanes are closed, how long the closures will last, and when the lanes are expected to be reopened.
    - Does not suggest or enable routes for first responders to reach an incident or event location.

4. Roles and responsibilities

In the context of the I-210 Pilot, implementation of the Quality Management Plan will rest primarily with the QA Lead. Significant oversight duties will also be assigned to the Caltrans Project Manager and PATH Project Manager.
Table 4-1 lists the Roles and Responsibilities related for QA/QC. This table has been copied in its entirety from the "I-210 Pilot - Project Management Plan"-Table 10-1.

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 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

Table 4-1 Roles and Responsibilities for QA/QC

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5. System High level Description

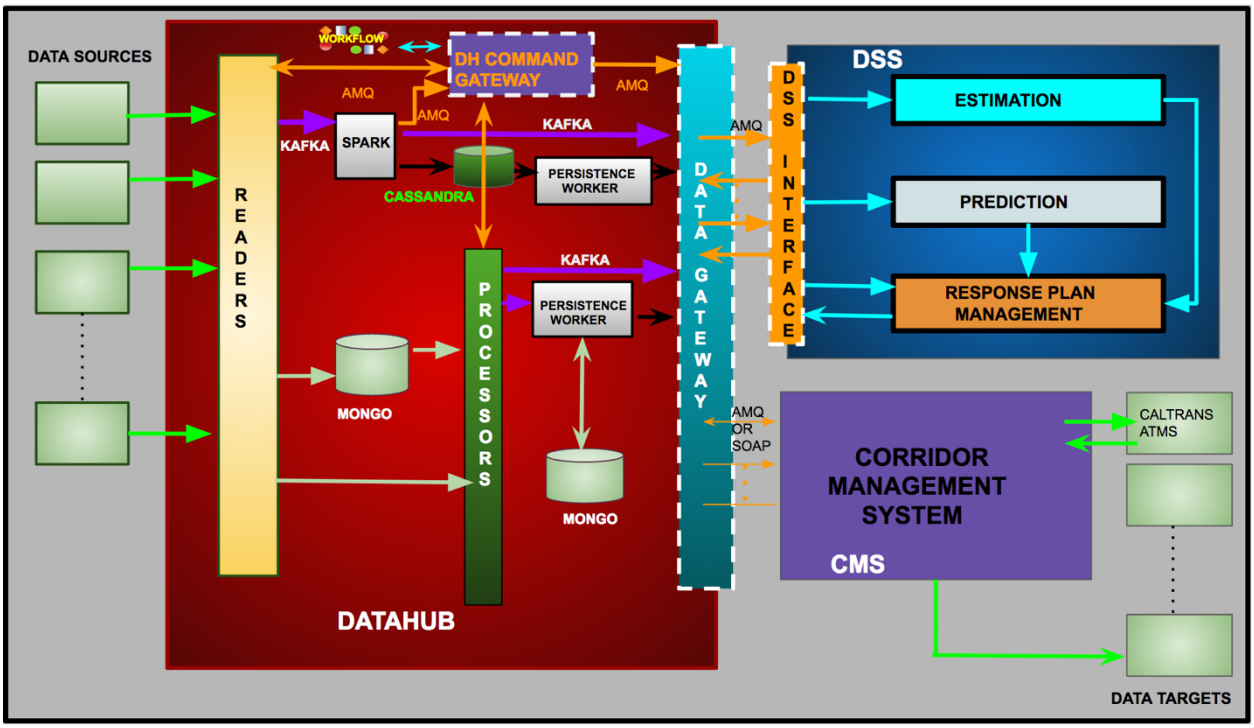

Figure 5-1 System High Level Design

Figure 5-1 provides an illustration of the I-210 system design. The system is divided into three major subsystems – the data hub, decision support system (DSS), and the Corridor Management System (CMS). The data hub is illustrated in the diagram in red, the DSS in blue, and the CMS in purple. Data flow is generally left to right in the diagram.

Data from field devices (e.g. intersection signals, sensing, ramp meters, and dynamic message signs) are provided to the system by traffic management centers (TMCs) (illustrated in green). The TMCs are managed by the local agencies and Caltrans. The left side of the diagram illustrates each of the TMCs providing data from their field devices. It is a critical design constraint that the ICM system never directly communicate with or provide commands to a field device.

The data hub has five primary responsibilities: receive data from each TMC, verify data quality and process the data for the CMS and DSS, provide a communications bus for managing data between the DSS, CMS, and data hub, provide data storage (including moving data to PeMS for archival storage and analytics), and secure the data. It does receive data by first communicating with each TMC source and collecting data from that source via a reader. Readers are specific to

their source and are the beginning of the data pipeline. The pipelines are used to move and process data throughout the system.

From each reader, the data is transferred either to a messaging system for streaming data or Mongo. Mongo will be used for larger data sets that are updated less frequently. Next the data is processed using a dedicated processor for each type of data, either a java process or within Apache Spark (streaming cases). Processors transform the data to a standard format, perform quality checks, process the data, and in some cases, provide machine learning services such as predictions for the data received. Data is then passed downstream in each pipeline on the messaging system.

Data is persisted using persistence workers that listen to the processed data messaging topics, and then store the data in either Cassandra or Mongo. Persistence workers also provide retrieval services for each data store.

Processed data is also passed to the data hub data gateway. The data gateway provides an external interface from the data hub to the Corridor Management System and the Decision Support System. The data hub data gateway provides routing of information to both the DSS and the CMS, and provides a method of routing information between the DSS and CMS as well, while guaranteeing the standardization of interfaces and capturing of any communication between the DSS and CMS.

The data hub control gateway is a data hub component that provides orchestration and workflow management of control and status messages for the data hub, as well as the DSS and CMS. It uses Netflix Conductor to provide workflow management and orchestration services to the entire system.

The DSS interface's primary roles are to provide an estimate of current traffic state for display to the operator (in the CMS interface) and provide response plans and response plan evaluation services. The DSS has three main components: response plan management, the rules engine, and modeling. The response plan management component receives incident information and coordinates the development and evaluation of response plans. The rules engine provides logic and rules to: decide when response plans should be generated, develop response plans for evaluation, and evaluate and rank response plans. The modeling component provides traffic estimation and prediction capabilities to support response plan creation, evaluation, and ranking. Communications between the response plan management and modeling are enabled via REST and ActiveMQ messaging.

The CMS system provides an interface for the ICM operator, is the source of incident information, allows the operator and stakeholders to view and approve or reject response plans, and upon response plan approval, executes the commands required to send the

approved response plan to the TMCs to implement. The green boxes on the right side of Figure 5-1 are the same TMCs illustrated on the left side of the figure, but the data flows displayed on the right, represent the commands sent to the TMCs to implement the response plan selected.

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6. Technology Stack

The technology stack includes the following:

- The primary components are built using Java 7 or 8 with the Spring framework. Hibernate is used with components requiring Postgres access.
- Persistence is built with Java based persistence workers (both for store and retrieve operations) and Postgres, Mongo, or Cassandra for persistence.
- Messaging via ActiveMQ and Kafka
- Apache Tomcat
- Log Management via Graylog
- Apache Spark
- Apache Camel
- Amazon Web Services, including the following AWS services:
    - EC2
    - RDS (Postgres)
    - S3
    - VPC
    - IAM
    - EMR
    - Other services for code repository, build, and deployment services
- Platform/Application Servers/OS
    - Most any version of Linux OS is acceptable, Ubuntu 14.04 is the current standard
    - Tomcat v8.5.1

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7. Primary Use Case

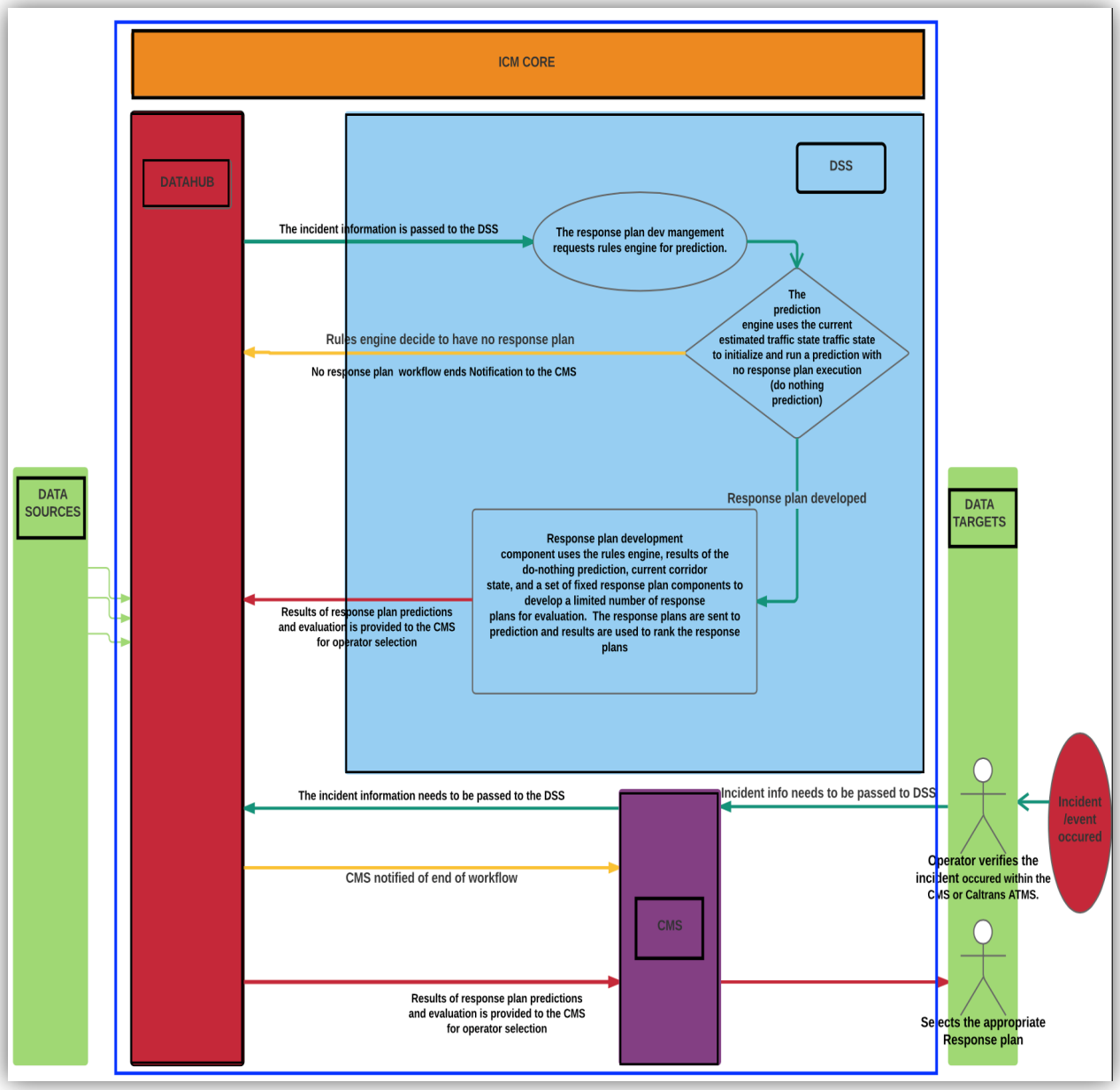

Figure 7-1 Primary Use Case

Figure 7-1 provides an illustration of the system's primary use case. This use case can be described as follows:

Name:		**Freeway Incident**
Description:		**Freeway incident occurs and is initiated at Caltrans TMC using ATMS**
Actors:		**Caltrans Operator/CT Operator** **Caltrans ATMS** **Corridor Management System** **Data Hub** **Decision Support System**
Basic Flow		
	Actor	Action
1	Freeway	Incident occurs and is reported to TMC
2	CT Operator	Inputs incident information, confirms incident
3	Caltrans ATMS	Incident passed to Corridor Management System
4	CMS	CMS registers confirmed event, passes to Data Hub, informs users
5	Data Hub	Data hub begins incident workflow, requests response plan from DSS
6	DSS	Response plan development requests "do nothing" prediction from modeling
7	DSS	Do nothing prediction completed using current estimated traffic state – results provided to response plan development
8	DSS	Response plan development uses the "do nothing" prediction and the rules engine to determine if a response plan should be developed
9	DSS	(Assuming response plan is required) The response plan development component uses the rules engine, results of the "do-nothing" prediction, current corridor state, and a set of fixed response plan components to develop a limited number of response plans for evaluation. It submits those response plans to the prediction engine.
10	DSS	The prediction engine runs a prediction for each response plan, along with another "do nothing "prediction" based on current corridor conditions. It provides the results of those predictions to the response plan development component.
11	DSS	The response plan development component uses the results of each prediction, current corridor state, and the rules engine to evaluate, rank, and select a recommended response plan. It provides the recommended response and the other response plans and their results to the Data Hub.
12	Data Hub	The Data Hub stores all results of the response plan request received from the DSS and forwards the recommended response plan and its results to the CMS.
13	CMS	The CMS provides the results to the ATMS.
14	CMS	The CMS provides the results to local agencies, who approve or reject the

		response plan.
15	ATMS	The ATMS provides the results to the operator.
16	Operator	The Caltrans Operator reviews and approves the response plan.
17	ATMS	The ATMS sends the approval results to the CMS.
18	CMS	The CMS verifies that all required jurisdictions have approved the plan.
19	CMS	The CMS sends the full results of approval to the ATMS and the Data Hub.
20	CMS	(Assuming all jurisdictions have approved the plan) The CMS sends the execution commands required to implement the response plan to each affected TMC.
21	TMCs	The TMCs execute the commands required to implement the response plan.
22	TMCs	The TMCs report asset status changes as the assets implement the response plan commands.
Alternative Flow 1		
9A	DSS	No response plan is required. DSS informs Data Hub workflow that no response plan is required or will be developed.
10A	Data Hub	Data Hub informs CMS that no response plan is required.
11A	CMS	CMS informs ATMS that no response plan is required. Closes incident and informs users.
Alternative Flow 2		
20B	CMS	The CMS displays disapproval of the plan.
21B	Data Hub	The Data Hub ends response plan workflow.

Table 7-1 Primary Use Case Description

Upon completion of this primary workflow, further processes involved in response plan life cycle management will occur, such as response plan evaluation, response plan generation to adjust to current conditions, response plan cancellation, and response plan closeout.

Other major use cases for which testing will be defined include the following:

- Planned Event
- Unplanned Event
- Second Incident or Event in Overlapping Zones of Influence
- Second Incident or Event in Non-Overlapping Zones of Influence
- Cancel or End Response Plan Implementation
- Operation during period of no incidents or events
- Archive to PeMS
- Archive to Glacier
- Operational Reporting
- Data Pipeline Failure

- Data Pipeline Resume Operations
- Event or Incident requiring response plan where no response plan is available
- DSS only response plan development

8. Testing Description and Coverage

This section describes the testing and test coverage for this system, with a description of the test setup and test strategy, including types of testing. In general, the following types of testing will be included in system testing, in either manual or automated tests:

- Unit
- Functional
- Performance
- Integration
- Security
- Regression
- API
- Acceptance

Testing will cover primarily the data hub and decision support systems. Testing of the corridor management systems (CMS) will be the responsibility of each CMS vendor. Integration testing of each CMS will be part of each CMS integration effort and evaluation.

8.1 Test Setup

Throughout the development process, a minimum of two full system environments are maintained. The development environment is where development occurs and unit tests are run. A test environment is also maintained identical to the development environment (at the last development release) for the purpose of system testing in accordance with this plan. Both development and test environments shall be versions of the target production environment (up to the current state of development) so that upon delivery, the system will be tested in an environment identical to the target development environment.

The test setup will include some additions to allow for testing including:

- Test automation server(s)
- Specific test data components to allow data sources for loading of specific data sets to data hub data pipelines, component interfaces, or system data stores
- Test monitoring components

8.2 Test strategy and coverage

8.2.1 Testing Strategy, Scope and Approach

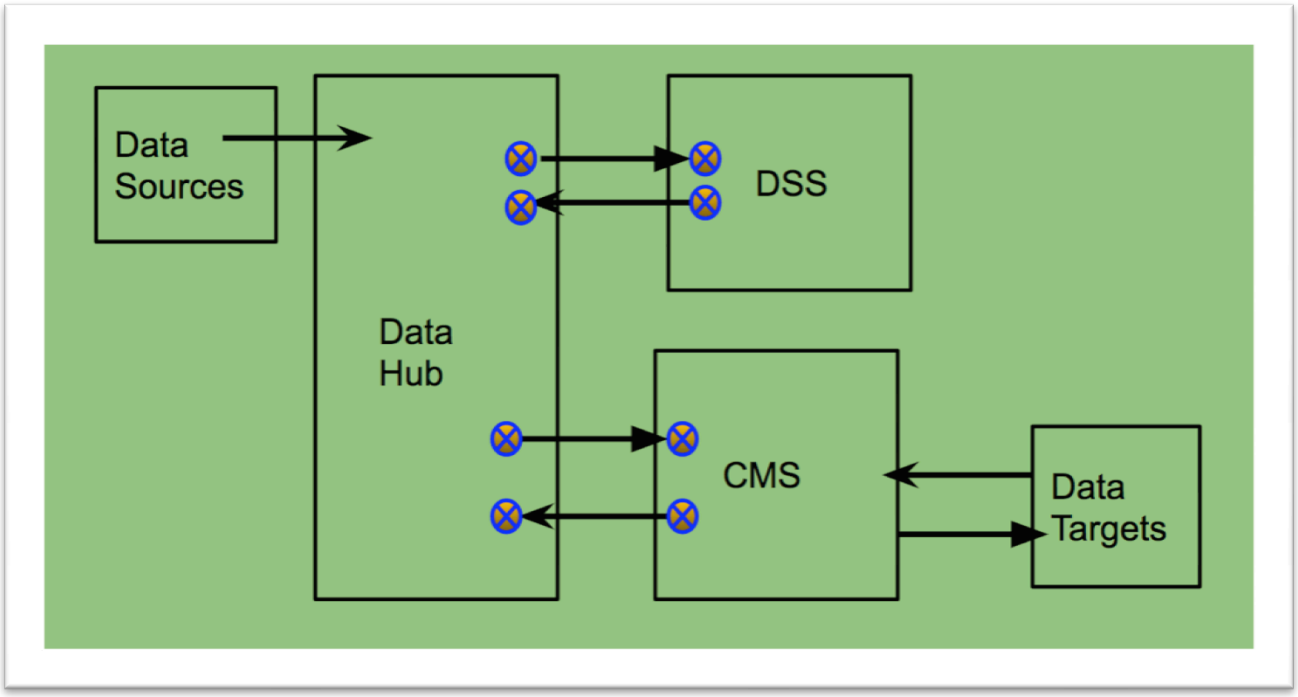

Figure 8-1 System Primary Test Hooks

The test strategy is defined based on the following principles and constraints:

- There are three independent primary subsystems that operate based on defined communication contracts between the subsystems and external data providers and receivers of commands (TMCs).
- Each primary subsystem shall be tested independently and as an integrated system, primarily at the primary test hooks designated by the arrows in Figure 8-1.
- There are three Corridor Management Subsystems, each provided by a separate vendor that will operate interchangeably with the other two subsystems. Testing for each of these subsystems is the responsibility of each vendor.
- Integration testing of the DSS and Data Hub are the responsibility of PATH. Integration testing of the CMS will be part of the evaluation of each vendor's system and is not described in this plan.
- Testing of the Data Hub interfaces provided for the CMS is described within this plan.
- There are limited resources available for development and testing of the system. This is a critical constraint that must be considered in development of testing.
- The Data Hub will be tested primarily using the external interfaces provided by the Data Hub.

- The DSS will be tested primarily using the external interfaces provided by the DSS.
- Integration testing of the Data Hub and DSS will be accomplished using a mockup of the CMS.
- Automated testing will be the preferred testing method.
- Integration testing will be a continuous process as each of the three CMS vendors are transitioned in and out of the production environment.
- There will be a single dedicated test environment that will be a mirror of the intended production environment. This will include connections to each data source. This will not include the ability to send commands to corridor assets via the TMCs.

8.2.1.1 Code/Test Coverage

Due to limited resources and high complexity of the system, there will be a limitation on test coverage and test automation. This will be addressed on a case-by-case basis depending upon the priority and criticality of each implemented requirement to be tested. The goal is to have sufficient coverage to ensure the system can be deployed with sufficient functionality and safety. Limited resources are a risk identified for this project.
To add to the complexity, there are three CMS vendors which need to be integrated with the system. There will be a limitation on regression testing with each new vendor integration with no guarantees of full interchangeability, but each vendor's product integration will be verified to ensure basic functionality.

8.2.1.2 Test Automation and Automation Criteria

Testing will include both manual and automated tests. In general, the following criteria will be used to determine if a test is to be automated:

8.2.1.2.1 Manual Testing

High priority test cases that cannot be automated will be tested manually. Lower priority tests, such as testing logging should be executed manually. Any test that cannot be automated will be executed manually. REST API & SOAP requests should be tested manually before they can be automated. Initially, connections to AMQ, Cassandra, Kafka, Postgres are tested manually.

8.2.1.2.2 Automation Testing

Acceptance test and high priority tests will be automated, unless manual intervention is required. JMeter scripting shall be used to automate testing when connecting to AMQ or Kafka; for database verification queries to Cassandra, Postgres, or Mongo; and, for REST or SOAP web service requests. Automation will be used to process the results obtained and compared with expected results.

Test cases to be automated are designated as automation test candidates in the test matrix. Not all automation test candidates shall be automated, but all automation test candidates shall, at a minimum, be tested manually.

8.2.1.3 Testing Scope

8.2.1.3.1 Types of Testing

The types of testing will include:

- Unit Tests
- Functional Tests
- API Tests
- Integration Tests
- Security Tests
- Performance and Stability Tests
- Acceptance Tests
- Regression Tests

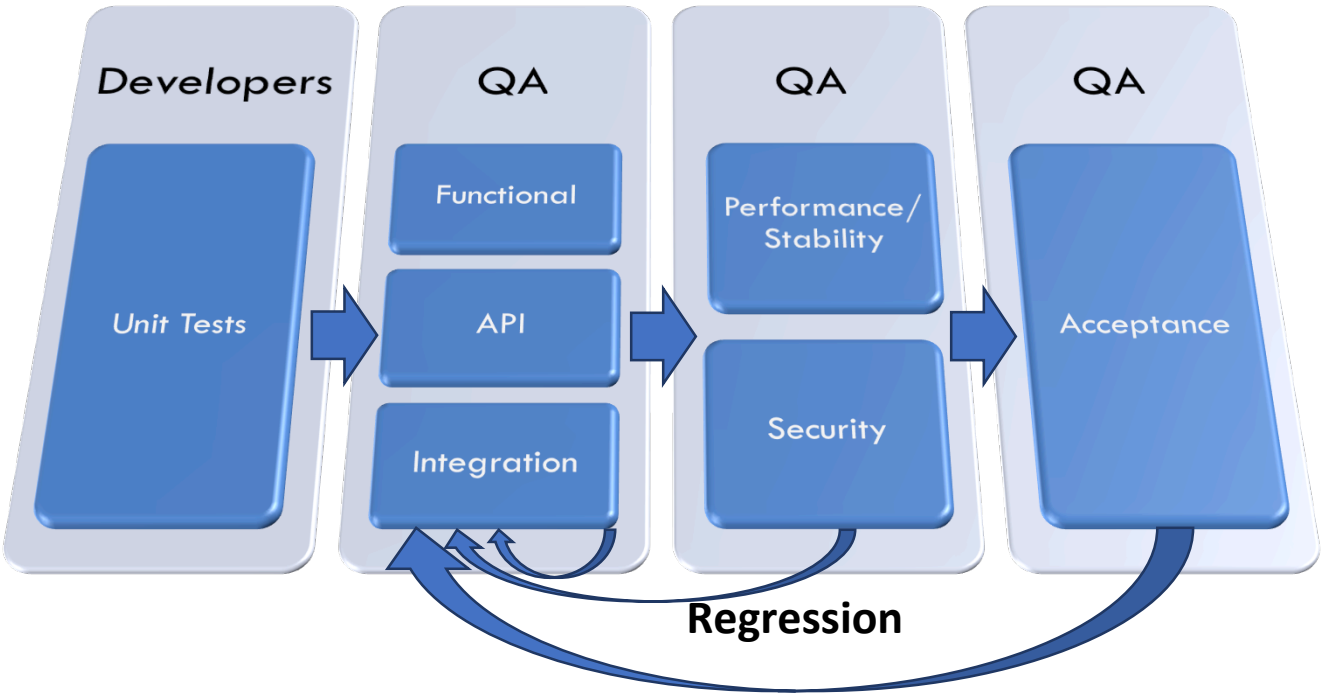

Figure 8-2 Test Case Life Cycle

In general, testing of the software shall flow as follows:

Developers unit test code as they develop individual code elements. Unit tests are run at each code build and deploy. Continuous integration ensures that this occurs automatically whenever a developer changes code.

Functional tests defined and run by the QA engineer for each discrete system function delivered by the development team upon delivery to the test environment.

API Tests are defined and run by the QA engineer for each API interface delivered by the development team upon delivery to the test environment.

Integration tests are tests that ensure functionality across the boundaries of the three primary subsystems, this includes functions that cross internal system boundaries or functions that cross the system boundary to external systems.

Functions are grouped into features for delivery into a production environment. The QA engineer develops and runs acceptance tests for each released feature upon delivery to the test environment.

Regression tests are collections of functional, acceptance, or other tests that, upon successful delivery (passing of the functional or acceptance test in the test environment), are run with every subsequent delivery to the test environment. The QA engineer ensures that regression tests are defined, maintained, and run on every subsequent delivery to the test environment.

Other testing will proceed on an ad-hoc basis depending upon the specifics of the tests. These include security, performance, stability, and documentation tests. Security tests are run in accordance with specific test cases developed according to their own test schedule. Performance and Stability tests are run in accordance with specific test cases designed to ensure sufficient system performance criteria and system stability criteria according to their own test schedule.

8.2.1.3.2 Unit Testing

All code developed by PATH will be unit tested. Unit test coverage will depend upon criticality of each component and will be determined jointly by the QA team and the development team.

8.2.1.3.3 Functional Testing

Functional testing ensures the functions of the system work as expected and are a part of the exit acceptance criteria for every system or module. Automated functional tests are executed every sprint as a regression test to ensure that no changes introduced within a sprint introduces new failure modes within the system. The following items are a very high level representation of what functional tests are in place for modules/components. The functional

tests are elaborated during each sprint as the modules and systems are completed by the development team.

8.2.1.3.3.1 Data Hub Data Pipelines

Each data pipeline will be tested to verify the following:

- Data integrity
- Data quality and calculated quality indicators
- Data processing
- Pipeline failure handling
- Data persistence
- Delivery to correct data gateway endpoint(s)
- Pipeline control

8.2.1.3.3.2 DSS (traffic estimation)

Traffic estimation will be tested for correct estimation (arterial and freeway) and process status reporting at DSS interfaces. Traffic estimations produced will be reviewed by researchers to verify estimations are within target accuracies for each critical estimation result (density, speed, flow). Regression tests may require set conditions (specified PeMS data set, scenario, and parameter set).

8.2.1.3.3.3 DSS (traffic prediction)

Traffic prediction will be tested for correct prediction (arterial and freeway) and process status reporting at DSS interfaces. Traffic predictions produced will be reviewed by researchers to verify predictions are within target prediction parameters. Researchers will also review initial traffic state provided by estimation to ensure a correct reproduction of initial traffic state. Regression tests will require set conditions (specified data sets, scenario, and parameters).

8.2.1.3.3.4 DSS (response plan generation)

Response plan generation will be tested at the DSS interface. Response plan generation will be tested under a set of fixed initial conditions including sensing and traffic asset data and a fixed set of rules. Researchers will review the created response plans to ensure the correct response plans are generated. Following testing with a fixed set of initial conditions and rules, the initial conditions and rules shall be varied and the results reviewed again to ensure proper operation.

8.2.1.3.3.5 Data Hub Orchestration and Workflow

Each workflow defined within the Data Hub's Conductor within the Command Gateway shall be verified, including primary and sub-workflows. Each possible workflow outcome and each workflow branch operation shall be verified under varying conditions.

8.2.1.3.4 API Testing

Refer to the design diagram “ICM Design - Full_2.pdf”.
API testing for the design diagram listed will be conducted for the data hub and DSS interface boundaries. Testing of the CMS interfaces is the responsibility of each CMS vendor and shall be verified during CMS evaluations. Each endpoint shall be tested for the following:

- Endpoint functionality
- Validation of API correctness with API design (format, configuration, frequency, protocol)
- Failover and recovery capability when required

In general, API testing will be part of functional, workflow, or acceptance testing, given the large number of interfaces and limited resources. Specific and comprehensive API testing will be limited based on risk assessment, issues identified during other testing, and workload priorities.

8.2.1.3.5 Integration testing

Each of the primary system components (Data hub, DSS, CMS) will be tested individually. End to end testing of these components for the various system processes is the objective of integration testing. As there are three different CMS vendor products being integrated, one at a time, the initial integration testing will be limited to the Data Hub and DSS, with a mock of the CMS interfaces. This testing will primarily be driven by the primary use case of incident management. As each CMS product is integrated, integration tests will be defined in cooperation with the CMS vendor based on the initial Data Hub and DSS integration, as well as secondary use case testing similar to the high-level test scenarios defined below.

Estimation:	Freeway and arterial estimation
Prediction:	Freeway and arterial prediction
Incident:	End to end from incident generation to response plan development
Failure cases – loss of instances/AWS services/system services	CMS integration and recovery after AWS recovery ATMS and CMS recovery
Pipelines:	40 pipelines prioritization
CMS integration checks:	Three vendor system integration and regression test

	execution
Caltrans ATMS integration:	Incident generation notification from ATMS to three vendor system integrations and regression test execution.
Multi-incident:	Handling of multiple simultaneous incidents
Data verification across system boundaries checks:	Data integrity is maintained for the data sources coming into the data hub, going out of the data hub, coming into the DSS.
Out of sequence data checks/validation/ late data:	Data integrity is maintained for the data sources coming into the data hub, going out of the data hub, coming into the DSS.
Loss of source resiliency – verify correctness when comes back on line:	Components going down, attempts of recover. How various components crashing or not available is handled.

Table 8-1 High Level Test Scenario

8.2.1.3.6 Security testing

Security testing will include a number of components, with tests that include:

- Initial review of security best practices implementation conducted jointly with Caltrans IT and PATH.
- Review of AWS Trusted Advisor results conducted by Caltrans IT and PATH.
- Tests for correct handling of malformed SOAP messages at Data hub external interfaces.
- Scanning Data Hub external interfaces using an open source scanning tool such as OWASP Zed Attack Proxy.

8.2.1.3.7 Performance testing

Performance tests will include tests to ensure the system performs at a level sufficient for 120 days of operation in accordance with the up-time requirements listed within the system requirements. This time period is chosen to simulate the data volumes expected to be stored at any time in the data hub. Testing will simulate 120 days of operation. This performance testing will include:

- Data pipeline performance
- Response plan generation performance
- Incident management lifecycle performance
- Multiple incident handling performance
- Logging system performance

Each of these performance test areas shall use a set of mock CMS endpoints. CMS performance will be evaluated as part of each CMS vendor evaluation.

8.2.1.3.8 Stability testing

Tests to determine the robustness of the components involved in ICM shall be completed. These tests will include the following:

- Stability in loss of data sources and pipeline components
- Stability in loss of ability to implement response plans due to non-responding assets (limited to Data Hub and DSS testing)

Testing will also include monitoring and reporting of system stability during testing and evaluation periods.

8.2.1.3.9 Acceptance test

Acceptance testing shall include testing of a subset of the requirements listed within the verification matrix. Each major system feature shall be tested as they are delivered by the development team to the test environment. The full matrix of tests developed during this process shall constitute the suite of acceptance tests for the system.

Acceptance tests for each sprint will be executed at least every week for reporting purposes.

8.2.1.3.10 Regression testing

Regression testing is the testing of existing software functionality that has been previously completed and tested to ensure that a change or addition to the software hasn't broken the existing functionality. Such tests can be performed manually on small projects, but in most cases, manual testing is too time-consuming and complicated. Each sprint will have the functional tests for that sprint automated for purposes of regression testing. Regression testing will be run on an ongoing, regularly scheduled basis to identify any issues as early in the development cycle as possible, with a minimum of at least once per sprint.

8.2.2 Entry and Exit Criteria

- The entry criteria refer to the desirable conditions necessary to start test execution.
- The exit criteria are the desirable conditions that need to be met following the completion of testing in order to proceed with the implementation.
- Entry and exit criteria are flexible benchmarks. If they are not met, the test team will consult with the development team and program management and assess the risk, identify mitigation actions, and provide a recommendation.

8.2.2.1 Minimum Entry and Exit Criteria

The minimum entry criteria to start each test cycle include the following:

- Develop test plan and guidelines to create test conditions, test cases, expected results and execution scripts.
- Provide guidelines on how to manage defects.
- Developers communicate to the test team any changes that need to be made to the test deliverables or application and when they will be completed.

The minimum exit criteria to proceed to deployment following each test cycle include the following:

- 100% of test scripts are executed
- No open Critical or major severity defects
- All remaining valid defects are documented for correction within a future release
- All expected and actual results are captured and documented within the test scripts
- All test metrics collected
- All defects logged in Jira

8.2.2.2 Test Execution

- There will be functional testing executed every sprint. Each cycle will execute all of the required test scripts.
- The objective of each execution is to identify any blocking, critical defects, and most of the major defects. It is expected to use some work-arounds in order to complete all of the test scripts.
- The objective of the final sprint execution is to identify remaining major and minor defects, remove any work-arounds from the previous sprints, correct gaps in the scripts and obtain performance results.
- Acceptance tests will be completed every sprint derived from the completed functional tests.

8.2.2.3 Validation and Defect Management

- It is expected that the testers execute all of the scripts in each of the cycles described above, as well as defining and completing additional testing if they identify gaps in the test scripts. If a gap is identified, the scripts and traceability matrix will be updated and then a defect logged against the scripts.
- The defects will be tracked through Jira only. The technical team will work on fixes.
- It is the responsibility of the tester to open the defects, link them to the corresponding script, assign an initial severity and status, retest and close the defect.
- It is the responsibility of the tester to review the severity of defects and facilitate with the development team the fix and its implementation, determine when the test can continue or should be halted, retest, and modify the status as the defect progresses through the cycle.
- It is the responsibility of the development team to review Jira on a daily basis, ask for details if necessary, fix the defect, communicate to the tester when the fix is complete, and implement the solution.

Defects found during the Testing will be categorized according to the bug-reporting tool “Jira” and the categories are:

Severity	Impact
1 (Blocker)	• Crashes the system • Causes the application to hang • Stops testing effort
2 (Critical)	• It causes a lack of vital program functionality with workaround.
3 (Major)	• This bug will degrade the quality of the system. There is a workaround for achieving the desired functionality. • This bug prevents other areas of the product from being tested. However other areas can be independently tested.
4 (Minor)	• There is an insufficient or unclear error message, which has minimum impact on product use.
5(Trivial)	• Cosmetic /enhancement

Table 8-2 Defect Categories

8.2.2.4 Test Metrics

Test metrics to measure the progress and level of success of testing will be developed and shared with the project manager for approval.

8.2.2.5 Defect Tracking & Reporting

The following diagram outlines the typical bug tracking or Jira ticket workflow to be used by the test and engineering team.

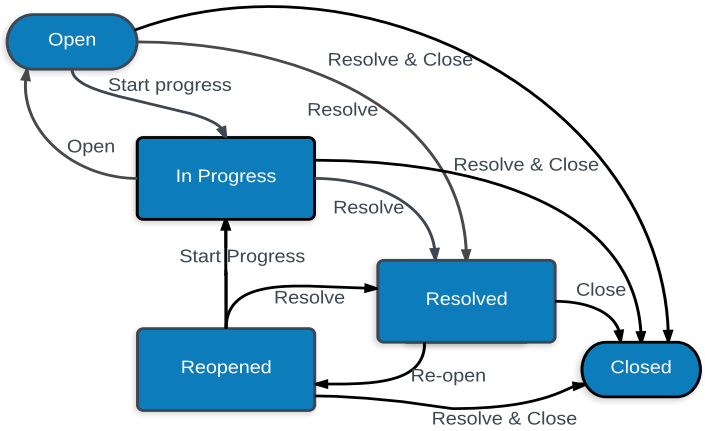

Figure 8-3 Defect Tracking Process

8.2.2.5.1 Opening a defect:

The following guidelines should be followed while creating a defect log in Jira:

- **Issue Type**: Bug
- **Summary**: Brief summary about the issue
- **Priority**: Blocker, Critical, Major, Minor, Trivial
- **Assignee:** Brian Peterson or Jeny Govindan. Assignee in turn assigns to a developer.
- **Label:** System component, function, or test description
- **Description**: Precondition, steps to reproduce, observed and expected behavior description
- **Attachments**: Related snapshot of the issue, Graylog attachments
- **Sprint**: Blockers should be assigned to the same sprint
- **Environment**: Specify if tested against Dev or Test environment

8.3 Verification Matrix

To define suitable, quality objectives, the issues and needs associated with each identified group of customers will be cataloged and used to create the Requirements Traceability Matrix "Table 10-2 – Requirements Traceability Matrix" listed in the I-210 Pilot - Project Management Plan.docx. The matrix couples 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.
The high-level verification matrix below is based on the I-210 Pilot - System Requirements document. Acceptance testing is a subset of this verification matrix.
Testing is limited to data management, decision support, and corridor management subsystem matrix elements that are listed with a criticality of High. As resources permit, medium and low

criticality tests will be defined when the requirement is addressed. Institutional Job Tasks are not considered part of this testing. Tests that are part of the vendor supplied corridor management system are generally tested as part of the vendor system evaluation as identified in the following section.

Table 8-3 Test Matrix

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1 Test Matrix for I-210 pilot project						
8.3.1.1 Institutional Requirements						
8.3.1.1.1 Corridor Strategic Planning						
IN-1.1	The Corridor Manager, in coordination with stakeholders, shall track anticipated changes to the ICM corridor's roadway network.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.2	The Corridor Manager, in coordination with stakeholders, shall track anticipated changes to the ICM corridor's transit networks of interest.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.3	The Corridor Manager, in coordination with stakeholders, shall track anticipated changes to the corridor's traffic control devices (traffic signals, ramp meters, others).	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.4	The Corridor Manager, in coordination with stakeholders, shall track anticipated changes to the corridor's traveler information devices (CMS, extinguishable trailblazer signs, etc.).	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.5	The Corridor Manager, in coordination with stakeholders, shall track required changes to existing sensors and sensor locations.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.6	The Corridor Manager, in coordination with stakeholders, shall track	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	anticipated changes to the metrics that must be provided by the ICM system.					
IN-1.7	The Corridor Manager, in coordination with stakeholders, shall determine requirements for new metrics.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.8	The Corridor Manager, in coordination with stakeholders, shall maintain a strategic plan for performance metric calculation.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.9	The Corridor Manager, in coordination with stakeholders, shall maintain a strategic plan for data collection.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-1.10	The Corridor Manager, in coordination with stakeholders, shall maintain a strategic plan for corridor control.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.2 Asset Existence						
IN-2.1	Stakeholders shall ensure sensing assets required by the corridor strategic plan are available.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-2.2	Stakeholders shall ensure traffic control assets required by the corridor strategic plan are available.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-2.3	Stakeholders shall ensure traveler information assets required by the corridor strategic plan are available.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-2.4	Stakeholders shall ensure transit assets required by the corridor strategic plan are available.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.3 Corridor Champions						
IN-3.1	Corridor Champions shall be high-level staff persons or elected officials with interest in transportation/transit issues.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
IN-3.2	Corridor Champions shall have longevity (for example, if an elected official, someone who is not termed out in the next year or so, if possible).	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-3.3	A list of current Corridor Champions from each stakeholder agency shall be developed and maintained by the Outreach and Communications Manager.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-3.4	The list of current Corridor Champions shall be distributed to all project stakeholders.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-3.5	Corridor Champion(s) shall be replaced if previous champion(s) leave.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.4 Organizational Composition and Structure						
IN-4.1	The Connected Corridors Steering Committee shall define roles, responsibilities, and reporting structures for the ICM system.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-4.2	Job descriptions shall be written for supporting ICM roles.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-4.3	Stakeholder agencies shall ensure that ICM staff are in place and trained.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-4.4	Oversight and advisory committees shall be set up and maintained.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.5 Management Structure and Processes						
IN-5.1	Processes shall be established to manage the ICM corridor.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-5.2	Managers shall be identified to manage the ICM corridor.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-5.3	Stakeholders shall develop new procedures and practices supporting ICM corridor management objectives.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-5.4	Caltrans, in consultation with system stakeholders, shall maintain a Risk Register.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.1.6 Interagency Trust and Communication						
IN-6.1	All agencies having a potential interest in ICM corridor operations shall be engaged in development, implementation, and operational ICM activities.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-6.2	Clear, consistent communication mechanisms shall be established among the corridor stakeholders.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-6.3	Quarterly meetings shall be held to keep ICM system stakeholders updated on system and corridor activities.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-6.4	Stakeholder agencies shall establish and maintain communications mechanisms with other stakeholder agencies.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-6.5	Information requests about the ICM system shall be appropriately followed up.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.7 Interagency Agreements						
IN-7.1	A Project Charter shall be drafted to get stakeholder agencies to agree on initial roles and responsibilities.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-7.2	A Memorandum of Understanding (MOU) shall be signed by project stakeholders to get formal agreement on expected roles and responsibilities.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-7.3	An Operations & Maintenance (O&M) Plan shall be signed by corridor stakeholders.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-7.4	The Outreach and Communications Manager, with assistance from corridor stakeholders, shall determine whether additional agreements may be needed to support system operations.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-7.5	Management of agreements shall be the responsibility of	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	the Outreach and Communications Manager.			implementation review.		
IN-7.6	Stakeholder agencies shall sign in a timely manner agreements submitted for their approval.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-7.7	Developed agreements shall be maintained, updated, and/or amended throughout the life of the project.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-7.8	Stakeholder agencies shall participate in the review and updating of documents related to the operation of the ICM system.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.8 Funding for ICM System						
IN-8.1	Potential funding sources shall be researched on an ongoing basis.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-8.2	Adequate support shall be provided for the development and submission of funding applications.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-8.3	Approved funding sources shall be managed, and necessary reports completed and submitted.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.9 Training and education						
IN-9.1	Adequate training shall be provided to individuals responsible for ICM operations.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.10 Public Outreach and Communications						
IN-10.1	An Outreach and Communications Manager shall be a Caltrans role responsible for handling general outreach and communication activities pertaining to the ICM system.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-10.2	Information on stakeholder agencies shall be collected and updated on an ongoing basis by the Outreach and	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	Communications Manager.					
IN-10.3	Key corridor stakeholders shall review documents submitted to them by agreed-upon deadlines.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-10.4	Agencies participating in the operation of the ICM system shall identify a PIO (or PIO role) who shall be actively involved in ICM outreach and communications activities, such as press events, announcements, briefings on incidents/events, etc.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-10.5	Ongoing, inclusive communication shall be established among corridor PIOs.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-10.6	Corridor stakeholders shall keep the Corridor Manager informed of scheduled events anticipated to have a noticeable impact on travel conditions along corridor arterials that may be used as detours by the ICM system.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.1.11 Management of Third-Party Relationships						
IN-11.1	The Corridor Manager in coordination with stakeholders shall manage third-party relationships.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
IN-11.2	Third-party purchasing choices and contracts shall be reviewed periodically under the direction of the Corridor Manager.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.2 Corridor Monitoring						
8.3.1.2.1 Static Transportation Network Characteristics						
CM-3.1	Roadway operators shall maintain and communicate to the Corridor Manager up-to-date definitions of roadway	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	facilities connected to the ICM Environment.					
CM-3.2	Parking facility operators shall maintain up-to-date definitions of park-and-ride facilities connected to the ICM Environment.	L	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
CM-3.3	Transit operators shall maintain up-to-date definitions of transit elements connected to the ICM Environment.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
CM-3.4	The Corridor Manager shall ensure that network definitions are up to date in all locations within the ICM Core system.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.2.2 Asset Inventory and Health Management						
CM-4.1	The ICM Core System shall continuously assess the health status of devices used to monitor traffic conditions.	H	Data Hub/DSS	1. Verify the ICM Core System shall monitor for fault and error messages that may be sent by individual traffic detection devices. 2. Verify valid PEMS sensor data monitoring traffic conditions. 3. Verify faulty & erroneous data from sensors can be detected inventory checks on PEMS sensors. 4. Verify flow checks and flow balances are stored in Cassandra. 5. Verify the ICM Core System shall monitor for fault and error messages that may be sent by individual traffic detection devices. 6. Verify erroneous travel time measurement from sensors can be detected. 7. Verify valid arterial sensor data is monitoring traffic conditions. 8. Verify faulty & erroneous data from arterial sensors can be detected. 9. Verify the ICM Core System shall monitor for	Connect to data endpoint, AMQ endpoint to verify the data is correct	Check for valid sensor data Check that the quality indicator is present & correct, the sensors are giving right information Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				faulty and error messages that may be sent by individual travel time measurement devices. Verify erroneous travel time measurement from arterial sensors can be detected.		
CM-4.2	The ICM Core System shall continuously assess the health status of devices used to control traffic within the corridor.	H	Data Hub/DSS	10. Verify the ICM Core System shall monitor for faulty and error messages that may be sent by traffic signal controllers. 11. Verify the ICM Core System shall monitor for faulty and error messages that may be sent by individual ramp meter controllers.	Connect to data endpoint, AMQ endpoint to verify the data is correct	Automation test candidate
CM-4.3	The ICM Core System shall continuously assess the health status of devices used to inform travelers.	H	Data Hub/DSS	12. Verify the error message and status information from changeable message signs (CMS), extinguishable trailblazer signs(arterials). 13. Verify the error message and status information from HAR. 14. Verify the health status is present and correct.	Connect to CMS &HAR SOAP & AMQ endpoint. Connect to HAR inventory endpoint.	Automation test candidate
CM-4.4	The ICM Core System shall continuously assess the health status of communication networks used by participating agencies to exchange information.	H	Data Hub/DSS	15. Verify ICM can monitor faulty or error messages that may be sent from RIITS communication network. 16. Verify the RIITS processed status message is correct.	Connect to RIITS center active verification SOAP endpoint.	
CM-4.5	The ICM Core System shall report on identified operational problems with devices used to monitor and manage travel within the corridor.	H	Corridor Management	17. Verify for each device with an identified or reported problem, the ICM Core System shall store the following information: Verify all physical devices (sensors, arterial sensors, intersection signals, ramp meter, environment sensors) with known problem record: • Date record was created or last updated • Date problem was	Will be part of vendor supplied CMS evaluation and acceptance criteria	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				first identified • Type of device affected • Location of device • Agency responsible for device operation and maintenance • Report problem with device Will be part of vendor supplied CMS evaluation and acceptance criteria. 18. Verify the ICM Core System shall notify daily the designated TMC or TCS operator of each stakeholder agency of identified problems with a traffic monitoring device operated by the agency. Verify TMC or TCS operator notifies daily of each stakeholder agency of identified problems with a traffic monitoring device operated by the agency.		
8.3.1.2.3 Control Asset State Monitoring						
CM-5.2	The ICM Core System shall monitor in real time the operational state of traffic control devices used along roadways under ICM management.	H	Decision Support	19. Verify status message from signal intersection along corridor arterial. Verify signal state messages are present and correct. 20. Verify status message from each on-ramps freeway section ramp meter. Verify on-ramp messages are present and correct.	Connect to the data hub intersection signal state endpoint. Connect to the data hub ramp meter state endpoint	
CM-5.3	The ICM Core System shall monitor in real time the operational state of traveler information devices under ICM management.	H	Decision Support	21. Verify HAR status message. 22. Verify CMS blazer status message. 23. Verify Trailblazer status message.	Connect to CMS, HAR, Trailblazer endpoint.	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.2.4 Traffic Monitoring						
CM-6.1	The ICM Core System shall monitor in real time traffic conditions on freeway segments within the ICM corridor every 30 seconds.	H	Data Hub	24. Verify latency of one minute or less for traffic volume measurements at Sensors on traffic lanes (live PEMS data). 25. Verify latency of one minute or less for traffic volume measurements at Sensors on HOV lanes (live PEMS data). 26. Verify latency of one minute or less for traffic volume at Sensors on freeway on-ramps (freeway on-ramp meter). 27. Verify latency of one minute or less for traffic volume at Sensors on freeway off-ramps (freeway off-ramp meter). 28. Verify latency of one minute or less for traffic volume at Sensors on freeway-to-freeway connectors (live PEMS data). 29. Verify latency of one minute or less for sensor occupancy on general purpose traffic lanes (live PEMS data). 30. Verify latency of one minute or less for sensor occupancy on HOV lanes (live PEMS data). 31. Verify latency of one minute or less for speed measurement on general traffic lanes (live PEMS data). 32. Verify latency of one minute or less for speed measurement on HOV lanes (live PEMS data).	Connect to data hub endpoint (SOAP & AMQ) and check the data is there and correct	Automation test candidate
CM-6.2	The ICM Core System shall monitor in real time traffic conditions on key corridor arterials.	H	Data Hub	33. Verify latency of one minute or less traffic flow measurements from sensors operated by Caltrans along key corridor arterials (all the	Connect to Intersect-ion signal sensors data endpoint and verify the	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				arterials ie Los Angeles County, City of Pasadena, City of Arcadia, City of Monrovia, city of Duarte). 34. Verify latency of one minute or less data collected by travel time measurement systems operated by local agencies along key corridor arterials (all the arterials ie Los Angeles County, City of Pasadena, City of Arcadia, City of Monrovia, city of Duarte).	data is there and correct Connect to travel time sensing data endpoint	
8.3.1.2.5 Transit Monitoring						
CM-7.1	The ICM Core System shall monitor for significant transit service disruptions along relevant transit routes within the corridor.	M	Data Hub	Testing to be defined when the requirement is addressed.		
CM-7.2	The ICM Core System shall monitor average ridership along transit services of interest within the corridor	L	Data Hub	Testing to be defined when the requirement is addressed.		
CM-7.3	The ICM Core System shall report on monitored transit operations within the ICM corridor.	M	Corridor Management	Testing to be defined when the requirement addressed.		
8.3.1.2.6 Park-and-Ride Monitoring						
CM-8.1	The ICM Core System shall monitor in real time park-and-ride availability at facilities operated by participating agencies within the corridor.	L	Data Hub	Testing to be defined when the requirement addressed.		
CM-8.2	The ICM Core System shall report on parking availability at facilities under ICM surveillance.	L	Corridor Management	Testing to be defined when the requirement addressed.		
8.3.1.2.7 Corridor Performance Metrics						
CM-9.1	The ICM Core System shall calculate and store metrics summarizing overall corridor performance.	H	Decision Support	35. Verify Productivity metrics for the entire corridor: • Vehicle-miles	Connect to estimation metric endpoint &	Corridor performance test for geographic

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				traveled (VMT) • Vehicle-hours traveled (VHT) • Vehicle hours of delay • Vehicle occupancy (person miles traveled, person hours traveled) • Estimate average vehicle occupancy factor	AMQ endpoint and check the data is there and correct	area/time spans Automation test candidate
CM-9.2	The ICM Core System shall calculate and store metrics summarizing the performance of mainline freeway operations.	H	Decision Support	36. Verify vehicle based metrics on freeway segment (estimation engine, vehicle sensing): • Total vehicle flow • Vehicle-miles traveled (VMT) • Vehicle-hours traveled (VHT) • Average travel time across segment • Average speed across segment • Vehicle-hours of delay (VHD) • Average delay per vehicle • Vehicle Occupancy Factor: Total person flow • Vehicle Occupancy Factor: Person-miles traveled (PMT) • Vehicle Occupancy Factor: Person-hours traveled (PHT) • Reliability metrics: Travel time index • Reliability metrics: Buffer index (extra time that travelers must add to their average travel time when planning trips to ensure on-time arrival) • HOV lane data from sensors	Connect to estimation metrics endpoint & AMQ and check the data is there and correct	Corridor performance test Automation test candidate
CM-9.3	The ICM Core System shall calculate and store metrics summarizing the performance of freeway ramp operations.	H	Decision Support	37. Verify vehicle based metrics on freeway on-ramp off-ramp (estimation & sensing): • Total vehicle flow	Connect to estimation metrics endpoint & AMQ	Corridor performance test Automation

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				• Vehicle-miles traveled (VMT) • Vehicle-hours traveled (VHT) • Vehicle-hours of delay (VHD) • Average delay per vehicle • Vehicle occupancy factors: Total person flow • Vehicle occupancy factors: Person-miles traveled (PMT) • Vehicle occupancy factors: Person-hours traveled (PHT)	endpoint and check the data for the freeway ramps is there and correct	test candidate
CM-9.4	The ICM Core System shall calculate and store metrics summarizing the performance of arterial traffic operations.	H	Decision Support	38. Verify the ICM Core System shall calculate and store the following based metrics on arterials: • Total vehicle flow • Vehicle-miles traveled (VMT) • Vehicle-hours traveled (VHT) 39. Verify the ICM Core System shall estimate and store the following person-based productivity metrics based on available average regional vehicle occupancy factors: • Total person flow • Person-miles traveled (PMT) • Person-hours traveled (PHT) 40. Verify the ICM Core System shall estimate and store the following person-based mobility metrics based on available average regional vehicle occupancy factors: • Person-hours of delay (PHD) • Average delay per person 41. Verify ICM Core System shall calculate and store the following vehicle-	Connect to estimation metrics endpoint, AMQ endpoint and check the data is there and correct	Arterial corridor performance test Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				based productivity metrics: • Vehicle flow (each approach) • Average delay per vehicle (each approach and overall intersection) 42. Verify the key intersections shall calculate and store the following person-based productivity metrics: • Person flow (each approach) • Average delay per person (each approach and overall intersection) 43. Verify the key intersections shall calculate and store the following vehicle-based productivity metrics: • Vehicle flow capacity (each approach and overall intersection) • Volume-to-capacity ratio (each approach and overall intersection) • Average queue length (each approach) 44. Verify the key intersections shall calculate and store vehicle-based mobility metrics: • Vehicle-hours of delay (each approach and overall intersection) • Average delay per vehicle (each approach and overall intersection) 45. Verify the key intersections shall calculate and average regional vehicle occupancy factors.		
CM-9.5	The ICM Core System shall calculate and store metrics	H	Decision Support	46. Verify the vehicle-based productivity measures:	Connect to estimation	Performance test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	summarizing the performance along user-defined routes.			• Maximum vehicle flow along each segment of the route • Vehicle-miles traveled along the route (VMT) • Vehicle-hours traveled along the route (VHT) • Verify the person-based productivity measures based on available average regional vehicle occupancy factors: • Maximum person flow along each segment of the route • Person-miles traveled along the route (PMT) • Person-hours traveled along the route (PHT) • Verify the following mobility measures: • Overall travel time along the route • Speed contour plot 47. Verify the following reliability measures: • Observed travel time variability along the route within the defined time period • Observed flow variability along the route within the defined time period • Travel time index for the route • Buffer index for the route (extra time that travelers must add to their average travel time when planning trips to ensure on-time arrival)	metrics endpoint & AMQ endpoint and check the data is reported correctly	Automation test candidate
CM-9.6	Decision Support shall compile performance metrics for each roadway	H	Decision Support	48. Verify metrics calculated for freeway elements (mainline sections, on-	Connect to estimation metrics data	Performance test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	management agency participating in the operation of the ICM system.			ramps, off-ramps, freeway-to-freeway connectors). 49. Verify metrics calculated for arterial segments managed by Los Angeles County. 50. Verify metrics calculated for arterial segments managed by Pasadena. 51. Verify metrics calculated for arterial segments managed by Arcadia. 52. Verify metrics calculated for arterial segments managed by Monrovia. 53. Verify metrics calculated for arterial segments managed by Duarte.	hub endpoint (SOAP & AMQ) and check the data is there and correct	Automation test candidate
CM-9.7	The ICM Core System shall compile metrics summarizing the performance of monitored transit services.	M	Decision Support	Testing to be defined when the requirement is addressed.		
CM-9.8	The ICM Core System shall compile metrics summarizing the performance of parking facilities.	L	Decision Support	Testing to be defined when the requirement is addressed.		
8.3.1.2.8 Traffic State Determination						
CM-10.1	The ICM Core System shall use available sensor data to determine the state of traffic along roadways of interest within the ICM corridor.	H	Decision Support	54. Verify that the sensing along the roadways of interest is properly assimilated into each estimation. 55. Verify sensor data to estimate the average traffic flow/traffic speed/travel times on freeway. 56. Verify the ICM Core System shall use available sensor data to estimate the prevailing average traffic flow rate on sections of roadways of interest to the system. 57. Verify the ICM Core System shall use available sensor data to estimate the prevailing average traffic flow rate between successive on-ramps along the sections	Connect to estimation endpoint, AMQ endpoint and check the data is there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				of I-210, I-605, and SR-134 within the ICM corridor. 58. Verify the ICM Core System shall use Sensor data to estimate the prevailing average traffic flow rate on HOV lanes between successive on-ramps along the section of I-210 within the ICM corridor. 59. Verify available sensor data to estimate prevailing average traffic flow rates on on-ramps along the sections of I-210, SR-134, and I-605 within the ICM corridor. 60. Verify available sensor data to estimate prevailing average traffic flow rates on off-ramps along the sections of I-210, SR-134, and I-605 within the ICM corridor. 61. Verify available sensor data to estimate prevailing average traffic flow rates on arterial segments along potential detour routes. 62. Verify available sensor data to estimate prevailing average traffic flow rates on arterial segments outside potential detour routes that may influence decision-making activities. 63. Verify the available sensor data to estimate prevailing average traffic speeds on sections of roadways of interest to the system. 64. Verify available sensor data to estimate the prevailing average traffic speed on the general-purpose traffic lanes between successive on-ramps along the sections of I-210, SR-134, and I-		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				605 within the ICM corridor. 65. Verify available sensor data to estimate the average traffic speed on the HOV lanes between successive on-ramps along the sections of I-210 and SR-134 within the ICM corridor. 66. Verify the available sensor data to estimate prevailing average traffic speeds on arterial segments along potential detour routes. 67. Verify the available sensor data to estimate prevailing average traffic speeds on arterial segments outside potential detour routes that may influence decision-making activities. 68. Verify the available sensor data to estimate prevailing average travel times along sections of roadways of interest to the system. 69. Verify the available sensor data to estimate prevailing average travel times on general-purpose traffic lanes between key interchanges along the section of I-210 within the ICM corridor. 70. Verify the available sensor data to estimate prevailing average HOV-lane travel times between key interchanges along the section of I-210 within the ICM corridor. 71. Verify the available sensor data to estimate prevailing average travel times along arterial segments that may be part of a detour route. 72. Verify the available sensor data to estimate,		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				where possible, average queue lengths along sections of roadways of interest to the system. 73. Verify the available sensor data to estimate prevailing average queue length on freeway on-ramps along the section of I-210 within the ICM corridor. 74. Verify the available sensor data to estimate prevailing average queue length on approaches to signalized intersections along potential detour routes. 75. Verify the available sensor data to determine the level of congestion on sections of roadways of interest to the system. 76. Verify the available sensor data to estimate the level of congestion between successive on-ramps along the sections of I-210, SR-134, and I-605 within the ICM corridor. 77. Verify the available sensor data to estimate the level of congestion on HOV lanes between successive on-ramps along the I-210, SR-134, and I-605 freeways. 78. Verify the available sensor data to estimate the level of congestion between key intersections on arterial segments along potential detour routes.		
CM-10.2	The ICM Core System shall attempt to use available sensor data to estimate traffic conditions on roadway sections of interest without instrumentation.	H	Decision Support	79. Verify the estimation is using the available sensor data. 80. Verify that the traffic on all roadways, with or without instrumentation are included in estimations.	Connect to estimation endpoint & AMQ endpoint and the data is there and correct (with sensors or not)	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.2.9 Historical Pattern Determination						
CM-11.1	The ICM Core System shall determine historical traffic patterns from available traffic data.	H	Decision Support	81. Verify for each traffic detector, ICM core shall determine upon request the following statistics over a specified period: • Average measured volumes for right-turn, thru, and left-turn movements • Volume variance for each movement • Average flow measurement • Average sensor occupancy • Average speed measurement (if available) • Flow variance • Sensor occupancy variance 82. Verify for each intersection for which turn movements are available, the ICM Core System shall determine upon request the following statistics over a specified period: • Average measured volumes for right-turn, thru, and left-turn movements • Volume variance for each movement • For each roadway segment for which travel time measurements are available, the ICM Core System shall determine the following statistics over a user- or system-specified period: • Average measured travel time • Travel time variance 83. Verify this is tested for each detector /intersection.	Connect to database to check the data is there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
CM-11.2	The ICM Core System shall determine historical patterns from available traffic control data.	H	Decision Support	84. Verify for each metered freeway on-ramp, the ICM Core System shall determine the following operational statistics over a specified period: • Average period during which the ramp meter was in operation • Average start time of metering operation • Average end time of metering operation • Average metering rate during active period • Proportion of time that each defined metering rate within the controller has been used 85. Verify for each signalized intersection, the ICM Core System shall determine the following operational statistics over a specified period: • List of activated signal timing plans • Total time during which each activated timing plan was operational • Average observed cycle length • Minimum and maximum observed cycle length • Average duration of each signal phase • Minimum and maximum duration of each signal phase • Average signal offset	Connect to database to check the data is there and correct	Automation test candidate
CM-11.3	The ICM Core system shall calculate variability statistics associated with real-time traffic data over a given interval.	H	Decision Support	86. Verify the Data Management shall include a function to obtain or calculate across days, weeks, months, or years the mean value of flow, speed, and travel	Connect to data base and verify the data is there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				time data provided to the ICM system by a given sensor or system for a given interval. 87. Verify the Data Management shall include a function to obtain or calculate across days, weeks, months, or years the standard deviation of flow, speed, and travel time data provided to the ICM system by a given sensor or system for a given interval. 88. Verify both mean and standard deviation.		
CM-11.4	The ICM Core System shall include a function to analyze historical data over time periods.	H	Decision Support	89. Verify ICM Core System shall include a function to analyze historical data over a range of dates. 90. Verify ICM Core System shall include a function to analyze historical data within one day of the collection of the historical data being collected. 91. Verify ICM Core System shall include a function to analyze historical data over specific weekdays within a given date range. 92. Verify ICM Core System shall include a function to analyze historical data over an interval (for instance, every 15 minutes, 1 hour, day, month, etc.) 93. Verify data hub can be configured to provide Historical data over time periods.	Connect to data base and verify the data is there and correct	Automation test candidate
CM-11.5	The ICM Core System shall notify system users whether a requested historical data compilation is feasible for the specified period and reporting interval based on available data and the characteristics of the available data.	H	Decision Support	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.3 Strategic Incident/Event Response Planning (Corridor Planning)						
8.3.1.3.1 Stakeholder Involvement						
SP-1.1	Stakeholders shall participate in incident/event response planning activities.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.3.2 Management of Response Plan Components						
SP-2.1	System stakeholders shall determine and maintain desired routes to be used as detours for incidents and events.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.2	System stakeholders shall be able to influence the selection of suitable detours around incidents or events.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.3	System stakeholders shall determine the signalized intersections in their jurisdictions whose traffic signal timing plans may be changed during an incident or event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.4	System stakeholders shall determine which freeway ramps shall have their metering rate changed during an incident or event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.5	System stakeholders shall identify or create, maintain, and distribute signal timing plans to be used along corridor arterials during incidents and events.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.6	System stakeholders shall identify or create, maintain, and distribute ramp metering plans to be used during incidents and events.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.7	System stakeholders shall determine messaging equipment that may be used to support the implementation of response plans.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.8	System stakeholders shall determine equipment (vehicles and other portables)	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	that may be used to support the implementation of response plans.					
SP-2.9	System stakeholders shall determine personnel available for deployment during an incident or event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.10	System stakeholders shall determine typical information to be sent to agency personnel when responding to an incident or event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.11	System stakeholders shall determine messages to be posted on fixed and/or portable CMS devices when responding to an incident or event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.12	The Corridor Manager, in consultation with all relevant stakeholders, shall determine the information to be sent to 511 services.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.13	The Corridor Manager, in consultation with all relevant stakeholders, shall determine the information to be sent to HAR stations used as part of response plans.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.14	The Corridor Manager, in consultation with all relevant stakeholders, shall determine the information to be sent to third-party providers.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-2.15	The ICM Core System shall include a function for stakeholders to specify predefined response plans, i.e., specific sets of response actions that may be considered as responses to an incident or event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.3.3 Incident Response Testing Capabilities						
SP-3.1	The ICM Core System shall include a function for traffic engineers to create mock incidents.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 94. Verify the ICM Core System shall include a function for traffic engineers to create mock incidents.		Manual test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
SP-3.2	The ICM Core System shall include functionality permitting mock incidents to be used to test the effectiveness of created or proposed response plans.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 95. Verify the ICM Core System shall allow user-created mock incidents to be submitted as real incidents for testing purposes. 96. Verify upon receiving a mock incident, the ICM Core System shall perform Real-Time Incident Planning and generate response plans addressing the mock incident as if it were a real incident. 97. Upon receiving a mock incident, the ICM Core System shall identify a recommended response plan as if the mock incident were a real incident. 98. Upon receiving a mock incident, the Implementation function shall recognize that a response plan is being generated for a mock incident and stop response activities at the identification of required field control actions. No field commands are to be issued. 99. Upon the execution of a mock incident, the ICM Core System shall store information permitting to the generation of a post-incident report.		Manual test
8.3.1.3.4 Rule Creation and Management						
8.3.1.3.4.1 Decision Support Rules						
SP-4.1	The ICM Core System shall include a function for users to define rules to be used in the development, evaluation, selection, and implementation of response	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	plans.					
SP-4.2	Rules for determining the existence of an incident shall be defined and maintained.	M	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.3	Rules for determining the severity of an incident shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.4	Rules for determining the zone of influence of an incident or event shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.5	Rules for assessing the level of impact of an incident or event on corridor operations shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.6	Rules for building response plans from a set of possible individual response actions shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 100. Verify the rules exist for creating response plans.		Manual test
SP-4.7	Rules for handling special management or operational situations shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 101. Verify rules limiting the use of specific roadway elements based on specific situations shall be defined and maintained. 102. Rules limiting the use of specific roadway elements without sufficient capacity shall be defined and maintained. 103. Rules limiting the use of specific roadway elements based on the operational status of traffic management devices on these elements shall be defined and maintained.		Manual test
SP-4.8	Rules for selecting a recommended response plan among a set of alternate plans shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 104. Verify alternate plans are defined.		Manual test
SP-4.9	Rules for sending response plan instructions to corridor assets shall be defined and maintained.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		Manual test
SP-4.10	Rules for determining agency personnel who should be	H	Corridor Management	105. Verify rules for determining agency		Manual test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	notified of a response planning action shall be defined and maintained.			personnel who should be notified of a response planning action shall be defined by traffic engineers from stakeholder agencies. 106. Verify rules exist for defining response plan notification.		
SP-4.11	The ICM Core System shall include a function for Traffic Engineers to specify the conditions under which the implementation of an approved response plan can be canceled.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
SP-4.12	System users shall specify the level of automation required for the approval of submitted modifications to active response plans.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
SP-4.13	Decision Support shall provide a means for users to group and categorize rules.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
8.3.1.3.5 Rules Testing and Evaluation						
SP-4.11	Proposed modification to existing rules shall be validated over a user-defined period prior to being introduced into the production system.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
SP-4.12	The ICM Core System shall provide an environment allowing proposed new rules or rule modifications to be tested and validated prior to their implementation.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.13	The ICM Core System shall conduct a rules test, exercising the rules using test data on a regular basis and providing a pass/fail check for the results of each rule execution.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.14	The Corridor Technical Manager shall conduct weekly and quarterly evaluations of the rules and their execution.	M	Corridor Management	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.3.6 Rule Documenting and Archiving						
SP-4.15	The ICM Core System shall provide a means for users to archive rules within the system.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SP-4.16	All developed rules shall be stored in a format usable by the DSS rules engine.	H	Data Hub	Testing to be defined when the requirement is addressed.		
SP-4.17	The ICM Core System shall utilize a configuration management system to manage rules.	M	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
8.3.1.3.7 Post-Incident/Event Analyses						
SP-5.1	The Corridor Manager shall conduct a post-incident analysis review with all affected agencies within one week of each significant event.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.3.8 Quarterly Operational Reviews						
SP-6.1	The Corridor Manager shall conduct a quarterly review of the operational effectiveness of the ICM Environment.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-6.2	As part of the quarterly effectiveness evaluation, the Corridor Manager shall assign a score to the observed effectiveness of response planning activities.	M	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SP-6.3	The Corridor Manager shall use results from quarterly operational assessments of decision support operations to influence corridor planning decisions.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.4 Real-Time Incident/Event Monitoring						
8.3.1.4.1 Incident/Event Identification						
IM-1.1.5	The ICM Core System shall maintain a list of active incidents and events affecting	H	Data Hub/DSS	107. Verify data hub maintains a list of active incidents and events.	Connect to the conductor	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	corridor operations.				and see the task status and see if the information is persisted	
IM-1.1	The ICM Core System shall be aware of when traffic incidents occur on corridor roadways of interest.	H	Data Hub/DSS	Will be part of vendor supplied CMS evaluation and acceptance criteria. 108. Verify law enforcement agencies shall inform the ICM Core System about new active incidents as soon as the incidents have been verified. Note: The system shall be able to operate without this requirement being met. 109. Verify the ICM Core System shall receive from first responding agencies information about active incidents or events affecting corridor operations being managed by these agencies. Note: The system shall be able to operate without these requirements being met. 110. Verify the ICM Core System shall receive from the California Highway Patrol information about major active incidents on the ICM corridor being managed by the agency. 111. Verify the ICM Core System shall receive from the Los Angeles County Sheriff's Department information about major active incidents on main corridor arterials in Duarte. 112. Verify the ICM Core System shall receive from the Pasadena Police Department information about major active incidents on main corridor arterials being managed by the agency. 113. Verify the ICM Core System shall receive from the Arcadia Police	Connect to the endpoint to capture the list of active incidents and events for corridor roadways	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				Department information about major active incidents on main corridor arterials being managed by the agency. 114. Verify the ICM Core System shall receive from the Monrovia Police Department information about major active incidents on main corridor arterials being managed by the agency. 115. Verify the Verdugo Fire Communications dispatch system shall send to the ICM Core System information about fire incidents expected to significantly affect roadway operations within the ICM corridor being managed by the agency. 116. Verify the ICM Core System shall receive from LA SAFE information about incidents being responded to by the agency. 117. Verify ICM Core System shall retrieve incidents reported by travelers on social media applications. 118. Verify ICM Core System shall include a function for system users to manually define new traffic incidents that should be considered by the response planning activities. (This can only be addressed in this release and will be addressed by corridor management system)		
IM-1.2	The ICM Core System shall be aware of major transit incidents occurring within the corridor.	M	Data Hub/DSS	Testing to be defined when the requirement is addressed.		
IM-1.3	The ICM Core System shall be aware of when scheduled events may affect corridor operations.	H	Data Hub/DSS	Will be part of vendor supplied CMS evaluation and acceptance criteria. 119. Verify the list of major scheduled events	Connect to	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				expected to have a significant impact on corridor operations. Verify the information about scheduled events from information systems used by stakeholder agencies (the Caltrans Lane Closure System (LCS) information about planned roadway closures that may affect corridor operations, Los Angeles County Lane Closure Website information about planned roadway closures that may affect corridor operations) 120. Verify incident information gets updated about planned lane/roadway closures when manually entered into the system by system users. When we get the CMS system we can verify the data is correct. 121. Verify incident information gets updated a function for users ie Stakeholders shall enter into the ICM Core System information about scheduled events or planned lane or roadway closure, to manually define new events that should be considered by the response planning activities. When we get the CMS system we can verify the data is correct.	the endpoint to capture the list of active incidents and events for corridor roadways	
IM-1.4	The ICM Core System shall be aware of when major weather events may affect travel conditions within the corridor.	L	Data Hub/DSS	Testing to be defined when the requirement is addressed.		
IM-1.5	The ICM Core System shall determine when unusual traffic conditions exist within the corridor.	H	Data Hub/DSS	Testing to be defined when the requirement is addressed.		
IM-1.6	The ICM Core System shall alert relevant TMC or TCS	H	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	operators when unusual traffic volumes or speeds are detected.					
IM-1.7	The ICM Core System shall have rules and parameters for incident detection that can be adjusted ("fine-tuned") to minimize false alerts and effectively deliver useful warnings to the operator.	H	Corridor Management	Testing to be defined when the requirement is addressed.		
IM-1.8	The ICM Core System shall ensure that duplicate incidents or events are not created when processing data from various sources.	M	DSS/Data Hub	Testing to be defined when the requirement is addressed.		
8.3.1.4.2 Incident/Event Verification						
IM-2.1	All incidents shall be verified before initiating response planning.	H	Decision Support	Will be part of vendor supplied CMS evaluation and acceptance criteria. 122. Verify if the incidents that have been verified to exist before developing response plans. 123. Verify if the events that have been verified to occur before developing response plans for scheduled.		Automation test candidate
IM-2.3	The ICM Core System shall remove from consideration any identified incident or event that has not been verified within a reasonable amount of time.	H	Decision Support	Will be part of vendor supplied CMS evaluation and acceptance criteria. 124. Verify if any identified faulty incident or event reported is removed from consideration. Keep log for future. Review all unverified incidents and events have been removed from consideration.		
8.3.1.4.3 Incident/Event Characterization						
IM-3.1	The ICM Core System shall obtain or be provided with information allowing it to assess the impact of an incident or event on corridor operations.	H	Decision Support	Will be part of vendor supplied CMS evaluation and acceptance criteria. Incident information will be part of the CMS. 125. Verify the impact of the incident.		Manual test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				• Type of incident • Time incident occurred • Expected duration of incident • Roadway segment on which incident is located • Location of incident along roadway segment • Lane(s) affected by the incident • Agency responsible for managing the incident 126. Verify the impact of the event. • Type of event • Location of event • Time event started • Expected duration of event • Roadway segment(s) affected by the event • Traffic lanes affected by the event on each affected roadway segment • Agency response for managing traffic event • Gather, store incident or event characteristics in advance from available data feeds.		
IM-3.4	The ICM Core System shall not develop response plans for incidents or events for which critical information is missing.	H	Decision Support	Will be part of vendor supplied CMS evaluation and acceptance criteria. 127. Verify no response plan will be generated for an incident or event that has not been located on a specific roadway segment. 128. Verify no response plan will be generated if no information about the number of lanes closed on the affected roadway. 129. Verify no response plan will be generated for an		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				incident or event if an expected duration has not been provided.		
IM-3.5	The ICM Core System shall log for future review any non-verified incident or event that has been removed from consideration.	M	Decision Support	Testing to be defined when the requirement is addressed.		
8.3.1.4.4 Incident/Event Information Dissemination						
IM-4.1	The ICM Core System shall notify the system's Real-Time Response Planning function of any new active incident, unscheduled event, or planned event occurring within the ICM corridor.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 130. Verify when an incident is inputted, it gets sent into the decision support system. Until CMS is available force this at the data hub endpoint for the CMS.		
IM-4.2	The ICM Core System shall include functionality to inform stakeholders, travelers, and industry partners of incidents and events.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
IM-4.3	The ICM Core System shall notify TMC/TCS operators of active incidents and events affecting travel conditions with the ICM corridor.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
IM-4.4	The ICM Core System shall inform first responders of active incidents and events affecting travel conditions with the corridor.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 131. Verify the ICM Core System shall inform Traffic Management Team of freeway incidents and corridor events that may require its deployment. 132. Verify the ICM Core System shall inform LA SAFE of identified freeway incidents. 133. Verify the ICM Core System shall inform the CHP of identified freeway incidents and major arterial incidents that may affect freeway operations. 134. Verify the ICM Core		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				System shall inform local first responding agencies of incidents and events that may affect travel conditions within their jurisdiction. • Inform the Los Angeles County Sheriff's Department of incidents and events expected to affect roadways managed by the City of Duarte. • Inform the Pasadena Police Department of incidents and events expected to affect roadways managed by the City of Pasadena • Inform the Arcadia Police Department of incidents and incidents expected to affect roadways managed by the City of Arcadia. • Inform the City of Monrovia Public Safety Manager of incidents and events expected to affect roadways managed by the city. • Inform the City of Duarte Public Safety Officer of incidents and events expected to affect roadways managed by the city. • Inform Verdugo Fire Communication dispatchers of incidents and events expected to affect roadways within the ICM corridor. • The Corridor Management Subsystem shall inform the Los Angeles County		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				Sheriff's Department of corridor incidents and events expected to affect roadways managed by Los Angeles County.		
IM-4.5	The ICM Core System shall inform transit field supervisors of active incidents and events affecting travel conditions with the corridor.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
IM-4.6	The ICM Core System shall inform corridor travelers, by multiple channels, of active incidents and events affecting travel conditions with the corridor.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. Testing to be defined when the requirement is addressed. 135. The ICM Core System shall send incident/event alerts to the regional 511 System, Nixle communication system, to third-party navigation application providers, and social media applications supporting ICM operations.		
IM-4.7	The ICM Core System shall include a function for sending incident information directly to first responders or agency staff in the field (i.e., via smartphone, tablet, or onboard vehicle device).	M	Corridor Management	Testing to be defined when the requirement is addressed. Will be part of vendor supplied CMS evaluation and acceptance criteria.		
IM-4.8	The ICM Core System shall disseminate information about incidents and events that enables the information recipients to assess how the incident or event may impact their activities.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
IM-4.9	The ICM Core System shall disseminate information about how identified incidents and events are expected to impact corridor travel conditions.	M	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
8.3.1.4.5 Incident/Event Termination						
IM-5.1	The ICM Core System shall attempt to determine when	L	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	an active incident or event has terminated.		/DSS			
IM-5.2	The ICM Core System shall permit event/incident termination.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 136. Only personnel from the agency associated with an incident or event shall be authorized to terminate an event. 137. When informed that an incident or event has terminated, the ICM Core System shall label the incident or event as having terminated. 138. The ICM Core System shall not terminate an incident or event without stakeholder approval. 139. Before marking an active incident or event as having terminated, the ICM Core System shall seek confirmation from relevant TMC/TCS operators that the incident or event has effectively been terminated. 140. TMC/TCS operators shall confirm that the incident or event has effectively been terminated before the ICM Core System identifies it as such. 141. The ICM Core System shall notify stakeholders if an incident or event has not been terminated within a user-defined time past the expected duration.		
8.3.1.4.6 Incident/Event Archiving						
IM-6.1	The ICM Core System shall log all identified incidents/events.	M	Corridor Management /DSS/Data Hub	Will be part of vendor supplied CMS evaluation and acceptance criteria. CMS will have log of all incidents. 142. Verify data hub log of all verified incidents. Automate the data hub		Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				part		
8.3.1.5 Determination of Reference Data for Response planning						
RP-1.1	At the onset of a response planning activity, the ICM Core System shall identify the set of data that will be used to assist in the evaluation of current corridor operations and the development of traffic forecasts.	H	Decision Support	143. Verify the rules exist wherever it is stored. This is a manual process. 144. Verify the response plan persistence contains current state information (Asset data, route data, response state).		
8.3.1.5.1 Incident/Event Impact Assessment						
RP-2.1	Prior to developing a response plan, the ICM Core System shall assess the near-future impacts of identified incidents on corridor operations.	H	Decision Support	145. Verify following the identification of an active incident or event (Prediction is run for minimum of an hour), the ICM Core System shall assess the potential impact of the incident or event on overall corridor operations over the next hour. 146. When evaluating the impact of a new active incident or event, the ICM Core System shall determine the extent of the zone of influence of the incident or event (Calculates zone of influence). 147. When evaluating the impact of a new active incident or event, the ICM Core System shall consider the cumulative effect of all other active incidents and events within the corridor, as well as future events scheduled to start during the evaluation period. 148. Verify the model it has run, has the correct state info and the info from other incidents. 149. Verify the predictions that are run include all other incident info and the current estimation.	Connect to the endpoint for prediction	Automation test candidate Manual test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
RP-2.2	The ICM Core System shall only conduct operational assessments of incidents and events that have been confirmed to exist.	H	Decision Support	Will be part of vendor supplied CMS evaluation and acceptance criteria. 150. Verify CMS only sends confirmed incidents.		
RP-2.3	Based on the results of the incident impact assessment, active incidents or events shall be categorized using rules specified in response planning as having a minor, medium, or major impact on corridor operations.	H	Decision Support	151. Verify ranking (1- 10) of response plan is received.	Connect to data hub endpoint that sends the information to the CMS.	Automation test candidate
8.3.1.5.2 Response Plan Generation						
RP-3.1	The ICM Core System shall assemble response plans for all incidents, unscheduled events, and planned events expected to generate average delays of 5 minutes or greater to travelers.	H	Decision Support	152. Verify the ICM Core System shall assemble response plans for freeway incidents expected to last longer (set a limit in the rules engine 10min/20 mins, beyond the limit and below the limit) than the number of minutes defined in the response plan trigger rules and expected to generate average delays of 5 minutes or greater to travelers. 153. Verify the ICM Core System shall assemble response plans for arterial incidents expected to last longer than the number of minutes defined in the response plan trigger rules and expected to generate average delays of 5 minutes or greater to travelers. 154. Verify the ICM Core System shall assemble response plans for planned road closures anticipated to last longer than the number of minutes defined in the response plan trigger rules and expected to	Feed a bunch of incidents and see the correct response for various limits that are put in	Automation test candidate Manual test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				generate average delays of 5 minutes or greater to travelers. 155. Verify the ICM Core System shall assemble response plans for planned events affecting roadway operations expected to last longer than the number of minutes defined in the response plan trigger rules and expected to generate average delays of 5 minutes or greater to travelers. 156. Verify the ICM Core System shall assemble response plans for unexpected events anticipated to last longer than the number of minutes defined in the response plan trigger rules and expected to generate delays of 5 minutes or greater. 157. Manual verification if the rules exist.		
8.3.1.5.3 Identification of Available Field Elements						
RP-3.2	When assembling a response plan, the ICM Core System shall only consider modifying available, working assets.	H	Decision Support	158. Verify the ICM Core System shall use status data collected from individual traffic signal controllers to determine whether changes to the operation of specific signalized intersections would be authorized. 159. Verify the ICM Core System shall use status data collected from individual ramp controllers to determine whether metering changes can be implemented at specific freeway on-ramps or freeway-to-freeway connectors. 160. Verify the ICM Core System shall use status data collected from fixed	Create a dummy message for a ramp meter that doesn't exist Negative test for various assets that aren't available	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				CMSs to determine whether desired information messages can be displayed on specific devices. 161. Verify the ICM Core System shall use status data collected from extinguishable trailblazer signs to determine whether the signs can be used to provide route guidance. 162. Verify the ICM Core System shall check the availability of portable CMSs to determine whether such devices can be deployed. 163. Verify the ICM Core System shall use status data collected from individual Highway Advisory Radios (HARs) to determine whether the stations could be used to broadcast incident/event-related messages. 164. Verify the ICM Core System shall remove from consideration any control element determined to be currently unavailable. 165. Verify the ICM Core System shall remove from consideration any control element projected to become unavailable within the anticipated period of application of the response plan to be developed.		
RP-3.3	When assembling a response plan, the ICM Core System shall only consider management resources available within each agency at the time of day a response plan is developed.	H	Decision Support	166. Verify the response plan management eliminates resources that are not available.	Status message with asset not available shouldn't be in the response plan generated. Put in a rule	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
					with the asset not available.	
RP-3.4	The ICM Core System shall include the capability to include or exclude a particular control asset from modification by response plans.	L	Decision Support	Testing to be defined when the requirement is addressed.		
8.3.1.5.4 Identification of Suitable Detours						
RP-3.5	When responding to an incident or event, the ICM Core System shall first assess the usability of user-defined predefined detours before attempting to assemble new detour routes.	L	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.6	If no predefined detour route is available, the ICM Core System shall conduct network searches to try to identify potential detours around incidents and events within a set of allowable roadway segments.	L	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.7	The ICM Core System shall be able to identify suitable detours for various types of vehicles.	M	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.8	The ICM Core System shall consider all applicable roadway geometrical restrictions when searching for suitable detours around an incident or event.	H	Decision Support	167. Verify the ICM Core System shall refrain from sending trucks along roadway segments for which there may be insufficient height clearance under bridges or structures. 168. Verify the ICM Core System shall refrain from sending trucks along roadway segments where there is insufficient turning radius to allow the vehicles to make intended right or left turns. 169. Verify the ICM Core System shall refrain from sending buses along roadway segments where there is insufficient turning radius		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				to allow the vehicles to make intended right or left turns. 170. Verify with traffic engineers that they route vehicles to routes sufficient for all vehicles.		
RP-3.9	The ICM Core System shall consider all applicable active traffic restrictions when searching for suitable detours around an incident or event.	H	Decision Support	171. Verify the ICM Core System shall not send traffic into school zones when children are walking to and from schools. 172. Verify the ICM Core System shall not send heavy vehicles on local arterials with active truck restrictions. 173. Verify to the extent possible, the ICM Core System shall refrain from sending traffic along arterial segments heavily traveled by buses (e.g., Colorado Blvd in Pasadena). 174. Verify rules are in place that this doesn't occur.		
RP-3.10	The ICM Core System shall consider the availability of traffic management devices along individual detours.	H	Decision Support	175. Verify the ICM Core System shall exclude from consideration identified detours where the proportion of traffic control signals that can be modified by the ICM Core System is below a user-defined threshold. 176. Verify the ICM Core System shall exclude from consideration identified detours where the proportion of devices that can be used to provide guidance along the identified route (such as CMSs and extinguishable trailblazer signs) is below a user-defined threshold. 177. Verify rules are in place that this works.		
RP-3.11	Unless necessary, the ICM Core System shall avoid sending traffic towards stop-controlled intersections.	H	Decision Support	178. Verify rules are in place that this works /no reroutes use stop controlled intersections.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
RP-3.12	The ICM Core System shall consider the congestion developing upstream and around an incident or event when searching for suitable detours around an incident or event.	H	Decision Support	179. Wherever possible, the ICM Core System shall select or develop detours starting from a point upstream of the congestion developing on the approach to an incident. 180. Wherever possible, the ICM Core System shall select or develop detour routes avoiding heavily congested roadway segments. 181. Verify predictions are getting a current estimation. 182. Verify rules are in place to make sure it works.		
RP-3.13	The ICM Core System shall be robust enough to incorporate projected traffic conditions on the freeways and arterials, if available, in determining the best detour(s) around incidents and events.	H	Decision Support	183. Verify predictions are used in evaluation.	Check multiple response plans (1-10 plans) are developed.	
RP-3.14	The ICM Core System shall include a function to identify and accommodate more than one detour being implemented simultaneously as a response to a given incident/event.	H	Decision Support	184. Verify response plans (1-10 plans) allow more than one simultaneous detour.		
RP-3.15	The ICM Core System shall rank potential detour routes around an incident or event based on their attractiveness relative to the incident or event. (Note: This requirement is ranked low, as the initial requirements state that response plan routes will be selected in advance. This requirement is in anticipation that at some point in the future the system will generate routes in real time.)	L	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.16	The ICM Core System shall include a function to remove routes from consideration based on control asset availability.	H	Decision Support	185. The ICM Core System shall eliminate from consideration roadway segments or routes along which the number of unavailable control assets exceeds a user-defined threshold.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				186. The ICM Core System shall eliminate from consideration roadway segments or routes where control assets critical to the implementation of a response plan (such as a traffic signal at a key intersection) are unavailable. 187. Verify rules are in place that this works.		
RP-3.17	The ICM Core System shall include a function to return a "no existing detour" solution as a suitable solution to the search of detour routes around an incident or event.	H	Decision Support	188. Verify that the "do nothing" response plan is selected when no better response plan is available.		
8.3.1.5.5 Identification of Suitable Control Actions (Response Plan Development)						
RP-3.18	The ICM Core System shall develop response plans seeking to minimize the anticipated impacts of identified active incidents/events on near-future corridor operations.	H	Decision Support	189. When developing a response plan, the ICM Core System shall promote actions seeking to minimize overall travel times/delays within the zone of influence of the related incident/event. 190. When developing a response plan, the ICM Core System shall consider the effects on corridor operations of all identified active incidents/events within the corridor. 191. When developing a response plan, the ICM Core System shall consider the effects of all future road/lane closures and events scheduled to occur within the zone of influence of the related incident/event during the incident's projected duration. 192. Verify rules are in place that this works. 193. Verify that future and current incidents and events & lane closures		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				are used in predictions.		
RP-3.19	Developed response plans shall be comprised of pre-approved control and management actions.	H	Decision Support	194. Verify every response plan from 1 or more is in place. All of them get used in some response plan. That the elements of a generated response plan have been approved. 195. Verify developed response plans shall be comprised, at a minimum, of one or more of the following control actions: • Individuals to be contacted at each agency about the incident being responded to. • Recommended alternate routes around an incident or event: • Recommended route(s) for passenger cars • Recommended route(s) for trucks • Recommended route(s) for buses • Ramp metering control actions: • Turning ramp meters to green ("Green-ball" operation) • Activation of a specific metering rate (0 to 15) • Intersection control: • Change in traffic signal control plan in operation 196. Verify Personnel deployment requests: • Full ramp closure • Locations where portable CMSs are to be deployed • Information dissemination: • Messages to post on fixed CMSs • Messages to post on		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				portable CMSs to be deployed along the corridor • Extinguishable trailblazer signs to be activated • Messages to broadcast on HARs 197. Information to disseminate to 511 systems, third-party information providers, and mobile travel application developers.		
RP-3.20	When developing a response plan, the ICM Core System shall favor the implementation of pre-approved response actions.	H	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.21	When developing response plans, the ICM Core System shall consider, if possible, the historical performance of previously developed combinations of response actions for past incidents or events of similar magnitude occurring at similar locations.	L	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.22	The ICM Core System shall only develop response plans that can be implemented if recommended.	M	Decision Support	Testing to be defined when the requirement is addressed.		
RP-3.23	The ICM Core System shall include a function to develop multiple potential response plans in response to a given incident or event.	H	Decision Support	198. Verify the ICM Core System shall be able to develop multiple response plans as a response to an incident or event.		
RP-3.25	The ICM Environment shall inform transit field supervisors as soon as possible of the response actions being considered to help them make decisions regarding potential transit service adjustments.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
8.3.1.5.6 Evaluation of Individual Response Plans						
RP-3.26	The ICM Core System shall evaluate all developed valid response plans.	H	Decision Support	199. Verify there is a “do nothing” and every response plan is evaluated. 200. The ICM Core System		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				shall always consider a "do nothing" scenario (scenario in which no action is taken) as one of the potential response plans to be evaluated. 201. The ICM Core System shall evaluate all response plans developed by Decision Support.		
RP-3.27	The ICM Core System shall produce a traffic forecast for each response plan being evaluated.	H	Decision Support	202. Verify prediction is run for every response plan. 203. Verify every prediction uses estimation as the initial state. 204. Verify that future and current incidents and events, lane closures & corridor asset state are used in predictions. 205. Verify that response plan implement all the plan elements such as intersection signal plan changes, ramp meter changes, road/lane changes, communication elements, manual interventions. 206. The traffic forecast for each response plan shall use the corridor's current traffic state as its initial state. 207. The traffic forecast for each response plan shall take into account expected changes in traffic patterns from known road closures, other incidents or events, etc. 208. The traffic forecast for each response plan shall implement all the plan elements (intersection signal plan changes, ramp meter changes, road/lane changes, communication elements, manual interventions) associated with the response plan being evaluated.		Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
RP-3.28	The ICM Core System shall evaluate the extent to which each developed response plan would improve/deteriorate corridor operations over a "do nothing" scenario.	H	Decision Support	209. Verify starting from "do nothing "scenario with each response plan over one-hour forecasts of corridor operations. 210. Verify each comparison is using current time as comparison starting point. 211. Verify predictions with vehicle-delay. 212. Verify each prediction generates a map for congestion. 213. Verify comparisons of response plan predictions of vehicle-delay with do nothing predictions of vehicle-delay. 214. Evaluation of the potential impacts of individual response plans on corridor operations shall be conducted over one-hour forecasts of corridor operations using the current time as a starting point. 215. For each evaluated response plan, the ICM Core System shall provide the forecasted increase/decrease in vehicle-delay incurred within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. • For each evaluated response plan, the ICM Core System shall provide the forecasted nominal increase/decrease in vehicle-delay incurred within the zone of influence of the associated incident or event when compared to the "do nothing" scenario.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				• For each evaluated response plan, the ICM Core System shall provide the forecasted percent increase in vehicle-delay incurred within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. 216. For each evaluated response plan, the ICM Core System shall provide the forecasted increase/decrease in person-delay incurred within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. • For each evaluated response plan, the ICM Core System shall provide the forecasted nominal increase/decrease in person-delay incurred within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. • For each evaluated response plan, the ICM Core System shall provide the forecasted percent increase in person-delay incurred within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. 217. For each evaluated		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				response plan, the ICM Core System shall provide the forecasted increase /decrease in travel demand resulting from the implementation of the response plan. • For each evaluated response plan, the ICM Core System shall provide the forecasted percent increase/decrease in vehicle-miles traveled within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. • For each evaluated response plan, the ICM Core System shall provide the forecasted percent increase/decrease in person-miles traveled within the zone of influence of the associated incident or event when compared to the "do nothing" scenario. • For each developed response plan, the ICM Core System shall provide a map showing the location of congested roadway segments associated with the response plan.		
RP-3.29	For each evaluated response plan, the ICM Core System shall produce a confidence index reflecting the potential ability of the proposed actions to positively affect corridor operations.	M	Decision Support	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.5.7 Selection of Recommended Response Plan						
RP-3.32	The ICM Core System shall always consider a "do nothing" scenario as a potential recommendation.	H	Decision Support	218. Verify every incident generates a "do nothing "response plan.		Automation candidate
RP-3.33	The ICM Core System shall rank all developed response plans based on their ability to improve corridor operations within the identified zone of influence of the incident or event that triggered the response planning.	H	Decision Support	219. Response plan ranking shall be made against the "do nothing" scenario 220. The ICM Core System shall assign a higher ranking to response plans reducing incurred delays within the zone of influence of the incident or event. 221. The ICM Core System shall assign a higher ranking to response plans increasing the number of vehicles or travelers able to travel through the zone of influence of the incident or event. 222. The ICM Core System shall assign a higher ranking to response plans where all involved corridor assets are available and in good operating condition. 223. The ICM Core System shall assign a higher ranking to response plans having a higher confidence index. 224. The ICM Core System shall rank a response plan as "Unacceptable – Jurisdictional Restricted" if implementation of the plan would violate a mandatory jurisdictional restriction (such as a school zone restriction, a truck restriction, etc.). 225. The ICM Core System ranking shall rank a response plan as "Unacceptable" if its implementation would result in a worse outcome than the "do		

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				nothing" scenario. 226. Verify each response plan is compared to the "do nothing" response plan. 227. Verify the rules exist for using incurred delay in response plan ranking. 228. Verify the rules exist for using number of vehicles or travelers able to travel through the zone of influence in response plan ranking. 229. Verify the rules exist for using corridor assets are available and in good operating condition in response plan ranking. 230. Verify the rules exist for using higher confidence index in response plan ranking. 231. Verify the rules exist for using mandatory jurisdictional restriction (such as a school zone restriction, a truck restriction, etc. in response plan ranking. 232. Verify the rules exist for ranking a response plan as "Unacceptable" for those worse than "do nothing" 233. Verify all the rules are implemented correctly.		
RP-3.34	The ICM Core System shall only recommend for implementation response plans with forecasted benefits exceeding given user-defined thresholds.	H	Decision Support	234. Verify each response plan for which the forecasted total vehicle-delay / person-delay reduction over the "do nothing" scenario exceeds a given user-defined threshold. 235. The ICM Core System shall only recommend for implementation response plans for which the forecasted total delay reduction over the "do nothing" scenario exceeds a given user-defined threshold. • The ICM Core		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				System shall only recommend for implementation response plans for which the forecasted total vehicle-delay reduction over the "do nothing" scenario exceeds a given user-defined threshold. • The ICM Core System shall only recommend for implementation response plans for which the forecasted total person-delay reduction over the "do nothing" scenario exceeds a given user-defined threshold. 236. The ICM Core System shall only recommend for implementation response plans for which the corridor throughput increase over the "do nothing" scenario exceeds a given user-defined threshold.		
RP-3.35	The ICM Core System shall recommend for implementation the response plan with the highest positive ranking.	H	Decision Support	237. Verify "do nothing" scenario comparison with other response plans and response plan recommended is with the highest positive ranking. The ICM Core System shall recommend the "do nothing" scenario should no alternative response plan with a positive ranking remain.		
RP-3.36	The ICM Core System shall permit manual selection of a response plan from a list of recommended response plans.	H	Corridor Management	238. Verify the response plan determined to be best suited can be selected manually. 239. The ICM Core System shall permit manual selection of response plans. 240. The TMC/TCS operator		

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				shall be able to manually select a response plan from a list of recommended response plans. 241. The ICM Core System shall not allow selection of a plan estimated to have a negative impact on corridor operations. 242. The ICM Core System shall not allow selection of a plan having a low confidence index.		
8.3.1.5.8 Response Plan Review and Approval						
RP-4.1	The ICM Core System shall submit for approval all the response plans that are recommended for implementation by the Decision Support module.	H	Corridor Management	243. Verify response plan best suited will be approved on a case to case basis before being deployed. 244. Approval of recommended response plans shall be required from all agencies having a role to play in the implementation of the plan or being affected by its implementation. 245. For each recommended response plan, the ICM Core System shall identify the individuals within each agency responsible for reviewing and approving the plan. 246. The ICM Core System shall notify all individuals responsible for reviewing/approving response plans when an agency has approved or rejected a recommended plan that has been submitted for review. 247. The ICM Core System shall only consider as approved a recommended plan that has received approval for its implementation from all agencies affected by its implementation.		
RP-	Individuals tasked with	H	Corridor	248. Verify response plan best		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
4.2	reviewing recommended response plans shall provide a review decision within a prescribed interval.		Management	suited will be approved/rejected within a prescribed interval. The ICM Core System shall inform agency representatives of the interval allowed to make a decision on the approval/rejection of a submitted response plan whenever this interval is changed.		
RP-4.3	The ICM Core System shall permit minor modifications to recommended plans submitted for stakeholder approval before final plan approval is obtained.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
RP-4.4	Following approval of a response plan, the ICM Core System shall immediately notify the response plan implementation functions of the need to implement a new response plan.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
8.3.1.5.9 Periodic Response Plan Updates						
RP-5.1	The ICM Core System shall continue to monitor, evaluate, and update the recommended response plan (e.g., suggest changes to messages, timing plans, meter rates, etc.) as an incident/event unfolds.	H	Decision Support	249. Verify response plan best suited will be updated /approved within a prescribed interval.		
RP-5.2	The ICM Core System shall automatically reassess every 5-15 minutes (depending on user configuration) the adequacy of the previously recommended plan and propose, if necessary, modifications to the existing plan.	H	Decision Support	250. Verify response plan best suited will be updated /approved every 5-15 minutes within a prescribed interval.		
RP-5.3	The ICM Core System shall automatically reassess the adequacy of the previously recommended response plan if there are changes to important characteristics of the incident or event being responded to.	H	Decision Support	251. Verify response plan is reassessed if the incident duration is more than 15 minutes. The ICM Core System shall automatically reassess the adequacy of the previously recommended response plan if there is a		

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				change in the number of lanes affected. 252. The ICM Core System shall automatically reassess the adequacy of the previously recommended response plan if the expected duration of the incident or event being responded to changes by more than 15 minutes.		
RP-5.4	The ICM Core System shall include a function for TMC and TCS operators to propose changes to an implemented response plan.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
RP-5.5	The ICM Core System shall submit for review and approval all proposed modifications to an active response plan.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
8.3.1.5.10 Response Termination						
RP-6.1	Following the termination of an incident or event, the ICM Core System shall continue to monitor, evaluate, and update the active response plan until travel conditions within the corridor have returned to an historical average.	H	Decision Support	253. Verify traffic conditions are assessed every 5 minutes after response plan termination. Following the closure of an incident or event, the ICM Core System shall continue assessing travel conditions within the corridor every 5 minutes to determine whether travel conditions have returned to historical average. 254. Traffic conditions shall be assumed to have returned to historical average when observed conditions are within the range of conditions typically observed for the given time of week and time of day in the absence of incidents or events.		
RP-6.2	Following the termination of an incident or event, active response planning shall continue until travel	H	Decision Support	255. Verify Post Incident response plan is in place past the termination of response plan. Following		

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	conditions within the corridor have returned to a historical average.			the closure of an incident or event, normal asset operations shall only be resumed once travel conditions within the corridor have returned to a normal state for the given time of day and day of week. 256. Following the identification of a need to continue response planning activities past the termination an incident or event, the ICM Core System shall assign the "Post-Incident/Event Response" label to the active response plan until response activities can formally be terminated.		
RP-6.3	The ICM Core System shall return corridor assets to normal operations when corridor operations have returned to normal.	H	Corridor Management	257. Verify once closure of an incident all control device return to normal operation. Upon determining that corridor operations have returned to normal after the closure of an incident or event, the ICM Core System shall instruct all control devices for which operation has been altered during the incident/event response to return to their defined normal operations for the time of day and day of week. 258. Prior to terminating response planning activities, the ICM Core System shall check that all control devices for which operation has been altered during the incident/event response have effectively returned to normal operation.		
RP-6.4	Before terminating a response activity, the ICM Core System shall seek appropriate approval from TMC/TCS operators that the	H	Corridor Management	259. Verify approval is required before terminating any response plan. TMC/TCS operators shall approve		

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	response planning activity can be terminated.			termination of response plans.		
RP-6.6	The ICM Corridor Manager shall have the authority to command the ICM Core System to terminate a response planning activity.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
RP-6.7	The ICM Core System shall inform relevant system operators when traffic conditions within the corridor are deemed to have returned to normal.	H	Corridor Management	260. Verify relevant operators are informed when traffic returns to normal. The ICM Core System shall notify the Corridor Manager when traffic conditions within the corridor have returned to normal state. 261. The ICM Core System shall notify the TMC/TCS operators of all agencies involved in the implementation of a response plan when traffic conditions within the corridor have returned to normal and that regular corridor operations are to resume. 262. The ICM Core System shall notify first responders involved in the implementation of a response plan that traffic conditions within the corridor have returned to normal and that regular corridor operations are to resume. 263. The ICM Core System shall notify transit agencies involved in the implementation of a response plan that traffic conditions within the corridor have returned to normal and that regular corridor operations are to resume. 264. The ICM Core System shall notify parking operators involved in the implementation of a response plan that traffic conditions within the corridor have returned to		

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				normal and that regular corridor operations are to resume. 265. The ICM Core System shall notify information providers involved in the implementation of a response plan that traffic conditions within the corridor have returned to normal and that regular corridor operations are to resume.		
RP-6.8	The ICM Core System shall inform relevant system operators when a response planning activity has been terminated.	H	Corridor Management	266. Verify relevant operators are informed when response plan is terminated. The ICM Core System shall inform affected TMC/TCS operators when a decision has been made to terminate a response planning activity. 267. The ICM Core System shall inform the owner of each field device (e.g., traffic signal controllers, fixed CMS, etc.) used in the implementation of a response plan when a decision has been made to return the device to normal operation. 268. The ICM Core System shall inform field supervisors of affected transit agencies when a decision has been made to terminate a response plan. 269. The ICM Core System shall inform affected first responders when a decision has been made to terminate a response planning activity. 270. The ICM Core System shall inform affected parking operators when a decision has been made to terminate a response planning activity. 271. The ICM Core System shall inform affected information providers		

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				when a decision has been made to terminate a response planning activity. 272. The ICM Core System shall inform all system stakeholders when all response planning activities have officially concluded.		
8.3.1.5.11 Response Planning Archiving						
RP-7.1	The ICM Core System shall log all response planning activities.	M		Testing to be defined when the requirement is addressed.		
RP-7.2	The ICM Core System shall archive developed response plans.	M		Testing to be defined when the requirement is addressed.		
8.3.1.5.12 Response Planning Performance Assessment						
RP-8.1	The ICM Core System shall generate a response plan within 5 minutes of the verification of an active incident or event.	H		273. Verify response plan ranking between 1 to 10 is generated within 5 minutes of verification of an active incident.		
RP-8.2	The simulation software shall be able to evaluate within a 5-minute interval the impacts of at least three candidate response plans over at least the next projected hour of operation.	H		274. Verify at least three response plan comparisons with projection for the next hour is generated within 5 minutes of verification of an active incident.		
8.3.1.6 Response Plan Implementation						
8.3.1.6.1 Response Plan Field Implementation						
PI-2.1	Upon receiving a new approved response plan, the ICM Core System shall determine the order and proper time at which control actions should be sent to individual control elements.	H	Decision Support	275. Verify the ICM Core System shall determine the order and time at which control actions would be sent to individual control elements.		
PI-2.2	The ICM Core System shall send response plan instructions to individual corridor assets.	H	Corridor Management	276. Verify the instructions are sent to the individual traffic control devices involved in the implementation of the		

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				plan such as • Individual traffic signal controllers specifying which timing plan to use at the corresponding intersection. • Individual ramp meter controllers specifying which metering algorithm/rate to use at the corresponding on-ramp or freeway-to-freeway connector. 277. Verify the instructions /commands are sent to the traveler information devices involved in the implementation of a response plan such as: • Individual fixed CMS devices specifying what message is to be posted on the device. • Individual portable CMS devices with remote communication capability specifying what message is to be posted on the device. • Individual extinguishable trailblazer signs along the selected detour(s). 278. Verify the ICM Core System shall send instructions to individual traffic control devices involved in the implementation of the plan. • The ICM Core System shall send commands to individual traffic signal controllers specifying which timing plan to use at the corresponding		

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				intersection. • The ICM Core System shall send commands to individual ramp meter controllers specifying which metering algorithm/rate to use at the corresponding on-ramp or freeway-to-freeway connector. 279. Verify the ICM Core System shall send instructions to traveler information devices involved in the implementation of a response plan. • The ICM Core System shall send commands to individual fixed CMS devices specifying what message is to be posted on the device. • The ICM Core System shall send commands to individual portable CMS devices with remote communication capability specifying what message is to be posted on the device. • The ICM Core System shall send activation commands to individual extinguishable trailblazer signs along the selected detour(s). 280. The ICM Core System shall send deployment requests to agency personnel having a role to play in implementing the plan. • Stakeholders shall		

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				permit the Core ICM System to contact designated agency personnel with requests for performing preapproved actions. • The ICM Core System shall send task requests to agency staff responsible for the deployment of portable CMSs, specifying how many signs are to be deployed and where. • The ICM Core System shall send deployment requests to field operation staff from each participating agency specifying where they should deploy and what task is to be accomplished. • The ICM Core System shall send traffic management requests to first responders from each participating agency.		
PI-2.3	The ICM Core System shall verify, to the extent possible, that field assets have the correct plan components.	H	Corridor Management	281. Verify the traffic control devices involved in the implementation of a response plan shall acknowledge receiving instructions sent by the ICM Core System. • Traffic signal controllers shall acknowledge receiving instructions on when to start a specific signal plan. • Ramp controllers shall acknowledge receiving instructions on		

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				when to start a particular ramp metering plan. 282. Verify the traveler information devices involved in the implementation of a response plan shall acknowledge receiving instructions sent by the ICM Core System. • Fixed CMS devices shall acknowledge receiving instructions on when to display a particular message. • Portable CMS devices with remote communication capability shall acknowledge receiving instructions on when to display a particular message. • Extinguishable trailblazer signs shall acknowledge receiving activation instructions. • HAR systems shall acknowledge receiving instructions on when to broadcast a particular message.		
PI-2.4	Assets failing to acknowledge in a timely manner receipt of instructions from the ICM Core System shall, to the extent possible, be checked to determine whether they have received the information.	H	Corridor Management	283. Verify traveler information devices involved in the implementation of a response plan failing to acknowledge shall be checked if they received instructions sent by the ICM Core system. 284. Traffic control devices failing to acknowledge within one minute the receipt of response plan implementation instructions shall be checked to see if they have received the instructions.		

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				• In the absence of timely acknowledgment, ramp controllers shall be checked to ensure that the metering change information sent by the ICM Core System has been received by the device. • In the absence of timely acknowledgment, traffic signal controllers shall be checked to ensure that the timing plan change information sent by the ICM Core System has been received by the device. 285. Traveler information devices failing to acknowledge within one minute receipt of messaging instructions shall be checked to see if they have received the instructions. • In the absence of timely acknowledgment, fixed CMS signs shall be checked to ensure that the messaging information sent by the ICM Core System has been received. • In the absence of timely acknowledgment, portable CMS signs shall be checked to ensure that the messaging information sent by the ICM Core System has been received. • In the absence of		

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				timely acknowledgment, extinguishable trailblazer signs shall be checked to ensure that the activation information sent by the ICM Core System has been received. • In the absence of timely acknowledgment, HAR systems shall be checked to ensure that the messaging information sent by the ICM Core System has been received.		
PI-2.5	The ICM Core System shall be responsible for performing initial checks on instruction receipt acknowledgments from corridor assets.	H	Corridor Management	286. To the extent possible, the ICM Core System shall provide an automated way to check whether instruction receipt acknowledgments have been received from corridor assets. 287. Human assets shall only be involved in verifying instruction receipt where automation is not possible or after automation verification has failed. 288. Asset acknowledgments and lack of acknowledgments shall be tracked in electronic format. 289. Asset checks and results shall be tracked in electronic format. 290. Verify instruction receipt acknowledgments have been received from corridor assets. 291. Verify human assets shall only be involved in verifying instruction receipt where automation is not		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				possible. 292. Verify asset acknowledgments and lack of acknowledgments are tracked in electronic format. 293. Verify asset checks and results are tracked in electronic format.		
8.3.1.6.2 Information Dissemination to Travelers						
PI-3.1	The ICM Core System shall inform corridor travelers of incidents, unscheduled events, and planned events occurring within the corridor.	H	Corridor Management	294. The ICM Core System shall inform travelers and fleet operators of roadway incidents, unscheduled events, and planned events occurring along corridor freeways and arterials that may be used as detours. 295. The ICM Core System shall inform travelers and fleet operators of planned roadway closures occurring along corridor freeways and arterials that may be used as detours. 296. The ICM Core System shall inform travelers and fleet operators of unscheduled roadway closures due to maintenance or other reasons occurring along corridor freeways and arterials that may be used as detours. 297. For each incident or event, the ICM Core System shall provide travelers and fleet operators with an assessment of travel conditions within the corridor. • For each incident or event, the ICM Core System shall provide travelers and fleet operators with estimates of current travel times or travel delays within		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				the corridor. • For each incident or event, the ICM Core System shall provide travelers and fleet operators with estimates of projected travel times or travel delays within the corridor at 15-minute intervals. 298. Verify ICM Core System informs travelers and fleet operators of roadway incidents, unscheduled events, and planned events occurring along corridor freeways and arterials that may be used as detours. 299. Verify ICM Core System informs travelers and fleet operators of planned roadway closures occurring along corridor freeways and arterials that may be used as detours. 300. Verify ICM Core System informs travelers and fleet operators of unscheduled roadway closures. 301. Verify for each incident ICM Core System provides travelers and fleet operators with an assessment of travel conditions. • Estimates of current travel times or travel delays within the corridor. • ICM Core System shall provide travelers and fleet operators with estimates of projected travel times or travel delays within the corridor at 15-minute intervals.		
PI-3.2	The ICM Core System shall	H	Corridor	302. Verify ICM Core System		

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	inform corridor travelers, by multiple channels, of recommended detours around incidents.		Management	will display detour information on relevant CMS: The ICM Core System shall display information about recommended detour(s) on relevant CMSs within and around the corridor. 303. The ICM Core System shall display, when needed, detour information on fixed CMSs operated by Caltrans along the I-210 freeway. 304. The ICM Core System shall display, when needed, detour information on fixed CMSs operated by Caltrans on relevant regional freeways. 305. The ICM Core System shall display, when needed, relevant detour information on fixed CMSs operated along corridor arterials by local agencies. 306. The ICM Core System shall display, when needed, relevant detour information on mobile CMSs operated by local agencies. 307. The ICM Core System shall display, when needed, relevant detour information on extinguishable trailblazer signs operated along corridor arterials by local agencies. 308. The ICM Core System shall send information about recommended detour(s) to the regional 511 System. 309. The ICM Core System shall send information about recommended detour(s) to participating third-party information providers.		

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				310. The ICM Core System shall make detour information available to navigation application providers (Waze, Google, etc.).		
PI-3.3	The ICM Core System shall send mode-specific detour information to corridor travelers.	H	Corridor Management	311. Verify ICM Core System will send mode-specific detour information to corridor travelers. 312. The ICM Core System shall send suitable detours around incidents and events to passenger cars. 313. The ICM Core System shall send suitable detours around incidents and events to truck fleet dispatchers and/or truck operators. 314. The ICM Core System shall send suitable detours around incidents and events to transit bus field supervisors and/or bus drivers.		
PI-3.4	The ICM Core System shall guide vehicle operators along recommended detours.	H	Corridor Management	315. Verify ICM Core System will guide detouring traffic along recommended detours, using various channels that may include fixed CMSs, mobile CMSs, fixed extinguishable trailblazer signs, fixed static signs, hands-free mobile applications, and/or radio broadcasts.		
PI-3.5	The ICM Environment shall send corridor travelers information on alternate transportation modes.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
PI-3.6	The ICM Environment shall provide travelers information about incidents and events occurring within the corridor in a consistent format.	H	Corridor Management	316. Verify ICM environment will provide travelers information about incidents and events occurring within the corridor.		
8.3.1.6.3 Implementation Override						
PI-4.1	Prior to initiating the implementation of an	M	Decision Support	Testing to be defined when the requirement is addressed.		

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	approved response plan, the ICM Core System shall check whether changes in corridor operations may warrant the development of a new response plan.					
PI-4.2	The ICM Core System shall initiate the development of a new response plan if changes in corridor operations render the currently approved response plan obsolete before its implementation.	L	Decision Support	Testing to be defined when the requirement is addressed.		
8.3.1.6.4 Response Plan Implementation Tracking						
PI-6.1	The ICM Core System shall track the implementation progress of approved response plans.	H	Corridor Management	317. Verify implementation progress of approved response plans is tracked. 318. Verify each recommended action implementation is logged. 319. Verify any failure to implement a change request is logged.		
PI-6.2	Upon termination of an incident or event response plan, the ICM Core System shall ensure that all assets are returned to the state of operation that would have been in effect had an incident or event not occurred.	H	Corridor Management	320. Verify upon termination of an incident or event response plan all assets are returned to state of operation.		
PI-6.3	The ICM Core System shall inform all TMC/TCS operators and transit field supervisors whether a recommended response has been successfully implemented.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 321. Verify ICM core shall inform all TMC/TCS operators and transit field supervisors whether a recommended response has been implemented, ICM Core System shall inform TMC/TCS operators and transit field supervisors when a response plan has been successfully implemented in its entirety. 322. The ICM Core System		

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				shall inform individual TMC/TCS operators and transit field supervisors of all implemented changes within their jurisdiction. 323. The ICM Core System shall inform the Corridor Manager and relevant TMC operators and transit field supervisors if a recommended response plan cannot be implemented. 324. In the case of implementation failure, the ICM Core System shall indicate why a recommended response plan could not be implemented.		
PI-6.4	The ICM Core System shall inform all TMC/TCS operators and transit field supervisors when all corridor assets have been returned to normal operations.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 325. Verify ICM Core System informs all TMC/TCS operators and transit field supervisors when all corridor assets have been returned to normal operations.		
8.3.1.6.5 Response Planning Archiving						
PI-7.1	The ICM Core System shall log all control activities related to the implementation of an approved response plan.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 326. Verify logging of all control activities related to implementation of an approved response plan.		
PI-7.2	The ICM Core System shall archive implemented response plans.	H	Data Hub	327. Data is archived to AWS glacier after 90 days.		
8.3.1.7 Data Management						
8.3.1.7.1 Data Quality						
DM-1.1	The Corridor Technical Manager and Corridor Data Analyst shall develop a data	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

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	quality management program for the ICM Environment.					
DM-1.2	For the ICM Environment, data quality requirements shall be specified for all data sources and system data elements.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
DM-1.3	Data quality shall be maintained.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.7.2 Data Management Needs						
8.3.1.7.2.1 Geographic and Institutional Data						
DM-2.1	Data Management shall store and provide access to information characterizing the corridor's institutional environment.	M	Data Hub	Testing to be defined when the requirement is addressed.		
8.3.1.7.2.2 Asset Inventory						
DM-2.2	Data Management shall store or provide access to information characterizing freeway segments.	H	Data Hub	328. For each freeway segment, Data Management shall store or provide access to the following information: General characteristics: • Number of general-purpose traffic lanes • Posted speed limit • Upstream mainline freeway segments, on-ramps, and connectors feeding traffic to the segment • Downstream mainline freeway segments, off-ramps, and connectors receiving traffic from the segment • Left and right shoulder widths • Median barrier height, if any • HOV treatment • Number of HOV lanes • Type of HOV	Connect to Road Network Information service endpoint	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				restriction (2+ or 3+ occupants) • Periods during which HOV restriction is in effect • Restrictions: o Vehicle height clearance under bridges or structures o Truck use restrictions 329. For each on-ramp or freeway-to-freeway connector, Data Management shall store or provide access to the following information: General characteristics: • Number of general-purpose traffic lanes • Posted speed limit • Roadway link(s) feeding traffic to the ramp • Mainline freeway segment(s) receiving traffic from the ramp • HOV treatment: • Number of HOV lanes • Type of HOV restriction (2+ or 3+ occupants) • Periods during which HOV restriction is in effect • Ramp metering: • Ramp meter present • Type of ramp metering (fixed, adaptive, etc.) • HOV vehicles allowed bypassing the ramp meter • Restrictions: o Vehicle height clearance under bridges or structures o Truck use restriction		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				330. For each off-ramp, Data Management shall store or provide access to the following information: General characteristics: • Number of general-purpose traffic lanes • Posted speed limit • Freeway segment(s) feeding traffic to the off-ramp • Roadway segment(s) receiving left-turning, thru, and right-turning traffic from the off-ramp • Restrictions: o Vehicle height clearance under bridges or structures o Truck use restriction		
DM-2.3	Data Management shall store or provide access to information characterizing arterial segments.	H	Data Hub	331. For each arterial segment, Data Management shall store or provide access to the following information: General characteristics: • Number of through traffic lanes • Posted speed limit • Roadway segment(s) feeding traffic to the arterial segment • Roadway segments receiving left-turning, thru and right-turning traffic from the arterial segment • Presence of hard median barrier • Restrictions: o Left-turn restrictions o Vehicle height clearance under bridges or structures o Truck use restrictions o Parking restrictions	Connect to Road Network Information service endpoint	
DM-	Data Management shall store	M	Data Hub	Testing to be defined when	Connect to	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
2.4	or provide access to information characterizing relevant transit services operated within the corridor (rail lines, transit routes, etc.).			the requirement is addressed.	Transit Routes and Transit State endpoint	
DM-2.5	Data Management shall store or provide access to information characterizing park-and-ride facilities operated within the corridor.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-2.6	Data Management shall store or provide access to information characterizing devices used to monitor traffic.	H	Data Hub	332. Data Management shall maintain an inventory of devices used to collect traffic flow data. 333. Data Management shall store or provide access to the following information for each device used to collect traffic flow data: • Sensor location • Sensor type • Device owner • Sensor identification number • Reporting system to which the sensor is connected • Movements covered by the sensor (through, left-turn, right-turn, combinations) • Data Management shall maintain an inventory of devices used to monitor travel times 334. Data Management shall store or provide access to the following information for each device used to collect travel times: • Sensor location • Sensor type • Device owner • Sensor identification number • Reporting system to which the sensor is connected	Connect to Travel Time Detector Inventory/maintenance & Travel time Detector Inventory	
DM-2.7	Data Management shall store or provide access to information characterizing devices used to monitor weather conditions.	L	Data Hub	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
DM-2.8	Data Management shall store or provide access to information characterizing signalized intersections.	H	Data Hub	335. Data Management shall maintain an inventory of signalized intersections under ICM management. 336. For each signalized intersection under ICM management, Data Management shall store or provide access to the following information: • Agency/Agencies owning the intersection • Agency/Agencies responsible for operation and maintenance of intersection • Type of signal controller used • Controller firmware • Number of approaches to the intersection 337. For each approach to a signalized intersection under ICM management, Data Management shall store or provide access to the following information: • Lane assignments (number of left, thru, right lanes) • Distance to upstream intersection • Posted speed limit • Length of left-turn bay, if any • Length of right-turn bay, if any	Connect to intersection signal inventory endpoint	
DM-2.9	Data Management shall store or provide access to information characterizing ramp metering operations within the corridor.	H	Data Hub	338. Data Management shall maintain an inventory of freeway ramps and freeway-to-freeway connectors equipped with ramp meters under ICM management. 339. For each metered on-ramp or freeway-to-freeway connector under ICM management, Data Management shall store or provide access to the	Connect to Ramp meter inventory	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				following information: • Location of ramp meter along the on-ramp or connector • Type of signal controller used • Ramp metering program installed in controller • Distance of queue sensors from ramp metering stop line		
DM-2.10	Data Management shall store or provide access to information characterizing devices that may be used to disseminate information to travelers.	H	Data Hub	340. Data Management shall maintain an inventory of fixed CMS devices within and outside the ICM corridor that may be used to disseminate information to travelers. 341. Data Management shall maintain an inventory of portable CMS devices that may be used to disseminate information to travelers. 342. Data Management shall maintain an inventory of extinguishable trailblazer signs that may be used to disseminate information to travelers. 343. For each fixed CMS that may be used by the ICM Environment, Data Management shall store or provide access to the following information: • Location of device • Device operator • Number of display lines • Total number of characters that can be displayed per line 344. For each portable CMS that may be used by the ICM Environment, Data Management shall store or provide access to the following information: • Device operator • Location where device is normally stored when not used	Connect to CMS Inventory (trailblazer inventory can be verified at this endpoint), HAR inventory	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				• Number of display lines • Total number of characters that can be displayed per line 345. For each extinguishable trailblazer sign that may be used by the ICM Environment, Data Management shall store or provide access to the following information: • Location of device • Device operator • Message(s) displayed by device when lit 346. For each HAR that may be used by the ICM Environment, Data Management shall store or provide access to the following information: • Station location • Broadcast frequency • Station operator		
8.3.1.7.2.3 Asset Capabilities (Background Operational Data)						
DM-2.11	Data Management shall store or provide access to information characterizing typical traffic signal operations at relevant intersections within the ICM corridor.	H	Data Hub	347. For each signalized intersection under ICM management, Data Management shall store or provide access to the following information: • Agency responsible for the operation of the intersection • Agency responsible for maintenance • Traffic control system managing the intersection • Type of signal controller used • Number of defined timing plans available 348. For each signal timing plan, Data Management shall store or provide access to the following information: • Typical times of operation	Connect to intersection signal control schedule endpoint	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				• Cycle length • Signal offset • Offset reference point within cycle • Phase sequence • Phase durations 349. For each approach to a signalized intersection, Data Management shall store or provide access to the following information: Prohibited right turn on red movements		
DM-2.12	Data Management shall store or provide access to information characterizing typical ramp metering operations within the ICM corridor.	H	Data Hub	350. For each metered on-ramp or freeway-to-freeway connector, Data Management shall store or provide access to the following information: • Minimum and maximum ramp metering rates allowed • Metering rate table • Metering algorithm used	Connect to Ramp meter inventory endpoint and Plans	
DM-2.13	Data Management shall store or provide access to information identifying typical detour routes that should be considered when responding to incidents.	H	Data Hub	351. Data Management shall store or provide access to information identifying typical preferred detour routes that should be considered for passenger cars. 352. Data Management shall store or provide access to information identifying typical preferred detour routes that should be considered for buses.	Connect to Route inventory endpoint Testing to be defined when the requirement is addressed	Automation test candidate
	8.3.1.7.2.4 Asset State Data					
DM-2.14	Data Management shall receive real-time data characterizing the operational status of devices supporting ICM operations.	H	Data Hub	353. For each traffic sensor, Data Management shall receive every 5 minutes or less the following device status data: • Whether the device is operating normally • Any error messages produced by the device or its associated	Connect to the Freeway Detector state endpoint	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				management system Testing to be defined when the requirement is addressed: 354. For each travel time measurement device, Data Management shall receive every 5 minutes or less the following status data: • Whether the device is operating normally • Any error messages produced by the device or its associated management system 355. For each signalized intersection, Data Management shall receive every 5 minutes or less the following device status data: • Whether the signal is operating normally • Timing plan in operation • Any error messages produced by the device or its associated management system 356. For each ramp meter, Data Management shall receive every 5 minutes or less the following device status data: • Whether the ramp meter is operating • Any error messages produced by the device or associated management system • Metering rate currently in operation 357. For each fixed CMS, Data Management shall	Connect to the Travel Time Detector Inventory endpoint Connect to the Intersection Detector State/ Intersection signal State endpoint to check the device status Connect to the Ramp meter state endpoint Connect to the CMS state endpoint	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				receive every 5 minutes or less the following device status data: • Whether the sign is active • Whether the sign is operating normally • Any error messages produced by the device or its associated management system 358. For each extinguishable trailblazer sign, Data Management shall receive every 5 minutes or less the following device status data: • Whether the sign is active • Whether the sign is operating normally • Any error messages produced by the device or its associated management system Testing to be defined when the requirement is addressed: 359. For each weather monitoring station providing data to the ICM Environment, Data Management shall receive every 15 minutes or less the following status data: • Whether the weather station is operational • Whether the monitoring station is operating normally • Any error messages produced by the device or its associated data collection system 360. Data Management shall receive every 5 minutes the data indicating	Connect to the CMS state endpoint Connect to the Environment-al Detector Inventory endpoint every 15 mins	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				whether ICM Environment components are operating normally or not.	Connect to the Data hub, DSS, CMS, center verification (cities /counties) endpoint	
	8.3.1.7.2.5 Asset Real-Time Data					
DM-2.15	Data Management shall receive real-time traffic data from individual traffic sensors operating within the corridor.	H	Data Hub	361. Data Management shall receive every 1 minute or less the following data from each traffic sensor located on general-purpose or HOV freeway lanes: • Recorded vehicle counts • Measured sensor occupancy • Estimated/measur-ed speed 362. Data Management shall receive every 1 minute or less the following real-time data from each traffic sensor located on freeway on-ramps, off-ramps, and freeway-to-freeway connectors: • Recorded vehicle counts • Measured sensor occupancy 363. Data Management shall receive every 5-15 minutes or less (details to be determined at design) the following real-time data from individual traffic sensors located along arterial segments: • Recorded vehicle counts 364. Based on data received from traffic sensors located on mainline general-purpose or HOV lanes, Data Management shall calculate, if	Connect to the Freeway Detector Data endpoint & Ramp detector data endpoint every 30secs Connect to the Intersection detector data endpoint Connect to the Intersection detector data endpoint Connect to the Freeway detector data endpoint	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				necessary, the following traffic statistics for each successive 5-minute interval for each sensor: • Average observed vehicle flow (in vehicles per hour) • Average estimated flow density (in vehicles per mile) • Average observed traffic speed (in miles per hour) 365. Based on data received from traffic sensors located on freeway on-ramps and off-ramps, as well as freeway-to-freeway connectors, Data Management shall calculate if necessary the following traffic statistics for each successive 5-minute interval for each sensor: • Average observed vehicle flow (in vehicles per hour) • Average estimated flow density (in vehicles per mile) • Average observed traffic speed (in miles per hour) 366. Based on data received from traffic sensors located on corridor arterials, Data Management shall calculate if necessary the following traffic statistics for each successive 5-minute interval for each sensor: • Average observed vehicle flow (in vehicles per hour) • Average estimated flow density (in vehicles per mile) • Average observed traffic speed (in miles per hour)	Connect to the Ramp detector data endpoint Connect to the Intersection detector data endpoint	
DM-2.16	Data Management shall receive real-time data from	M	Data Hub	367. Data Management shall receive every 5 minutes	Connect to the travel	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	travel time measurement systems within the corridor.			or less travel time measurements from Bluetooth travel time measurement systems in operation within the corridor. 368. Data Management shall receive every 5 minutes or less travel time measurements from Pasadena's SMART system in operation along Orange Grove Boulevard.	time detector inventory endpoint every 5 mins	
DM-2.17	Data Management shall receive real-time data from participating probe vehicle monitoring systems covering the ICM corridor.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-2.18	Data Management shall receive real-time data characterizing incidents and events occurring within the corridor.	H	Data Hub	Will be part of vendor supplied CMS evaluation and acceptance criteria. 369. Data Management shall receive every 5 minutes or less information updates about traffic incidents that have been identified to have occurred. 370. Data Management shall receive every 5 minutes or less information updates about active events affecting corridor operations. 371. Data Management shall receive every 5 minutes or less information updates about unusual traffic congestion patterns that may have been detected by the ICM Environment and Core System. Will be part of vendor supplied CMS evaluation and acceptance criteria. Testing to be defined when the requirement is addressed. 372. Data Management shall receive every 5 minutes or less information updates about planned lane closures scheduled	Connect to the LCS schedule	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				to occur during the current operation day.	endpoint for the incidents and events	
DM-2.19	Data Management shall receive real-time data characterizing the operational performance of relevant transit services within the corridor.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-2.21	Data Management shall receive real-time data characterizing observed ramp metering operations within the corridor.	H	Data Hub	373. For each ramp meter, Data Management shall receive the following information each time a change in metering rate is implemented within one minute of the time of the change: • Time ramp metering rate was changed • Metering rate that was activated	Connect to the Ramp Meter State endpoint for verifying the relevant data	
DM-2.22	Data Management shall receive real-time data characterizing the current operational status of traffic signals in operation within the corridor.	H	Data Hub	374. For each signalized intersection under ICM surveillance, Data Management shall receive at the end of each signal cycle the following operational information: • Signal timing plan in effect • Start time of signal cycle • Signal cycle length • Signal coordination status • Signal offset • Offset reference phase	Connect to the Intersection Signal State endpoint	
DM-2.23	Data Management shall store information characterizing the typical range of values associated with the data received.	M	Data Hub	Testing to be defined when the requirement is addressed.		
8.3.1.7.2.6 Response Plan Data						

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
DM-2.24	Data Management shall maintain an updated list of active incidents and events affecting corridor operations.	H	Data Hub	375. Verify at any given time, Data Management shall maintain the following lists of active incidents and events affecting corridor operations: • Active traffic incidents • Active unusual congestion events reported by the ICM Environment or Core System • Active transit incidents • Active planned road/lane closures • Active planned events • Active weather events having the potential to affect travel conditions with the corridor 376. Verify for each identified incident and event, Data Management shall collect and periodically update the following information characterizing the incident or event: • Identification number assigned to the incident or event • Location of incident or event • Time incident occurred or event started • Time all lanes were cleared or opened • Time traffic conditions returned to normal • Roadway segment(s) affected by incident or event • Number of lanes closed on each affected roadway segment • Location of closed lanes on each affected roadway	Query the DB to get the list of created mock incidents (create view on CMS as part of CMS evaluation and see the list of incidents)	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				segment • Agency responsible for managing the incident / event traffic		
DM-2.25	Data Management shall maintain a log of response planning activities conducted as a result of an active incident or event.	H	Data Hub	377. Verify following the identification of an active incident or event, Data Management shall collect and periodically update the following information describing the resulting response planning activities: • Identification number assigned to the incident or event • Time when response planning activities were initiated • Information about recommended response plans, if any: ○ Time a recommended response plan was proposed ○ Identification number of recommended response plan ○ Response plan evaluation score ○ Time response plan was approved ○ Time response plan was implemented ○ Time response plan was replaced by another plan or terminated ○ Response plan element implementation schedule ○ Response plan	Connect to the Response Plan Service endpoint to verify the relevant information	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				element implementation success or failure and time of implementation ○ Time when response planning activities were terminated		
DM-2.26	Data Management shall collect and store information describing each developed response plan.	H	Data Hub	378. Verify for each developed response plan, Data Management shall store or provide access to information describing the recommended control actions associated with the plan. This includes: • Agencies involved in the implementation of the response plan • Recommended alternate route(s) around incident/event for which the response plan was developed ○ Recommended route(s) for passenger cars ○ Recommended route(s) for buses • Recommended metering actions at freeway on-ramp: ○ Ramps with recommended full closure ○ Ramps with recommended green ball operation ○ Ramps with recommended metering change ○ Recommended metering rate at each ramp • Recommended traffic signal control actions: ○ Intersections for which signal timing plans	Connect to the Response Plan Service endpoint to verify the relevant information Storing will be verified at the database	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				are to be changed o Signal timing plan to activate at each identified intersection • Information dissemination strategy: o Messages to post on fixed CMSs o Where to deploy portable CMSs and what message to post at each location o Extinguishable trailblazer signs to activate o Which HARs to activate and what message to broadcast on them o Information to disseminate to the regional 511 System o Information to make available to third-party information providers and mobile travel application developers • Requested personnel deployments to specific corridor locations: o Implementation schedule		
DM-2.27	Data Management shall collect and store information describing each implemented response plan.	H	Data Hub	379. Verify for each implemented response plan, Data Management shall store or provide access to information describing the control actions taken. This includes: • Time plan was	Connect to the Response Plan Service endpoint to verify the relevant information	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				activated • Time plan was terminated (updated with another plan or closed) • Agencies involved in the implementation of the plan o Requested personnel deployments to specific corridor locations o Response plan element implementation times • Recommended alternate route(s) around the incident/event: o Recommended route(s) for passenger cars o Recommended route(s) for buses • Recommended metering actions at freeway on-ramp: o Ramps with recommended full closure o Ramps with recommended green ball operation o Ramps with recommended metering change o Recommended metering rate at each ramp • Recommended traffic signal control actions: o Intersections for which signal timing plans are to be changed o Signal timing		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				plan to activate at each identified intersection • Information dissemination strategy: o Messages posted on fixed CMSs o Locations where portable CMSs were deployed o Message posted on each deployed portable CMS o Extinguishable trailblazer signs activated o Activated HARs, with what message broadcasted o Information disseminated to the regional 511 System o Information made available to third-party information providers and mobile travel application developers • Requested personnel deployments to specific corridor locations • Response plan element implementation times		
	8.3.1.7.2.7 Data Archiving					
DM-2.28	Data Management shall archive ICM Core System configuration elements.	H	Data Hub	Verify the back up to AWS glacier. Data Management shall archive road network information. 380. Data Management shall		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				archive ICM Core System configuration, security, error/fault, and status information. 381. Data Management shall archive ICM Core System rules information. 382. Data Management shall archive all asset capability data provided to the ICM Core system.		
DM-2.29	Data Management shall archive data collected as part of ICM Core System operations.	H	Data Hub	Verify the back up to AWS glacier. 383. Data Management shall archive information detailing the response plans that were developed and implemented in response to specific incidents or events. 384. Data Management shall archive traffic estimation and prediction information.		
DM-2.31	Data Management shall provide a means for users to configure archiving functions.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-2.32	Data Management shall archive selected data sets for a period of 5 years.	M	Data Hub	Testing to be defined when the requirement is addressed.		Glacier will keep it for 5 years.
	8.3.1.7.2.8 Maintenance Logs					
DM-2.33	Data Management shall collect and archive all maintenance alerts and notifications generated by the ICM Environment and Core System.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-2.34	Data Management shall collect and archive all maintenance activity logs entered by participating agencies.	L	Data Hub	Testing to be defined when the requirement is addressed.		
	8.3.1.7.2.9 Administrative Logs					
DM-2.35	Data Management shall log when users access the system.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-2.36	Data Management shall log ICM Core System and subsystem activities.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-	Data Management shall log	M	Corridor	Testing to be defined when		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
2.37	all system changes made by system users.		Management	the requirement is addressed.		
8.3.1.7.3 Data Communication Interface						
8.3.1.7.3.1 Incoming Data Communication Channel						
DM-3.1	Data Management shall include a function to retrieve data disseminated through regional communication networks.	H	Data Hub	Data Management components shall include a function to retrieve data disseminated through the IEN. (Not valid REQ) 385. Data Management components shall include a function to retrieve data disseminated through RIITS. Verify each pipeline connected to RIITS. 386. Verify Data Management components shall include a function to retrieve data disseminated through Caltrans' Freeway Performance Measurement System (PeMS). Verify each pipeline connected to Freeway detector.		IEN is not the source of information for the system
DM-3.2	Data Management shall receive traffic detection data from traffic management systems operated by local agencies.	H	Data Hub	387. Data Management shall receive traffic sensor data from Caltrans' freeway traffic surveillance system. 388. Data Management shall receive traffic sensor data from Caltrans' TSMSS system. 389. Data Management shall receive traffic sensor data from Pasadena's QuicNet system. 390. Data Management shall receive traffic sensor data from Pasadena's SCATS system. 391. Data Management shall receive traffic sensor data from Arcadia's TransSuite system. 392. Data Management shall receive traffic sensor data from Los Angeles		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				County's KITS system. 393. Data Management shall receive traffic sensor data from Monrovia's KITS system hosted on the Los Angeles County KITS server. 394. Data Management shall receive traffic sensor data from Duarte's KITS system hosted on the Los Angeles County KITS server.		
DM-3.3	Data Management shall receive data from travel time monitoring systems installed within the corridor.	H	Data Hub	395. Data Management shall receive travel time data collected by Pasadena's Digiwest BlueMAC system. 396. Data Management shall receive travel time data collected by Pasadena's SMART Signal System deployed along Orange Grove. 397. Data Management shall receive travel time data collected by Arcadia's Iteris Vantage system. 398. Data Management shall receive travel time data from the travel time monitoring system used by the Los Angeles County Department of Public Works. 399. Data Management shall receive travel time data from the system used by the City of Monrovia to monitor travel times on city arterials. 400. Data Management shall receive travel time data from the system used by the City of Duarte to monitor travel times on city arterials, if different from Los Angeles County's system. 401. Data Management shall receive travel time data from the system used by Caltrans to monitor travel times along the sections of I-210, SR-134,	Connect to travel time detector data endpoint	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				and I-605 freeways under ICM management.		
DM-3.4	Data Management shall receive data from participating probe data providers.	L		Testing to be defined when the requirement is addressed.		
DM-3.5	Data Management shall receive operational data from transit management systems.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.6	Data Management shall receive traffic signal operational data from traffic management systems operated by local agencies.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.7	Data Management shall receive operational data from electronic traveler information message signs operated along corridor roadways of interest.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.8	Data Management shall receive operational data from HAR stations within and around the corridor used to disseminate information to travelers.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.9	Data Management shall receive incident information from dispatch systems used by first responders.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.10	Data Management shall receive planned lane closures from systems maintained by roadway management agencies.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.11	Data Management shall receive alerts from regional notification systems.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.12	Data Management shall receive incident data from crowd-sourcing applications.	L	Data Hub	Testing to be defined when the requirement is addressed.		
DM-3.13	Data Management shall use communication protocols and methods for incoming data appropriate to the design needs of the system.	H	Data Hub	Verify the stored data is in the right format. Incoming data eg: TMDD messages are correct.		
DM-3.14	Data Management shall use data transformation methods for all incoming data appropriate to the specific data formats and communication protocols and its intended use within the system. Possible transformation methods may	H	Data Hub	Design review is not a system test.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	include ETL, streaming, service layers, or others. Specific methods shall be defined during system design.					
DM-3.15	Data Management shall use the system of record, as defined in the System Integration requirements, as the initial source or final destination for data.	H	Data Hub	Design review is not a system test.		
	8.3.1.7.3.2 Outgoing Data Communication Channels					
DM-3.16	The ICM Core System shall include a function to disseminate data using regional communication networks.	H	Corridor Management	The ICM Core System components shall include a function to send data through the IEN. (Not valid REQ) Will be part of vendor supplied CMS evaluation and acceptance criteria. 402. The ICM Core System components shall include a function to send data through RIITS.	IEN is not the current source of data	
DM-3.17	The ICM Core System shall include a function to send traffic signal change requests to traffic management systems operated by local agencies.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 403. The ICM Core System shall include a function to send traffic signal change requests to Caltrans' TSMSS system. 404. The ICM Core System shall include a function to send traffic signal change requests to Pasadena's Transparity system. 405. The ICM Core System shall include a function to send traffic signal change requests to Pasadena's SCATS system. 406. The ICM Core System shall include a function to send traffic signal change requests to Arcadia's TransSuite system. 407. The ICM Core System shall include a function to send traffic signal change requests to Los Angeles County's KITS system. 408. The ICM Core System shall include a function to		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				send traffic signal change requests to Monrovia's KITS system hosted on the Los Angeles County KITS server. 409. The ICM Core System shall include a function to send traffic signal change requests to Duarte's KITS system hosted on the Los Angeles County KITS server.		
DM-3.18	The ICM Core System shall include a function to change metering rates in operation at freeway on-ramps and freeway-to-freeway connectors.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 410. The ICM Core System shall include a function to send metering rate requests to the ATMS module used by Caltrans to manage ramp-metering operations.		
DM-3.19	The ICM Core System shall include a function to send message posting requests to electronic message signs used to disseminate information to travelers within the corridor.	M	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
DM-3.20	The ICM Core System shall include a function to send message broadcast requests to HAR stations used to disseminate information to travelers in and around the corridor.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-3.21	The ICM Core System shall include a function to send relevant information to participating first responding agencies.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-3.22	The ICM Core System shall include a function to send relevant information to participating transit agencies.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-3.23	The ICM Core System shall include a function to send alerts to participating agencies.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-3.24	The ICM Core System shall include a function to send information to regional traveler information systems.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
DM-3.25	The ICM Core System shall include a function to send information to traveler	L	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	information systems used by truck fleet dispatchers and truck operators.					
8.3.1.7.4 Data Formats						
DM-4.1	The ICM Environment shall store or provide access to data in commonly used formats.	H	Data Hub	411. Verify to the extent possible, the ICM Environment shall transmit data in the Transportation Management Data Dictionary (TMDD) or National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) format. 412. Verify to the extent possible, the ICM Environment shall store or provide access to collected transit route data in the General Transit Feed Specification (GTFS) format.		
DM-4.2	Collected traffic data shall be aggregated in intervals no longer than 15 minutes. All data aggregations shall be appropriate to the intended use of the information.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-4.3	All data used by the ICM Environment shall be stored in electronic format.	M	Data Hub	Testing to be defined when the requirement is addressed.		
8.3.1.7.5 Data Verification and Validation						
DM-5.1	Data Management shall validate all field measurements.	H	Data Hub	413. Data Management shall validate unverified traffic data obtained from traffic sensor data, using validated historical data and expected values for the period associated with the data • Data Management shall validate unverified traffic volume data obtained from traffic sensor data, using validated	Connect to Freeway detector data & intersection detector endpoint, and verify the quality indicators are there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				historical data and expected values for the period associated with the data. • Data Management shall validate unverified sensor occupancy data obtained from traffic sensor data, using validated historical data and expected values for the period associated with the data Testing to be defined when the requirement is addressed. 414. Data Management shall validate unverified traffic speed estimates obtained from traffic sensor data, using validated historical data and expected values for the period associated with the data. 415. Data Management shall validate received incident/event data, using validated historical data and expected values for the period associated with the data. 416. Data Management shall validate unverified transit data received from participating transit agencies, using validated historical data and expected values for the period associated with the data. 417. Data Management shall validate unverified parking occupancy data obtained from parking management systems, using validated historical data and expected values for the period associated with the data.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				418. Data Management shall validate received weather data, using validated historical data and expected values for the period associated with the data.		
DM-5.2	Data Management shall validate all received control device data that have not been previously validated by the system supplying the information.	H	Data Hub	419. Verify Data Management shall validate unverified operational data received from control devices connected to the ICM system, using validated historical data and expected values for the period associated with the data. • Data Management shall validate unverified signal timing data received, using validated historical data and expected values for the period associated with the data. • Data Management shall validate unverified ramp metering data received, using validated historical data and expected values for the period associated with the data. • Data Management shall validate unverified fixed CMS operational data received, using validated historical data and expected values for the period associated with the data.	Connect to CMS, Ramp meter, intersection signal state endpoint, and validate the data is correct	
DM-5.4	Data Management shall mark as “potentially invalid” received field measurements data failing a verification or validation test.	H	Data Hub	420. Verify Data Management shall mark as “potentially invalid” unverified flow measurements received from field devices or systems deviating by more than two standard deviations from the	Connect to Freeway detector & Intersection detector & travel time detector endpoint and	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				historical average or falling outside a user-defined accepted range for the corresponding time period in the absence of active major incidents/events. 421. Verify Data Management shall mark as “potentially invalid” unverified intersection turning counts received from field devices or systems deviating by more than two standard deviations from the historical average or falling outside a user-defined accepted range for the corresponding time period in the absence of active major incidents/events. 422. Verify Data Management shall mark as “potentially invalid” unverified speed measurements or estimates received from field devices or systems deviating by more than two standard deviations from the historical average or falling outside a user-defined accepted range for the corresponding time period in the absence of active major incidents/events. 423. Data Management shall mark as “potentially invalid” unverified travel time measurements received from field devices or systems deviating by more than two standard deviations from the historical average or falling outside a user-defined accepted range for the corresponding time period in the absence of active major incidents/events.	check the quality of data	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				Testing to be defined when the requirement is addressed: 424. Data Management shall mark as "potentially invalid" unverified parking occupancy data received from parking management systems deviating by more than two standard deviations from the historical average or falling outside a user-defined accepted range for the corresponding time period in the absence of active major incidents/events. 425. Data Management shall mark as "potentially invalid" unverified data received from transit agencies deviating by more than two standard deviations or falling outside a user-defined accepted range from the historical average for the corresponding time period in the absence of active major incidents/events. 426. Data Management shall mark as "potentially invalid" any weather data received from weather stations falling outside a user-defined accepted range.		
DM-5.5	Data Management shall include a function to determine a range of typical values for the data that may be supplied by traffic management devices.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-5.6	Data Management shall mark as "invalid" data received from traffic management devices falling outside the normal range of values associated with the device operations.	M	Data Hub	Testing to be defined when the requirement is addressed.		
DM-5.7	The ICM Core System shall not use invalid or erroneous	H	Data Hub	427. Verify the ICM Core System shall ignore any	Look at the downstream	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	data in its corridor operational assessments and decision-making processes.			data marked as having failed a validity test. 428. Verify the ICM Core System shall ignore redundant data.	process and inject data is marked as invalid and doesn't use this data. Data hub will mark this as invalid data and downstream doesn't use it Individuals for each consuming test will be run on an individual basis (this is not a data hub test but this data is not consumed)	
DM-5.8	The ICM Environment shall inform relevant TMC and TCS operators when data anomalies or abnormalities are identified.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria: 429. Verify the ICM Environment shall inform the designated maintenance manager of the agency operating a device when anomalies or abnormalities are identified in the data received from the device. 430. Verify the ICM Environment shall inform the Traffic Engineer of the agency operating a device when anomalies or abnormalities are identified in the data received from the device. 431. Verify the ICM Environment shall inform ICM Environment users when anomalies or abnormalities are identified in the data received from a device connected to the ICM system.		
DM-5.9	The ICM Environment shall submit for review field	H	Corridor Management	Will be part of vendor supplied CMS evaluation and		Manual test

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	measurement data that have been flagged as "potentially invalid."			acceptance criteria.		
8.3.1.7.6 Data Storage and Warehousing						
DM-6.1	Data Management shall store in a central repository all data utilized or created by the system not being stored elsewhere.	H	Data Hub	Design review test, not a system test.		
DM-6.2	Data Management shall store in a central repository all data characterizing the operation of the ICM Core System not stored elsewhere.	H	Data Hub	Design review test, not a system test.		
DM-6.4	Data shall be stored using state-of-the-art technology by methods that are extensible and scalable.	H	Data Hub	Design review test, not a system test.		
DM-6.5	Data shall be stored using technologies appropriate to the design needs of the system (performance, cost, size, etc.). Technologies shall include both SQL and Non-SQL technologies as dictated by design needs and constraints.	H	Data Hub	Design review test, not a system test.		
8.3.1.7.7 Data Documentation and Maintenance						
DM-7.1	The ICM Environment shall have an ICM data dictionary.	H	Data Hub	432. Verify System interface design spec doc. 433. The Data Dictionary shall contain a listing of all Data Hub data elements, their definition, data format, and size. 434. The Data Dictionary shall contain a listing of all data sources and their data elements, their definition, data format, and size. 435. The Data Dictionary shall contain a listing of all externally available data provided by the system, including their data elements, their definition, data format, and size. 436. The Data Dictionary shall		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				contain a listing of all available system-produced, externally available interfaces and messages, documenting the data available, transmission protocols, and formats. 437. The Data Dictionary shall describe system standards for capturing and managing data, including issues of the time value of data, data provenance, data types, data standard use and selection, and data security. 438. The Data Dictionary shall describe data quality standards for all data elements. Data quality standards shall include standards for: • Data accuracy • Methods to measure and verify data quality • Required levels of data quality (such as degraded performance vs. unable to perform function results) • Required responses for data that does not meet data quality standards • Required timeliness standards for each data source • Required completeness for each data source 439. Data quality shall be uniquely specified for each data source and internally processed data element. 440. 90% of all data elements must include a data quality standard. 441. The Data Dictionary shall describe system		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				standards and validation. Included will be specific data validation specifications for all incoming and processed data elements. 442. Maintenance including updates, reviews, and accuracy of the Data Dictionary shall be the responsibility of the Corridor Data Analyst, along with assigned data analysts and database administrators.		
DM-7.2	The Corridor Data Analyst shall ensure that all data has a data quality specification and that data is meeting those specifications at all times.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
DM-7.3	Stakeholders shall be able to communicate needs for data additions, removals, or format changes to the system data processes and design.	H		Will be addressed after the pilot release. Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.8 Decision Support						
8.3.1.8.1 Corridor Road and Asset Information Access						
DS-1.1	Decision Support shall receive from Data Management the status of the road network, including current incident information, roadway maintenance actions, and closures.	H	Decision Support	443. Verify all pipelines are available at the data hub gateway for Decision Support. 444. Verify each endpoint for decision support is available. 445. Verify Decision Support shall receive all road status information from Data Management/Data Hub at a frequency of 30 seconds or less. 446. Verify all road status information received from Data Management shall be processed and available to Decision Support within 1 minute of the data's time of measurement.	Connect to appropriate AMQ topic and check the information is correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
DS-1.2	Decision Support shall receive from Data Management current sensor data.	H	Decision Support	447. Verify PEMS pipeline sensor data. 448. Verify decision support shall receive sensor data from Data Management at a frequency of every 30 seconds or less. 449. Verify all sensor data received from Data Management shall be processed and available to Decision Support within 1 minute of the data's time of measurement. 450. Verify intersection signal sensor data. 451. Verify Decision Support shall receive sensor data from Data Management at a frequency of every 30 seconds or less. 452. Verify all sensor data received from Data Management shall be processed and available to Decision Support within 1 minute of the data's time of measurement.	Connect to appropriate AMQ topic and check the information is correct	Automation test candidate
DS-1.3	Decision Support shall receive from Data Management the operational status of the traffic control assets, including traffic sensors, environmental sensors, intersection signals, ramp meters, and CMS devices.	H	Decision Support	453. Verify decision support shall receive all operational status information from Data Management at a frequency of 30 seconds or less. 454. Verify all operational status information received from Data Management shall be processed and available to Decision Support within 1 minute of the data's time of measurement.	Connect to appropriate AMQ topic and check the information is correct	Automation test candidate
DS-1.4	Decision Support shall receive from Data Management the operational status of transit assets.	M	Decision Support	Testing to be defined when the requirement is addressed.		
DS-1.5	Decision Support shall use reliable data from corridor assets.	H	Decision Support	455. Verify all sensor information received shall be evaluated for data quality. Methods for evaluating quality shall	Connect to appropriate AMQ topic and check the	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				be determined according to the specific sensor type. These methods and the specific thresholds required by the system shall be defined during the system design phase. 456. Data from a sensor that fails data quality checks shall cause the sensor to be considered failed for the purposes of the uptime requirement. 457. Longevity inventory check shall be performed over a period of time (day, week, month), when the software is stable and running.	information is correct	
DS-1.6	Decision Support shall receive from Data Management the operational status and availability of all organizational assets.	M		Testing to be defined when the requirement is addressed.		
8.3.1.8.2 Corridor Traffic State Estimation						
DS-2.1	Decision Support shall estimate on a continuous basis the current state of vehicle traffic on roadway links under ICM consideration.	H	Decision Support	458. Verify estimation provides current state of vehicle traffic for every link. 459. Decision Support shall maintain a characterization of the current vehicle traffic conditions on the link for each freeway segment under ICM consideration. • For each freeway segment under ICM consideration, Decision Support shall estimate the current average traffic density across the segment. • For each freeway segment under ICM consideration, Decision Support shall estimate the current average traffic flow across the segment.	Connect to freeway estimation endpoint & AMQ check if the data is there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				460. Verify Decision Support shall maintain a characterization of the current vehicle traffic conditions on each arterial segment under ICM consideration. • For each arterial segment under ICM consideration, Decision support shall estimate the average traffic flow able to travel across the link. • For each user-defined arterial route, Decision support shall estimate the current average travel time along the route. • For each arterial segment under ICM consideration, Decision support shall estimate whether the segment is: • Not congested • Experiencing low-level congestion • Experiencing high-level congestion • Oversaturated 461. Verify Decision Support shall maintain a characterization of current vehicle traffic conditions at each intersection under ICM consideration. For each major approach to an intersection under ICM consideration, Decision Support shall determine whether the approach is: • Undersaturated • Oversaturated • Spilling back across the upstream intersection For each intersection under ICM consideration,	Connect to arterial estimation endpoint & active check if the data is there and correct	

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				Decision Support shall determine whether the overall intersection is: • Undersaturated • Oversaturated • Spilling back across upstream intersections on at least one approach 462. Current traffic state shall be estimated on an ongoing basis, delayed no more than 5 minutes behind actual time. 463. Traffic state estimation snapshot shall be provided every 5 minutes. 464. Current traffic state estimates shall be based on the latest information available from the data hub.		
DS-2.3	Decision Support shall include in its current traffic state estimation effects associated with active incidents and events.	H	Decision Support	465. Verify current traffic state estimation effects associated with active incidents and events. 466. Decision Support shall identify in its current traffic state estimation lane blockages and/or capacity constraints caused by active incidents that have been verified. 467. Decision Support shall identify in its current traffic state estimation lane blockages and/or capacity constraints caused by planned lane or roadway closures.	Connect to freeway estimation endpoint & AMQ check if the data is there and correct	Automation test candidate
DS-2.4	Decision Support shall include in its current traffic state estimation the effect of the current working state of all traffic sensors set to supply information to the ICM Core System.	H	Decision Support	468. Verify the effect of the current working state of all traffic sensors. Decision Support shall assess the effect of the quality of incoming information on the quality of its current traffic state estimates. 469. Verify Decision Support shall assess the effect of missing information on the quality of its current	Connect to freeway estimation endpoint & AMQ check if the data is there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				traffic state estimates. 470. Verify Decision Support shall provide an overall confidence level for all current traffic estimates.		
DS-2.5	Decision Support shall include in its current traffic state estimation effects associated with the operational status of traffic control devices.	H	Decision Support	471. Verify Decision Support shall include in its current traffic state estimation the effects of the traffic signal control plan currently in use at individual signalized intersections. 472. Verify Decision Support shall include in its current traffic state estimation the effects of current ramp metering operations on freeway on-ramps and freeway-to-freeway connectors.	Connect to arterial estimation endpoint & AMQ check if the data is there and correct	Automation test candidate
DS-2.6	Decision Support shall provide reliable estimates of current traffic conditions within the corridor.	H	Decision Support	Testing to be defined when the requirement is addressed.		
DS-2.7	Decision Support shall compare the current corridor traffic state to historical traffic patterns and provide a measure of variability from the normal historical traffic pattern.		Decision Support	Testing to be defined when the requirement is addressed.		
8.3.1.8.3 Corridor Traffic State Forecasting						
DS-3.1	Decision Support shall include a function to produce forecasts of future states of vehicle traffic on roadway links under ICM consideration.	H	Decision Support	473. Verify Decision Support forecasts shall compute and display the following basic traffic characteristics for each roadway link under ICM consideration at the end of each forecast interval: • Forecasted average traffic flow rate across the link • Forecasted average traffic speed across the link • Forecasted average traffic density along the link 474. Verify Decision Support forecasts shall compute	Connect to prediction endpoint & active MQ and the data is there and correct	Automation test candidate

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				and display the following vehicle-based productivity metrics for each forecast reporting interval for each roadway link under ICM consideration: • Vehicle-miles traveled (VMT) • Vehicle-hours traveled (VHT) 475. Verify Decision Support forecasts shall compute and display the following vehicle-based mobility metrics for each forecast reporting interval for each roadway link under ICM consideration: • Average travel time across link • Average delay per vehicle traversing the link • Vehicle-hours of delay (VHD) incurred on the link since start of forecast interval 476. Verify Decision Support forecasts shall compute and display the following person-based productivity metrics for each forecast reporting interval for each roadway link under ICM consideration: • Person-miles traveled (PMT) • Person-hours traveled (PHT) 477. Verify Decision Support forecasts shall compute and display the following person-based mobility metrics for each forecast reporting interval for each roadway link under ICM consideration: • Average delay per person traversing the link • Person-hours of delay (PHD) incurred		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				on the link since start of forecast interval		
DS-3.2	Traffic forecasts shall be based on the latest traffic and demand information available for the corridor at the time the forecast is requested.	H	Decision Support	478. Verify Decision Support shall conduct traffic forecasts using the latest field and estimated data available at the time the forecast is requested. 479. Verify Decision Support shall not attempt to replace the set of field and estimated data used to conduct a forecast in the middle of a forecasting process.	Connect to prediction endpoint & active MQ and the data is there and correct	Automation test candidate
DS-3.3	Decision Support shall include in its traffic forecasts the effect of the current working state of all traffic sensors set to supply information to the ICM Core System.	H	Decision Support	480. Verify Decision Support shall evaluate the effect of the quality of incoming information on the quality of its traffic forecasts. 481. Verify Decision Support shall evaluate the effect of missing information on the quality of its traffic forecasts. 482. Verify Decision Support shall calculate and display an overall confidence level for all traffic forecasts.	Connect to prediction endpoint & active MQ and the data is there and correct	Automation test candidate
DS-3.4	Decision Support shall complete a traffic forecast for each response plan developed (known as a response plan forecast).	H	Decision Support	483. Verify response plan is in place as per prediction results.		
DS-3.5	Decision Support shall include a function for ICM Core System users to specify under which circumstances traffic forecasts of existing control strategies (“no change scenario”) are to be executed.	H	Corridor Management	Testing to be defined when the requirement is addressed.		
DS-3.6	Decision Support shall include a function for ICM Core System users to specify the time horizon to which traffic forecasts are to be executed (forecast over the next 30 minutes, 1 hour, 2 hours, etc.).	H	Corridor Management	Testing to be defined when the requirement is addressed.		
DS-3.7	Decision Support shall include a function for ICM Core	H	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	System users to specify the data reporting interval within a traffic forecast (e.g., forecast data reported every 5 minutes, 15 minutes, 1 hour, etc.)					
DS-3.8	Decision Support shall include a function for ICM Core System users to specify the interval at which Decision Support is to execute traffic forecasts (e.g., new forecast every 15 minutes).	H	Corridor Management	Testing to be defined when the requirement is addressed.		
DS-3.9	Decision Support shall be able to complete forecasts of corridor operations in a timely manner.	H	Decision Support	484. Verify predictions are completed within 5 minutes. Decision Support shall be able to complete a traffic forecast within 5 minutes of receiving a forecast request.		
DS-3.10	The Corridor Manager shall periodically ensure the accuracy of the traffic forecasts produced by Decision Support.	H	Institutional Job Tasks	Testing to be defined when the requirement is addressed.		
DS-3.11	Decision Support shall archive the results of traffic forecasting activities for future analyses.	H	Decision Support	485. Verify data hub stores the predictions and PEMS saves this information. 486. Decision Support shall archive all forecasted traffic states for use in post-incident/event analysis. 487. Verify Decision Support shall archive the results of all forecast comparisons to field data for future analyses.		
8.3.1.8.4 Rules Engine Capabilities						
8.3.1.8.4.1 Rule Application						
DS-4.1	The rules engine shall have state-of-the-art rules engine capabilities.	H	Decision Support	488. Verify the rules engine selected has all the mentioned capabilities: Decision Support, rules, evaluation. Performance shall not degrade linearly with increases in the number of rules.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				489. Verify Decision Support rules engine shall implement a Rete or similar algorithm within its inference engine. 490. Verify Decision Support rules engine shall implement a hybrid-chaining (forward and backward chaining) rules execution (NOTE: Likely uses for backward chaining – constantly evaluating current traffic state looking for incident, looking for multiple possible routes). 491. Decision Support rules engine shall include a function for recursive rules definition and processing. 492. Decision Support rules engine shall include a function for geospatial-based rules execution. Geospatial results may be implemented as an external query process. 493. Decision Support rules engine shall allow for deterministic results. 494. Decision Support rules engine shall allow for non-deterministic results (NOTE: Likely usage finding routes, incidents) 495. Decision Support rules engine shall include a function to react to events in the corridor, in effect listening for events and executing rules as a result (NOTE: In a manner, similar to a reactive transitive query). 496. Decision Support rules engine shall allow for external class/method, procedure, and service execution in rules estimations.		
DS-4.2	Decision Support shall be able to implement the rules defined in Section 9.3.4.	H	Decision Support	497. Verify if the rule can be implement to create appropriate response		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	Section 9.3.4 =>Rule Creation and Management			plans.		
DS-4.3	Decision Support shall include a function for Traffic Engineers to manage the rules to be applied to incident/event response.	H	Corridor Management	498. Verify the spreadsheet can be uploaded and rules be changed. Decision Support shall provide a means for Traffic Engineers to activate/deactivate rules to be used.		
DS-4.4	Decision Support shall execute rules automatically or on demand.	H	Decision Support	Testing to be defined when the requirement is addressed.		
8.3.1.8.4.2 Post-Response Evaluation						
DS-4.5	Decision Support shall maintain a log of rule execution for post-incident/event evaluation.	H	DSS/Corridor Management	Testing to be defined when the requirement is addressed.		
DS-4.6	Decision Support shall provide a post-incident/event rules evaluation and analysis.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
DS-4.7	Decision Support shall generate a daily operational evaluation report at the end of each day providing a summary of the rules execution and details of the specific rules operation, to be reviewed by the Corridor Technical Manager.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
8.3.1.9 Core System User Interfaces						
8.3.1.9.1 User Interfaces for Managing Asset Information						
UI-1.1	The ICM Core System shall include a user interface to create, view, update, and delete asset inventory data.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 499. Verify the ICM Core System shall include a user interface to create, view, update, and delete the inventory of roadway links and intersections (network inventory) defining the ICM corridor. 500. Verify the ICM Core System shall include a user interface to create, view, update, and delete		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				travel time measurement device inventory. 501. Verify the ICM Core System shall include a user interface to create, view, update, and delete weather measurement device inventory. 502. Verify the ICM Core System shall include a user interface to create, view, update, and delete signal inventory. 503. Verify the ICM Core System shall include a user interface to create, view, update, and delete ramp meter inventory. 504. Verify the ICM Core System shall include a user interface to create, view, update, and delete transit asset inventory. 505. Verify the ICM Core System shall include a user interface to create, view, update, and delete traffic sensor inventory. 506. Verify the ICM Core System shall include a user interface to create, view, update, and delete fixed CMS inventory. 507. Verify the ICM Core System shall include a user interface to create, view, update, and delete portable CMS inventory. 508. Verify the ICM Core System shall include a user interface to create, view, update, and delete extinguishable trailblazer sign inventory. 509. Verify the ICM Core System shall include a user interface to create, view, update, and delete HAR inventory. 510. Verify the ICM Core System shall include a user interface to create, view, update, and delete organizational asset inventory.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				511. Verify the ICM Core System shall include a user interface to create, view, update, and delete parking asset inventory. 512. Verify the ICM Core System shall include a user interface to create, view, update, and delete video camera inventory.		
UI-1.2	The ICM Core System shall include a user interface to view and update asset health information.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 513. The ICM Core System shall include a user interface to view and update traffic signal health information. 514. The ICM Core System shall include a user interface to view and update ramp meter health information. 515. The ICM Core System shall include a user interface to view and update parking asset health information. 516. The ICM Core System shall include a user interface to view and update transit asset health information. 517. The ICM Core System shall include a user interface to view and update fixed CMS health information. 518. The ICM Core System shall include a user interface to view and update portable CMS inventory and state information. 519. The ICM Core System shall include a user interface to view and update extinguishable trailblazer sign health information. 520. The ICM Core System shall include a user interface to view and update HAR health information.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				521. The ICM Core System shall include a user interface to view and update organizational asset health information. 522. The ICM Core System shall include a user interface to view and update CCTV camera health information. 523. The ICM Core System shall include a user interface to view and update traffic sensor health information. 524. The ICM Core System shall include a user interface to view and update travel time measurement device health information. 525. The ICM Core System shall include a user interface to view and update weather measurement device health information.		
UI-1.3	The ICM Core System shall include a user interface to view and update asset availability.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 526. The ICM Core System shall include a user interface to view and update traffic signal availability. 527. The ICM Core System shall include a user interface to view and update ramp meter availability. 528. The ICM Core System shall include a user interface to view and update parking asset availability. 529. The ICM Core System shall include a user interface to view and update transit asset availability. 530. The ICM Core System shall include a user interface to view and update fixed CMS availability.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				531. The ICM Core System shall include a user interface to view and update portable CMS availability. 532. The ICM Core System shall include a user interface to view and update extinguishable trailblazer sign availability. 533. The ICM Core System shall include a user interface to view and update HAR availability. 534. The ICM Core System shall include a user interface to view and update organizational asset availability. 535. The ICM Core System shall include a user interface to view and update road network segment availability. 536. The ICM Core System shall include a user interface to view and update CCTV camera availability. 537. The ICM Core System shall include a user interface to view and update traffic sensor availability. 538. The ICM Core System shall include a user interface to view and update travel time measurement device availability. 539. The ICM Core System shall include a user interface to view and update weather measurement device availability.		
UI-1.4	The ICM Core System shall include a user interface to view and update asset state.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 540. The ICM Core System shall include a user interface to view and update scheduled lane/road closures.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				541. The ICM Core System shall include a user interface to view and update traffic signal state. 542. The ICM Core System shall include a user interface to view and update ramp meter state. 543. The ICM Core System shall include a user interface to view and update parking asset state. 544. The ICM Core System shall include a user interface to view and update transit asset state. 545. The ICM Core System shall include a user interface to view and update fixed CMS state. 546. The ICM Core System shall include a user interface to view and update portable CMS state. 547. The ICM Core System shall include a user interface to view and update extinguishable trailblazer sign state. 548. The ICM Core System shall include a user interface to view and update HAR state. 549. The ICM Core System shall include a user interface to view and update organizational asset state. 550. The ICM Core System shall include a user interface to view and update road network state. 551. The ICM Core System shall include a user interface to view and update traffic sensor state. 552. The ICM Core System shall include a user		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				interface to view and update travel time measurement device state. 553. The ICM Core System shall include a user interface to view live CCTV camera video streams. 554. The ICM Core System shall include a user interface to pan and tilt CCTV cameras. 555. The ICM Core System shall include a user interface to view and update weather measurement device state.		
UI-1.5	The ICM corridor asset management user interface shall be capable of continuous operations in the event of any individual system failure.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
8.3.1.9.2 User Interfaces for Managing Incident/Event Information						
UI-2.1	The ICM Core System shall include a user interface to create, view, update, and delete incident/event information.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 556. The ICM Core System shall include a user interface to create, view, update, and delete the following information for an incident: • Type of incident • Time incident occurred • Expected duration of incident • Roadway/transit segment on which incident is located • Location of incident along roadway/transit segment • Lane(s) affected by the incident • Agency responsible for managing the		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				incident • Verification status of incident 557. The ICM Core System shall include a user interface to create, view, update, and delete the following information for an event: • Type of event • Time event occurred • Expected duration of event • Roadway/transit segment(s) on which event is located • Location(s) of event along roadway/transit segment(s) • Lane(s) affected by the incident • Agency responsible for managing the incident • Verification status of event 558. The ICM Core System shall provide a function permitting users to confirm that an incident or event has been verified to exist. 559. The ICM Core System shall include a function to set interval thresholds within which newly identified incidents or events shall be verified.		
8.3.1.9.3 User Interface for Managing Mock Incidents						
UI-3.1	The ICM Core System shall include a user interface permitting users to create mock incidents.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 560. The ICM Core System shall include a user interface permitting users to create, view, update, and delete mock incidents. 561. The ICM Core System shall include a map-		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				based interface enabling users to choose the location for the mock incidents to be tested. 562. The ICM Core System shall include a user interface for setting the start time for mock incidents. 563. The ICM Core System shall include a user interface for specifying the duration of mock incidents. 564. The ICM Core System shall include a user interface for specifying lanes, bus routes, or tracks affected by mock incidents. 565. The ICM Core System shall include a user interface for specifying an end time for mock incidents. 566. The ICM Core System shall include a user interface for specifying whether a special response plan is required as a response to mock incidents. 567. The ICM Core System shall include a user interface permitting users to assign a name to a mock incident.		
UI-3.2	The ICM Core System shall include a user interface permitting the testing of mock incidents.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 568. Verify mock incidents can be identified as mock incidents in the data hub. 569. The ICM Core System shall include an interface permitting the submission of mock incidents to the Decision Support module for testing purposes. 570. The ICM Core System shall include an interface permitting the generation of a post-incident report based on		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				a submitted mock incident. 571. The ICM Core System shall include an interface permitting the displaying on a map of the response plan elements that have been recommended for submitted mock incidents.		
8.3.1.9.4 User Interfaces for Managing Response Plans						
8.3.1.9.4.1 Response Plan Viewing						
UI-4.1	The ICM Core System shall include a user interface for viewing response plans.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 572. For each response plan, the ICM Core System shall display summary information about the incident or event that triggered the development of the plan. 573. For each response plan, the ICM Core System shall display a list of all the agencies involved in the implementation of the plan. 574. For each response plan, the ICM Core System shall display the recommended detour route(s) for passenger cars, trucks, and buses. 575. For each response plan, the ICM Core System shall display a list of ramp meters that are to be modified and information about the metering strategy/rate to be used at each location. 576. For each response plan, the ICM Core System shall display a list of intersections where traffic signal operations are to be altered and information about the timing plan to be		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				activated at each intersection. 577. For each response plan, the ICM Core System shall display a list of fixed freeway/arterial CMSs where incident/detour messages are to be posted and what message is to be posted at each location. 578. For each response plan, the ICM Core System shall display the locations where extinguishable trailblazer signs are to be activated. 579. For each response plan, the ICM Core System shall display the locations where portable CMSs are to be deployed and what message is to be posted at each location. 580. For each response plan, the ICM Core System shall display the HAR stations that are to be activated and what message is to be broadcasted at each location. 581. For each response plan, the ICM Core System shall display a summary of personnel required to implement the response plan. 582. For each response plan, the ICM Core System shall display a list of constraints that may have affected the development of the response plan.		
UI-4.2	The ICM Core System shall allow system users to access information about active response plans while in the field.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
	8.3.1.9.4.2 Response Rules Management					
UI-4.3	The ICM Core System shall provide a user-friendly	H	Corridor Management	Testing to be defined when the requirement is addressed.		

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	interface for managing rules used by the Decision Support module to identify, evaluate, and respond to incidents and events.					
UI-4.4	The ICM Core System shall provide a means for users to document the requirements for specific rules and dependent rules within the system for display with the rule.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
	8.3.1.9.4.3 Response Plan Development					
UI-4.5	The ICM Core System shall provide a user interface allowing users to submit requests for specific actions to be included in a response plan.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-4.6	The ICM Core System shall include a function for users to manually specify whether specific control assets can be used for the generation of a response plan.	H	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-4.7	The ICM Core System shall provide a user interface permitting modification to preferences affecting how response plans are evaluated.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 583. The ICM Core System shall include a user interface permitting the setting of weighting functions for the calculation of prediction-based performance metrics used in the evaluation of response plans. • The ICM Core System shall include an interface permitting users to set different weight factors to be applied to metrics associated with specific prediction intervals (e.g., 0-15 minutes, 15-30 minutes, etc.). • The ICM Core System shall include an interface		

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				permitting users to set different weight factors to be applied to various vehicle types (e.g., higher weights for buses). 584. The ICM Core System shall include a user interface permitting the selection of person-based or vehicle-based metrics in the evaluation of response plans.		
UI-4.8	For each developed response plan, the ICM Core System shall display a list of system elements that were not selected because of operational problems, if any.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
	8.3.1.9.4.4 Response Plan Selection					
UI-4.9	The ICM Core System shall provide an interface summarizing the various response plans developed, the result of their evaluation, and the plan recommended for implementation.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
UI-4.10	The ICM Core System shall provide an interface allowing users to select the approach to be used for the evaluation of corridor impacts of each developed response plans where multiple alternatives exist (such as selection between use of user-defined rules, or specific evaluation tools or models).	L	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-4.11	The ICM Core System shall provide an interface allowing users to manually select the response plan to implement among the proposed plans developed by the system.	H	Corridor Management	Testing to be defined when the requirement is addressed.		
	8.3.1.9.4.5 Response Plan Approval					
UI-4.12	The ICM Core System shall include a user interface permitting each stakeholder agency to specify the level of automation desired for the approval of submitted	H	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	recommended response plans.					
UI-4.13	The ICM Core System shall include an interface permitting the setting of the level of automation required for the approval of submitted modifications to an active response plan.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-4.14	The ICM Core System shall provide an interface allowing individuals responsible for approving response plans to review plans submitted for their approval.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 585. The ICM Core System shall provide individuals tasked with approving a response plan an interface detailing the plan submitted for approval. • The response plan approval interface shall display a map showing the recommended detour(s) for each vehicle type. • The response plan approval interface shall display a map showing the location of all control elements associated with a response plan. • The response plan approval interface shall display a map showing the control actions associated with each control element. • The response plan approval interface shall provide a comparative performance summary of the proposed response plan against the “do nothing” scenario (current situation). 586. The ICM Core System shall provide individuals tasked with approving a response plan an		

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				interface allowing them to compare alternate response plans that may have been produced by the Decision Support module. 587. The ICM Core System shall provide individuals tasked with approving a response plan an interface allowing them to enter their approval decision. 588. The ICM Core System shall provide individuals tasked with approving a response plan a summary of the approval status of the plan by other agencies/individuals from which approval is sought.		
8.3.1.9.4.6 Response Plan Implementation						
UI-4.15	The ICM Core System shall include a user interface for directing the implementation of an approved response plan.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 589. Verify the ICM core will have a user interface for directing the implementation of an approved response plan. 590. The ICM Core System shall include a function for directing the implementation of road network changes (ramp closures, etc.). 591. The ICM Core System shall include a function for directing the implementation of traffic signal changes. 592. The ICM Core System shall include a function for directing the implementation of ramp meter changes. 593. The ICM Core System shall include a function for directing the implementation of organizational asset required actions. 594. The ICM Core System		

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				shall include a function for directing the implementation of transit asset required changes. 595. The ICM Core System shall include a function for directing the implementation of messages on fixed CMS signs. 596. The ICM Core System shall include a function for directing the deployment of portable CMS signs. 597. The ICM Core System shall include a function for directing the activation of extinguishable trailblazer signs. 598. The ICM Core System shall include a function for directing the activation of HAR broadcasts. 599. The ICM Core System shall include a function for directing the dissemination of information to 511 services, media, and other information outlets.		
UI-4.16	The ICM Core system shall include an interface permitting stakeholders to specify whether they require the ICM Core System to seek confirmation from them that an incident or event has been terminated before allowing the ICM Core System to terminate the event.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-4.17	The ICM Core System shall include an interface for system users to manually indicate that an incident or event has terminated.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 600. Verify that data hub can process a termination request when an incident or event is terminated. 601. The ICM Core System shall include an interface for TMC and TCS		

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				operators to manually inform the ICM Core System that an incident or event has terminated. 602. Only TMC/TCS operators from the agency associated with an incident or event shall be authorized to inform the ICM system that a specific incident or event has terminated.		
UI-4.18	The ICM Core System shall include an interface indicating whether a recommended response plan has been successfully implemented in the field.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 603. Verify information about a response plan is displayed on the interface. 604. The ICM Core System shall include an interface indicating when and if a response plan has been successfully implemented in its entirety. 605. The ICM Core System shall include an interface listing all implemented response plan components within a selected jurisdiction. 606. The ICM Core System shall include an interface indicating if a recommended response plan cannot be implemented. 607. In the case of implementation failure, the ICM Core System shall indicate why a recommended response plan could not be implemented.		
UI-4.19	The ICM Core System shall inform stakeholders of system elements that were not selected because of operational problems but that would otherwise have been part of the response plan.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-4.20	The ICM Core System shall provide response plan	H	Corridor Management	608. Verify approved response plan information is		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	information to stakeholders.			provided to relevant operators/ supervisors. 609. The ICM Core System shall inform TMC/TCS operators of approved response plans that are to be implemented within the corridor. 610. The ICM Core System shall inform transit field supervisors of response plan elements that may affect bus service operations. 611. The ICM Core System shall provide detailed information to first responders about approved response plans. 612. The ICM Core System shall include a function for system users to access information about active response plans while in the field.		
	8.3.1.9.4.7 User Interfaces for Managing ICM Core System Information					
UI-5.1	The ICM Core System shall include a function for viewing all ICM log activity.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
UI-5.2	The ICM Core System shall provide a means for users to customize ICM Environment operations.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 613. Verify the ICM Core System shall provide input screens for manual input or edit of system configuration information. 614. Verify the ICM Core System shall display input screens for manual input or edit of user administration information. 615. Verify the ICM Core System shall display input screens for manual input or edit of user preferences.		
UI-5.3	The ICM Core System shall allow operational parameters to be changed without requiring a system restart.	M	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
UI-5.4	The ICM Core System shall provide a user interface to permit start and shut-down of Core System components.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
	8.3.1.9.4.8 Geospatial Visualization of Data					
UI-6.1	The ICM Core System shall display on a map the devices that may be used to manage traffic within the ICM corridor.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 616. The ICM Core System shall display on maps roadway segments under ICM management. 617. The ICM Core System shall display on maps the signalized intersections connected to the ICM system. 618. The ICM Core System shall display on maps the ramp meter controllers connected to the ICM system. 619. The ICM Core System shall display on maps the fixed CMS devices connected to the ICM system. 620. The ICM Core System shall display on maps the extinguishable trailblazer signs connected to the ICM system. 621. The ICM Core System shall display on maps the HAR stations connected to the ICM system. 622. The ICM Core System shall display on maps the park-and-ride facilities connected to the ICM system.		
UI-6.2	The ICM Core System shall display on a map information about transit services of interest to ICM operations.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.3	The ICM Core System shall display on a map information about the devices used to monitor corridor operations.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.4	The ICM Core System shall include a function for users to access from maps key geometric characteristics	M	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	about individual roadway links under ICM management.					
UI-6.5	System users shall be able to access from map displays information about the traffic management devices in the ICM inventory.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.6	The ICM Core System shall include a function for users to access from map displays available video feeds from nearby CCTV cameras.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
UI-6.7	The ICM Core System shall include a function for users to view on a map the current operational status of roadway segments under ICM management.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 623. The ICM Core System shall include a function for users to view, if available, the latest measurements from traffic detection devices displayed on map. 624. Maps shall be able to color roadway links based on the level of congestion on the link. 625. Maps shall be able to display upon request the current traffic state of a link displayed on the map for which the information is available: • For roadway links for which field data is available, maps shall be able to display traffic states determined from the field data. • For links for which field data is not provided, maps shall be able to display estimated traffic states produced by the ICM System, if such information is available. • The ICM Core System shall include a function for users to determine what current traffic state information (density, speed, flow		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				rate, etc.) is to be displayed. • Maps shall indicate whether the displayed traffic states are derived from field data or an estimation process.		
UI-6.8	The ICM Core System shall include a function for users to view on a map the projected operational status of roadway segments under ICM management.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 626. The ICM Core System shall be able to display on maps forecasted states for roadway links for which a forecast exists. 627. The ICM Core System shall include a function for users to determine which available forecasted traffic states (density, speed, flow rate, etc.) are to be displayed.		
UI-6.9	The ICM Core System shall include a function for users to view on a map historical status data for roadway segments under ICM management.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.10	The ICM Core System shall include a function for users to view on a map the operational status of traffic management devices in the ICM inventory.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.11	The ICM Core System shall include a function for users to view on a map the operational status of transit services of interest to the ICM System.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.12	The ICM Core System shall include a function for users to view on a map the operational status of monitored park-and-ride facilities.	L	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.13	The ICM Core System shall include a function to plot on a map the location of incidents and events being tracked.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 628. The ICM Core System shall include a function to plot on a map the		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				location of all active verified incidents and events. 629. The ICM Core System shall include a function to plot on a map the location of scheduled near-future events. 630. The ICM Core System shall include a function to plot on a map the location of active and near-future scheduled road closures. 631. The ICM Core System shall include a function to plot on a map the location of incidents and events awaiting verification. 632. The ICM Core System shall include a function to plot on a map the location of closed incidents or events that are still subject to response planning (until corridor conditions return to normal).		
UI-6.14	The ICM Core System shall include a function for users to access detailed incident or event information from map displays.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 633. For each displayed incident, the ICM Core System shall include a function for users to access the following information: • Incident status (e.g., pending verification, active, closed, etc.) • Incident type • Roadway segment on which the incident is located • Number of lanes affected • Anticipated zone of influence • Expected duration (if not closed) • Responsible agency 634. For each displayed event, the ICM Core System shall include a function		

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				for users to access the following information describing the event: • Type of event (lane closure, special event, etc.) • Event status (scheduled, active, recently terminated) • Roadway segment(s) affected • Number of lanes affected • Anticipated zone of influence • Expected start time • Expected duration (if not closed) • Responsible agency 635. The ICM Core System shall provide the means to access from a map incident/event information based on the active status of the incident or event. • The ICM Core System shall display a list of active incidents and events that have been verified. • The ICM Core System shall display a list of active incidents and events with an active response plan. • The ICM Core System shall display a list of active incidents and events that are pending verification. • The ICM Core System shall display a list of scheduled events expected to start within the current day.		
UI-6.15	The ICM Core System shall include a function for users to view on a map the availability of traffic management devices connected to the ICM	M	Corridor Management	Testing to be defined when the requirement is addressed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	Environment for the development of response plans.					
UI-6.16	The ICM Core System shall include a function for users to view response plan elements on a map.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 636. The ICM Core System shall display on a map the recommended detour(s) for each vehicle type. 637. The ICM Core System shall display on a map the location of all field devices associated with a response plan. • The ICM Core System shall display on a map the location of all traffic signals associated with a response plan • The ICM Core System shall display on a map the location of all ramp meters associated with a response plan. • The ICM Core System shall display on a map the location of all fixed CMS devices associated with a response plan. • The ICM Core System shall display on a map the locations where portable CMS devices are recommended to be deployed. • The ICM Core System shall display on a map the locations of all extinguishable trailblazer signs that are to be activated. • The ICM Core System shall display on a map the locations of all HAR		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				stations that are to be activated. 638. The ICM Core System shall display on a map the control actions associated with each response plan element. • The ICM Core System shall display on a map the timing plan that is to be activated at each affected signalized intersection. • The ICM Core System shall display on a map the metering strategy that is to be activated at each affected freeway on-ramp. • The ICM Core System shall display on a map the message that is to be displayed at each affected fixed CMS device. • The ICM Core System shall display on a map the messages that are to be posted at each location where a portable CMS device is to be deployed. • The ICM Core System shall display on a map the message provided by each activated extinguishable trailblazer signs.		
UI-6.17	The ICM Core System shall use a layered approach to display information on maps.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.18	The ICM Core System shall provide a means for users to create and customize visualizations.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-6.19	The ICM Core System shall provide a geospatial approach to manage corridor information.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 639. The ICM Core System		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				shall provide a means for users to modify asset usage and state (within the parameters allowed by the owning agency) from geospatial displays. 640. The ICM Core System shall provide a means to initiate incident confirmation, response plan development, response plan selection, and response plan implementation from the primary geospatial displays.		
UI-6.20	Geospatial displays shall include a function for animation where time-based data analysis is available.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
8.3.1.9.4.9 Reporting, Charting, and Graphing Functions						
UI-7.1	The ICM Core System shall provide standard and customized reporting capabilities.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 641. The ICM Core System shall provide a means to create and save reports for users to run either scheduled or on demand. 642. The ICM Core System shall provide a means to display reports on the screen. 643. The ICM Core System shall provide a means to print reports. 644. The ICM Core System shall provide a means to save report output in standardized formats, including pdf and image-based formats.		
UI-7.2	The ICM Core System shall include a function to produce traffic summary reports for specific roadway elements.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-7.3	The ICM Core System shall include a function to produce operational summary reports for individual devices in operation within the ICM corridor.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-7.4	The ICM Core System shall	M	Corridor	Testing to be defined when		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	include a function to produce summary reports of system activities.		Management	the requirement is addressed.		
UI-7.5	The ICM Core System shall display plot-based (2d, 3d, heat map) visualizations of corridor information.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 645. The ICM Core System shall provide plot-based displays of corridor traffic density and velocity values from traffic state determinations along user-selected routes in 2d (spatial point in time) and heat map (spatial and time variant). 646. The ICM Core System shall provide plot-based displays of corridor traffic density and velocity forecasts along user-selected routes in 2d (spatial point in time) and heat map (spatial and time variant). 647. The ICM Core System shall provide plot-based displays of corridor asset availability (% of assets by type or geographic area out of service or degraded). 648. The ICM Core System shall provide plot-based displays of corridor asset reliability, quality, and accuracy (asset quality metrics, asset reliability metrics vs. time by type or geographic area). 649. The ICM Core System shall provide plot-based displays of corridor sensor data along user-selected routes in 2d (spatial point in time) and heat map (spatial and time variant). 650. The ICM Core System shall provide plot-based displays of corridor roadway capacity. 651. Plot displays shall include a function for animation where time-based		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				analysis is available. 652. Plot displays shall include drill-down capabilities to display additional detail when available.		
UI-7.6	The ICM Core System shall provide multiple types of graphing displays.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 653. The ICM Core System shall display organization information in organizational charts. 654. The ICM Core System shall display rules in decision tree charts. 655. The ICM Core System shall display rules in flow charts. Plots shall include pie, line, bar, and histogram charts.		
UI-7.7	The ICM Core System shall include a function to display information in tables.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 656. The ICM Core System shall include a function to display corridor asset inventories in tables. 657. The ICM Core System shall include a function to display user-defined routes in tables. 658. The ICM Core System shall include a function to display corridor transit routes and inventory in tables. 659. The ICM Core System shall include a function to display corridor transit asset state in tables. 660. The ICM Core System shall include a function to display corridor maintenance activity and schedules in tables. 661. The ICM Core System shall include a function to display appropriate rules-based information (i.e., location and hours of schools, event information, facility location and hours of operation information,		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				etc.) in tables.		
UI-7.8	The ICM Core system shall provide visualizations showing differences between plots.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 662. The ICM Core System shall provide displays of corridor traffic density and velocity values identifying differences between the state of the corridor traffic at the time forecasts were initiated and the current estimated traffic state.		
UI-7.9	The ICM Core System shall calculate upon request travel times or travel delays between selected points within the corridor.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-7.8	The ICM Core System shall report on observed traffic operations within the corridor.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-7.9	The ICM Core System shall report on observed versus estimated/predicted values.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-7.10	The ICM Core System shall include a function for system users to run queries on the performance of monitored roadways.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
UI-7.11	The ICM Core System shall include a function for system users to specify the period over which historical data is to be analyzed.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 663. The ICM Core System shall include a function for system users to specify the range of dates for which historical data is to be analyzed. 664. The ICM Core System shall include a function for system users to specify the specific time period within a day for which historical data is to be analyzed. 665. The ICM Core System shall include a function for system users to specify the specific weekdays within a given date range for which historical data is to be analyzed.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				666. The ICM Core System shall include a function for system users to specify the interval within a given time period with which historical statistics are to be calculated (for instance, every 15 minutes, 1 hour, day, month, etc.).		
8.3.1.9.5 Post-Incident/Event Analysis Report						
UI-8.1	The ICM Core System shall create post-incident/event analysis reports for incidents and events for which response plans were generated.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 667. The post-incident/event analysis report shall include a detailed description of the incident or event for which a potential response was evaluated. Minimal information to be presented includes: • Type of incident/event • Location where incident/event occurred • Time incident occurred or event started • Formal duration of incident/event (up to incident clearance or event closure) • Time when travel conditions were reported to have returned to normal following termination of the incident or event • Roadway segment(s) affected by the incident • Reported lane closures on each affected roadway segment • Agency responsible for managing the		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				incident or event 668. For each response plan evaluated, the post-incident/event analysis report shall identify all elements included in the response plan. 669. The post-incident/event analysis report shall include the results of the rules analysis, including source data used in the analysis, rules evaluated, data quality evaluation, and final recommendations of the rules analysis. 670. The post-incident/event analysis report shall identify response plan elements automatically selected by the ICM Core System and plan elements that were manually input by agency staff. 671. For each recommended response plan, the post-incident/event analysis report shall identify any plan modifications that were made by agency staff after the initial plan development. 672. For each recommended response plan, the post-incident/event analysis report shall detail the results of any required approval actions by agencies involved in the implementation of the plan. 673. For each recommended response plan, the post-incident/event analysis report shall identify which plan elements were successfully implemented, which elements were not fully successfully implemented, and a timeline of the response plan implementation and		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				de-escalation. 674. The post-incident/event analysis report shall include an analysis of the accuracy of the traffic forecast at the base of the response recommendation ("no action" or "response plan recommendation"). 675. The post-incident analysis report shall reference any additional events that occurred during the same impact period anywhere on the corridor.		
8.3.1.9.6 Interface to Caltrans' ATMS						
UI-9.1	The ICM Environment shall include UI functionality within the Caltrans ATMS for use by Caltrans' operators.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 676. The ICM Environment shall provide ATMS operators with an ATMS interface providing the ability to create, edit, and review incident /event information. 677. The ICM Environment shall provide ATMS operators with an ATMS interface providing the ability to review response plans. 678. The ICM Environment shall provide ATMS operators with an ATMS interface providing the ability to reject or approve response plans.		
8.3.1.9.7 Interagency Communication						
UI-9.1	The ICM Environment shall facilitate communication between staff from different agencies.	M	Corridor Management	Testing to be defined when the requirement is addressed.		
8.3.1.9.8 Integrated Visualization and Reporting						
SI-2.1	The ICM Core System shall	H	Corridor	Will be part of vendor		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	provide a single visualization and reporting user interface for all ICM Core System Operations.		Management	supplied CMS evaluation and acceptance criteria. 679. The ICM Core System shall provide a single visualization and reporting user interface for corridor traffic state. 680. The ICM Core System shall provide a single visualization and reporting user interface for traffic forecasts. 681. The ICM Core System shall provide a single visualization and reporting user interface for corridor asset inventories. 682. The ICM Core System shall provide a single visualization and reporting user interface for corridor asset information. 683. The ICM Core System shall provide a single visualization and reporting user interface for corridor sensing data. 684. The ICM Core System shall provide a single visualization and reporting user interface for corridor analytic data and metrics. 685. The ICM Core System shall provide a single visualization and reporting user interface for response plan information. 686. The ICM Core System shall provide a single visualization and reporting user interface for management, maintenance, and operations functions.		
8.3.1.9.9 Integrated Control Functions						
SI-3.1	The ICM Core System shall provide integrated functions for major functional areas.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 687. The ICM Core System		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				shall provide an integrated set of functions for corridor monitoring. 688. The ICM Core System shall provide an integrated set of functions for incident/event management. 689. The ICM Core System shall provide an integrated set of functions for response plan management. 690. The ICM Core System shall provide an integrated set of functions for data management. 691. The ICM Core System shall provide an integrated set of functions for decision support capabilities. 692. The ICM Core System shall provide an integrated set of functions for system management. 693. All traffic state assessment and traffic forecasting shall be accomplished within Decision Support. 694. All ICM rules evaluation shall be accomplished within a common rules engine. 695. ICM control functions shall be capable of continuous operations in the event of any individual system failure.		
8.3.1.9.10 Integrated Data Definition, Capture, and Processing						
SI-4.1	The ICM Core System shall have an integrated point of access with consistent data definitions and formatting for internal system data access and data processing.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 696. All data collected by the ICM Core System shall be available through the common ICM data access interfaces.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				697. All data collected by the ICM Core System shall be managed through the common ICM user interfaces. 698. All data collected by the ICM Core System shall be defined and used in a common manner and format cross all ICM system components.		
SI-4.2	All data collected by the ICM Core System shall be managed within the appropriate security context.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SI-4.3	All ICM data shall be processed in a consistent manner, using design techniques that ensure that each data element is consistently defined, processed, and calculated to ensure the integrity and accuracy of the data element.	H	Data Hub	Not part of system testing. Will be evaluated during post implementation review.		
SI-4.4	The ICM Environment corridor data processing and access shall be capable of continuous operations in the event of any individual system component failure.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
8.3.1.9.11 Ownership of software, hardware, data, and algorithms						
SI-5.1	The ICM Environment shall maintain ownership of each data element and data record.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SI-5.2	The ICM Environment shall maintain ownership of rules.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SI-5.3	The ICM Environment shall maintain ownership of algorithms and workflows.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SI-5.4	The ICM Environment shall maintain ownership of hardware.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SI-5.5	The ICM Environment shall maintain ownership of software.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
8.3.1.9.12 System of Record/Location for Data						
SI-6.1	The ICM Environment shall define a single system of record for each data element.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.10 System Management						
8.3.1.10.1 System Access and Security						
SM-1.1	The ICM Environment shall grant access for system functionalities to authorized users only.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 699. The ICM Environment shall allow only authorized users to access its functionalities. 700. The ICM Environment shall report all unauthorized access attempts.		
SM-1.2	The ICM Environment shall allow multiple users to simultaneously access system functionalities from various locations.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria.		
SM-1.3	The ICM Environment shall provide secure access to its functionalities.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 701. The ICM Environment shall provide a means for system users to log in to access system functionalities. 702. The ICM Environment shall implement encrypted multi-factor authentication for system access.		
SM-1.4	The ICM Environment shall provide a secure means of information transmission.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 703. The ICM Environment shall implement encrypted multi-factor authentication for system access. 704. The ICM Environment shall provide a means to maintain secure		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				connections between internal and external system components. 705. The ICM Environment shall implement industry-standard point-to-point encryption for all information transmission.		
SM-1.5	The ICM Environment shall provide a secure means for storing information.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 706. The ICM Environment shall implement, at any storage point, encryption of information deemed sensitive.		
SM-1.6	The ICM Environment shall track system access and usage.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 707. The ICM Environment shall track system access history. 708. The ICM Environment shall track authorized user action history.		
SM-1.7	The ICM Environment shall allow ICM Environment users to manage access to ICM Environment components.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 709. The ICM Environment shall provide a means for ICM Environment users to create/edit authorized user accounts. 710. The ICM Environment shall provide a means for ICM Environment users to create/edit authorized user groups. 711. The ICM Environment shall provide a means for ICM Environment users to edit authorized user privileges.		
SM-1.8	The ICM Environment shall provide a validated secure environment.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 712. The ICM Environment shall implement commercial or open-source off-the-shelf security component solutions approved by the stakeholders. 713. The ICM Environment		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
				shall implement penetration testing for developed software, certification of penetration testing for purchased software solutions. 714. The ICM Environment shall implement security reviews of the integrated solution and each primary component.		
SM-1.9	The ICM Environment shall protect the system environment from unauthorized intentional modification or unintentional modifications.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 715. The Corridor Technical Manager, following industry-standard security processes, shall develop security procedures. 716. The Corridor Technical Manager shall designate an IT Security Officer for the ICM Environment who shall have responsibility for the security of the ICM Environment and its operations. 717. The IT Security Officer shall implement security protocols and processes for the ICM Environment. 718. The IT Security Officer shall conduct formal reviews of ICM Environment security processes at a regular frequency in accordance with the security protocols and processes, with a minimum frequency of quarterly. 719. The IT Security Officer shall direct a formal review of ICM Environment security, led by stakeholders and consultants, at a regular frequency in accordance with the security protocols and processes, with a minimum frequency of annually.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
SM-1.10	The Corridor Technical Manager shall develop and implement security protocols and processes to ensure secure operations of the ICM Environment.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.10.2 ICM System Health Monitoring						
SM-3.1	The ICM Environment shall monitor the health status of its core components.	H	Corridor Management	Will be part of vendor supplied CMS evaluation and acceptance criteria. 720. The ICM Environment shall include a function to perform self-checks without operator assistance. 721. The ICM Environment shall report any identified operational issue with its core components.		
8.3.1.10.3 System Reliability						
SM-2.8	The ICM Environment shall have a service level agreement.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-2.9	The ICM System shall provide a system uptime metrics report for the ICM Environment.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-2.10	The ICM Environment shall allow for degraded system performance in the event of component failure.	M	Corridor Management / DSS/Data Hub	Testing to be defined when the requirement is addressed.		
SM-2.11	The ICM Core System shall have a System Recovery Plan.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-2.12	The ICM Environment shall implement redundant critical system component design.	M	Corridor Management / DSS/Data Hub	Not part of system testing. Will be evaluated during post implementation review.		
SM-4.1	The ICM Environment shall be available 24 hours a day, 7 days a week.	H	Corridor Management / DSS/Data Hub	722. Longevity test for data hub and Decision Support can work for a week or longer.		Longevity test
SM-4.2	The ICM Environment shall be available 85% of the time during normal operation, not including routine maintenance and outages due to factors beyond the	H	Corridor Management / DSS/Data Hub	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	control of system users.					
SM-4.3	All traffic monitoring devices connected to the ICM Environment shall be maintained in good operational condition.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-4.4	All traveler information devices that may be used by the ICM Environment shall be maintained in good operational condition.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.10.4 System Maintenance						
SM-5.1	The ICM Environment shall maintain a backup of its core operating parameters.	H	Corridor Management / DSS/Data Hub	723. Verify there is a backup and frequency of backups can be configured. 724. The ICM Environment shall store a backup of the system inventory and configuration parameters once per day. 725. The Corridor Technical Manager shall have the ability to specify the frequency of system backups.		
SM-5.2	The ICM Environment shall not be required to run continuously without maintenance.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-5.3	Maintenance of ICM Environment elements shall be the responsibility of the agency owning/operating each element.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-5.4	All traffic sensors providing information to the ICM Environment shall be maintained and calibrated according to the manufacturers' specifications.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-5.5	All corridor assets providing automated data feeds to Decision Support shall be maintained in accordance with the manufacturers' specifications for the assets.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-5.7	ICM Environment operators shall develop and maintain a list of critical elements that should receive maintenance priority should they fail.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
SM-5.9	The ICM Environment shall log all received alerts and notifications regarding systems operations.	H	Corridor Management	726. Verify logs of all received alerts and notification/errors.		
SM-5.10	The ICM Environment shall log all maintenance-related activities conducted on devices connected to the system.	L	Corridor Management	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.10.5 Software Maintenance and Updates						
SM-6.1	The ICM Environment software shall receive regular updates.	H	Corridor Management / DSS/Data Hub	Not part of system testing. Will be evaluated during post implementation review.		
SM-6.2	The Corridor Technical Manager shall produce an annual report of system software maintenance, providing a year in review of the previous year, and a plan for the coming year of software maintenance and bug fix activities, schedule, and budget.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-6.3	The ICM Environment shall maintain a managed repository of software configuration changes and activities.	H	Corridor Management	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.10.6 System Upgrades						
SM-7.1	The ICM Environment shall have a 5-year system upgrade plan.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-7.2	The ICM Environment shall have an annual upgrade plan that identifies the system upgrades from the 5-year plan that will be implemented within the next year.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-7.3	The Corridor Technical Manager shall develop a system of governance to ensure each proposed system upgrade receives the appropriate priority and reflects the needs of all corridor stakeholders.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-7.4	The Corridor Technical Manager shall ensure system	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post		

Test REQ ID	Description	Criticality	Related Subsystem	Test Cases/Description	Test Method	Notes or comments
	upgrades are developed, delivered, and implemented according to the budget and planning identified in the annual upgrade plan.			implementation review.		
SM-7.5	The Corridor Technical Manager shall provide updates to the 5-year and annual upgrade plans when changes are identified and approved according to the governance system of the corridor.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-7.6	All system upgrades shall be managed and implemented in accordance with the industry standards appropriate to the specific upgrade elements.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
8.3.1.10.7 Supporting Documentation and Training						
SM-7.7	The ICM Environment shall have documentation of its operations and maintenance.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		
SM-7.8	The ICM Environment shall provide a means for system users to access relevant system documentation when logged into the system.	H	Corridor Management	Not part of system testing. Will be evaluated during post implementation review.		
SM-7.9	The Corridor Manager and Corridor Technical Manager shall develop a training program for the ICM Environment and ICM Core System.	H	Institutional Job Tasks	Not part of system testing. Will be evaluated during post implementation review.		

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9. Reference Documents

CommonLinks-CC.htm
I-210 Pilot - Project Management Plan
I-210 Pilot - System Requirements
I-210 Pilot High-Level Design
https://connected-corridors.berkeley.edu/resources/document-library

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10. Definition of Terms

Term	Definition
Alert	Notification sent by the ICM system to individuals or units. Alerts may be displayed on screen, sent by email, text message, radio message, or telephone.
Archive	Data that has been stored for historical purposes and can be retrieved upon request, usually to a location and using a storage method that has large capacity and slower retrieval times.
Area of Impact (area of influence)	The road network elements impacted by an incident or event.
Asset	See *Corridor Asset*.
Asset Inventory	An inventory of corridor assets taken at any point in time. Asset inventory includes locations of fixed position assets, and types of corridor assets. Can be specified for a type of assets, such as intersection signal asset inventory. Also includes the attributes of each individual asset, such as intersection or ramp meter signal capabilities and currently available signal/ramp meter plans.
Asset State	The condition of a corridor asset at a point in time. This condition includes working state (usually operational, failed, or some degraded operational state), location of mobile assets, signal or ramp meter plan that is in operation at that point in time, and all most recent data received by the asset at that point in time.
Authentication	Verifying a user's identity.
Authorization	Verifying a user's permissions to view specific data elements or perform specific functions.
Availability	A description of whether an asset is available for use in a response plan or not.
Backward Chaining Rules	Rules that are defined so that a specific goal is specified, and the possible alternatives that will achieve that goal are identified by execution of the rule. A potential ICM-related example would be rules that are defined to create a list of alternative routes between two defined points and set limitations on what road links can be used at various times for the route creation. In this example, the goal is a route between the two points. The rules are executed to find all the possible alternatives, essentially working backwards to find solutions that fit the rules given to achieve the goal.
Caltrans ATMS	Advanced Traffic Management System (ATMS) software tool, which provides real-time information on highway conditions to detect traffic incidents, manage the flow of traffic, and disseminate traveler information. ATMS helps Caltrans reduce commuting times, maximize roadway capacity, and generally provide safer traveling routes. It also provides operators with unified access and control to multiple types of roadway devices rather than having to operate disparate systems.
CMS	Changeable message sign. Includes both fixed and mobile devices.
CMS	Corridor Management System
Configuration Management	Maintaining a timeline of changes to an entity, ensuring traceability of changes in time, content, and author of the change.
Contact Details	Information for a specific individual or organizational unit, including names, phone numbers, email addresses, physical address, specific to the type of contact methods available for the individual or unit.

Term	Definition
Corridor Asset	Any corridor element available for use within a response plan or that provides information to the ICM System. Assets include the following types of elements: • Intersection traffic signals • Ramp meters • Organizational units or individuals (people resources) • Equipment • Mobile or stationary CMS elements • Traffic sensors and other measurement devices • Communication elements (511, HAR, third party information providers) • Parking facilities • Transit elements
Corridor State	Information describing the state of the corridor at a specific point in time. State information includes: • Corridor road network closures • Corridor road network lane blockages • Incident information • Event information • Asset inventory • Asset state • Sensor information • Transit information • Transit state • Traffic conditions (density, flow, velocity) on the road network • Response plans currently implemented or in the process of being implemented
Current Traffic State	Determining a value of traffic density, flow, and velocity for each link in the road network at the current time and with the data available at the current time. Also includes values for current turn volumes and ratios at each turn movement within the road network.
Data Hub	A core component of the ICM system which has primary responsibility for receiving, processing, storing, and providing data for all ICM system components.
Data Quality	A measure of the quality of data being received by the ICM System. Factors considered in data quality of a specific asset or type of assets include: • Percent of working assets • Individual asset state, including level of asset degradation • Percent of time reliable data is provided by the asset • Specific filtering or algorithmic verification of incoming data specific to the asset or asset type
Data Restoration	Restoration of data to service in the event of system or component failure.
Decision Support	A core component of the ICM System, providing traffic conditions, incident and event information, forecasts of traffic, proposed response plans and associated traffic forecasts, asset inventories and asset availability, maintenance information, organizational information, road network conditions, and previous corridor planning and study information to users to support corridor operations and decision making.
Delay	A measure of the typical time a traveler would experience along a route over and above the time the traveler would experience at free-flow traffic conditions.
Demand	A measure of traffic demand (flow) at an entrance to the road network or between specify entry and exit points.
Deterministic	A solution to an algorithm or rule execution for which the execution of the algorithm or rule, given the same input data, will always provide the same answer at any point in time.
Device State	See Asset State.
System Recovery Plan	A plan developed that provides procedures, operations, and actions that are taken in the event of system failure or loss of capabilities, including any required system shutdown procedures, data protection actions, system and data recovery actions, procedures for restoration of the system to operational state, and post-event actions to be taken.
Trailblazer	Local street signs (“Trailblazer” signs) will activate to help you navigate around an incident if you exit the freeway to detour around traffic

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