Integrated Corridor Management Initiative: Demonstration Phase Evaluation

San Diego Air Quality Test Plan

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16. Abstract

This report presents the test plan for conducting the Air Quality Analysis for the United States Department of Transportation (U.S. DOT) evaluation of the San Diego Integrated Corridor Management (ICM) Initiative Demonstration. The ICM projects being deployed in San Diego include a suite of strategies aimed at balancing corridor transportation supply and demand to promote overall corridor efficiency and safety. Operational strategies to be deployed in the San Diego I-15 highway corridor include: simulations to predict travel conditions for improved incident response, interdependent response plans among agencies, traffic diversion to strategic arterials, traveler mode shift to the BRT system during major freeway incidents, and comparative travel time information to the public and operating agencies for freeway, HOT lanes, arterial streets, and BRT. Technologies that will be used to carry out these strategies include a Decision Support System, a 511 traveler information system (telephone and website), a regional center-to-center information exchange network, dynamic message signs, adaptive ramp metering, and responsive traffic signals. This Air Quality Analysis Test Plan is based on the ICM Initiative Demonstration National Evaluation Framework. This test plan provides an overview of the Air Quality Analysis and describes the specific quantitative data that will be collected to support the analysis. Data analysis methodologies as well as risks and mitigations associated with this evaluation analysis are also discussed in this test plan.

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS i

LIST OF ABBREVIATIONS v

1.0 INTRODUCTION 1-1
1.1 ICM Program 1-1
1.2 ICM Demonstration Phase Deployments 1-3
1.2.1 Overview of the San Diego ICM Deployment 1-3
1.2.2 San Diego ICM Deployment Schedule 1-8
1.2.3 Comparison to the Dallas ICM Deployment 1-8
1.3 National Evaluation Objectives and Process 1-10
1.3.1 U.S. DOT Hypotheses 1-10
1.3.2 Evaluation Analyses 1-11
1.3.3 Evaluation Process and Timeline 1-12
1.3.4 Roles and Responsibilities 1-13

2.0 ANALYSIS OVERVIEW 2-1
2.1 Evaluation Hypotheses and Key MOEs 2-2

3.0 QUANTITATIVE DATA 3-1
3.1 Link Lengths 3-1
3.2 Link Throughput 3-1
3.3 Average Link Speed and Average Grade 3-1
3.4 Link Characterization 3-4
3.5 Road Grade (1 Hz) 3-4
3.6 Vehicle Speed (1 Hz) 3-4
3.7 Source Type Distributions 3-5
3.8 Vehicle Age Distributions 3-5
3.9 Fuel Formulation and Market Share 3-6
3.10 Inspection and Maintenance Program Data 3-6
3.11 Meteorological Data 3-6

4.0 QUALITATIVE DATA 4-1

5.0 DATA ANALYSIS 5-1
5.1 Hypothesis 1: ICM Will Have Positive or No Impact on Air Quality 5-1
5.2 Annual Air Quality Impact Estimation 5-2
5.3 Exogenous Factors 5-2

6.0 RISKS AND MITIGATIONS 6-1
6.1 Risk 1: Dependency of Air Quality Analysis on AMS Model 6-1
6.2 Risk 2: AMS Model Temporal Resolution 6-1
6.3 Risk 3: Possibility of Grade Data Unavailability from AMS 6-2
6.4 Risk 4: Conversion of AMS Vehicle Class to MOVES Source Type 6-2
6.5 Risk 5: Inadequate or Unavailable Link Information 6-3

TABLE OF CONTENTS (CONTINUED)

Page

List of Tables

Table 1-1. Summary of San Diego DSS Functionality 1-6
Table 1-2. San Diego ICM Deployment Schedule 1-8
Table 1-3. U.S. DOT ICM Evaluation Hypotheses 1-10
Table 1-4. Relationship Between U.S. DOT Hypotheses and Evaluation Analyses 1-11
Table 2-1. Air Quality Analysis Hypotheses, MOEs, Data, and Sources 2-4
Table 3-1. Quantitative Data Summary 3-2
Table 6-1. Risks and Mitigations 6-1

List of Figures

Figure 1-1. I-15 Corridor Boundaries of San Diego ICM Deployment 1-4
Figure 1-2. Context of San Diego ICM System Data Inputs and Outputs 1-7
Figure 1-3. Sequence of Evaluation Activities 1-12
Figure 2-1. Overview of Air Quality Analysis 2-2

LIST OF ABBREVIATIONS

AMS	Analysis, Modeling and Simulation
CARB	California Air Resources Board
CHP	California Highway Patrol
DSS	Decision Support Systems
EMFAC	EMission FACtor model (developed by CARB)
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GHG	Greenhouse Gases
GIS	Geographic Information Systems
GUI	Graphical User Interface
HOT	High-Occupancy Tolling
HOV	High-Occupancy Vehicle
I-15	Interstate 15
ICM	Integrated Corridor Management
ICMS	Integrated Corridor Management System
I/M	Inspection and Maintenance
IMTMS	Intermodal Transportation Management System
iNET	Intelligent NETworks
ITS	Intelligent Transportation Systems
KTT	Knowledge and Technology Transfer
LRT	Light Rail Transit
MOE	Measure of Effectiveness
MOVES	Motor Vehicle Emissions Simulator
MTS	Metropolitan Transit System
NCTD	North County Transit District

NOAA	National Oceanographic and Atmospheric Administration
OES	Office of Emergency Services
PeMS	Freeway Performance Measuring System
RITA	Research and Innovative Technology Administration
R/T	Real-time
RVP	Reid Vapor Pressure
SANDAG	San Diego Association of Governments
SD SAFE	San Diego County Service Authority for Freeway Emergencies
TMDD	Traffic Management Data Dictionary
U.S. DOT	U.S. Department of Transportation
VMT	Vehicle Miles Traveled
Volpe Center	John A. Volpe National Transportation System Center

1.0 INTRODUCTION

This report presents the plan for conducting the Air Quality Analysis, one of seven analyses that comprise the United States Department of Transportation (U.S. DOT) national evaluation of the San Diego Integrated Corridor Management (ICM) Initiative demonstration phase. The ICM demonstration phase includes multimodal deployments in the U.S. 75 corridor in Dallas, Texas and the Interstate 15 (I-15) corridor in San Diego, California. Separate evaluation test plan documents are being prepared for each site. This document, which focuses on San Diego, is referred to as a "test plan" because, in addition to describing the specific data to be collected, it describes how that data will be used to test various evaluation hypotheses and answer various evaluation questions.

The primary thrust of the national ICM evaluation is to thoroughly understand each site's ICM experience and impacts. However, it is expected that various findings from the two sites will be compared and contrasted as appropriate and with the proper caveats recognizing site differences.

The remainder of this introduction chapter describes the ICM program and elaborates on the hypotheses and objectives for the demonstration phase deployments in Dallas and San Diego, as well as the subsequent evaluation analyses. The remainder of the report is divided into five sections. Chapter 2 summarizes the Air Quality Analysis overall. Chapters 3 and 4 describe the quantitative and qualitative data that will be used in this analysis. Chapter 5 describes how the data will be analyzed. Chapter 6 presents the risks and mitigations associated with air quality data.

1.1 ICM Program[1]

Congestion continues to be a major problem, specifically for urban areas, costing businesses an estimated $200 billion per year due to freight bottlenecks and drivers nearly 4 billion hours of time and more than 2 billion gallons of fuel in traffic jams each year. ICM is a promising congestion management tool that seeks to optimize the use of existing infrastructure assets and leverage unused capacity along our nation's urban corridors.

ICM enables transportation managers to optimize use of all available multimodal infrastructure by directing travelers to underutilized capacity in a transportation corridor—rather than taking the more traditional approach of managing individual assets. Strategies include motorists shifting their trip departure times, routes, or modal choices, or transportation managers dynamically adjusting capacity by changing metering rates at entrance ramps or adjusting traffic signal timing plans to accommodate demand fluctuations. In an ICM corridor, travelers can shift to transportation alternatives—even during the course of their trips—in response to changing traffic conditions.

[1] This section has largely been excerpted from the U.S. DOT ICM Overview Fact Sheet, "Managing Congestion with Integrated Corridor Management," http://www.its.dot.gov/icms/docs/cs_over_final.pdf, developed by SAIC for U.S. DOT. At the direction of U.S. DOT, some of the original text has been revised to reflect updates and/or corrections.

The objectives of the U.S. DOT ICM Initiative are:

- Demonstrate how operations strategies and Intelligent Transportation Systems (ITS) technologies can be used to efficiently and proactively manage the movement of people and goods in major transportation corridors through integration of the management of all transportation networks in a corridor.
- Develop a toolbox of operational policies, cross-network operational strategies, integration requirements and methods, and analysis methodologies needed to implement an effective ICM system.
- Demonstrate how proven and emerging ITS technologies can be used to coordinate the operations between separate multimodal corridor networks to increase the effective use of the total transportation capacity of the corridor.

The U.S. DOT's ICM Initiative is occurring in four phases:

- Phase 1: Foundational Research – This phase researched the current state of corridor management in the United States as well as ICM-like practices around the world; conducted initial feasibility research; and developed technical guidance documents, including a general ICM concept of operations to help sites develop their own ICM concept of operations.
- Phase 2: Corridor Tools, Strategies and Integration – U.S. DOT developed a framework to model, simulate and analyze ICM strategies, working with eight Pioneer Sites to deploy and test various ICM components such as standards, interfaces and management schemes.
- Phase 3: Corridor Site Development, Analysis and Demonstration – This phase includes three activities:
    1) Concept Development – Eight ICM Pioneer Sites developed concepts of operation and requirements documents.
    2) Modeling – U.S. DOT selected Dallas, Minneapolis and San Diego to model their proposed ICM systems.
    3) Demonstration and Evaluation – Dallas and San Diego will demonstrate their ICM strategies; data from the demonstrations will be used to refine the analysis, modeling and simulation (AMS) models and methodology.
- Phase 4: Outreach and Knowledge and Technology Transfer (KTT) – U.S. DOT is packaging the knowledge and materials developed throughout the ICM Initiative into a suite of useful multimedia resources to help transportation practitioners implement ICM.

An on-going ICM Initiative activity, AMS is very relevant to the evaluation. AMS tools were developed in Phase 2 and used by the sites to identify and evaluate candidate ICM strategies. In Phase 3, the proposed Dallas and San Diego ICM deployments were modeled. As sites further refine their ICM strategies, AMS tools continue to be used and iteratively calibrated and validated, using key evaluation results, in part. The AMS tools are very important to the evaluation for two reasons. First, the evaluation will produce results that will be used to complete validation of the AMS tools, e.g., updating the AMS assumptions related to the percentage of travelers who change routes or modes in response to ICM traveler information. Second, the calibrated AMS tools will serve as a source of some evaluation data, namely the corridor-level, person-trip travel time and throughput measures that are difficult to develop using field data.

1.2 ICM Demonstration Phase Deployments[2]

This section summarizes the San Diego ICM deployment and briefly contrasts it with the Dallas deployment.

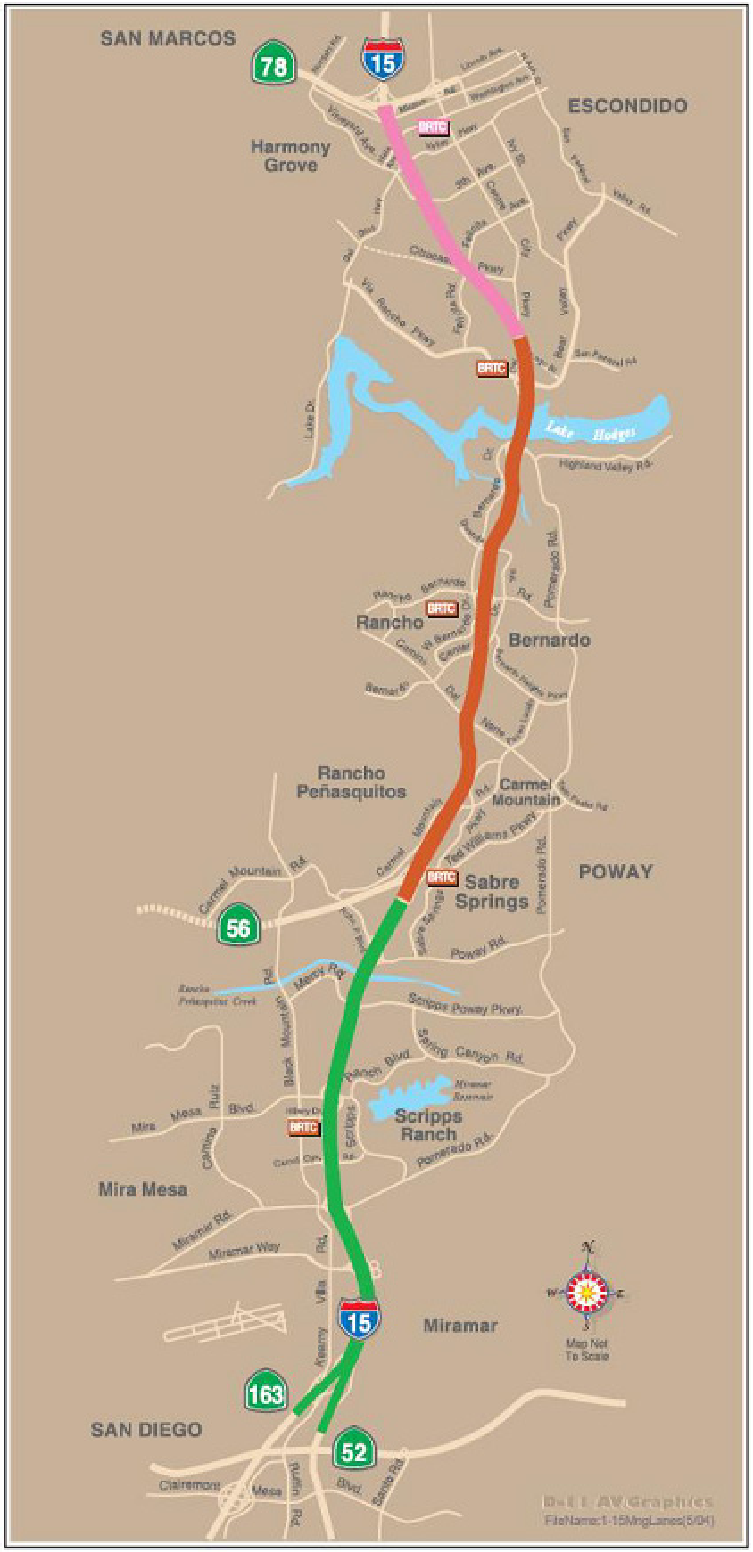
1.2.1 Overview of the San Diego ICM Deployment

The I-15 project is a collaboration led by the San Diego Association of Governments (SANDAG), along with U.S. DOT; the California Department of Transportation; Metropolitan Transit System (MTS); North County Transit District (NCTD); the cities of San Diego, Poway, and Escondido; San Diego County Service Authority for Freeway Emergencies (SD SAFE); County of San Diego Office of Emergency Services (OES); and California Highway Patrol (CHP), in addition to private sector support.

The San Diego ICM corridor includes the portion of I-15, a north-south facility, from S.R. 78 in the north to the S.R. 163 interchange in the south, as shown in Figure 1-1. I-15 is a primary artery for the movement of commuters, goods, and services from inland northern San Diego County to downtown San Diego. Weekday traffic volumes range from 170,000 to 290,000 vehicles on the general purpose lanes.

The corridor currently has a 20-mile, four-lane concurrent flow high-occupancy toll/managed lanes facility with two reversible center lanes, the “I-15 Express Lanes.” Approximately 30,000 vehicles use the I-15 Express Lanes during weekdays, and the corridor experiences recurring congestion.

[2] Information in this section has been excerpted from “Integrated Corridor Management,” published in the November/December 2010 edition of Public Roads magazine. The article was authored by Brian Cronin (RITA), Steve Mortensen (FTA), Robert Sheehan (FHWA), and Dale Thompson (FHWA). With the consent of the authors, at the direction of U.S. DOT some updates or corrections have been made to this material.



San Diego Association of Governments, January 2011

Figure 1-1. I-15 Corridor Boundaries of San Diego ICM Deployment

The San Diego ICM focuses on five primary ICM goals to augment technical management, software and systems development, and cutting-edge innovation:

1. The corridor's multimodal and smart-growth approach shall improve accessibility to travel options and attain an enhanced level of mobility for corridor travelers.
2. The corridor's safety record shall be enhanced through an integrated multimodal approach.
3. The corridor's travelers shall have the informational tools to make smart travel choices within the corridor.
4. The corridor's institutional partners shall employ an integrated approach through a corridor-wide perspective to resolve problems.
5. The corridor's networks shall be managed holistically under both normal operating and incident/event conditions in a collaborative and coordinated way.

To achieve these goals, SANDAG and its partnering agencies will contribute $2.2 million for the $10.9 million project. San Diego will use investments in ITS to implement a "smart" transportation management system that combines road sensors, transit management strategies, video, and traveler information to reduce congestion. The smart system will deliver information to commuters via the Internet and message signs, and will enable managers to adjust traffic signals and ramp meters to direct travelers to high-occupancy vehicle (HOV) and high-occupancy tolling (HOT) lanes, bus rapid transit, and other options. Specific examples of practices the San Diego site team intends to employ include the following:

- Provide corridor users with the operational condition of all corridor networks and components, such as comparative travel times, incident information, and expected delays.
- Use a decision support system with real-time simulation, predictive algorithms, and analysis modeling.
- Establish, improve, and automate joint agency action plans for traveler information, traffic signal timing, ramp metering, transit and Express Lanes.
- Identify means of enhancing corridor management across all networks, including shared control multi-jurisdictional coordination of field devices such as lane controls, traveler information messages, traffic signal timing plans, and transit priority.

Technology investments that are being implemented as part of the ICM deployment in San Diego and which will be used to carry out ICM operational strategies include:

- A Decision Support System (DSS) that will utilize incoming monitoring data to assess conditions, forecast conditions up to 30 minutes in the future, and then formulate recommended response plans (including selecting from pre-approved plans) for consideration by operations personnel. Table 1-1 summarizes expected San Diego DSS functionality.

- Enhancement of the Intermodal Transportation Management System (IMTMS) regional information exchange network, a system previously implemented using non-ICM funding and which is being enhanced using ICM funding, depicted in Figure 1-2.
- Adjustments to ramp meter timing to support diversions to or from the freeway
- Lane use modifications, namely the four configurable, managed (variably priced high-occupancy toll) lanes in the I-15 median.
- Upgrades to selected traffic signal systems, including new traffic signal coordination timings and responsive traffic signal control on two arterial streets paralleling I-15.
- Arterial street monitoring system, including additional traffic detectors.

Table 1-1. Summary of San Diego DSS Functionality

Functionality	Summary
Expert-System Based DSS	The Expert System combines a rule base using incident response parameters with knowledge base information on roadway geometry and field device locations to automatically generate response plans consisting of strategies such as DMS signing, signal timing, and ramp metering and incident checklists. The heart of the DSS subsystem within the Integrated Corridor Management System (ICMS) is the ability to analyze collected data, ascertain abnormal or scheduled events, determine appropriate responses, and suggest a set of actions that collectively form a "Response Plan." The Response Plan may be manually or automatically generated, but if automatically generated, will include the capability for human operator review and modification. This is particularly critical for field device (i.e., DMS and camera) control actions.
Real-Time Monitoring of Transportation System Conditions through the DATA-HUB (IMTMS)	The DSS – DATA HUB takes the data received from participating agencies and provides fused data to participating agencies as XML data feeds and to the general public through the regional 511 system. The DSS – DATA HUB will provide for a dynamic, Web-based Graphical User Interface (GUI) to selected agencies for the monitoring of corridor performance and operations. This portion of DSS functionality is the Intelligent NETworks (iNET) program
Real-Time Simulation modeling to help assess impacts of response plans	The DSS will use a micro/meso scale modeling tool to assess the impact of short-term responses to the planned and unplanned events in the corridor (such as the recent wildfires in San Diego). The real-time modeling component will use the DATA-HUB inputs, along with the DSS-Response Plans to generate corridor level impact assessments of response plans.
Offline simulation and modeling to help fine-tune response plans	Response plans will be reviewed periodically using offline simulation and modeling approaches to make changes to the rules of practices, generate modified rules of practice, and assess the performance retroactively of the DSS
DSS-Network prediction	DSS includes a network prediction capability that looks at capacity and demand conditions across the corridor up to an hour in advance in 15 minute slices. The network prediction looks at estimating demand and the consequent travel conditions across the various modes in the corridor. This information is shared with the corridor operators. The prediction will be refreshed every 3-5 minutes.

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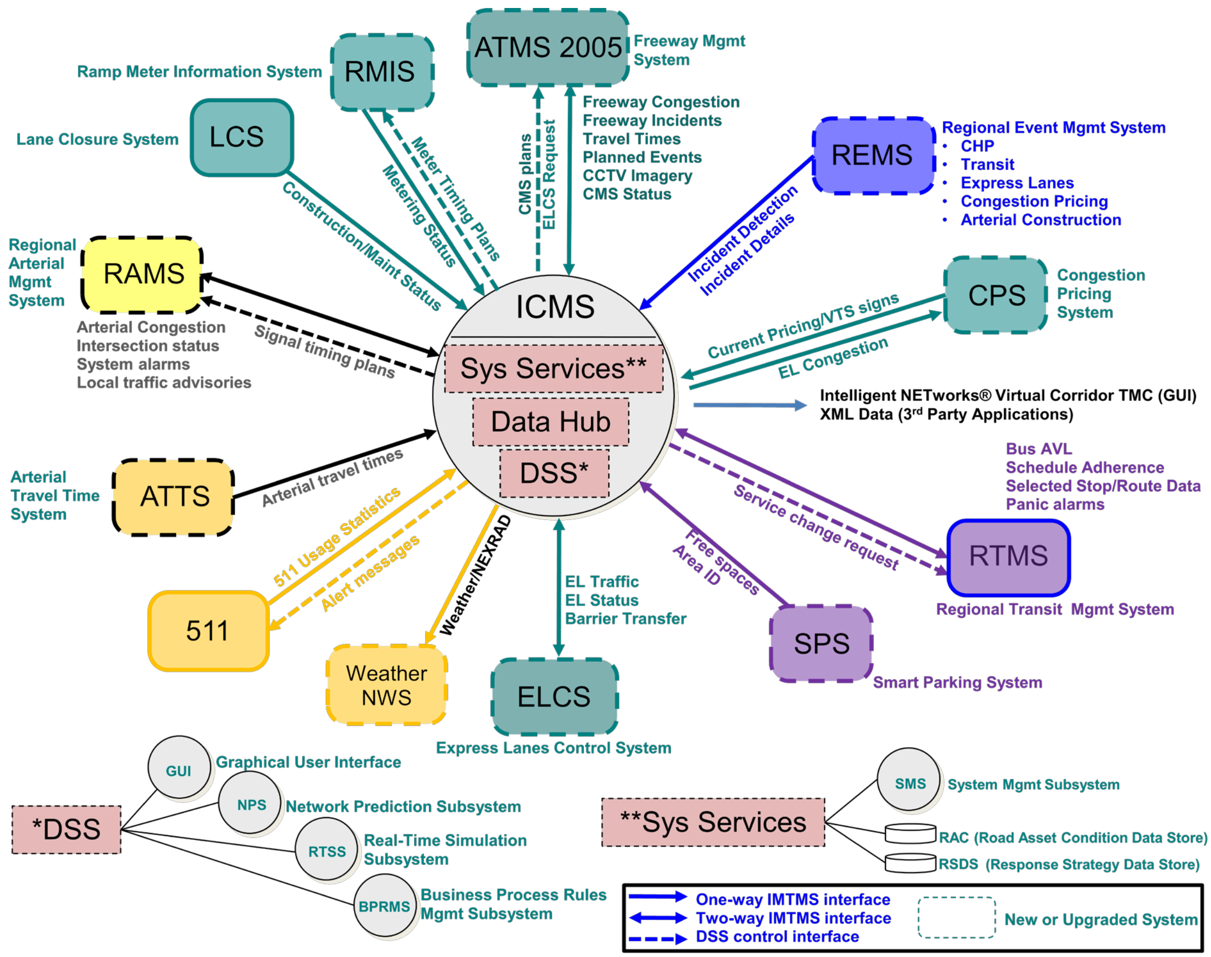

Figure 1-2. Context of San Diego ICM System Data Inputs and Outputs

It is expected that the various San Diego ICM system capabilities and strategies will be utilized in several different contexts and timeframes. These contexts and timeframes are expected to become more definitive and elaborated as the sites proceed with the design and implementation of their systems; various scenarios have been explored that consider the use of the ICM system as a response strategy for wildfires, a crash involving hazardous materials, and heavy congestion at different locations along the corridor. Further, these uses are expected to evolve as the sites work through their six-month "shakedown" periods following the initial system go-live dates, and possibly, continuing to some extent into the 12-month post-deployment data collection period. Currently, it is expected that the ICM systems will be applied in at least the following general contexts and timeframes:

1. In "real time" (or near real time), based on congestion levels
2. In advance, e.g., pre-planned:
    a. Anticipating a specific, atypical event, such as major roadway construction or a large sporting event; and

b. Periodic or cyclical (e.g., seasonal) adjustments to approaches based on lessons learned and evolution of the ICM strategies and/or in response to lasting changes in transportation conditions either directly related to ICM strategy utilization (e.g., drivers who may have switched to transit during a specific ICM-supported traffic incident choosing to continue to use transit on a daily basis) or other, non-ICM related changes such as regional travel demand.

1.2.2 San Diego ICM Deployment Schedule

Table 1-2 presents the San Diego ICM deployment schedule. As indicated in Table 1-2, individual components of the deployment will be completed in a phased manner, with full ICM system operations currently scheduled to commence in February 2013. The San Diego site team has indicated that they do expect, to at least some degree, to begin using individual components and associated ICM strategies as they become available prior to the overall system go-live. The approach to this analysis attempts to take that phasing into consideration. Since both the completion dates of the individual ICM components and the San Diego site team's utilization of them are expected to evolve as the ICM system design, implementation and shakedown periods progress, the approach presented in this test plan may flex somewhat in response.

Table 1-2. San Diego ICM Deployment Schedule

Activity	Completion Date
Complete Planning Phase	November 2010
Design/Build Phase (complete unit testing):	
Iteration 1: Intelligent NETworks (iNET) Integrated Corridor Management System (ICMS) configuration, new datahub interfaces, Traffic Management Data Dictionary (TMDD) v3.0 conversion, error-checked real-time (R/T) Traffic model, response plan data store design	April 2012
Iteration 2: R/T traffic model with response plans, iNET updates for response plan and event management	August 2012
Iteration 3: Predictive modeling, iNET update for predictive modeling, integration of all DSS capabilities in all subsystems	January 2013
Additional field element construction	January 2013
Complete Acceptance Testing	January 2013
Operations Go Live	February 2013
Complete Shakedown Period	July 2013
Complete Evaluation One Year Operational Period	July 2014

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1.2.3 Comparison to the Dallas ICM Deployment

The overall objectives of the San Diego ICM deployment are similar to those in Dallas and many of the same general operational strategies are planned, focusing on improving the balance between travel supply and demand across multiple modes and facilities, including highways, arterial streets and transit. The major distinctions in the ICM strategies to be utilized by each site generally flow from the differences in their transportation systems:

- The San Diego corridor includes extensive bus rapid transit whereas the U.S. 75 corridor in Dallas includes the Red Line Light Rail Transit (LRT) service.
- The San Diego corridor includes concurrent flow HOT/managed lanes whereas the Dallas corridor includes HOV lanes:
  - The San Diego corridor includes a recently expanded four-lane managed lane system in the I-15 median that is variably priced high occupancy tolling and includes two reversible center lanes. The San Diego site team does not expect ICM to impact their variable pricing decisions but it will impact their use of the four configurable managed lanes.
  - The Dallas U.S.-75 corridor includes access-controlled, HOV lanes located in the median, although, like San Diego with the HOT lanes, they do not expect ICM to impact their occupancy requirement decisions.
  - Both sites currently lift HOV restrictions during major incidents.
- Both sites include major arterials that run parallel with the freeways. However, while the arterial in Dallas is continuous for the length of the corridor, there is no single continuous arterial running parallel to I-15 in San Diego; Black Mountain Road, Pomerado Road, and Centre City Parkway are parallel arterials in the I-15 corridor.
- The Dallas corridor includes an extensive frontage road system, while the San Diego I-15 corridor includes auxiliary lanes between most freeway interchanges that function similarly, though with less capacity.
- The San Diego corridor includes ramp meters on I-15 and so their traffic signal timing strategies include ramp meter signals. Dallas does not use ramp meters.
- Both sites include changes to traffic signal timing plans during heavy demand and/or incidents. The Dallas deployment includes improved traffic signal timing response plans to adjust signal timing in response to real-time traffic demands along the major parallel arterial. The San Diego deployment includes responsive traffic signal control along Black Mountain and Pomerado Roads, both of which are major arterials that parallel I-15.

1.3 National Evaluation Objectives and Process

This section summarizes key aspects of the overall ICM national evaluation. A more comprehensive discussion is contained in the National Evaluation Framework document and the details of individual analyses are documented in this and other test plans.

1.3.1 U.S. DOT Hypotheses

The U.S. DOT has established the testing of eight "hypotheses" as the primary objective and analytical thrust of the ICM demonstration phase evaluation, as shown in Table 1-3. There are a number of cause-effect relationships among the U.S. DOT hypotheses; for example, enhanced response and control is dependent on enhanced situational awareness. These relationships will be examined through the evaluation in addition to testing the individual hypotheses. Another important relationship among the hypotheses is that DSS is actually a component of enhanced response and control and, depending on the specific role played by the DSS, may also contribute to improved situational awareness.

Table 1-3. U.S. DOT ICM Evaluation Hypotheses

Hypothesis	Description
The Implementation of ICM will:	
Improve Situational Awareness	Operators will realize a more comprehensive and accurate understanding of underlying operational conditions considering all networks in the corridor.
Enhance Response and Control	Operating agencies within the corridor will improve management practices and coordinate decision-making, resulting in enhanced response and control.
Better Inform Travelers	Travelers will have actionable multi-modal (highway, arterial, transit, parking, etc.) information resulting in more personally efficient mode, time of trip start, and route decisions.
Improve Corridor Performance	Optimizing networks at the corridor level will result in an improvement to multi-modal corridor performance, particularly in high travel demand and/or reduced capacity periods.
Have Benefits Greater than Costs	Because ICM must compete with other potential transportation projects for scarce resources, ICM should deliver benefits that exceed the costs of implementation and operation.
The implementation of ICM will have a positive or no effect on:	
Air Quality	ICM will affect air quality through changes in Vehicle Miles Traveled (VMT), person throughput, and speed of traffic, resulting in a small positive or no change in air quality measures relative to improved mobility.
Safety	ICM implementation will not adversely affect overall safety outcomes, and better incident management may reduce the occurrence of secondary crashes.
Decision Support Systems*	Decision support systems provide a useful and effective tool for ICM project managers through its ability to improve situational awareness, enhance response and control mechanisms and provide better information to travelers, resulting in at least part of the overall improvement in corridor performance.

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* For the purposes of this hypothesis, the U.S. DOT considers DSS functionality to include both those carried out by what the sites have labeled their "DSS" as well as some related functions carried out by other portions of the sites' ICM systems.

1.3.2 Evaluation Analyses

The investigation of the eight U.S. DOT evaluation hypotheses have been organized into seven evaluation "analyses," shown in Table 1-4, which generally correlate with the hypotheses. A separate analysis investigates institutional and organizational issues, which relate to all of the hypotheses since the ability to achieve any intended ICM benefits depends upon successful institutional coordination and cooperation.

Table 1-4. Relationship Between U.S. DOT Hypotheses and Evaluation Analyses

U.S.DOT Hypotheses	Evaluation Analysis Area
• Improve Situational Awareness • Enhance Response and Control	Technical Assessment of Operator Capability to Monitor, Control, and Report on the Status of the Corridor
• Better Inform Travelers	Traveler Response (also relates to Enhance Response and Control)
• Improve Corridor Performance	Quantitative Analysis of the Corridor Performance – Mobility
• Positive or No Impact on Safety	Quantitative Analysis of the Corridor Performance – Safety
• Positive or No Impact on Air Quality	Air Quality Analysis
• Have Benefits Greater than Costs	Benefit-Cost Analysis
• Provide a Useful and Effective Tool	Evaluation of Decision Support Systems

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The evaluation features a "logic model" approach in which each link in the cause-effect sequence necessary to produce the desired impacts on transportation system performance is investigated and documented, beginning with the investments made ("inputs"), the capabilities acquired and their utilization ("outputs") and traveler and system impacts ("outcomes").

Collectively, the results of the eight evaluation analyses will provide a comprehensive understanding of the ICM demonstration phase experience:

- What ICM program-funded and other key ICM-supporting investments did the Dallas and San Diego site teams make, including hardware, software, and personnel (inputs)?
- What capabilities were realized through those investments; how were they exercised and to what extent did they enhance previous capabilities (outputs)?
- What were the impacts of the ICM deployments on travelers, transportation system performance, safety and air quality (outcomes)?
- What institutional and organizational factors explain the successes and shortcomings associated with implementation, operation and effectiveness (inputs, outputs and outcomes) of ICM and what are the implications for U.S. DOT policy and programs and for transportation agencies around the country (Institutional and Organizational Analysis)?

- How well did the DSS perform (DSS Analysis)?
- What is the overall value of the ICM deployment in terms of benefits versus costs (Benefit-Cost Analysis)?

1.3.3 Evaluation Process and Timeline

Figure 1-3 shows the anticipated sequence of evaluation activities. The evaluation will collect 12 months of baseline (pre-ICM deployment) data and, following a 6-month shakedown period, 12 months of post-deployment data.

The major products of the evaluation are two interim technical memoranda after the end of the baseline and post-deployment data collection efforts and a single final report documenting the findings at both sites as well as cross-cutting results. Two formal site visits are planned by the national evaluation team to each site: as part of evaluation planning during national evaluation framework development and test planning-related visits. Additional data collection trips will be made by various members of the national evaluation team during baseline and post-deployment data collection.

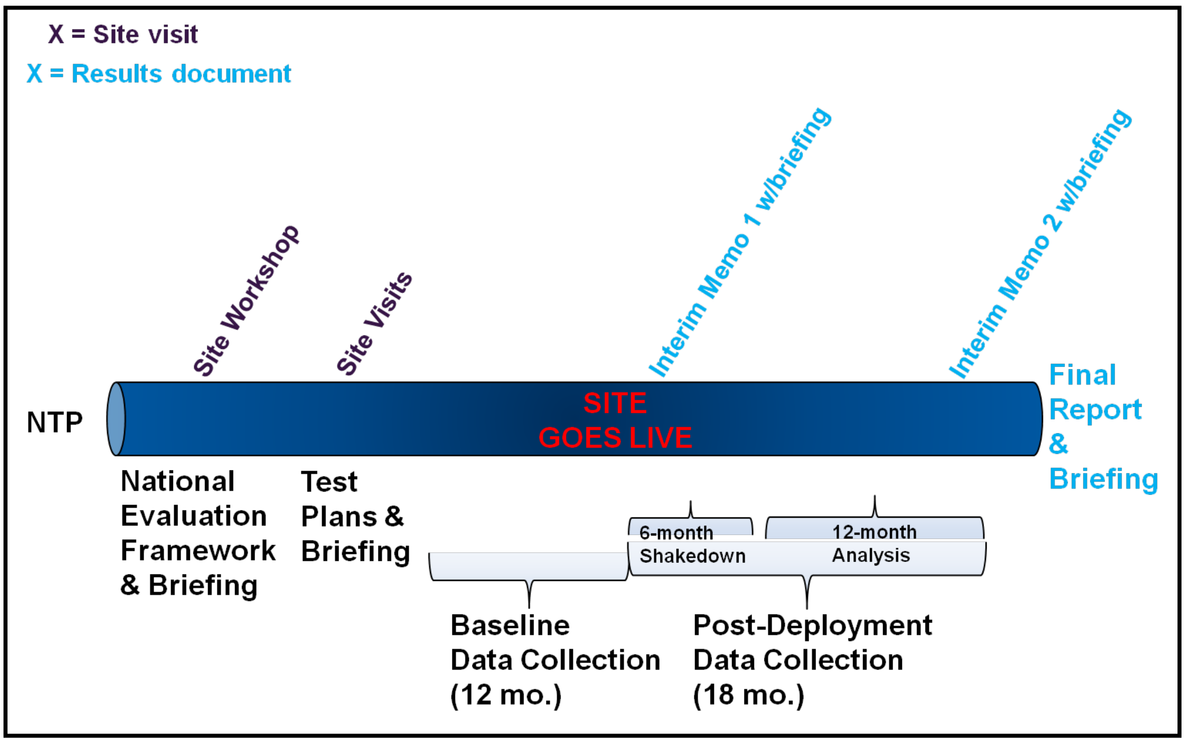

Figure 1-3. Sequence of Evaluation Activities

Based on current deployment schedules for both Dallas and San Diego, the anticipated schedule for major evaluation activities in San Diego is as follows:

- Finalize test plans – Summer 2012
- Collect baseline (pre-ICM deployment) data – Winter 2012 through Winter 2013
- Complete Interim Technical Memorandum on baseline data – Spring 2013
- Collect post-deployment data – Winter 2013 – Summer 2014
- Complete Interim Technical Memorandum on evaluation results – Fall 2014
- Complete Final Report – Spring 2015

1.3.4 Roles and Responsibilities

The U.S. DOT ICM Management Team is directing the evaluation and is supported by the Volpe National Transportation Systems Center (Volpe Center), Noblis and ITS America. The national evaluation team is responsible for leading the evaluation consistent with U.S. DOT direction and is responsible for collecting certain types of evaluation data—namely partnership documents and conducting workshops and interviews. The national evaluation team is also responsible for analyzing all evaluation data—including that collected by the national evaluation team as well as the Volpe Center and the San Diego site team—preparing reports and presentations documenting the evaluation results, and archiving evaluation data and analysis tools in a data repository that will be available to other researchers. The San Diego site team is responsible for providing input to the evaluation planning activities and for collecting and transmitting to the national evaluation team most of the evaluation data not collected directly by the national evaluation team. The national evaluation team will create and disseminate surveys to the San Diego site team, who will assist and coordinate with logistics. The Volpe Center is providing technical input to the evaluation and will carry out the traveler survey activities discussed in the Traveler Response Test Plan. The U.S. DOT Analysis, Modeling and Simulation contractor, Cambridge Systematics, will provide key AMS modeling results to the evaluation, namely person-trip measures that cannot be feasibly collected in the field, and will utilize certain evaluation outputs, such as those related to traveler response, to calibrate the AMS tools post-ICM deployment.

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2.0 ANALYSIS OVERVIEW

This chapter provides a high-level overview of the approach to the Air Quality Analysis, including a discussion of evaluation hypotheses to be tested and measures of effectiveness (MOEs).

The ICM deployments are intended to accomplish a number of outcomes, which include shifting travelers from congested roadways to less congested roads and/or transit, delay or elimination of trips, and improvements to roadway capacity and performance via both enhanced incident response and improved signal coordination and timing. The United States Environmental Protection Agency (EPA) MOtor Vehicle Emissions Simulator (MOVES) model will be used to estimate changes in motor vehicle emissions associated with these outcomes for both ICM sites. MOVES is being phased in as a replacement for the MOBILE6 model for analyses across the U.S., and represents a significant update to on-road mobile source modeling capabilities, including extensive new vehicle emission rates, test data, and functionality. In MOVES, users specify vehicle types, temporal and spatial ranges, pollutants, road types, and other parameters to produce emissions calculations on local, regional, state, or national bases.

The primary inputs to MOVES used in this analysis are vehicle activity data, including both roadway link-specific vehicle throughput and representative link speeds. The activity data used as input to MOVES will be derived from AMS travel demand modeling outputs, which are the most comprehensive source of information for vehicle throughput and speeds for all links of interest in the study area. The selection of modeled scenarios will be driven in part by the scenarios studied in the mobility portion of the Corridor Performance Analysis. Other model inputs will be derived from regional EMission FACtor model (EMFAC) data provided by SANDAG and/or California Air Resources Board (CARB). Emissions will be modeled on a before/after basis for a number of different scenarios at the project level, which is the finest degree of modeling available in MOVES. At this level, MOVES allows for modeling of emission effects from a group of specific roadway links.

The Air Quality Analysis approach is summarized in Figure 2-1. Additional detail pertaining to quantitative model inputs is provided in Chapter 3.0. Data analysis methodology is discussed in detail in Chapter 5.0, and associated risks and mitigations are presented in Chapter 6.0.

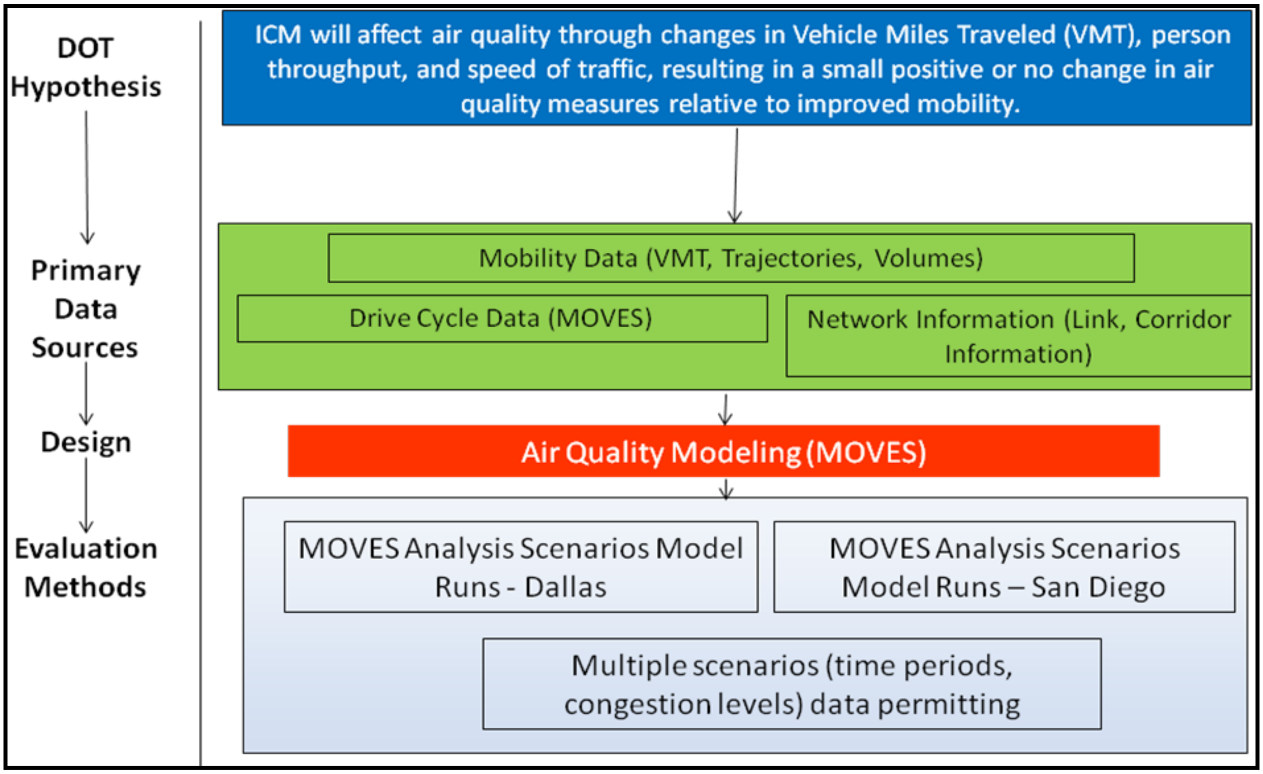

Figure 2-1. Overview of Air Quality Analysis

2.1 Evaluation Hypotheses and Key MOEs

The U.S.DOT hypothesis relating to Air Quality Analysis consists of the following statement:

> *"ICM will affect air quality through changes in Vehicle Miles Traveled (VMT), person throughput, and speed of traffic, resulting in a small positive or no change in air quality measures relative to improved mobility."*

In many of the other ICM evaluation analyses, the broad U.S. DOT hypotheses have been decomposed into a number of more specific hypotheses that can be individually tested. In the case of the Air Quality Analysis, this is not necessary as the U.S. DOT hypothesis is sufficiently narrow and testable.

Changes to VMT modeled in MOVES will be dependent on vehicle activity data collected both by the sites in the field and outputs from the AMS microsimulation model. While overall, it is anticipated that VMT and vehicle roadway throughput will be reduced throughout each corridor as a result of ICM implementation, potential changes in activity distribution across different roadway links must and will be accounted for in the Air Quality Analysis. Similarly, anticipated improvements in roadway travel speeds and/or improved traffic flow (reflected in steadier cruising speeds with less "stop and start" acceleration, deceleration and idle) will be assessed.

The primary MOEs associated with the Air Quality Analysis are reductions in emissions for criteria and greenhouse gases (GHG) as modeled using MOVES. These MOEs can be further classified as:

- Reductions in emissions due to VMT reductions
- Reductions in emissions due to vehicle throughput changes
- Reductions in emissions due to decreased congestion (and associated speed profile changes)

A variety of input data is required to obtain representative model emissions from MOVES. For the purposes of this analysis, the input data needed can be classified as either *roadway link and vehicle activity information* (e.g., link lengths, link characterization, vehicle trajectories, vehicle throughputs) or *fleet characterization* (e.g., age distribution, fuel parameters, vehicle inspection and maintenance programs). A summary of quantitative data required for the Air Quality Analysis, along with related MOEs and study hypotheses, is provided in Table 2-1.

Table 2-1. Air Quality Analysis Hypotheses, MOEs, Data, and Sources

Data Element		MOE	Hypotheses
Quantitative Data			
1. Roadway Link and Vehicle Activity Information	1.1 Link Lengths	• Reductions in emissions due to VMT reductions • Reductions in emissions due to vehicle throughput changes • Reductions in emissions due to decreased congestion (and associated speed profile changes)	• ICM will affect air quality through changes in Vehicle Miles Traveled (VMT), person throughput, and speed of traffic, resulting in a small positive or no change in air quality measures relative to improved mobility.
	1.2 Link Vehicle Throughput		
	1.3 Average Link Speed		
	1.4 Link Characterization		
	1.5 Road Grade		
	1.6 Vehicle Speed		
2. Fleet Characterization and Other Regional Data	2.1 Source Type Distributions		
	2.2 Vehicle Age Distributions		
	2.3 Fuel Formulation and Market Share		
	2.4 Inspection and Maintenance Program Data		
	2.5 Meteorological Data		
Qualitative Data			
This test plan utilizes no qualitative data.			

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3.0 QUANTITATIVE DATA

This chapter describes the quantitative data elements to be used in the Air Quality Analysis. Table 3-1 summarizes the data requirements for the Air Quality Analysis Test Plan. Eleven different data elements are listed for both the baseline (i.e., pre-deployment) and post-deployment phases of the ICM Analysis, which are approximately calendar years 2012 and 2013, respectively. In all cases, the data elements will be derived either from AMS travel demand model outputs, or from existing EMFAC inputs developed by SANDAG for use in regional analyses. The sources, timing, and other details of data collection are discussed in the sections that follow.

3.1 Link Lengths

Roadways in the I-15 corridor are represented in the AMS model as a series of links. MOVES also models roadway emissions using individual links at the project level. Using roadway links previously defined by the San Diego site's AMS modelers (to include the entire corridor) and used in the mobility portion of the Corridor Performance Analysis, the national evaluation team will obtain link lengths, in miles, for each modeled roadway link in the corridor from AMS model outputs. We expect that roadway link identifiers and lengths will remain constant across all modeled scenarios.

3.2 Link Throughput

Since project level MOVES runs are performed for a single hour in a given run, the national evaluation team will request vehicle throughputs (in units of vehicles per hour) for all links of interest in an AMS model output "snapshot". Each snapshot will represent a single hour of modeled traffic, for each of the six scenarios to be modeled (as described in Chapter 5.0). We expect vehicle throughputs to vary across modeled scenarios.

3.3 Average Link Speed and Average Grade

MOVES can calculate operating mode distributions for individual links using only average link speed (in mi/hr) and average percent grade over the length of the link. The national evaluation team will request these two parameters for each link of interest in the I-15 corridor, as output from the AMS model, for each scenario to be modeled. We expect that average vehicle speed will vary across scenarios, but average percent grade will remain constant.

It should be noted that average link speed and average grade are fallback parameters for use in calculation of operating mode within MOVES; ideally, operating mode for each link will be calculated using second-by-second speed and road grade, as discussed below.

Table 3-1. Quantitative Data Summary

Data Element	Location	Data Collection Frequency	Data Collection Period (pre-/post-)		Data Collection Responsible Party	Data Transmittal
			Start	End		
Roadway Link and Vehicle Activity Information						
1.1 Link Lengths	San Diego I-15 corridor[3]	AMS model snapshots for selected scenarios	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output	April 2013 April 2014 (Email to National Evaluation Team)
1.2 Link Throughput	San Diego I-15 corridor	AMS model snapshots for selected scenarios	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output	April 2013 April 2014 (Email to National Evaluation Team)
1.3 Average Link Speed and Average Grade	San Diego I-15 corridor	AMS model snapshots for selected scenarios	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output	April 2013 April 2014 (Email to National Evaluation Team)
1.4 Link Characterization	San Diego I-15 corridor	AMS model snapshots for selected scenarios	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output	April 2013 April 2014 (Email to National Evaluation Team)
1.5 Road Grade (1 Hz)	San Diego I-15 corridor	AMS model snapshots for selected scenarios	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output	April 2013 April 2014 (Email to National Evaluation Team)
1.6 Vehicle Speed (1 Hz)	San Diego I-15 corridor	AMS model snapshots for selected scenarios	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output	April 2013 April 2014 (Email to National Evaluation Team)

[3] Refer to Figure 1-1 for a map of the corridor.

Table 3-1. Quantitative Data Summary (Continued)

Data Element	Location	Data Collection Frequency	Data Collection Period (pre-/post-)		Data Collection Responsible Party	Data Transmittal
			Start	End		
Fleet Characterization and Other Regional Data						
2.1 Source Type Distributions	San Diego I-15 corridor	AMS model snapshots for selected scenarios, OR SANDAG EMFAC-derived data	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – AMS Model Output OR SANDAG EMFAC derived data	April 2013 April 2014 (Email to National Evaluation Team)
2.2 Vehicle Age Distributions	San Diego I-15 corridor	SANDAG EMFAC derived data	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – SANDAG EMFAC derived data	April 2013 April 2014 (Email to National Evaluation Team)
2.3 Fuel Formulation and Market Share	San Diego I-15 corridor	SANDAG EMFAC derived data	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – SANDAG EMFAC derived data	April 2013 April 2014 (Email to National Evaluation Team)
2.4 Inspection and Maintenance Program Data	San Diego I-15 corridor	SANDAG EMFAC derived data	Jan 2012 Jan 2013	Dec 2012 Dec 2013	San Diego Site Team – SANDAG EMFAC derived data	April 2013 April 2014 (Email to National Evaluation Team)
2.5 Meteorological Data	San Diego I-15 corridor	NOAA Climatological Data	Jan 2012 Jan 2013	Dec 2012 Dec 2013	National Evaluation Team from NOAA	April 2013 April 2014 (National Evaluation Team will collect)

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3.4 Link Characterization

MOVES requires that each link in the analysis be assigned a specific road type. Road types are assigned based on two factors: whether a road is restricted (freeway) or unrestricted (non-freeway), and whether the road is located in an urban or rural area. Road types are important in MOVES because each type has a particular set of drive schedules associated with it.

Per previous discussions with the San Diego team, all links in the corridor will be classified as urban in nature. Interstate 15, along with State Routes 52, 56, 78, and 163 will be classified as restricted roadways; all other roadways will be classified as unrestricted. We expect that roadway link characterization will remain constant across all modeled scenarios.

3.5 Road Grade (1 Hz)

According to SANDAG, grade information for the roadway network consists of average grade between nodes. Since grade information for the San Diego ICM corridor is available at a resolution other than 1 Hz, it will need to be averaged or interpolated into a 1 Hz format for use in MOVES. The national evaluation team will work with the San Diego site team to locate other potential source of grade information (e.g., Geographic Information System [GIS]/Google or SANDAG files) in order to supplement the existing grade data. If necessary, the national evaluation team may apply known average grades over an entire link on a second-by-second basis. If grade information is not available for certain links, flat terrain will be modeled, and appropriate caveats applied to model outputs. In any case, we expect that by-link percent road grade values will remain constant across all modeled scenarios.

3.6 Vehicle Speed (1 Hz)

The national evaluation team currently plans to input second-by-second vehicle speeds to MOVES for use in its vehicle operating mode calculations. From these speeds, acceleration and deceleration profiles will be created by the MOVES model for use in calculation of emissions. These speed values will be obtained for each roadway link, covering the entirety of the link, for each scenario of interest. This information will be obtained from post-processed AMS model outputs. These model outputs are currently available at a one-second resolution, which can be directly input into MOVES. The vehicle speeds obtained will represent instantaneous speed for all aggregate vehicle types driving on a given link. We expect that by-link vehicle speed values will vary across all modeled scenarios.

It is important to note that vehicle speeds play a critical role in the Air Quality Analysis, in that speeds generated by AMS are necessary to capture baseline driving patterns, as well as changes in such patterns arising from implementation of ICM in the corridor. Even more so than other MOVES model inputs derived from AMS, we are reliant upon AMS speeds to provide an accurate picture of traffic flows in the corridor, and the AMS model must be specially calibrated for Air Quality Analysis purposes.

According to the AMS contractor for this project, the pre-deployment baseline AMS models are already calibrated. For the post-deployment models, the typical needs for model calibration will include:

- *Volumes, travel times, speeds and bottlenecks for freeways*. The AMS contractor will obtain these from site Freeway Performance Measuring System (PeMS) data.
- *Volumes, travel times, speeds and bottlenecks for arterials*. It is our understanding that required data for arterials will be available prior to AMS model calibration. The AMS contractor has requested 2-3 days of travel time runs and volumes for calibration.
- *GPS-based vehicle acceleration and deceleration data*. For emissions analysis purposes, it would be helpful to have some GPS data that can provide vehicle acceleration and deceleration information. The AMS contractor will discuss with site the level of information necessary to properly calibrate that AMS model with respect to second-by-second vehicle speeds, as well as other AMS-derived parameters presented in this section.

3.7 Source Type Distributions

MOVES requires, at the link level, a distribution of vehicles traveling on each link for the given hour being modeled. This information is input to the model by specifying MOVES source type fractions (with values summing to 1.0 across all source types).

The national evaluation team will first obtain passenger car and combined truck fractions for each link from SANDAG regional travel demand model information. However, MOVES requires specific fractions for a number of different truck types. The national evaluation team will work with the San Diego site team to convert general AMS truck fractions to specific MOVES source type fractions using fleet characterization data from SANDAG, based on either travel demand model information or EMFAC data, as appropriate.

If specific source type fractions are not available on a per-link basis, regional source type distributions from SANDAG county-level EMFAC analyses may be applied across all links. Alternately, regional vehicle registration data from CARB (or other State of California sources) may be used to derive representative source type distribution values. We expect that by-link source type distributions will vary across modeled scenarios.

3.8 Vehicle Age Distributions

MOVES requires age information for the fleet in its emissions calculations. This information consists of age fractions, for vehicles from 0-30 years old, for each modeled source type in a given calendar year. The national evaluation team will obtain age distributions for calendar years 2012 and 2013 in the I-15 corridor from existing EMFAC inputs prepared by SANDAG. We expect that vehicle age distributions will remain constant across modeled scenarios for each calendar year modeled.

3.9 Fuel Formulation and Market Share

MOVES requires data describing both physical characteristics of gasoline and diesel fuels to be modeled, as well as the market shares of various fuel mixes that may be present in a given area. This information includes fuel Reid vapor pressure (RVP), oxygenate percentages, sulfur levels, and other relevant fuel data. The national evaluation team will obtain fuel formulation and market share information for calendar years 2012 and 2013 in the I-15 corridor from existing EMFAC inputs prepared by SANDAG. We expect that these data will remain constant across modeled scenarios for each calendar year modeled.

3.10 Inspection and Maintenance Program Data

Local inspection and maintenance (I/M) program information is input to MOVES to determine the effects of such programs in reducing vehicle emissions. This data will include specification of I/M test procedures in place for the San Diego area (e.g., OBDII testing for 1996 and newer vehicles) for affected MOVES source types and model year ranges, along with an associated compliance factor. The national evaluation team will obtain I/M program information for the area surrounding the I-15 corridor from existing EMFAC inputs prepared by SANDAG. We expect that these data will remain constant across all modeled scenarios.

3.11 Meteorological Data

MOVES requires ambient meteorological data, consisting of hourly temperature (degrees F) and relative humidity (%) values, for calculation of vehicle emissions. The national evaluation team will obtain meteorological data for the I-15 corridor from National Oceanographic and Atmospheric Administration (NOAA) climatological records.

4.0 QUALITATIVE DATA

No qualitative data elements are currently required for use in the Air Quality Analysis Test Plan.

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5.0 DATA ANALYSIS

This section describes how the air quality data will be analyzed. Specifically, for each hypothesis relevant to the Air Quality Analysis, the approach to testing the hypotheses and/or drawing conclusions will be discussed, including statistical and analytical processes and tools. Generally, the national evaluation team will use AMS model outputs generated as part of the ICM evaluation, along with other required inputs to the MOVES model, to calculate emissions of hydrocarbons, carbon monoxide, carbon dioxide equivalents, oxides of nitrogen, and particulate matter, along with fuel consumption estimates, for vehicles in the I-15 corridor. This analysis will be performed for three scenarios both before and after implementation of the ICM, for a total of six modeled scenarios.

5.1 Hypothesis 1: ICM Will Have Positive or No Impact on Air Quality

In evaluation of the sole Air Quality hypothesis, MOVES2010b will be the primary tool used to estimate on-road mobile source emissions changes arising from ICM implementation in the San Diego area. The goal of the analysis will be to estimate these emissions for three selected traffic scenarios, and the national evaluation team will execute MOVES at the project domain level to achieve this goal. At this level, the model must be run for a single hour, day, type (weekend or weekday), month, and county. Specific required inputs to MOVES were described previously in Chapter 3.0.

A total of six MOVES model runs will be executed for the Air Quality Analysis, consisting of three scenarios evaluated both before (baseline calendar year 2012) and after (calendar year 2013) ICM implementation. To provide an accurate picture of emissions changes associated with the ICM, model runs will be developed and executed in accordance with the most recent versions of EPA's "PM Hotspot Guidance"[4] and "Project Level CO Guidance".[5] Although this Air Quality Analysis is not, strictly speaking, a hotspot project, these documents provide a useful basis for developing project domain level inputs to the MOVES model. It is important to note here that, unlike the methodology set forth in the aforementioned guidance documents, it is not necessarily our intent to provide annual average emissions for the I-15 corridor (although a simplified approach for doing so is presented in Section 5.2 below). Rather, to the extent possible, we intend to demonstrate the effects of ICM on vehicle emissions over a variety of traffic and congestion situations.

Each scenario modeled will present a before/after ICM basis, with associated air quality impacts, for a particular hour. The national evaluation team will work to ensure that scenarios that are modeled capture appropriate changes in both traffic volume and speed profiles associated with the ICM deployments, since MOVES is particularly sensitive to adjustment of these variables. In setting up these scenarios, consideration will be given to modeling significant incidents (e.g., traffic obstructions or sporting events) when possible, during which more substantial air quality impacts are expected. Such incidents may be modeled in addition to, or possibly instead

[4] http://www.epa.gov/otaq/stateresources/transconf/policy/420b10040.pdf

[5] http://www.epa.gov/otaq/stateresources/transconf/policy/420b10041.pdf

of, typical daily conditions or minor incident conditions when substantial impacts are unlikely, depending on data availability.

Currently, the national evaluation team anticipates the modeling of the following three scenarios in MOVES, consistent with AMS model outputs that will be prepared in conjunction with the mobility portion of the Corridor Performance Analysis:

- *Typical non-peak vehicle activity*
- *Typical high congestion vehicle activity*
- *Major congestion incident*

MOVES outputs for each scenario modeled will consist of grams per hour of emissions for each link and source type of interest. Emissions will be totaled by before/after scenarios and analyzed to determine the effect of ICM implementation on corridor air quality. The national evaluation team will summarize model inputs and outputs in a report provided in both electronic and hard copy forms, along with all model input runstreams, input databases, and output databases.

5.2 Annual Air Quality Impact Estimation

Although annual air quality impacts are typically calculated using MOVES at the county or regional scale, there is a need in the ICM Evaluation to estimate such impacts by deriving them from project-level MOVES outputs (conducted for an individual hour). The national evaluation team proposes that such an estimate be produced by allocating air quality impacts from the scenarios described in Section 5.1 across all 8,760 hours of a given year, as appropriate. This will be done by extrapolating applicable factors, developed in coordination with the mobility portion of the Corridor Performance Analysis that would set forth how many hours per year the scenarios listed above could be considered to be representative.

Proper weighting of both the baseline and post-deployment hourly air quality results allows for a simple estimation of annualized air quality impacts. This estimate, in turn will be used in the Cost-Benefit Analysis to determine a dollars per ton-year benefit for each pollutant of interest.

5.3 Exogenous Factors

The influence of the exogenous factors (such as fluctuations in demand due to gas prices) will be accounted for by the AMS models. As such the air quality modeling stage and air quality results directly do not account for exogenous factors. In other words, the approach to controlling for exogenous factors in the Air Quality Analysis will be to utilize activity data that has, to the extent possible and as provided via AMS model outputs, been corrected to eliminate as much exogenous factor influences as possible.

6.0 RISKS AND MITIGATIONS

Table 6-1 identifies the risks associated with this analysis and the national evaluation team's response plan for each risk. The risks associated mitigations strategies are discussed in further detail below.

Table 6-1. Risks and Mitigations

Risk	Mitigation Strategy
1. Dependency of Air Quality Analysis on AMS model	Work with AMS contractor to ensure that necessary data is provided by San Diego site team for proper calibration of post-ICM deployment AMS model
2. AMS Model Temporal Resolution	Post-process AMS data using averaging or interpolation to derive second-by-second resolution
3. Possibility of grade data unavailability from AMS	Develop other, more coarse sources of grade data. Alternately, assume flat terrain.
4. Conversion of AMS vehicle class to MOVES source type	Supplement truck fractions using data available from SANDAG. Alternatively, apply regional source distribution across all links or derive from registration data.
5. Inadequate or unavailable link information	Application of throughputs to selected representative links across the evaluation area.

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6.1 Risk 1: Dependency of Air Quality Analysis on AMS Model

It is important to emphasize that the results of the Air Quality Analysis and, in particular, the ability of the analysis to correctly characterize changes in on-road vehicle emissions due to changes in localized traffic flow, is *highly dependent* on accurate estimates of second-by-second vehicle speeds from the AMS model. Accuracy in these estimates necessarily requires calibration of the AMS model.

Special calibration and validation of the model must therefore be conducted by the AMS contractor to ensure that MOVES inputs required for the Air Quality Analysis are accurate, representative, and comprehensive. If calibration data is not available, or if validation cannot be performed for the AMS model, subsequent air quality estimates could be erroneous. To mitigate this risk, the national evaluation team will work with the AMS contractor and San Diego site team to ensure that field data to support the AMS calibration process is available and of necessary quality and coverage to ensure that AMS model validation is successful.

6.2 Risk 2: AMS Model Temporal Resolution

It is possible that, for some roadways, the AMS model output that will be used as input to the MOVES model for this analysis may be calculated at a resolution other than 1 second (1 Hz). However, the MOVES model *requires* percent road grade and vehicle speeds on a by-link basis at a one-second resolution. Any such AMS model data will need to be post-processed (via averaging or interpolation) to achieve the necessary MOVES input format. There is a risk that such post-processing may introduce bias to the model results such that emissions are under- or over-estimated.

To mitigate this risk, the national evaluation team will work closely with the San Diego area AMS modelers to develop post-processing routines that produce best-available, representative grade and speed information for links of interest. In cases where AMS model data is unavailable or cannot be adequately processed for a given link, the evaluation will proceed using average throughputs and speeds for that link, using MOVES to calculate an appropriate operating mode based on its internal drive schedules information.

6.3 Risk 3: Possibility of Grade Data Unavailability from AMS

At the present time, it is anticipated that while the San Diego site team will be able to derive an average grade for a particular link, 1 Hz resolution grade information will not be readily obtainable without significant acquisition of supplementary data and subsequent post-processing. Inadequate grade information poses a risk to the analysis via potential over- or under-estimation of vehicle emissions.

To mitigate this risk, the national evaluation team has several options. As stated above in Chapter 3.0, if grade information is not available from AMS model outputs at the necessary level of specificity, the national evaluation team will work with the San Diego site team to locate an alternative source of grade information (e.g., GIS/Google or SANDAG/CARB files). If necessary, the San Diego site team may apply known average grades over an entire link on a second-by-second basis. In the unlikely worst case scenario, where grade information is not available for certain links at all, flat terrain will be modeled, and appropriate caveats applied to model outputs.

6.4 Risk 4: Conversion of AMS Vehicle Class to MOVES Source Type

In order to properly characterize the I-15 corridor fleet, AMS vehicle classes must be converted to MOVES source types on a by-link basis. The AMS model output currently provides a breakdown of cars and aggregate trucks[6] for each link, but the MOVES model requires additional specificity. This conversion is potentially complicated, and may have the effect of over- or under-representing specific truck classes in the fleet, thereby affecting aggregate on-road vehicle emissions. To mitigate this risk, the national evaluation team will work with the San Diego site team to develop a conversion method that characterize trucks as accurately as possible, supplemented with previously developed EMFAC vehicle types fractions developed by SANDAG.

[6] These trucks are not broken out into MOVES-specific source types or even by weight class; rather, all different types of trucks are categorized collectively in the AMS model as simply “trucks”.

As stated in Chapter 3.0, if specific source type fractions are not available on a per-link basis, regional source type distributions from SANDAG's EMFAC analyses may be applied across all links. Alternately, regional vehicle registration data from CARB (or other State of California sources) may be used to derive representative source type distribution values. Note, however, that use of regional sources is not ideal at the project level, since changes in the hourly resolution of the fleet makeup are lost.

6.5 Risk 5: Inadequate or Unavailable Link Information

It is anticipated that throughputs and speeds obtained from the AMS model will include all of the roadway links in each corridor. The resolution of these links should thus be sufficient to adequately describe vehicle traffic and activity patterns for the purposes of air quality modeling. However, in the event that not every individual roadway in the ICM corridor is available from the AMS model for input to MOVES, there is a risk that the Air Quality Analysis may under estimate emissions from on-road vehicles in the corridor.

To mitigate this risk, the national evaluation team will select a sufficient number of representative links to cover both the spatial variations and differences in driving activity within the corridor. Per EPA's "Hotspot Guidance", an appropriate sampling of vehicles and links "can be used to model higher volume segments by adjusting the resulting sum of emissions to account for higher traffic volume." In this way, the trajectories and volume/average speed data obtained from the field can be assigned to a smaller number of links, and the sum of the modeled emissions from these links adjusted by an appropriate factor to represent all of the emissions in the area for a given scenario.

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