BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair
Karl H. Quackenbush, Executive Director, MPO Staff

MEMORANDUM

DATE **August 18, 2016**

TO **David J. Mohler, Executive Director**
Office of Transportation Planning, MassDOT

FROM **Karl H. Quackenbush**
CTPS Executive Director

RE **Work Program for: I-90/I-495 Interchange Project**

Action Required

Review and approval

Proposed Motion

That the Boston Region Metropolitan Planning Organization, upon the recommendation of the Massachusetts Department of Transportation Highway Division, vote to approve the work program for the I-90/I-495 Interchange Project presented in this memorandum

Project Identification

Unified Planning Work Program Classification

Technical Support/Operations Analysis

CTPS Project Number

23327

Client

Massachusetts Department of Transportation, Highway Division
Project Supervisor: Renata Welch

CTPS Project Supervisors

Principal: Scott Peterson
Manager: Ed Bromage

Funding

MassDOT Contract # TBD

Impact on MPO Work

The MPO staff has sufficient resources to complete this work in a capable and timely manner. By undertaking this work, the MPO staff will neither delay the completion of nor reduce the quality of any work in the UPWP.

Background

The Interstate 90 and 495 (I-90/I-495) interchange, Massachusetts Turnpike Exit 11A, serves commerce traveling to and from northern New England and points west and south. Travel on this interchange includes commuter traffic associated with jobs in the MetroWest region, Boston, and the Route 128 corridor. The interchange connects I-90 to the substantial job market along the I-495 corridor and serves recreational travelers who journey to and from Cape Cod and points west and south. In addition, Exit 11A is an important connection in the heavily utilized truck corridor between New York and Maine (I-84, I-90, I-495, and I-95).

Currently, all on- and off-ramps to and from the Turnpike consist of two lanes. However, backups on the main lines of both the Turnpike and I-495 associated with this interchange are common occurrences during peak commuting hours.

The Massachusetts Department of Transportation (MassDOT) is conducting a study to examine four possible reconfigurations of this interchange. Based on engineering and environmental metrics, MassDOT will select one configuration to further in the design and construction process. MassDOT has targeted the reconstruction to occur during 2021–2025.

This interchange and associated ramps are located in Westborough—within the boundaries of the Central Massachusetts Regional Planning Commission (CMRPC) – and Hopkinton and Southborough (municipalities within the Boston Region MPO region). Because the Boston Region MPO travel-demand model does not extend west of I-495 to cover other diversion routes, MPO staff—the Central Transportation Planning Staff (CTPS)—will use the Massachusetts statewide travel-demand forecasting model for this effort. CTPS updated this model in May–August 2015, and again in June–July 2016, and it is consistent with the 164 communities covered by the Boston Region MPO model.

The June–July 2016 update of the statewide model is very relevant to this study because it reflects the conversion to a new bi-directional tolling system on the Tobin Bridge, Callahan/Sumner Tunnels, and Ted Williams Tunnel. Presently, they collect inbound tolls only, but the conversion to bi-directional tolling is underway with the construction of overhead gantry barriers. In addition, the June–July 2016 model update included converting the Turnpike's mainline tolls from being origin- and destination-based to open-road tolling.

During the next several weeks, CTPS staff will meet with MassDOT staff to acquire the latest data from the existing origin- and destination-based toll system, and determine what data might be available for the study of MassDOT's interchange project when the gantry system comes on line.

Objectives

The objective of this work scope is to:

1. Provide MassDOT with traffic projections for each reconfiguration alternative, as well as for a No-Build (do nothing) option. The forecast will be made for 2022 and 2040. The forecasts will be for AM and PM peak hours, and for daily travel conditions. These outputs will be consistent with those developed for the Long-Range Transportation Plan (LRTP).
2. Provide vehicle emissions factors, an environmental-justice analysis, and other travel characteristics as needed by MassDOT to support their metrics calculations, and alternatives analysis.

Work Description

The study area will focus on the 11A interchange as well as two additional interchanges on I-495: one interchange will be to the north, I-495 at Route 9; and one interchange to the south, I-495 at West Main Street. While these interchanges are specifically highlighted in the scope for MassDOT's study, data for I-90 interchanges 10, 10A, 11, and 12 also may be made available if needed by MassDOT.

For this work, CTPS will use the statewide model. As noted previously, the statewide model had a major update in the summer of 2015 by CTPS and is generally consistent with the Boston Region MPO model. In addition, the model was updated in June–July 2016 to reflect the new toll collection system for I-90, the Tobin Bridge, Callahan/Sumner Tunnels, and Ted Williams Tunnel. The salient features of the statewide model are as follows:

- The geography covered by the statewide model includes all of Massachusetts, all of Rhode Island, and New Hampshire to a point just south of Concord.
- Highway network representation is based on MassDOT's road inventory system as of spring 2012. All roads classified as collectors or higher are included in the network. Roads in other states came from GIS databases from those states.
- The transportation analysis zones (TAZs) are based on 2010 Census block groups except for the regional model area, in which the model zones are used.

- The land use in the model is consistent with state control totals (established in July 2015 by MassDOT's Office of Transportation Planning) for 2012, 2020, 2030, and 2040.
- Statewide model transit mode shares in the 164 municipalities found in the Boston Region MPO model area are consistent with the Boston Region MPO model.
- Vehicle types represented in the highway assignment are single-occupant autos, high-occupancy autos (two or more riders), light trucks, medium trucks, and heavy trucks. These truck definitions are consistent with the Transportation Research Board's, Quick Response Freight Forecasting Manual.
- The entry-exit toll structure on the Turnpike is reflected in the base year of the model. Mainline open road tolling as well as the bi-directional tolling on the Tobin Bridge, Callahan/Sumner Tunnels, and Ted Williams Tunnel is reflected in future years.
- The time-of-day simulations are for the following four time periods, which together, total 24 hours. The model is designed to simulate a typical Wednesday in May, which is considered to approximate an average annual weekday.
    - AM Peak Period 6:00 AM–9:00 AM
    - Midday 9:00 AM–3:00 PM
    - PM Peak Period 3:00 PM–6:00 PM
    - Early Evening/Night 6:00 PM–6:00 AM
- The statewide model's post-processing system links to the US Environmental Protection Agency's (EPAs) Motor Vehicle Emission Simulator (MOVES) air quality analysis software, and environmental-justice analysis. Both of these tools are consistent with tools used in the Boston Region MPO's LRTP.

The processes for developing the needed traffic-volume forecasts are as follows:

1. Develop a 2016 land-use scenario for the statewide model area through linear interpolation of 2012 and 2020 land-use data.
2. Develop a 2016 network scenario in the statewide model, which will reflect relevant projects completed between 2012 and 2016 (if any).
3. Calibrate the model to 2016 weekday travel patterns and volumes, which will focus on the AM and PM peak periods as well as the daily traffic volumes. The calibration will focus on the study area, not the entire modeled region.
4. Develop No-Build typical weekday traffic forecasts for 2022 and 2040—AM and PM peak hours and daily. The vehicle types forecasted will be autos,

two-axle commercial vehicles, single-unit trucks with more than two axles, and articulated vehicles.

5. Develop Build scenario typical weekday traffic forecasts for four alternatives for 2022 and 2040—AM and PM peak hours and daily—using the same vehicle types as the No-Build forecasts.
6. Develop metrics and documentation. Metrics will include system measures such as vehicle-miles traveled (VMT) and vehicle-hours travelled (VHT), as well as toll revenue changes.

The tasks associated with completing this work are as follows:

Task 1 Data Collection and Analysis

Subtask 1.1 Traffic Volumes

Weekday traffic volumes are needed to improve calibration of the statewide model and are the basis for the operational analysis of the proposed interchange reconfiguration. CTPS will investigate existing MassDOT data sources, and will use any additional counts provided by the project team. CTPS will normalize these counts, which then will be used to calibrate the statewide model further using both manual and automated procedures.

The project team (not CTPS) will be responsible for establishing the base set of balanced counts for the current interchange configuration, and the two neighboring interchanges on I-495, which are included in the analysis. The balanced counts should be consistent from interchange to interchange within the study area. The counts also should be balanced by vehicle type for those vehicle types to be used in the operations and environmental analyses. CTPS will use these balanced counts as the foundation on which all future counts will be based. Forecasts of future interchange volumes will be made by applying model changes to the base set of balanced counts, which will be for the AM and PM peak hours, and daily conditions.

Subtask 1.2 Turnpike Origin/Destination Data

CTPS will use the most recent available origin and destination (O/D) reports from MassDOT for the total number of vehicles—by vehicle type, for each month, for the entire year—that travel interchange to interchange in the I-90 corridor between Exits 10 and 12. If MassDOT is unable to provide updated reports, CTPS will use the 2012 O/D (interchange-to-interchange) data that it currently possesses.

This information will be used for base-year model calibration.

Product of Task 1

- An Excel worksheet showing observed counts. This Excel worksheet may contain many tabs showing details of the existing data such as O/D patterns.

Task 2 Existing Conditions Model Analysis

This task consists of refining and enhancing the base-year statewide model set for the I-90/I-495 interchange area, including the I-495/Route 9 and I-495/West Main Street interchanges. Model calibration will be performed for the typical weekday; two model runs will be examined with traffic data for both before and after the toll technology conversion. MassDOT will define the new toll configuration, following implementation of the new gantry technology.

CTPS will examine existing and historical vehicle probe data on congested speeds and O/D pairs to help inform the project team of weekend, seasonal, and holiday travel pattern variability.

Products of Task 2

- An Excel worksheet presenting a comparison between the observed counts and the model output for the base year prior to implementing the new toll technology. This Excel document would display details of the existing data and model output, such as O/D patterns.
- An Excel worksheet showing a comparison between the observed counts and the model output for the base year following implementation of the new toll technology. This Excel document will show details of the existing data and model output, such as O/D patterns.
- An Excel worksheet showing a comparison between pre-and-post new technology implementation for traffic counts, vehicle classifications, and congested speeds.

Task 3 Adjust PM Peak Period

Based on feedback from the project team about peak-hour volumes, CTPS will examine the need to shift nighttime travel demand into the PM period to allow for a longer peak period than the model initially specifies.

Product of Task 3

- Adjusted tabular inputs for the highway assignment step in model

Task 4 No-Build and Alternatives Analysis

CTPS will model a typical May weekday for four Build scenarios and one No-Build scenario for both an interim construction year 2022 and a 2040 horizon year. The Build scenarios will utilize the same land use and demographic assumptions. Should MassDOT desire different land use projections, its consultants will be responsible for providing the needed data in the necessary formats for use in the model. The statewide model set will be run to produce 2040 (AM and PM peak hours and daily) volumes for autos and three commercial truck types.

The results will be analyzed by comparing traffic conditions under the No-Build scenario to conditions with the various interchange reconfigurations presented in the Build scenarios. The comparisons will be made based on daily VMT and daily VHT. CTPS will conduct select link analyses on the I-90 Exit 11A ramps to examine the change in traffic flows and regional travel patterns as a result of these interchange improvements. In addition to volumes, CTPS will also provide congested speeds for the AM and PM peak hours.

Changes in the capacity of the Exit 11A interchange may result in more traffic using the interchange and consequently higher toll revenues. CTPS will quantify the diversion (if any) from such alternate routes as I-290, Route 20, and Route 9. CTPS will estimate daily revenue changes associated with each of the Build scenarios. For these revenue calculations, CTPS will rely on MassDOT to define the volume of electronic toll collection (ETC) equipped vehicles and non-ETC equipped vehicles. Similarly, MassDOT will need to identify differences in the tolls for the various collection systems across all vehicle classification types.

Products of Task 4

- Excel files showing the volumes and analysis metric summaries associated with each alternative
- Revenue calculations for the No-Build scenario and each Build scenario

Task 5 Support Air Quality Analyses

CTPS will coordinate with the study team for air quality analyses based on the model outputs from Task 4. CTPS will provide the project team with AM and PM peak hour volumes, average daily traffic (ADT) volumes, congested speeds, VMT values, or other necessary model outputs. Using the EPA's MOVES2014 model, CTPS will provide TAZ-level emissions factors from cars and trucks of carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter (PM2.5 and PM10).

Product of Task 5

- Tabular model outputs used for input into MOVES2014 air quality analyses

Task 6 Perform Environmental-Justice Analyses

CTPS will conduct environmental-justice analyses for the proposed interchange improvements. After identifying communities of concern, performance measures—relating to accessibility to health care, higher education, and jobs; mobility and congestion; and environmental impacts—will be used as indicators of benefits and burdens for environmental-justice and non-environmental-justice communities. This analysis will be conducted at the TAZ level.

Product of Task 6

- Tabular summaries of environmental-justice analyses

Task 7 Project Coordination

The project team consists of MassDOT, HNTB as the primary consultant with Howard Stein Hudson and HMMH as sub-consultants, as well as participation from Metropolitan Area Planning Council (MAPC), CMRPC, and the 495 MetroWest Corridor Partnership. CTPS will verify demographics and infrastructure project mix in the interim and forecast years with the project team; and utilize traffic counts and vehicle classification counts provided by MassDOT. CTPS will attend coordination meetings as directed by MassDOT. CTPS may also help prepare presentation materials for these and other meetings as directed by MassDOT.

Product of Task 7

- Coordination with the project team, attendance at meetings, and other assistance as needed

Task 8 Documentation

A technical memorandum documenting all of the model methodology, assumptions, results, and analyses findings will be provided to MassDOT and the study team.

Product of Task 8

- A technical memorandum documenting the project

Estimated Schedule

It is estimated that this project will be completed in nine months after work commences. The proposed schedule, by task, is shown in Exhibit 1.

Estimated Cost

The total cost of this project is estimated to be $87,097. This includes the cost of 29.5 person-weeks of staff time, overhead at the rate of 102.7 percent, printing, travel, equipment, consultants, and other direct costs. A detailed breakdown of estimated costs is presented in Exhibit 2.

KQ/bcl/ejb

Exhibit 1
ESTIMATED SCHEDULE
I-90 and I-495 Interchange Project

Task	Month								
	1	2	3	4	5	6	7	8	9
1. Data Collection and Analysis									
2. Existing Conditions Model Analysis									
3. Adjust PM Peak Period									
4. No Build and Alternatives Analysis									
5. Support Air Quality Analyses									
6. Perform Environmental-Justice Analyses									
7. Project Coordination									
8. Documentation									

Exhibit 2
ESTIMATED COST
I-90 and I-495 Interchange Project

Direct Salary and Overhead	**$87,097**

Task	Person-Weeks				Direct Salary	Overhead (102.70%)	Total Cost
	M-1	P-5	P-3	Total			
1. Data Collection and Analysis	0.2	0.8	2.5	3.5	$4,827	$4,957	$9,784
2. Existing Conditions Model Analysis	1.0	2.0	4.0	7.0	$10,295	$10,573	$20,868
3. Adjust PM Peak Period	0.0	1.2	0.0	1.2	$2,324	$2,387	$4,710
4. No Build and Alternatives Analysis	0.5	1.5	6.0	8.0	$10,846	$11,139	$21,985
5. Support Air Quality Analyses	0.2	0.2	1.5	2.0	$2,705	$2,778	$5,483
6. Perform Environmental-Justice Analyses	0.2	0.2	1.0	1.5	$2,109	$2,166	$4,275
7. Project Coordination	0.5	1.0	1.0	2.5	$3,955	$4,062	$8,017
8. Documentation	1.2	1.0	1.5	3.8	$5,907	$6,067	$11,974
Total	4.0	8.0	17.5	29.5	$42,968	$44,129	$87,097

Other Direct Costs	**$0**

TOTAL COST	**$87,097**

Funding

MassDOT Environmental