TECHNICAL MEMORANDUM

DATE: **March 30, 2017**
TO: **Boston Region Metropolitan Planning Organization (MPO)**
FROM: **Seth Asante, MPO Staff**
RE: **Low-Cost Improvements to Express-Highway Bottleneck Locations**
Selection of Study Locations

1 BACKGROUND

This memorandum presents the results of Task 2—screen bottleneck locations and select locations for analysis—of the work program for Low-Cost Improvements to Express-Highway Bottleneck Locations: federal fiscal year (FFY) 2017.[1] In Task 2, MPO staff indicated that we will present the results to the MPO for discussion.

According to the Federal Highway Administration (FHWA), "Much of recurring congestion is due to physical bottlenecks—potentially correctible points on the highway system where traffic flow is restricted. While many of the nation's bottlenecks can only be addressed through costly major construction projects, there is a significant opportunity for the application of operational and low-cost infrastructure solutions to bring about relief at these chokepoints."[2]

In the past, MPO staff analyzed several express-highway bottleneck locations in three studies, which were very well received by the Massachusetts Department of Transportation (MassDOT) and FHWA.[3,4,5] Previous study locations included

[1] Karl H Quackenbush, CTPS Executive Director, work program to the Boston Region Metropolitan Organization, "Low-Cost Improvements to Express-Highway Bottleneck Locations: FFY 2017," December 15, 2016.

[2] Federal Highway Administration, *Recurring Traffic Bottlenecks: A Primer: Focus on Low-Cost Operations Improvements,* US Department of Transportation, Federal Highway Administration, June 2009, p. 1.

[3] Seth Asante, MPO staff, memorandum to the Transportation Planning and Programing Committee of the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Bottleneck Locations, Phase I," June 2, 2011.

[4] Chen-Yuan Wang, MPO staff, memorandum to the Transportation Planning and Programing Committee of the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Bottleneck Locations, Phase II," dated March 12, 2012.

[5] Seth Asante, Seth Asante, MPO staff, memorandum to the Transportation Planning and Programing Committee of the Boston Region Metropolitan Planning Organization, "Low-Cost Improvements to Express-Highway Bottleneck Locations," December 3, 2015.

sections of I-95 in Burlington, Lexington, and Weston; sections of I-93 in Woburn; and sections of Route 3 in Braintree. Some of the recommendations from those studies have been executed, such as the I-95 northbound and southbound subtract-a-lane at Interchange 24 in Weston; I-95/Route 3/Middlesex Turnpike Interchange in Lexington and Burlington; and FHWA has interviewed MPO staff about these successful implementations.

The cause and duration of highway bottlenecks vary. In general, recurring bottlenecks, the subject of this work program, are influenced by the design or operation present at the point where the bottleneck begins, for example: merges, diverges, lane drops, traffic weaving, abrupt changes in highway alignment, low-clearance structures, lane narrowing, intended disruption of traffic for management purposes, and less-than-optimal express-highway design.

This memorandum presents the process used to select the bottleneck study locations. MPO staff will submit this proposal to the MPO for discussion and approval.

2 SELECTION OF STUDY LOCATIONS

Selection of study locations was a two-stage process that comprised inventorying and screening candidate locations.

2.1 Inventorying Candidate Locations

MPO staff developed an initial list of candidate locations in the MPO region based on the following parameters:

- Consultations with MassDOT Highway Division
- Staff knowledge of bottleneck locations in the Boston MPO region
- Review of congestion management process (CMP) monitoring data, and recent MPO and other planning studies

The inventory process yielded 14 bottleneck locations for screening, which are presented in the following table. Nine of the locations are in the Boston Region MPO area and five are located in the Merrimack Valley Planning Commission (MVPC).

Inventory of Express-Highway Bottleneck Locations for Screening

Location Number	City / Town	MPO Region	MassDOT District	Express-Highway Section	Problem
1	Lexington*	Boston Region	4	I-95 northbound between Exit 29 (Rte 2) and Exit 30 (Rte 2A/ Service Plaza)	Merge/ diverge
2	Woburn/ Reading*	Boston Region	4	I-93 southbound between Commerce Way and I-95	Merge/ diverge
3	Randolph/ Canton*	Boston Region	6	Rte 24 northbound between Exit 20 (Rte 139) and Exit 21 (I-93)	Merge/ diverge
4	Randolph/ Canton*	Boston Region	6	Rte 24 southbound between Exit 20 (Rte 139) and Exit 21 (I-93)	Merge/ diverge
5	Medford	Boston Region	4	I-93 southbound between Rte 16 on-ramp and Exit 31 (Rte 16 off-ramp)	Weave
6	Wilmington	Boston Region	4	I-93 northbound between Exit 40 (Rte 62) and Exit 41 (Rte 125)	Merge/ diverge
7	Canton / Randolph	Boston Region	6	I-93 northbound between Exit 1 (I-95) and Exit 4 (Rte 24)	Merge/ diverge/ weave
8	Canton / Randolph	Boston Region	6	I-93 southbound between Exit 1 (I-95) and Exit 4 (Rte 24)	Merge/ diverge/ weave
9	Reading	Boston Region	4	I-95 northbound between Exit 37 (I-93) and Exit 38 (Rte 28)	Weave
10	Andover/ Lawrence	MVPC	4	I-495 northbound between Exit 41 (Rte 28) and Exit 42 (Route 114)	Merge/ diverge
11	North Andover/ Lawrence	MVPC	4	I-495 northbound between Exit 42 (Rte 114) and Exit 43 (Massachusetts Avenue)	Merge/ diverge
12	North Andover/ Lawrence	MVPC	4	I-495 southbound between Exit 42 (Rte 114) and Exit 43 (Massachusetts Ave)	Merge/ diverge
13	Methuen	MVPC	4	I-495 northbound Exit 47 (Rte 213)	Acceleration/ deceleration lane lengths
14	Methuen	MVPC	4	I-495 southbound Exit 47 (Rte 213)	Acceleration/ deceleration lane lengths

Source: Central Transportation Planning Staff.
MVPC = Merrimack Valley Planning Commission
Note: Asterisks and bolding denote locations selected for analysis.

2.2 Screening Candidate Locations

MPO staff selected four bottleneck locations for analysis in FFY 2017 (the first four locations cited in the table above). After consulting with the MassDOT Highway Division, staff determined that these four locations likely could be corrected with low-cost mitigation strategies. The other bottlenecks in the Boston Region MPO area also could be corrected in a low-cost manner, but were not selected because of funding resources—these locations would be considered in future bottleneck studies. However, location 9 in the table above likely could not be correctible in a low-cost manner.

MPO staff used the following criteria to screen the bottleneck locations:

- Does the location qualify as a bottleneck? A long traffic queue upstream trailing free-flowing traffic downstream usually characterizes the location as a bottleneck. In addition, the upstream congestion must be recurring—in other words, the location experiences routine and predictable congestion because traffic volume exceeds the available capacity at that location.
- Is a physical design constraint or operational conflict that is inherent in the location the cause of the bottleneck? Examples of these are:
    - Lane drop—one or more travel lanes are lost, requiring traffic to merge
    - Weaving area—drivers must merge across one or more lanes in order to access an entry or exit ramp
    - Merge area—on-ramp traffic merges with mainline traffic in order to enter the freeway
    - Major interchanges—high-volume traffic is directed from one freeway to another
    - Horizontal curves—abrupt changes in highway alignment force drivers to slow down because of safety concerns
- Can the bottleneck be fixed with low-cost operational and geometric improvements? These would exclude costly long-term solutions such as expansion and major transit investments that alter drivers' mode choice. Examples of low-cost operational and geometric improvements are:
    - Using a short section of shoulder as an additional travel lane, an auxiliary lane, or for lengthening an acceleration or deceleration lane
    - Restriping merge and diverge areas to better serve traffic demand
    - Providing better traveler information to allow drivers to respond to temporary changes in lane assignment, such as using a shoulder as an additional travel lane during peak periods
    - Providing all-purpose reversible lanes
    - Changing or adding signs and striping

Based on the screening criteria and consultations with MassDOT Highway Division officials, MPO staff selected locations 1, 2, 3 and 4 for study. Below is staff's rationale for not selecting locations 9 through 14:

Location 9: I-95 Northbound between Exit 37 (I-93) and Exit 38 (Route 28) in Reading

This section of highway frequently is congested because of a lane drop, intensive weaving, and merging and diverging activities, especially during the PM peak period, which slows down mainline traffic. During that time, The I-95 northbound

mainline carries about 6,000 vehicles per hour, the Exit 37 off-ramps carry about 3,000 vehicles per hour, and the Exit 37 on-ramps carry about 2,600 vehicles per hour. Adding an auxiliary lane northbound on I-95 would provide more room for the merging and diverging activities and reduce disturbance to mainline traffic. Staff did not select this location because the weave problem at Exit 37 could not be corrected in low-cost manner and an auxiliary lane would need to be extended for a long distance (about three-to-four interchanges downstream) to reduce congestion and queue, which could be expensive.

Locations 10, 11, 12, 13, and 14

These bottleneck locations are in the MVPC area; they were not screened or considered in the selection process because they are not in the Boston Region MPO area.

3 SELECTED BOTTLENECK LOCATIONS FOR STUDY

Location 1: I-95 Northbound between Exit 29 (Route 2) and Exit 30 (Route 2A/Service Plaza) in Lexington

This section of highway, about 0.75 miles long, frequently is congested because of merging and diverging activities, especially during the PM peak period. The northbound on- and off-ramps connect to and from Route 2 (Concord Turnpike), Route 2A (Merrett Road), and the service plaza. During peak periods, I-95 northbound carries about 6,100 vehicles per hour; the on-ramp from Route 2 westbound carries about 1,000 vehicles per hour; and about 600 vehicles per hour exit to Route 2A at Exit 30 and the service plaza. The merging and diverging activities of these vehicles slow down I-95 northbound mainline traffic upstream of the Route 2A interchange, which makes it difficult to enter I-95 northbound for the Route 2 traffic.

Location 2: I-93 Southbound between Commerce Way and I-95 in Woburn and Reading

This bottleneck is located on I-93 southbound in the section where traffic diverges onto I-95 southbound. During the AM peak period, traffic going to I-95 southbound backs up that ramp onto I-93 mainline traffic, thus impacting flow on the rightmost low-speed southbound lane. As a result, motorists attempt to get into the breakdown lane as soon as possible to stay clear of the low-speed lane, but usually vehicles are still queuing on the low-speed lane. The other three southbound lanes are almost in free flow conditions (that is, uncongested conditions with drivers traveling at posted speeds) during this period. In the segment, the four I-93 southbound lanes carry between 6,500 and 7,000 vehicles per hour of which about 2,000 vehicles exit to I-95 southbound.

Location 3: Route 24 Northbound between Exit 20 (Route 139) and Exit 21 (I-93) in Randolph, Canton, and Stoughton

This bottleneck is located on Route 24 northbound at the point where traffic diverges onto I-93 northbound and southbound during AM peak periods. The impact of the bottleneck extends from I-93 in Randolph to Route 139 in Stoughton, about two miles long. During this period, Route 24 northbound carries about 6,000 vehicles per hour, of which 2,500 vehicles exit to I-93 southbound and 3,500 to I-93 northbound. The merging activity of these vehicles on I-93 slows down traffic on the Route 24 connector ramps and backs up traffic on Route 24.

Location 4: Route 24 Southbound between Exit 20 (Route 139) and Exit 21 (I-93) in Randolph, Canton, and Stoughton

This bottleneck is located on Route 24 southbound at the point where traffic from the I-93 connector ramps merge onto Route 24 southbound during PM peak periods. The merging activity of these vehicles creates a bottleneck that causes a traffic queue to extend from the Canton Street Bridge under Route 24 onto the I-93 northbound and southbound lanes, creating a bottleneck about a mile long. During this period, Route 24 southbound carries about 6,000 vehicles per hour of which about 3,000 vehicles enter from I-93 southbound and another 3,000 from I-93 northbound.

4 SUMMARY

By identifying and evaluating a comprehensive list of potential improvements at the four locations, MPO staff will rely on their technical expertise and judgment regarding the nature of bottlenecks. MPO staff will seek input from MassDOT Highway Division staff that are familiar with the region’s express-highway system operations.

This study addresses the MPO’s goal of reducing congestion and increasing safety on the region’s express-highway system. MPO staff will submit this proposal to the MPO for discussion and approval. If the MPO approves these locations for study, staff will meet with officials from MassDOT to discuss specifics, conduct field visits, collect data, and perform various analyses.

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