# Baltimore Regional Congestion Management Process: Development of a Process to Analyze Areas of Congestion and Associated Mobility Issues

## 1. Introduction and Purpose

The congestion management process (CMP) intends to explore congestion and mobility issues (e.g., delay, reliability) across the transportation system network to identify locations with problems and the source of those problems. In order to prioritize areas with the greatest needs, it is important to develop a process that assists in identifying locations with poor performance based on the identified CMP performance metrics.

This document identifies a process for analyzing areas of congestion. Recognizing that the CMP is intended to address multimodal performance issues, this process also includes analyses related to other mobility issues, such as transit performance. This document discusses the process in terms of two contexts:

1) Ranking congestion problems for purposes of communications with the public, elected officials, and other decision-makers; and
2) Analyzing congestion and mobility issues to support state, regional, and local-level staff in understanding key problems and identifying needs that will lead to regional or local priorities or additional studies (e.g., corridor planning studies, transportation systems management and operations plans).

In both cases, recommendations were developed building on data and tools that BMC has available in order to reduce burden on BMC staff time and to leverage the capabilities of existing resources, such as use of the Probe Data Analytics (PDA) Suite, which BMC has access to via the I-95 Corridor Coalition.

To support recommendations both on ranking and analyzing congestion and mobility issues, the ICF team performed a scan of the CMP analysis and ranking methodologies employed by other MPOs, including the Delaware Valley Regional Planning Commission (DVRPC), New York Metropolitan Council (NYMTC), and Metropolitan Washington Council of Governments (MWCOG), among others. These summaries are presented in an Appendix. The ICF team also took into consideration the methods identified for consideration in the Federal Highway Administration’s CMP Guidebook.

## 2. Ranking Congestion Problems

The Baltimore Metropolitan Council (BMC) currently develops a Quarterly Congestion Analysis Report, which includes a Bottleneck Ranking identifying the top ten bottlenecks in the region. This report is designed primarily for use by the public, media, and elected officials to communicate in a relatively simple way the congestion issues in the region.

## 2.1 Current Bottleneck Ranking Methods – Quarterly Congestion Analysis Report

The Quarterly Congestion Analysis Report identifies the Top 10 Congested Bottlenecks in the Baltimore Metropolitan area using the PDA Suite. Congestion analysis is performed at the road segment level. A segment is considered 'congested' if its current reported speed falls below 60% of the reference speed for at least a period of 5 minutes.

INRIX provides reference speed values for each segment, which represent the 85th percentile observed speed for all time periods, with a maximum value of 65 mph. Adjacent road segments meeting this condition are joined together to form the bottleneck queue. When reported speeds on every segment associated with a bottleneck queue have returned to values greater than 60 percent of their reference values and have remained that way for 10 minutes, the bottleneck is considered cleared. The process ignores bottlenecks whose total queue length, determined by adding the length of each road segment associated with the bottleneck, is less than 0.3 miles.

The PDA Suite calculates a Base Impact for each bottleneck, which is measured as the aggregation of queue length over time for congestion at each location in mile minutes. The Base Impact is calculated using two physical measures of the queue – the queue length and the queue duration. The current bottleneck ranking is conducted based on this Base Impact.

## 2.2 Recommended Rankings

### *Ranking Based on Total Delay*

As noted above, the Quarterly Congestion Analysis Report identifies the top 10 congested bottlenecks based on their Base Impact value calculated using INRIX data. While this approach accounts for the length and duration of the queue, it does not include a measure of the volume of users impacted by the queue.  Accounting for the volume of vehicles affected would add value in identifying needs by reflecting the total amount of time people are spending in delay due to the bottleneck. For instance, two roadways could have the same queue length and duration but if one has a significantly larger volume of traffic (for instance, four-lanes in each direction compared to two-lanes in each direction), there will be a larger amount of delay.

To account for the volume of vehicles and people affected, it is recommended that rankings be conducted based on the estimated Total Delay. Data on Total Delay is directly available in the PDA Suite, and is calculated for each bottleneck as follows:

Total Delay = Base Impact X Delay X AADT X Day of the week factor

where,

- Base Impact = Length in miles for the duration of bottleneck
- Delay = Observed Travel time minus Free Flow Travel time
- AADT = Annual Average Daily Traffic

This is a simple modification to the existing methodology that requires minimal additional effort in the PDA Suite but helps rank bottlenecks not simply by their physical attribute but also by their total impacts on the users. (Note: In an ideal situation, the corridors would be ranked based on person-hours of delay, but that information is not directly available from the PDA Suite.)

### *Separate Rankings for Freeways and Non-Freeway Roadways*

Rather than just having one ranking of the top ten bottlenecks, separate ranking analyses for freeways (e.g., Interstates and non-Interstate limited access roadways, including parkways) and non-freeway roadways (e.g., generally arterials, including U.S. routes and state highway routes with signalized intersections) are recommended.

Interstates and freeways tend to have higher queue lengths, congested durations and volumes of vehicles, as compared to arterials. Since the ranking of road segments by 'Total Delay' uses these three criteria, the interstates and freeways are almost always ranked higher for congestion. Even using the current Base Impact methodology, nine of the top ten congested bottlenecks as per the Congestion Analysis Report (Quarter 4, 2019) were on Interstates, with the remaining one on the Baltimore-Washington (B-W) Parkway.

The traffic patterns and causes of congestion on non-freeway segments are different from freeway segments, as well as the potential solutions. The bottlenecks on freeways are often caused due to high volumes and/or incidents, while bottlenecks on non-freeways often are due to various factors, including intersection queues, traffic signals, and density of roadway network. Moreover, the solutions will differ for freeways and non-freeway roadways, where traffic signal improvements, transit and bicycle/pedestrian infrastructure, and other strategies could be applied. Therefore, separate ranking analyses for freeways and non-freeways is recommended. The ranking of non-freeways is proposed to be done using the same 'Total Delay' method. The division is recommended to be made at the freeway/non-freeway level and not at the Interstate/non-Interstate level because there are non-Interstate roadways such as U.S. 50 in Anne Arundel County and the B-W Parkway, which have traffic patterns and driving behavior generally similar to Interstates.

A sample of rankings for both freeways and non-freeway for the fourth quarter of 2019 is shown in Figures 1 and 2 below.

**Figure 1. Top 10 Freeway Bottlenecks in the Baltimore Region, 4th Quarter 2019**

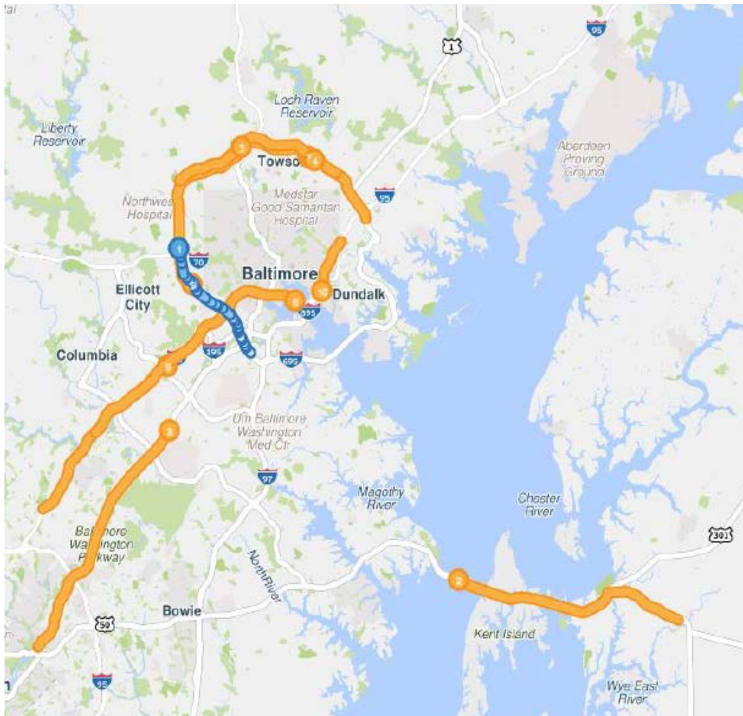
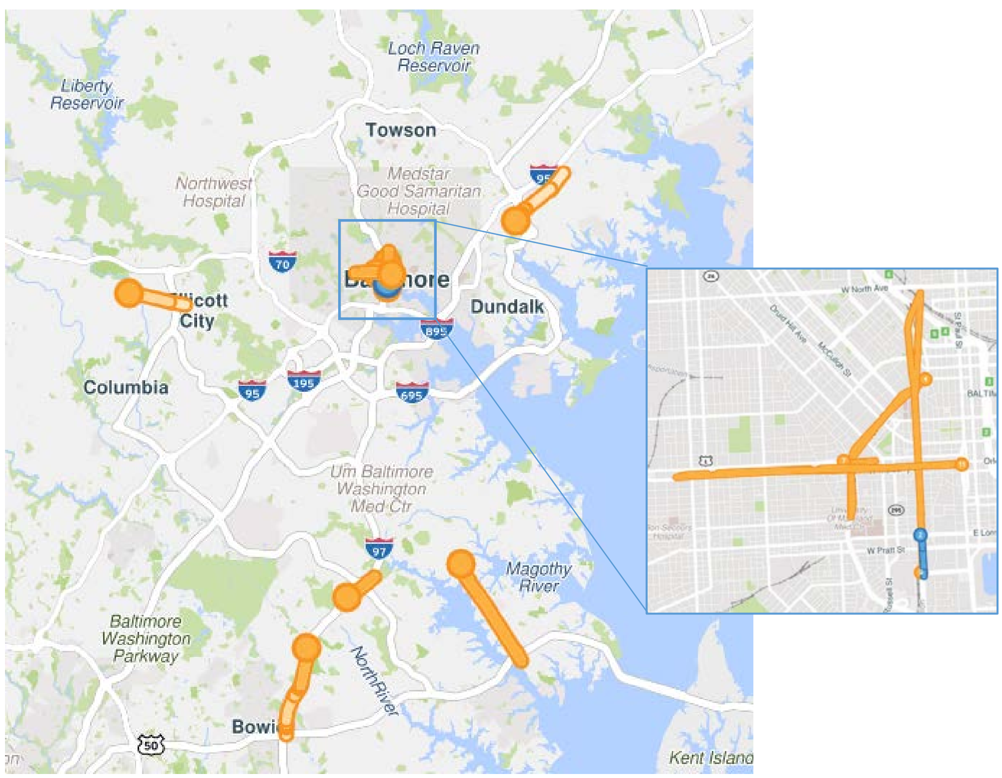



**Figure 2. Top 10 Non-Freeway Bottlenecks in the Baltimore Region, 4th Quarter 2019**



# 3. Methods to Support Analysis of Congestion and Mobility Needs

In addition to the public-facing bottleneck rankings, BMC has recently developed the [BMC CMP Tool] using ArcGIS online, which maps bottlenecks, as well as several other performance metrics. This tool can serve as a strong analytical tool for supporting the analysis of congestion and mobility issues by transportation agency staff in order to identify regional and local priorities. It may also be used by interested parties, including land use planners, community groups, and the public to better understand congestion and mobility issues and engage in the transportation decision-making process (and to consider policies related to land use, parking, incentives, travel demand management, etc.).

BMC's CMP is intended to be more than just presenting data on congestion. It should identify congestion and mobility needs and the causes of congestion in order to support identification of solutions. It is recommended that this analysis build on the BMC CMP Tool as a basis with the intent to provide updated information on congestion/mobility issues on an annual (or biennial) basis to support identification of priorities by local governments and partners.

At a high-level, this analysis process would involve the following three key components:

1. Integrate all the proposed CMP performance metrics into the BMC CMP Tool, updated on an annual basis.
2. Identify a set of **priority congested roadway corridors** using the analysis of bottlenecks (both freeway and non-freeway). Conduct additional analyses using selected performance metrics to characterize the congestion issues (specifically, assessing the intensity, duration, and overall extent of congestion, as well as reliability and safety), and conditions regarding travel options to support identification of solutions.
3. Identify a set of **priority multimodal needs** (roadway reliability, transit, pedestrian/bicycle, and park-and-ride) based on analyses of deficiencies (e.g., exceeding a defined threshold) or gaps in performance for these options.

These components are described below.

## 3.1. Integrate CMP Performance Metrics into the CMP Tool

As a first step, each of the 17 performance metrics recommended for the CMP should be integrated into the BMC CMP Tool or provided via other sources as a basis for analysis and communications among partners. These metrics are mapped in different ways:

- By geography (e.g., Census block):
  - Number of jobs accessible within a 30-minute drive
  - Number of jobs accessible within a 45-minute transit trip
  - Non-SOV mode share*
- By roadway segment (freeways and major arterials):
  - Travel time index*
  - Duration of congested conditions*

    - Person hours of peak hour excessive delay*
    - Average bus speed
    - Anticipated growth in V/C ratio in peak period
    - Level of travel time reliability*
    - Truck travel time reliability index (Interstates)*
- By transit route (bus, light rail, subway, commuter rail):
    - On-time performance*
    - Frequency (plus potentially geographic area around transit stops at different frequency levels)
- By roadway/path segment (arterials, local, and off-road paths)
    - Bicycle network extent
    - Bicycle level of traffic stress (LTS)
- By point:
    - Park and ride lot utilization*
    - Roadway crashes (number could be aggregated by road segment)
    - Pedestrian/bicycle crashes (number could be aggregated by road segment)

Those with an asterisk (*) can be most readily updated on an annual basis and are recommended to be brought directly into BMC's CMP Tool. Others could be brought into the tool or alternatively could be shared through special analyses that are conducted on a periodic basis (such as every 3-4 years). For instance, the number of jobs accessible within a 30 minute drive trip, number of jobs accessible within a 45-minute transit trips, and anticipated growth in V/C ratio in the peak period rely upon use of the region's travel demand model, and these analyses could be updated with each update to the region's long range transportation plan. Information on other metrics, such as average bus speed, transit route frequency, bicycle network extent, and bicycle level of traffic stress, can be collected through coordination with other agencies, such as the Maryland Department of Transportation. BMC could work with the agencies to compile the information periodically and share in a format that would help support regional discussions for the CMP.

While these data are extensive, there is value in having the ability to display all the metrics in order to analyze potential causes and solutions and to provide a strong platform for on-going regional cooperation.

## 3.2 Identify Priority Congested Roadway Corridors

It is recommended that BMC identify a set of priority congested roadway corridors, building on the analysis of bottlenecks conducted for the quarterly Congestion Analysis Report. This process will involve the following steps:

## Step 1: Identify Top Freeway and Non-Freeway Bottlenecks

First, building on the approach used for the quarterly analysis, BMC would identify the top freeway and non-freeway bottlenecks for the year. Two different approaches could be used for this analysis:

1) Rank the top 15 bottlenecks in each category (freeways and non-freeways) using an annual analysis of the data from the PDA Suite, similar to the approach used for the quarterly reports: This approach has the benefit of simplicity, since the PDA Suite allows a simple ranking of the top corridors.

2) Aggregate the information on the top 10 bottlenecks in each category (freeways and non-freeways) directly from each of the four quarterly reports in order to identify a top set of priority corridors for the year: This approach has the benefit of identifying some corridors that may only show up as a bottleneck during part of the year due to seasonal traffic or other conditions but might not rise to the top 15 using annual data. The disadvantage is that a larger number of corridors will be identified and additional work will be needed to overlay the bottlenecks and consolidate those that are essentially the same bottleneck but differ by length during different seasons. For instance, using data for 2019, the northbound B-W Parkway shows up a bottleneck in both the 3rd and 4th quarters, as does the approach to the Bay Bridge from the Eastern Shore, but the length of the Eastern shore queue varied. Some other bottlenecks, such as the western approach to the Bay Bridge showed up in the 3rd Quarter but not in other quarters, as shown below.

**Figure 3. Top 10 Bottlenecks in the Baltimore Region, 3rd Quarter 2019**

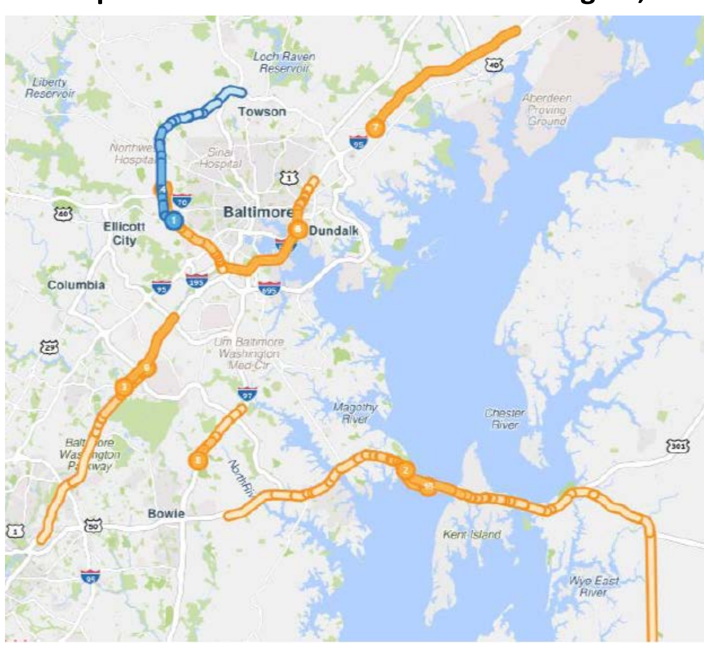
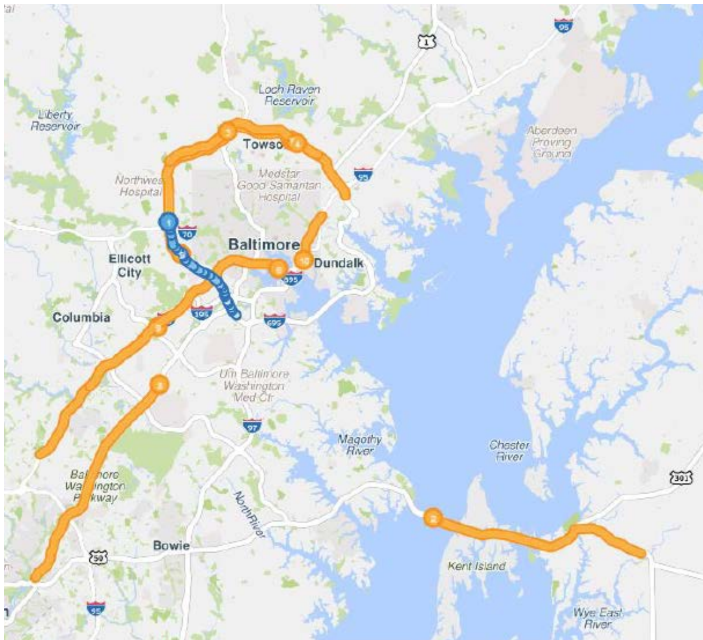


**Figure 4. Top 10 Bottlenecks in the Baltimore Region, 4th Quarter 2019**




By including the top ten freeway bottlenecks in any of the quarters, the resulting list of priority congested freeway corridors will likely include more than 15 corridors in total for focus. ***We recommend using the simpler approach of ranking the top 15 bottlenecks in each category (freeways and non-freeways) using an annual analysis of the data from the PDA Suite***. Additional analysis of each of these bottlenecks (described below under Steps 2, 3, and 4) will help to describe the congestion issues for each bottleneck, including seasonal patterns.

## Step 2: Conduct Additional Analyses to Characterize the Congestion Issues

Next, once the list of priority congested freeway and non-freeway corridors is identified, additional analysis is recommended to be conducted to characterize the congestion issues. This analysis would build directly on the work conducted to describe congestion issues in the Quarterly Congestion Analysis Reports, and may address:

- Whether the bottleneck appeared seasonally or across all quarters of the year;
- Primary times of day of congestion; and
- Ranking of the bottleneck in terms of Base Impact weighted by "Speed Differential" or "Congestion" measures in the PDA Suite. Both measures account for the length and duration of the queue and the speed of traffic on the roadway, but not volumes of traffic. As a result, they reflect the conditions experienced by the individual driver.

If resources allow for BMC staff to conduct additional analysis, staff could also use the following selected performance metrics to further characterize the congestion issues:

For freeways:

- Travel time index (measure of peak period congestion intensity)*

- Duration of congested conditions
- Person hours of peak hour excessive delay
- Anticipated growth in V/C ratio in peak period*
- Level of travel time reliability (weekdays and weekends)*
- Roadway crashes (number could be aggregated by road segment)

For non-freeways:

- Travel time index (measure of peak period congestion intensity)*
- Duration of congested conditions
- Person hours of peak hour excessive delay
- Anticipated growth in V/C ratio in peak period*
- Level of travel time reliability (weekdays and weekends)*
- Roadway/pedestrian/bicycle crashes (number could be aggregated by road segment)

Those with an asterisk (*) would be the primary measures. Duration of congestion and person hours of peak hour excessive delay are already largely accounted for in the identification of the bottleneck. The primary measures focus on congestion intensity, travel time reliability, and anticipated growth in congestion. The remaining measures may be analyzed depending upon the availability of resources.

Using the BMC CMP Analysis Tool, maps of each of these metrics can be analyzed and developed for each of the priority corridors to help in understanding issues related to congestion.

## Step 3: Identify Travel Options

It is recommended that for each of the priority corridors, in addition to characterizing traffic congestion issues, an overlay of travel options be provided. This information can then provide a more comprehensive picture of whether options are available as alternatives to driving and how those options are performing.

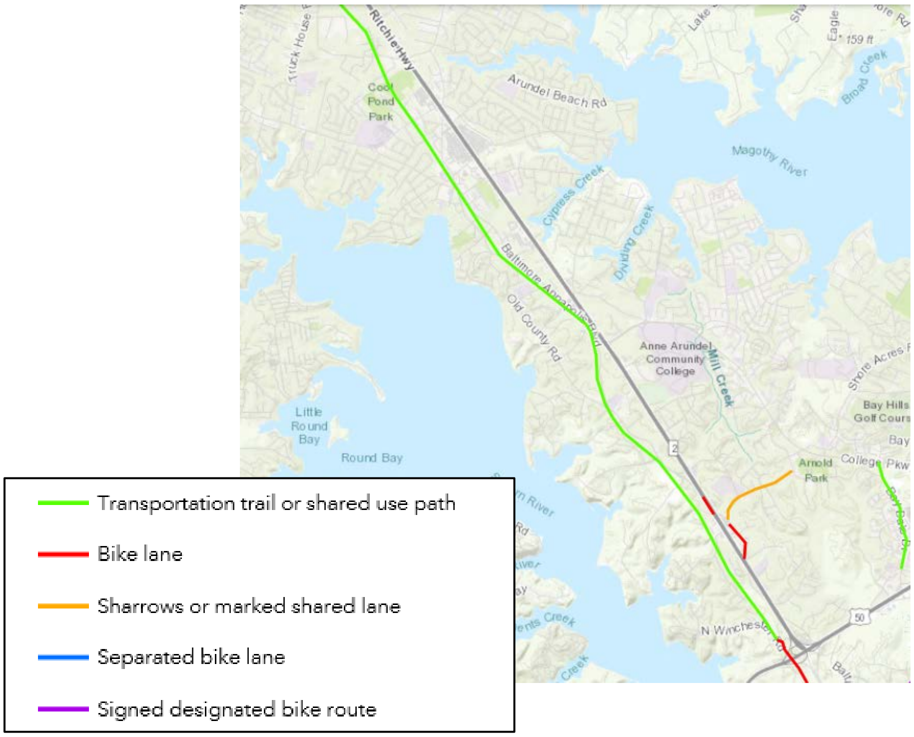
These travel options would include information on:

- Transit routes and frequencies*
- Bus speeds (for non-freeway segments)
- Bicycle network extent*
- Bicycle level of traffic stress (LTS)
- Park and ride lot utilization*

Note: Those with asterisk are recommended as the primary measures. The computation of the remaining measures is more labor-intensive and may be performed depending upon the availability of resources.

An partial example is shown in the figure below for one of the non-freeway bottlenecks, MD-2, Ritchie Highway, in Anne Arundel County. This figure shows bicycle facilities along the corridor. Additional information on transit routes and frequencies, as well as park and ride lot utilization, is also recommended at a minimum to be shown.

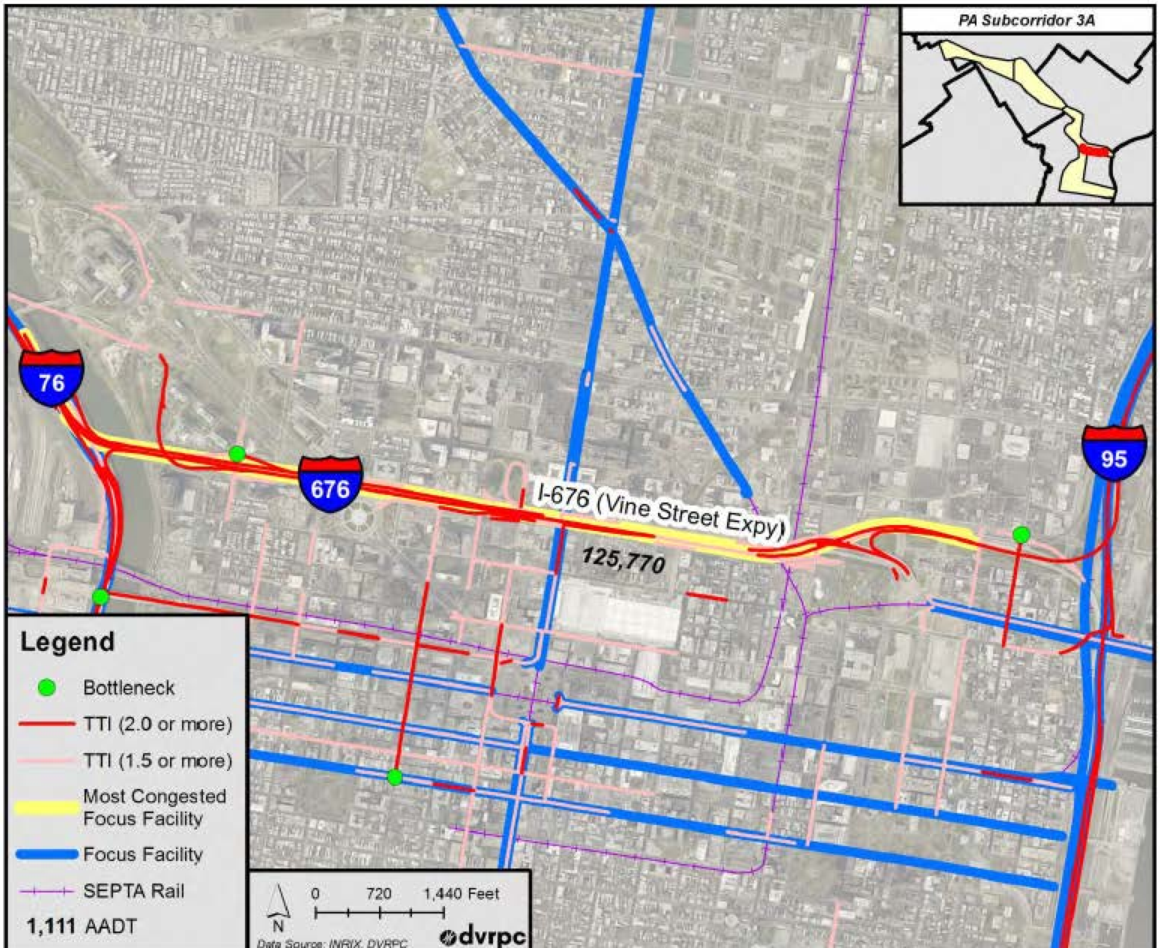
**Figure 5. Bicycle Facilities along the MD-2 Corridor, Anne Arundel County**




## Step 4: Prepare Priority Congested Roadway Corridor Profiles

Building on the information gathered and analyzed under Steps 2 and 3, it is recommended that a brief one-pager profile be developed for each of the priority congested roadway corridors, displaying key information on traffic congestion and available options. BMC already implements a simple version of such profiles as part of its Quarterly Congestion Analysis Reports. These profiles can be enriched by adding information about the additional measures described under Steps 2 and 3. The template for this profile may be decided considering the level of effort required and the available resources. The image below illustrates an example of a profile template from the Delaware Valley Regional Planning Commission, which shows the congested facility, along with key statistics on congestion measures, as well as additional factors. The profile could also attempt to identify some explanation for the key causes of congestion, based on the analysis combined with local information (e.g., a high number of traffic crashes, high volumes of vehicles accessing a major activity center, interstate traffic, etc.).

**Figure 6. Example of Potential Priority Congestion Roadway Corridor Profile (from DVRPC)**




**Summary of Conditions**

I-676 (Vine Street Expy) from I-76 to I-95 in the City of Philadelphia is ranked **#3** and **#1** in peak travel time vehicle and volume delay, respectively, and **#7** and **#1** in peak planning time vehicle and volume delay, respectively. The limited access interstate contains three travel lanes in each direction.

| Congestion Measures | |
|---|---|
| TT PM Peak Vehicle Delay (sec): | 162.29 |
| PT PM Peak Vehicle Delay (sec): | 349.47 |
| Facility Miles: | 4.11 |
| TT PM Peak Volume Delay (hr): | 256:33:05 |
| PT PM Peak Volume Delay (hr): | 547:50:18 |
| High Level of Travel Time Reliability: | Yes |
| High Truck Travel Time Reliability: | Yes |
| High Peak Hour Excessive Delay: | Yes |
| TDM Forecasted Congestion (miles): | 0.33 |

**Planned Improvements on 2045 LRP & FY 2019-22 TIP**

* 2045 LRP: MRP X - South Jersey BRT; #192 - Vine St Expy Cap; #193 - 30th St Station
* FY 2019-22 TIP: MPMS #91490 - Signal/ITS improvements

**Very Appropriate Strategies**

1) Intelligent Transportation Systems (ITS)
2) Integrated Corridor Management (ICM)
3) Incident Management
4) Signal Improvements
5) Transit Infrastructure Improvements
6) Expanded Parking for Existing Transit Stations (including remote, all modes)

| Additional Factors | |
|---|---|
| National Highway System: | Yes |
| DVRPC High Crash Frequency: | Yes |
| DVRPC High Crash Severity: | Yes |
| Transit Route: | Yes |
| Park and Ride: | No |
| Bottleneck Intersections, Segments: | 0,14 |
| Traffic Signals: | N/A |
| AADT: | 125,770 |

Source: DVRPC.

## 3.2 Identify Priority Multimodal Needs

In addition to the analysis focused on bottlenecks, the CMP provides an opportunity to identify mobility needs that go beyond more traditional measures of traffic congestion. Specifically, the CMP is recommended to explore issues that relate to roadway reliability, the performance of transit (speeds and on-time performance), the viability of bicycle and pedestrian options, availability of park and ride facilities, and freight performance. For each of these issues, the following approach is recommended:

### Step 1. Map the Performance Metrics Across the Region

Drawing on the BMC CMP Analysis Tool, first develop maps that display the following performance metrics across the region:

- Level of travel time reliability (LOTTR)
- Bus speeds
- Transit on-time performance
- Bicycle level of traffic stress
- Park and ride lot utilization

### Step 2. Identify Deficiencies or Gaps in Performance

Based on the mapping, identify appropriate thresholds for each of the metrics that qualify as a "problem area." In general, the following figures could be used as thresholds to flag a problem area, although it will be important to look at the data in order to understand whether these figures should be adjusted:

- LOTTR: Over 1.5 (to signify high level of unreliability)
- Bus speeds: Under 10 miles per hour (to indicate particularly low speeds; threshold may need to be adjusted for different types of routes and locations)
- Transit on-time performance: Measured in relation to MDOT MTA on-time performance goals: Core Bus - 80%; Light Rail - 95%; Metro Subway - 95%; MARC Train - 93%
- Bicycle level of traffic stress: Qualitative - Identify areas with gaps in low traffic stress routes (LTS3 or under) near transit centers and activity centers
- Park and ride lot utilization: Over 85% (potentially signifying at capacity), under 15% (potentially signifying underutilized facility)

The facilities and routes that are flagged as having potential needs can then be identified as potential areas for further study for potential treatments to address these issues.

An example is provided below, and descriptions of each of these performance areas.

#### *Road Segments with Poor Travel Time Reliability*

Improving travel time reliability (consistency and predictability of travel time) is one of the key objectives of BMC's congestion management process. An important step to address reliability issues is identifying the roadways with poor travel time reliability (these may be existing identified priority congested roadway corridors, but in some cases may not). The proposed methodology maps the roadway segments based on the LOTTR performance metric. Since the LOTTR data is available at TMC level (Traffic Message Channel), which are short length road segments, mapping is a more efficient method as compared to ranking.

For purposes of federal performance measures, LOTTR is calculated for four different time periods – AM peak, midday, PM peak and weekend. For purposes of this analysis, it is recommended that the highest LOTTR for the AM peak and PM peak be mapped together, and separately the weekend value – reflecting the recognition that it would be valuable to identify roads with high levels of weekend unreliability. Moreover, different travel patterns for weekdays and weekends would be valuable to note, given different types of travelers and potential congestion management solutions. Similarly, the causes of unreliability on highways may be different from the causes of unreliability on arterials. To account for these differences, separate mapping for each different facility type/ weekday and weekend is proposed. Figures 7 to 10 provide samples of reliability maps produced using the LOTTR values for each roadway segment using INRIX data for the year 2019, made available by the RITIS PDA/NPMRDS Suite. Note that these maps are broken out by Interstate and Non-Interstate (although U.S. 50 across the Bay Bridge has been mapped to Interstate). For purposes of the CMP, however, it is suggested that these maps be broken down for freeways and non-freeway facilities.

**Figure 7. Weekday LOTTR for Interstates, 2019**

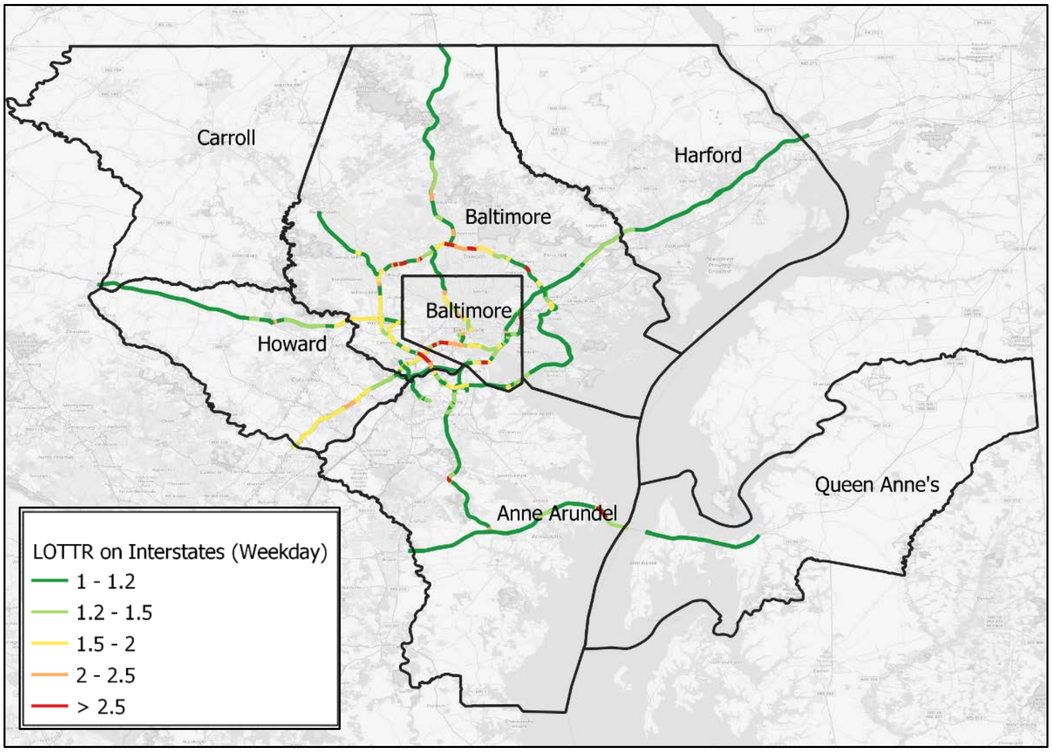



**Figure 8. Weekday LOTTR for Non-Interstates, 2019**

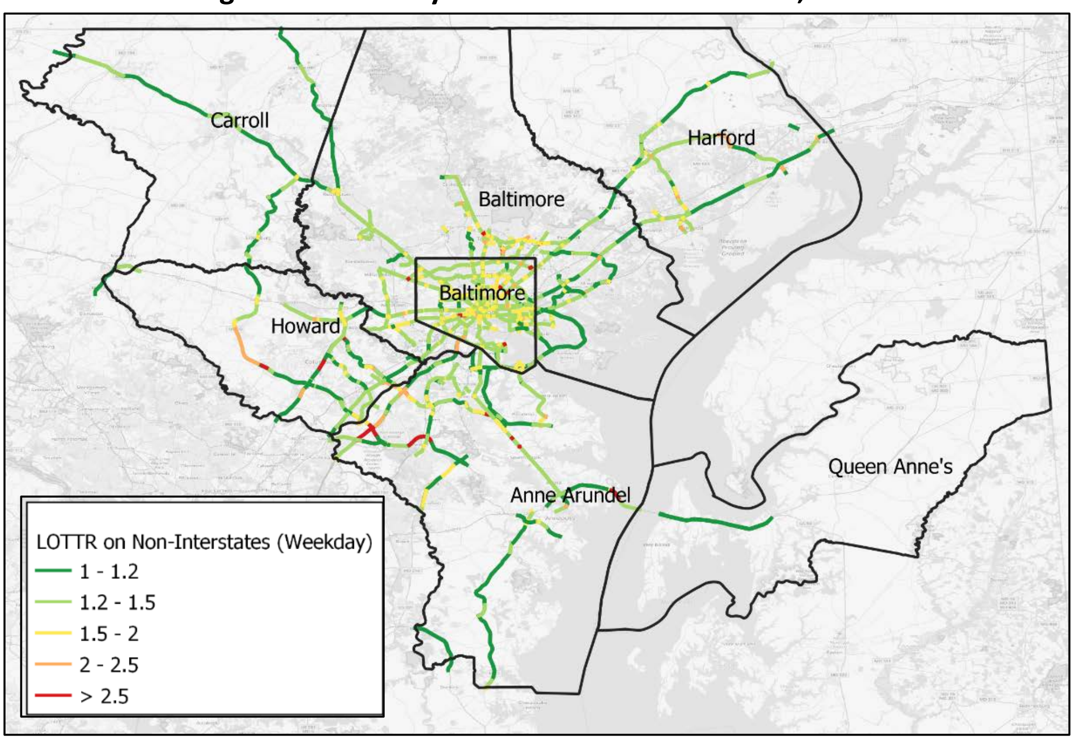


**Figure 9. Weekend LOTTR for Interstates, 2019**

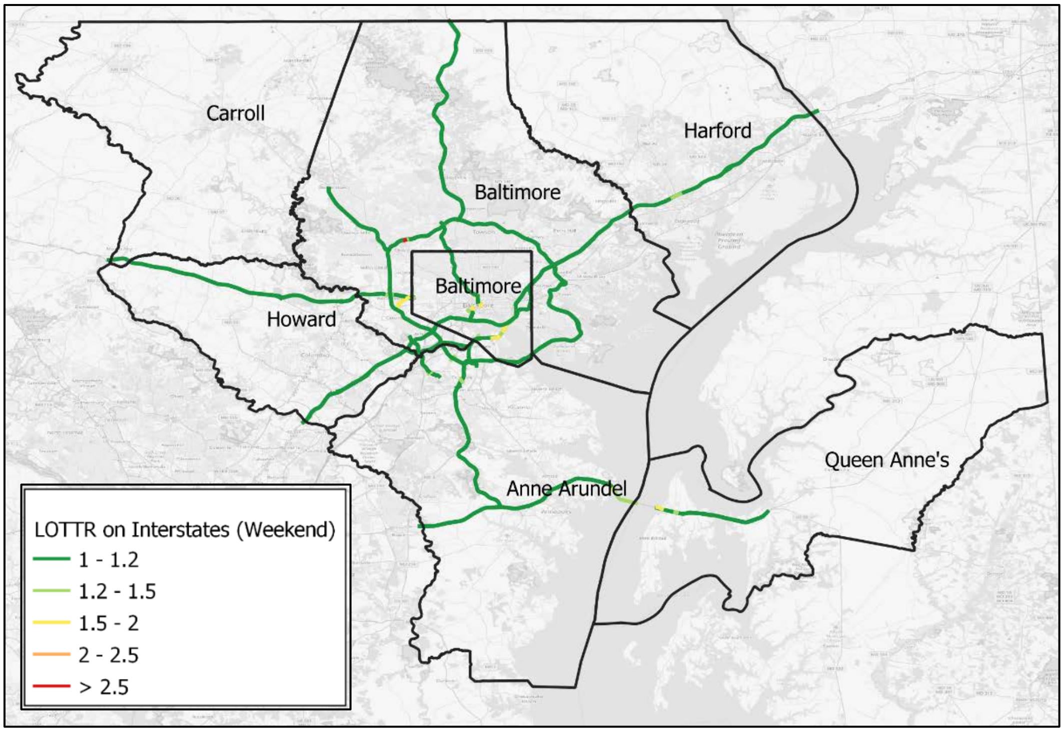
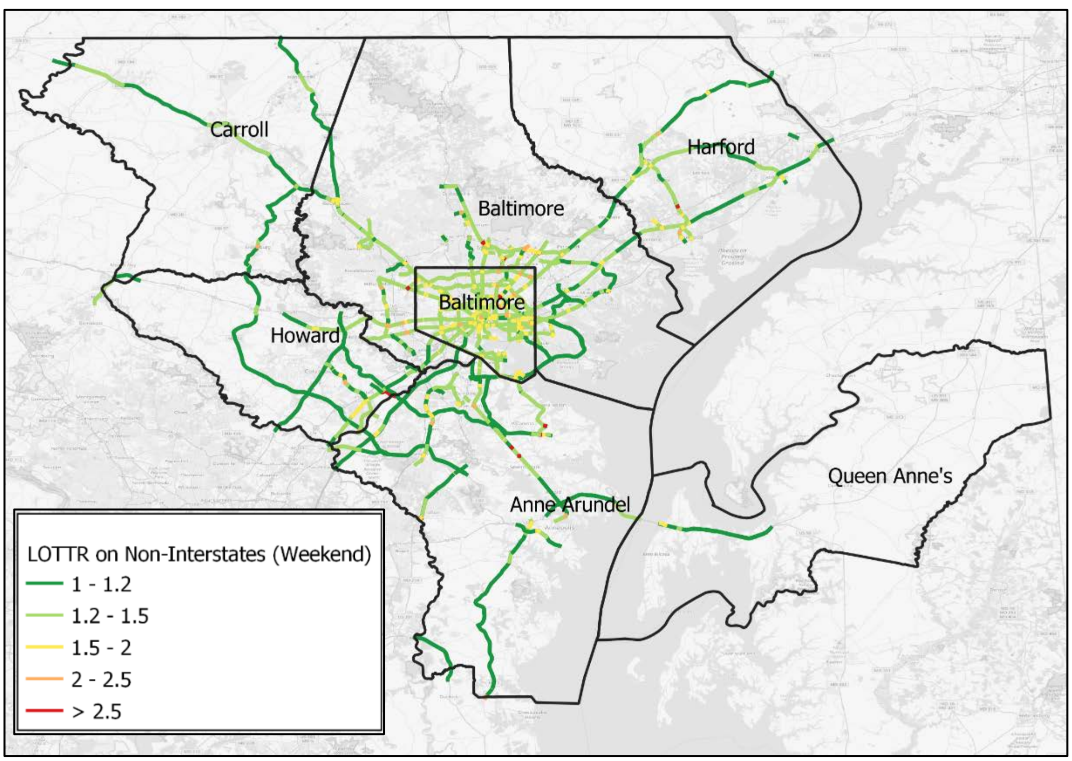



**Figure 10. Weekend LOTTR for Non-Interstates, 2019**




Sources for all maps: RITS NPMRDS

The weekday LOTTR values for interstates generally correspond with bottlenecks that have been identified in the quarterly congestion reports. However, LOTTR provides additional information about the variability in travel speeds (since a roadway could be consistently congested or may have high levels of variability). The LOTTR information generally shows much more reliable travel times on Interstates on weekends than during peak weekday hours but shows fairly high levels of unreliability on urban arterials.

### *Bus Routes with Lowest Bus Speeds*

The analysis for low bus speeds can be performed as a two-step process. The first step is simpler and involves identifying bus routes or segments of routes with low bus speeds (where the speed is lower than the threshold value selected, such as 10 miles per hour). This analysis can help locate corridors that might benefit from investments like dedicated bus lanes, transit signal priority, or operational changes like fewer stops or enforcing no parking zones. This ranking methodology directly supports the CMP objective of enhancing transit as a travel choice. The methodology is fairly simple and directly relies on data on the 'average bus speeds' performance metric values, flagging those under a speed threshold.

A second step of analysis could be conducted, comparing the bus speeds with respect to auto speeds. This is a more labor-intensive analysis and may be performed depending upon the availability of resources. When computing average bus speeds over corridors/segments, care should be taken when both local and express buses use the segment as the speeds over the segments for express and local buses could be vastly different based on the different stopping patterns which could obfuscate the average speeds.

### *Transit Routes with Poor On-Time Performance*

The reliability of transit service is an important factor for transit users. Identifying and solving for low transit reliability can help increase the non-SOV mode-share, and thus, directly support the CMP objective of enhancing transit as a travel choice. This ranking methodology is directly based on the values of the performance metric 'transit on-time performance'.

According to National Transit Database 2019, there are 11 transit agencies operating in the Baltimore region, although MDOT MTA is the only large agency and operates 88% of the transit vehicles operated by all 11 agencies combined. Since MDOT MTA already performs an on-time performance analysis by mode and by route for its Performance Improvement Dashboard, the level-of-additional effort required to identify routes with worst on-time performance is low.

### *Gaps in Viable Bicycling Routes (using Level of Traffic Stress)*

Bicycle level of traffic stress (LTS) provides an indication of how comfortable it is for bicycling, based on factors related to the roadway/path facility and traffic levels. A detailed description of the LTS calculation is provided in the Data Collection and Management Plan. The existence of routes with high LTS figures, however, does not necessarily mean there is a problem for bicyclists. There may be other parallel or connecting routes that allow bicyclists to reach their destinations using low traffic stress routes. Consequently, maps on LTS should be used in a qualitative analysis to identify areas with gaps in connectivity between low traffic stress routes (LTS3 or under), particularly connecting to transit centers and activity centers.

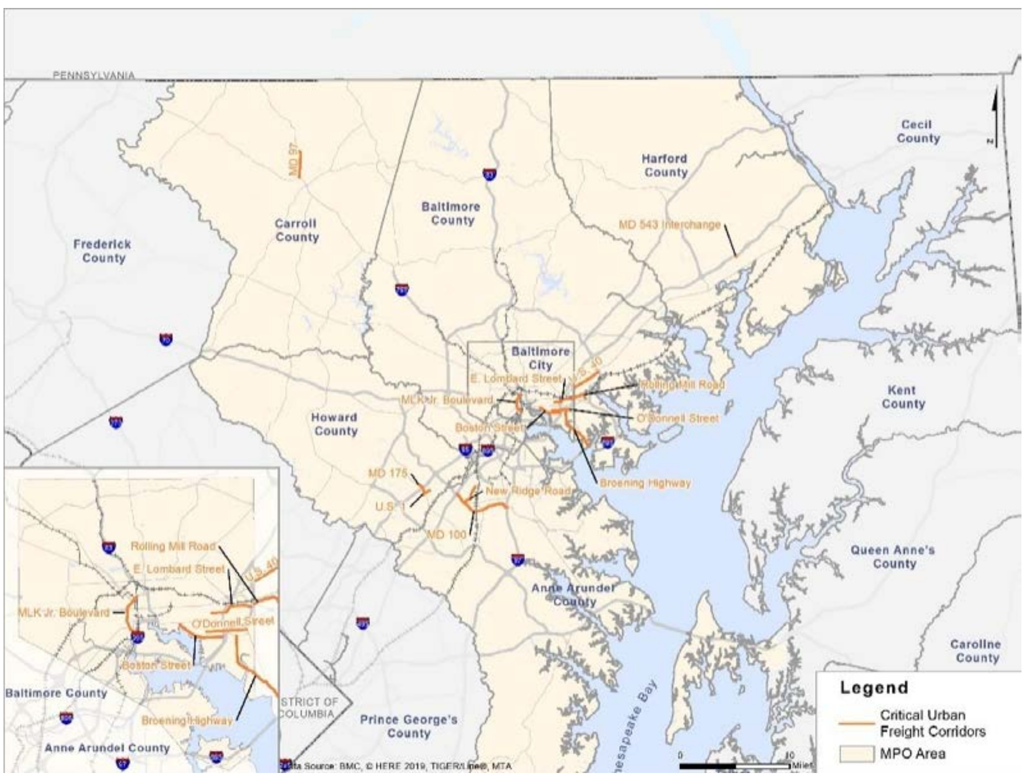
### *Park and Ride Lots with Utilization Concerns*

Finally, park and ride lot utilization data can be used to identify areas of potential need – both from the perspective of highly utilized facilities which may be at or reaching capacity and from the perspective of low utilized facilities which may be underutilized due to poor access, limited or no bus services, or other factors.

## Step 3. Analyze Key Performance Metrics for Freight Corridors (Special Analysis)

Using the interstate highways and designated freight corridors for the Baltimore region, it is recommended to map the TTI and LOTTR for each of these facilities to identify potential congestion and reliability issues for key goods movement routes. This analysis could be conducted on a periodic basis (such as every 3-4 years) as part of a specialized freight study or analysis. Thresholds that might be used for urban freight corridors to flag congestion are a TTI over 1.5 and LOTTR over 1.5.

**Figure 11. BMC Critical Urban Freight Corridors**




Source: BMC

## 4. Using the Information to Inform Decision Making

The information from this analysis will be used to identify and flag key priority roadway corridors in the region for analysis, as well as to identify deficiencies in performance related to roadways, transit, bicycling, and park and ride facilities. This information can be used by an on-going CMP committee that would meet periodically (recommended approximately three times per year) to explore the data and support local jurisdictions in identifying priority needs and solutions. This information also can be particularly valuable to identify both freeway and non-freeway corridors with congestion issues that span jurisdictional boundaries in order to facilitate coordination and collaboration among local governments. In addition to the regional analysis, the data from the PDA suite on bottlenecks could be used to rank top 5 bottlenecks in each local jurisdiction and use the CMP tool to conduct more detailed analysis for individual jurisdictions. In addition to ranking bottlenecks in terms of Total Delay, additional ranking could be conducted using the Base Impact weighted by “Speed Differential” or “Congestion” measures in the PDA Suite, which takes the perspective of the individual driver (rather than accounting for traffic volumes) and might identify bottlenecks on roadways that have a lower overall volume but nonetheless create significant delays for those who use the facilities.

A separate memo on Implementation Recommendations includes more detailed recommendations for integrating this information into processes to enhance data-driven decision-making and collaboration among regional partners.

Prepared by ICF for BMC, with input from the CMP Steering Committee.

# Appendix

## DVRPC CMP 2019

### Ranking of congested roadway facilities:

The peak hour vehicle delay for a facility is the sum of the vehicle delay on each link along the facility, divided by the total facility length. It is measured in seconds.

The peak hour volume delay for a facility is the sum of the total delay faced by all vehicles on each link along the facility, divided by the total facility length. It is measured in hours.

The top 5 congested facilities using each of the following four ranking methods are selected as the 'focus roadway facilities' for detailed CMP analysis.

- Peak vehicle delay (AM or PM, whichever is higher) using travel time index
- Peak vehicle delay (AM or PM, whichever is higher) using planning time index
- Peak hour volume delay (AM or PM, whichever is higher) using travel time index
- Peak hour volume delay (AM or PM, whichever is higher) using planning time index

### Ranking of congested intersection bottlenecks:

Prescreening: Any intersection that has one or more connected segment with a TTI>2.5 + some intersections handpicked using CATT Lab PDA Bottleneck ranking tool

The peak hour vehicle delay for an intersection is calculated in the same manner as above for the highest congestion bottleneck segment approach, the remaining approach segments that touch the intersection, and any trailing segments with a TTI of 1.4 or more. It is measured in seconds.

The peak hour volume delay for an intersection is calculated in the same manner as above for the highest congestion bottleneck segment approach, the remaining approach segments that touch the intersection, and any trailing segments with a TTI of 1.4 or more. It is measured in hours.

The top 5 congested intersections using each of the following two ranking methods are selected as the 'focus intersection bottlenecks' for detailed CMP analysis.

- Peak vehicle delay (AM or PM, whichever is higher) using travel time index
- Peak hour volume delay (AM or PM, whichever is higher) using travel time index

## NYMTC CMP 2017

Pre-screening: Demand to capacity ratio > 0.8, along with visual inspection of corridors that experience congestion defined by high D/C ratios.

For ranking, a multi-criterion ranking method using 4 criteria is used, with each criterion carrying different weights as below:

- Magnitude (45%) – Daily one-way traffic on the link
- Intensity (25%) – Level of congestion that is based on demand-to-capacity ratio
- Importance (15%) – Functional class of the roadway
- Consistency (15%) – length of the corridor of consecutive congested links on the transportation network

Top 10 links in each county are selected for detailed analysis.

## MWCOG CMP 2016 Technical Report

Ranking of roadways using two methods:

- Individual traveler perspective (Top 10 roadways from each method selected)
  - TTI*Roadway length for all time
  - AADT*TTI*Roadway length for all time
- Systemwide perspective (Top 10 roadways from each method selected)
  - TTI*Roadway length for weekday peak hours
  - AADT*TTI*Roadway length weekday peak hours

## Southern California Association of Governments (SCAG) CMP 2019

Ranking of top 100 bottlenecks based on total annual delay. Also identifies the length and time of day for each bottleneck.

## South Jersey TPO CMP 2018

Ranking of bottlenecks using Probe Data Analytics Tool (CATT Lab) – which calculates an impact factor for each bottleneck based on its duration, length and frequency of occurrence.

## Association of Central Oklahoma Governments

Ranking of all roadway segments based on TTI, separately for AM peak and PM peak. All the segments with a TTI>1 are selected as 'Focus Congestion Network'.

## NCTCOG CMP 2013 (Dallas-Fort Worth)

Corridors are given a score using a multi-criterion scoring system, based on four equally weighted criteria:

- Existence of alternative roadway infrastructure (considers parallel roadways)
- Existence of modal options (considers rideshare, HOV, transit and bike/ped)
- System demand (considers passengers and freight demand)
- System reliability (considers safety measures and ITS)

Further guidance on scoring each criterion (total 25 points each) is provided.

## Other Miscellaneous

There are several other MPO CMP's that do not consider ranking of roadways and/or intersections. They generally have a selection criterion (e.g. State highways + all roads that meet a certain criteria). Some of them measure the performance measures for all the selected roads to group them into levels of congestion.