Baltimore Regional Congestion Management Process: Proposed Performance Metrics and Data Collection & Management Plan

1. Introduction and Purpose

Performance measures are a critical component of the congestion management process (CMP). They are used to assess the performance of the region's transportation network, identify regional and local congestion and mobility issues, and support the identification of strategies. As per the Metropolitan Transportation Planning Final Rule 23 CFR450.320(a) and (b) released in 2007, the development of a congestion management process should result in **multimodal system performance measures** and strategies that can be reflected in the metropolitan transportation plan and TIP.

Performance measures can be applied at various scales, such as statewide, regional, or county or jurisdiction-level, and these measures are often reported as aggregate figures (e.g., number of roadway fatalities, percent of person-miles traveled on the Interstate with reliable travel times). For the CMP, the intent is to be able to explore congestion and mobility issues (e.g., reliability, accessibility) across the transportation system network in order to **identify locations with problems and the source of those problems**. Consequently, this document identifies "metrics" that can be mapped in a geospatial format, such as by road segment, transit route, or sub-regional geographic (e.g., census tract, traffic analysis zone).[1]

The Baltimore Metropolitan Council (BMC) has already begun developing an interface for mapping this information in the form of its BMC CMP Analysis Tool using ArcGIS online, which will be live on BMC's website soon. The proposed performance metrics were recommended with the intent they will be integrated into this tool for use by BMC and regional stakeholders in order to identify areas with mobility challenges or potential needs, which will support the identification of strategies to address these problems or needs.

This document identifies a core set of proposed performance metrics to support the region's CMP objectives and describes a methodology for collecting and analyzing the required data associated with each metric. Some metrics may be directly taken from other data sources, such as the Maryland Department of Transportation (MDOT) or the Regional Integrated Transportation Information System (RITIS) Probe Data Analytics (PDA) Suite, while others require calculations or modeling using several data sources. For each metric, this document identifies the data sources, provides details about their scale

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[1] While the CMP regulation refer to "performance measures", the Transportation Performance Management (TPM) regulations discuss "metrics" that can be aggregated into statewide or regional performance measures. FHWA defines a "metric" as a quantifiable indicator of performance, while a "performance measure" is an expression based on a metric that is used to establish targets and to assess progress toward achieving the targets. For instance, a "level of travel time reliability" (LOTTR) index is a metric that can be mapped across roadway segments; the "percentage of person-miles traveled on the Interstate system that are reliable" (calculated based on a threshold for LOTTR) is a performance measure that can be reported for a state or region. To be consistent with the latest TPM terminology, throughout this document, we generally refer to "performance metrics" for the CMP.

and update frequencies, describes the methodology to access them, and finally suggests a methodology to compute the metric from the selected data source, as applicable.

2. Method of Selection of Performance Metrics

As a first step, the ICF team identified a long list of potential performance metrics that support the congestion management objectives, building on an understanding of available data in the region and practices being used by other metropolitan planning organizations (MPOs) around the country. Specifically, the ICF team used the following steps to identify the long list:

1. Conducted a review of regional and statewide plans and documents to identify regional measures and metrics currently being used.
2. Conducted interviews with regional stakeholders representing a wide array of groups, including emergency responders, freight stakeholders, Maryland Department of Transportation (MDOT) business units, local government, and the Baltimore Regional Transportation Board (BRTB) Public Advisory Committee (PAC).
3. Conducted a scan of practices from other MPOs, including the Delaware Valley Regional Planning Commission (DVRPC), Hampton Roads Transportation Planning Organization (HRTPO), New York Metropolitan Council (NYMTC), and Wilmington Area Planning Council (WILMAPCO).

The team then discussed this list with the CMP Steering Committee during its third meeting on January 24, 2020 to narrow down this list. The screening process was also informed by the considerations mentioned in the Federal Highway Administration's CMP Guidebook. Finally, the ICF team selected a final list of performance metrics and identified thresholds for use (e.g., What is considered "on-time" for transit services? What level is considered "excess delay"?).

3. Proposed CMP Performance Metrics

The proposed set of CMP performance metrics are organized to support the CMP objectives developed earlier in the study process, as seen in Figure 1.

Figure 1: BMC's CMP Objectives

Objective 1: Enhance access to jobs and other opportunities
Objective 2: Improve travel times and reduce traveler delay on all modes of travel
Objective 3: Improve travel time reliability and resiliency for motorists and transit
Objective 4: Improve freight reliability
Objective 5: Enhance travel choices - access to transit, bicycling, walking, and other non-SOV modes
Objective 6: Reduce traffic incidents that contribute to traveler delays and loss of life or injury
Objective 7: Enhance interjurisdictional coordination to optimize transportation system performance

A primary list of 17 performance metrics is proposed to support the first six objectives, as summarized in Table 1. These metrics rely on quantitative data and are intended to support identification of congestion and mobility problems or needs within the region. This list recognizes that while there are a large list of possible metrics, it will be important to identify a reasonable number of metrics that can be used for mapping and can be updated on a periodic (e.g., quarterly or annual) basis. This table is followed by a description of each metric, including a rationale for selecting the metric, cautions about the metric, and information on the data source(s), data collection methodology, and calculation methodology, including general level of effort or complexity. We also have identified other potential secondary metrics that may be considered but seemed less critical or valuable than the primary metrics.

No quantitative performance metrics have been proposed for the seventh objective focused on enhancing interjurisdictional coordination. This objective focuses on institutional processes, rather than system outcomes that can be measured on the CMP network. This objective will be evaluated qualitatively and will be discussed in a technical memo on implementation of the CMP.

Table 1: Summary of Proposed CMP Performance Metrics

No.	Recommended Performance Metric	Geography for display	Data Sources
Objective 1: Enhance access to jobs and other opportunities			
1.	Number of jobs accessible within a 30-minute drive	Census block	BMC regional travel model
2.	Number of jobs accessible within a 45-minute transit trip	Census block	BMC regional travel model
Objective 2: Improve travel times and reduce traveler delay on all modes of travel			
1.	Travel time index (ratio of peak-period to off-peak travel time)	Roadway segment	RITIS PDA / NPMRDS Suite
2.	Duration of congested conditions (e.g., on typical weekdays, weekends)	Roadway segment	RITIS PDA / NPMRDS Suite
3.	Person hours of peak hour excessive delay	Roadway segment	RITIS PDA / NPMRDS Suite
4.	Average bus speeds	Route/segment by type of service by time period	Swiftly, MDOT Maryland Transit Administration (MTA), Regional Transportation Agency of Central Maryland (RTA)
5.	Anticipated growth in V/C ratio in peak period (base year to 2045)	Roadway segment	BMC regional travel model
Objective 3: Improve travel time reliability and resiliency for motorists and transit			
1.	Level of Travel Time Reliability (LOTTR)	Roadway segment	RITIS PDA /NPMRDS Suite

No.	Recommended Performance Metric	Geography for display	Data Sources
2.	Transit on-time performance - Bus - Rail	Route	Swiftly, MDOT MTA, RTA
Objective 4: Improve freight reliability			
1.	Truck Travel Time Reliability (TTTR) Index	Roadway segment	RITIS PDA / NPMRDS Suite
Objective 5: Enhance travel choices, including access to transit, bicycling, walking, and other non-SOV modes			
1.	Non-SOV mode share	Census tract	American Community Survey (ACS)
2a.	Transit network extent and frequency	Route	Swiftly, MDOT MTA, RTA
2b.	Access to frequent transit (secondary)	Geographic area (around transit stops)	Swiftly, MDOT MTA, RTA
3.	Bicycle network extent	Roadway/path segment	BMC Regional Bicycle Facilities dataset
4.	Bicycle Level of Traffic Stress (LTS)	Roadway/path segment	MDOT
5.	Park and ride utilization	Facility-level	MDOT SHA
Objective 6: Reduce traffic incidents that contribute to traveler delays and loss of life or injury			
1.	Number of crashes	Point location (or aggregated by roadway segment)	Maryland Statewide Vehicle Crashes database
2.	Number of pedestrian/bicycle crashes	Point location (or aggregated by roadway segment)	Maryland Statewide Vehicle Crashes database
Objective 7: Enhance interjurisdictional coordination to optimize transportation system performance			
No quantitative metric proposed for system performance analysis. To be evaluated as part of implementation process.			

Most of the data used for the performance metrics listed above are updated on a frequency to allow annual updates for the CMP. However, many could be updated more often, such as quarterly. Some that rely on the regional travel demand model, such as accessibility measures and forecasts for future traffic congestion increases, would be updated on a less frequent basis associated with updates to the regional model and/or regional transportation plan.

Objective 1: Enhance access to jobs and other opportunities

1. Number of jobs accessible within a 30-minute drive

Rationale: This metric addresses an overall mobility outcome by measuring the number of jobs that can be accessed within a 30-minute drive time from locations within the region. This metric is affected by not only traffic speeds and congestion levels but also over time by the location of jobs and households within the region. This metric may be particularly valuable to compare current accessibility to anticipated future accessibility (using travel modeling) in order to understand patterns of change and the benefits of proposed investments, as well as to compare accessibility for different population segments (e.g., low-income and minority communities).

Caveats: Just because a location is very accessible to jobs does not mean that residents are necessarily qualified for or able to obtain those jobs; for instance, many low-income communities are accessible to a large number of jobs but households may not have access to vehicles or the education and qualification to obtain those jobs. Also, simply because an area has low accessibility to jobs within a 30-minute drive does not necessarily mean that it would be cost-effective or valuable to implement strategies to enhance roadway access or capacity, particularly in outlying areas.

Data Sources:

- Number and location of jobs: BMC regional trip-based model
- Travel times (auto): Utilize BMC regional travel model data (for current year analysis and forecasting).
- Geography: BMC regional trip-based model TAZ data.

Scale of Data:

- BMC regional travel model – TAZ level

Data Update Frequency:

- BMC regional travel model – variable

Threshold: 30 minutes is recommended as a primary threshold; additional thresholds can also be added, such as a 45-minute threshold.

Data Collection Method: Compute travel time skims from each TAZ (centroid) to every other TAZ (centroid). Note that the auto travel times include in and out of vehicle time, with out of vehicle times (between location and vehicle) estimated as 1 minute for rural/suburban zones and 8 minutes for downtown (walk between parking garage and office door).

Methodology: For each TAZ, select the centroid of every other TAZ that is located within a 30-minute commute via auto and sum the number of jobs available in the associated TAZs.

Level of effort: Medium, requires basic analysis using the regional model data

Note: Since the BMC Regional model is not updated at a fixed frequency, an alternative approach to conduct this analysis is by using data from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics Program (LEHD), which is updated annually. The LEHD Origin-Destination Employment Statistics (LODES) dataset includes the number of jobs at a census block group level. Data for the BMC region can be downloaded using the OnTheMap tool. Using travel time skims from the BMC regional model, the block groups located within the threshold drive time of a particular block group can be identified and the number of jobs in them can be summed up.

2. Number of jobs accessible within a 45-minute transit trip

Rationale: This metric addresses an overall mobility outcome by measuring the number of jobs that can be accessed within a 45-minute transit travel time (considering in and out of vehicle travel time) from locations within the region. This metric is affected by not only transit availability and speeds but also over time by the location of jobs and households within the region. This metric may be particularly valuable to compare current accessibility to anticipated future accessibility (using travel modeling) in order to understand patterns of change and the benefits of proposed investments, as well as to compare accessibility for different population segments (e.g., low-income and minority communities).

Caveats: Just because a location is very accessible to jobs does not mean that residents are necessarily qualified for or able to obtain those jobs; for instance, many low-income communities are accessible to a large number of jobs but households may not have the education and qualification to obtain those jobs. Moreover, this metric accounts for the time it takes via transit to access destinations during peak hours but does not account for limitations in frequency of transit service off-peak, which affects the viability of using transit for some jobs. The methodology does not account well for transit trips that must be accessed by driving (such as driving to a park-and-ride facility to catch a bus or train). Also, simply because an area has low accessibility to jobs within a 45-minute transit trip does not necessarily mean that it would be cost-effective or valuable to implement new transit services, particularly in low density outlying areas.

Data Sources:

- Number and location of jobs: BMC regional trip-based model
- Travel times (transit): Utilize BMC regional travel model data (for current year analysis and forecasting).
- Geography: BMC regional trip-based model TAZ data.

Scale of Data:

- BMC regional travel model – TAZ level

Data Update Frequency:

- BMC regional travel model – variable

Threshold: 45 minutes is commonly used as a threshold for a reasonable transit trip time, accounting for both in-vehicle transit time and out-of-vehicle time, including walk access, wait time, any transfer time, and walk egress. Additional thresholds can also be added, such as 30 minutes in order to be consistent with the travel time threshold used for driving.

Data Collection Method: Compute travel time skims via transit from each TAZ (centroid) to every other TAZ (centroid). Note that the travel times should include in and out of vehicle travel time, with in vehicle consisting of TAZ to TAZ transit skim (bus, rail, and MARC), and out of vehicle consisting of walk access, initial wait (assumed half the headway), transfer wait, and walk egress. Typically, only walk access skims are considered so zones that are "must drive" to access transit are not considered.

Methodology: For each TAZ, select the centroid of every other TAZ that is located within a 45-minute commute via transit and sum the number of jobs available in the associated TAZs. [Alternatively, another methodology could be applied, using the centroid locations (latitude and longitude) as input in Open Trip Planner network. From each centroid, measure the transit travel time to every other centroid as described by Hillsman and Barbeau (2011). For each centroid, select all the centroids that are within a transit travel time of 30 minutes. To measure the sum of jobs accessible within a 30-minute transit trip, sum the number of jobs in each of these selected centroids, as measured from the BMC regional model. A detailed description of the entire methodology is described by Owen and Murphy (2018).

Level of effort: Medium, requires basic analysis using the BMC regional model

Note: Since the BMC Regional model is not updated at a fixed frequency, the alternative approach using LEHD-LODES data as described in the earlier performance measure can be used. The travel time skims used for this case are transit travel times in place of auto travel times.

Other Potential Metrics:

In addition to these two metrics focused on access to jobs, similar mapping could be conducted in terms of **access to health care (e.g., hospitals, clinics, medical facilities) or recreation (e.g., parks)**. These analyses would require identifying locations of each of these facilities, which is generally available, but interpretation as part of the CMP is more challenging and would likely be better suited to specialized studies or analyses rather than as part of on-going monitoring for the CMP. For instance, is it more valuable for a community to have access to eight medical facilities than access to three facilities within a 30-minute drive? And are all parks equal in terms of their utility for the public? As a result, we recommend that a specialized study could be conducted, particularly for purposes of environmental justice (EJ) or equity analysis, but not to include as part of on-going monitoring and analysis for the CMP.

Objective 2: Improve travel times and reduce traveler delay on all modes of travel

1. Travel time index (ratio of peak-period to free-flow travel time)

Rationale: This metric provides an indication of the intensity of traffic congestion by comparing travel time in the peak period to the travel time during free-flow travel conditions (for instance, a value of 1.35 indicates that a 20 minute free-flow trip takes on average 27 minutes [20 minutes x 1.35] during peak periods. This metric is useful for showing how significantly congestion affects peak travel times on different roadways, accounting for the different posted speed limits on different types of roads (e.g., freeways vs. arterials).

Caveats: In urban areas, free-flow travel is generally not expected during peak periods, and so a moderately high travel time index may not necessarily be viewed as a "problem" that needs to be solved. Moreover, the average travel time in the peak period may reflect a wide variation in times.

Data Source: RITIS PDA / NPMRDS Suite

Scale of Data TMC level; TTI can be calculated during different time periods, including AM peak (6 AM – 10 AM), PM peak (3 PM – 7 PM), and Weekend Peak (1 PM – 7 PM).

Data Update Frequency: Monthly

Threshold: For mapping purposes, color coding can be used at different threshold levels, such as 1.0, 1.2, 1.4, 1.6, 1.8, 2.0+, etc.

Data Collection Method:

The travel time index for all the TMCs in the BMC region can be computed by using the Trend Map tool in the RITIS PDA / NPMRDS Suite. The trends map tool allows you to create maps and download the data in an excel format.

The Trend Map tool allows users to customize the data used for the analysis based on the following selections.

- TMC Segments: The user can select the source of the TMC segments from HERE, INRIX, NPMRDS INRIX, and TomTom; further the tool allows user to select the TMCs for analysis based on location (State/County), Direction, Zip Code and Road Classes or a list of Segment codes. The tool also allows to save and retrieve the TMC segments for future analysis.
- Time Periods: The user can choose specific Date Range or Specific Month or Year
- Data Source: The user can choose the source of data from HERE, INRIX, NPMRDS from INRIX (for passenger vehicles, trucks or both passenger vehicles and trucks), and TomTom.
- Granularity: The user can choose the granularity of the data from 1,5,10,15 or 60 minutes

As BMC has access to the PDA / NPMRDS Suite, it is recommended to use the INRIX data to be consistent with other traffic analysis performed by BMC.

The TTI values on an aggregate level (All Southbound, Northbound, Westbound, Eastbound, Clockwise and Counterclockwise TMCs) for the selected region can be directly computed in the Performance Summaries tool from the RITIS PDA / NPMRDS Suite.

Methodology: Select the appropriate time period for analysis (e.g., month, year) and time range to generate performance data across the network.

Level of effort: Low, data is directly available from RITIS PDA / NPMRDS Suite.

2. Duration of congested conditions

Rationale: This metric provides an indication of the duration of congested conditions over the course of a typical day (for instance, is a roadway typically congested for 2 hours each day or 6 hours each day?). This metric can be calculated both for weekdays and weekends, or for individual days of the week (if desired). As a result, this metric provides further context on over how long a period might travelers typically expect congestion.

Caveats: No significant caveats.

Data Source: RITIS PDA / NPMRDS Suite

Scale of Data: TMC or Roadway segment

Data Update Frequency: Monthly

Threshold: A threshold of 60% of free flow speed is recommended to be used to define congestion, consistent with how BMC currently analyzes bottleneck duration, using the RITIS Probe Data Analytics Suite. This threshold reflects a pretty significant level of congestion on freeways (e.g., a 60 mph freeway operating below 36 mph) and is similar to the approach used to calculate "excessive delay" for the federal performance metric of peak-hour excessive delay.

Data Collection Method: Congestion related data can be collected for individual road segments using the congestion scan tool in the RITIS PDA Suite. On the congestion scan tool page, select the Baltimore Urbanized area zone (UZA) or enter a list of all the TMC codes in the 'select roads' section. Select individual time periods and the granularity of the data required, for instance, a month, quarter, or year and 5 minutes, respectively. Select INRIX as the data source. Upon submission, a congestion scan of the selected roadway segment(s) for the selected time period is displayed. Ensure the data type is 'Speed (mph)' and save the data as an excel file. export the resulting data for each TMC to an excel readable format. The tutorial video can provide further guidance on using the Congestion Scan tool. As BMC has access to the PDA Suite, it is recommended to use the INRIX data from the analysis to be consistent with other traffic analysis performed by BMC.

Methodology: The excel file includes the average speed data for each individual roadway segment for every 10-minute period for the specified period. Select all the 10-minute periods for which the speed was lesser than the threshold value. The total duration of time in these selected periods, when converted into hours gives a measure of the hours of congested conditions on a typical weekday or weekend.

Level of effort: Low, data are directly available from RITIS NPMRDS.

3. Person hours of peak hour excessive delay (PHED)

Rationale: This metric provides an indication of the amount of time experienced by travelers in excessive delay, which reflects the extra amount of time spent in congested conditions beyond what might be considered normal delay; it also accounts for the total volume of travelers affected by that congestion. Using excessive delay as a metric for the CMP supports the federal performance measure of "annual hours per capita of peak hour excessive delay" used for urbanized areas.

Caveats: This metric accounts for excessive delay during weekday peak hours (morning and afternoon), but (using the Federal definition) does not account for weekend excessive delay. Separate analysis could potentially be conducted to assess weekend excessive delay.

Data Sources: RITIS PDA / NPMRDS Suite

Scale of Data TMC or Roadway segment

Data Update Frequency: Monthly

Threshold: Speed threshold of 20 mph or 60% of free-flow speed, whichever is greater, is used to define the speed at which "excessive delay" is calculated (this is based on the federal definition of excessive delay used in reporting for the national performance measure related to peak hour excessive delay)

Data Collection Method: Person hours of excessive delay can be computed for a selected year for the Baltimore Urbanized area zone (UZA). In the RITIS PDA Suite, the PHED is computed through the MAP-21 tools. In the MAP-21 tools, select Geography (Baltimore UZA), then select measure (Annual Hours of Peak Hours of Excessive Delay Per Capita, then choose the PM peak Period Duration (3 to 7 PM or 4 to 8 PM) and then select the year for analysis. A widget of Map can be created, which shows the PHED for each of the TMCs available in the BMC UZA area. From the Map widget, the PHED data for each TMC can be exported to an excel file and stored locally for further analysis. The tutorial video provides additional guidance on using the MAP-21 tool for the PHED measure. For roadway segments outside of the Baltimore UZA, a separate analysis could potentially be conducted by the user by making use of the raw travel times available through the massive data downloader available in the PDA Suite. As BMC has access to the PDA Suite, it is recommended to use the INRIX data from the analysis to be consistent with other traffic analysis performed by BMC.

Methodology: The measure of person-hours of excessive delay for each TMC within the Baltimore UZA is directly available in the excel file. For TMC segments outside of the BMC UZA separate analysis will have to be conducted.

Level of effort: Low for the TMC segments within the UZA. High for segments outside the UZA.

4. Average bus speeds

Rationale: This metric addresses congestion affecting buses and can be influenced by strategies such as bus rapid transit, bus-only lanes, and transit signal priority. Bus speeds in relation to auto speeds are an important factor for choice riders.

Caveats: Bus speeds are affected by many different factors, including the number of bus stops and crowding along a route, as well as the speed limit of the roadways used for travel. As a result, speed along can be difficult to interpret. However, the information could be used to identify bus routes with particularly low speeds that might benefit from priority treatments. Additionally, this performance metric is measurable only for transit agencies that have installed GPS devices in their vehicles to collect Automatic Vehicle Location (AVL) database.

Data Source: Swiftly; transit data collection and provision platform and MDOT Maryland Transit Administration (Maryland MTA).
Note: Swiftly has agreements with agencies like Maryland MTA and the Regional Transportation Agency of Central Maryland (RTA) to analyze the real-time transit data. Swiftly also pulls out GTFS feeds that are publicly available from smaller transit agencies, which can be used for this purpose. For agencies that are collecting AVL data but do not make it public and are not working with Swiftly, in-house analysis needs to be done to calculate the average bus speeds.

Scale of Data: Bus route level by type of service (express, local, rapid transit, etc.) for different time periods (AM peak, midday, PM peak, weekend)

Data Update Frequency: Variable

Threshold: For mapping purposes, color coding can be used at different threshold levels, such as above 40, 30, 25, 20, 15, 10, 5, and below 5 mph.

Data Collection Method: Request a Swiftly API key via MDOT Maryland Transit Administration (Maryland MTA). Use Swiftly API with this key to access to bus speeds for individual routes of the Maryland MTA bus network. Note: MDOT MTA has this information available in a format that can be provided to BMC via Shapefiles. RTA has data available through the Swiftly API

Methodology : Swiftly API allows collection of real-time as well as historical vehicle speeds on a selected set of routes, the description for which is provided in the 'GTFS-rt-vehicle-positions' section. The query returns the position (variable: 'latitude' and 'longitude') and speed (variable: 'speed') of the selected vehicle(s) and route(s) in a human readable format. The data can also be converted to an excel readable format for further uses, like measuring the average speed of vehicles on all routes at a given time, or the vehicle speed for a given route averaged over a longer time period.

Level of effort: Medium, will require multiple analyses for different types of service and for different time periods.

5. Anticipated growth in V/C ratio in peak period: base year to future year (e.g., 2045)

Rationale: This metric helps identify the roadway segments that anticipate an increase in traffic volume to capacity ratio and associated congestion. As a result, this metric is helpful to identify locations that are anticipated to have growing traffic congestion problems in the future. The analysis accounts for future socioeconomic and land use forecasts along with programmed projects approved for funding. Including these forecasts in the CMP will help to identify potential congestion problems that can be addressed through strategies that help minimize or mitigate the future congestion increase.

Caveats: The analysis is based on modeling, and therefore includes all of the uncertainties with future forecasts (e.g., uncertainties with land use, economic, and demographic changes, as well as assumptions about travel behavior).

Data Source: BMC regional travel model

Scale of Data: TMC or roadway segment

Data Update Frequency: Variable; select a future year in connection with updates to regional travel modeling for metropolitan transportation plan updates.

Threshold: A 25% increase in V/C ratio for either the AM or PM peak is suggested as a possible threshold, reflecting a significant increase in traffic volume to available capacity over the planning horizon (for comparison, the Delaware Valley Regional Planning Commission [DVRPC] used a 30% increase threshold in its recent 2019 CMP update). The analysis should be based on links with moderate existing congestion to identify those at risk of future high congestion (rather than links without congestion where an increase in volumes may not be as problematic).

Data Collection Method: Use the BMC Regional travel model to access the V/C ratio value during the AM peak and the PM peak for each individual roadway segment for the base year as well as the forecasted value for the target forecast year (e.g., 2050).

Methodology: Calculate the percentage change in V/C ratio from the base year to the forecast year (e.g., 2050) for each roadway segment. Links with a change equal to the threshold value or more for AM and/or PM peak can be flagged as high anticipated growth V/C segments. Segments that already have a high V/C ratio value and further anticipate growth in the congestion can be given more weight.

Level of effort: Medium, requires running BMC Regional travel model, but data should be available from long range plan model runs

Other Potential Metrics:

In addition to the metrics above, **average speed on roadways** (in miles per hour) can be used as a metric. This metric is generally easy to understand and is already collected and mapped in the BMC CMP Analysis Tool for morning and afternoon peak periods. Data can be presented during different time periods, including AM peak (6 AM – 10 AM), PM peak (3 PM – 7 PM), and Weekend Peak (1 PM – 7 PM). For mapping purposes, color coding can be used at different threshold levels, such as 60, 50, 40, 30, 20, and 10 mph.

A caveat is that data on speeds can be difficult to interpret in a mapped format due to different speed limits and “free flow” speeds on different types of facilities. For instance, an average speed of 45 mph on a freeway generally signifies congestion while an average speed of 45 mph on a major arterial may mean no congestion. As a result, average speed is a less valuable metric than the other recommended metrics for this objective. Its most important value is as a source for calculating other metrics.

Another potential performance metric is **Intersection Level of Service (LOS)**. It allows mapping of the level of service of individual intersections, which provides an indication of the level of delay at these intersections. All intersections with LOS as ‘E’ or ‘F’ can be considered as congested, with the general description of each LOS is as below:

- A - Free Flow
- B - Stable Flow (slight delays)
- C - Stable flow (acceptable delays)
- D - Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
- E - Unstable flow (intolerable delay)
- F - Forced flow (congested and queues fail to clear)

When discussed with the CMP Steering Committee during its fourth meeting on March 20, 2020, there was a general consensus not to include it as part of the on-going CMP, due to the lack of a universal LOS measurement method and also because the required data are not updated on a specified time-frame. As a result, data for different intersections will reflect different time periods of analysis, based on the most recent data available. MDOT SHA’s Data Services Division (DSD) performs counts and posts them on the Traffic Monitoring System (TMS) whenever requested by others using a Critical Lane Volume (CLV) methodology. MDOT SHA’s Travel Forecasting and Analysis Division (TFAD) is working on a new LOS app using that same TMS database and traffic counts. TFAD is using a Highway Capacity Manual (HCM) methodology instead of CLV where Synchro models are available and the LOS is D or worse at signalized intersections. If these data are updated consistently with comparable information, then intersection LOS could be considered for incorporation in the CMP in the future.

Objective 3: Improve travel time reliability (consistency and predictability) and resiliency for motorists and transit

1. Level of Travel Time Reliability (LOTTR)

Rationale: This metric addresses the variability of travel time, which is a very important consideration for travelers. It also supports the region's target for travel time reliability in relation to the federal measure, which is calculated based on the 80th percentile travel time compared to the 50th percentile travel time for 4 time periods:

- 6 AM – 10AM, weekdays
- 10AM – 4 PM, weekdays
- 4PM – 8 PM, weekdays
- 6 AM – 8 PM, weekends

Caveats: No significant caveats, except that the concept can be difficult to communicate. A higher LOTTR value reflects a worse level of travel time reliability.

Data Source: RITIS PDA / NPMRDS Suite

Scale of Data: TMC or roadway segment by 5-minute interval

Data Update Frequency: Monthly

Threshold: A LOTTR of 1.5 for any of the four periods is considered "unreliable" for purposes of the national performance measure and would be a good threshold for reporting unreliable segments, using the highest LOTTR rating for each of the four periods. For each segment, LOTTR values can be presented on a scale reflecting the highest (worst) LOTTR value for any of the four periods, such as above 2.0, above 1.75, above 1.5, and below 1.5. A LOTTR of 1.5 reflects that a typical 20-minute trip would take 30 minutes or more on about 20 percent of trips (based on 80th percentile).

Data Collection Method: LOTTR can be calculated for individual road segments using the MAP - 21 tool from the RITIS PDA Suite. On the tool page, select the BMC Metropolitan Planning Area (MPA) as the geography. Select two measures – the interstate travel time reliability measure and the non-interstate travel time reliability measure. Select the year for which analysis is being done. Create a map with the following selection and further download the data as a GIS shapefile or an XML file. The tutorial video can provide further guidance on using the MAP-21 tool.

As BMC has access to the PDA Suite, it is recommended to use the INRIX data from the analysis to be consistent with other traffic analysis performed by BMC.

Methodology: The LOTTR values for each road segment for different time periods are directly available in the downloaded data under the field names 'LOTTR_AMP', 'LOTTR_MIDD', 'LOTTR_PMP' and 'LOTTR_WE' respectively. The final LOTTR value is considered as the maximum of the four values and is stored under the field 'lottr'.

Level of effort: Low, data is directly available from RITIS NPMRDS.

2. Transit on-time performance (bus, light-rail, subway, and commuter rail)

Rationale: This metric addresses the reliability of transit services, which is a very important consideration for transit users. It also supports the regional transportation goal of helping people move reliably and efficiently.

Caveats: The route level measurement takes into consideration schedule adherence at scheduled points along the route. Additionally, this performance metric is measurable only for transit agencies that have installed GPS devices in their vehicles to collect Automatic Vehicle Location (AVL) database.

Data Source: Swiftly; a transit data collection and provision platform and MDOT Maryland Transit Administration (MTA). Data are available for individual modes (bus, light-rail, heavy-rail, commuter rail) from MDOT MTA. Data are also available from MDOT MTA for commuter rail by line, minutes of delay, and delay reason (host railroad forced delay, safety incidents, track maintenance, etc.). RTA information is also available via Swiftly.
Note: For agencies that are collecting AVL data but do not make it public and are not working with Swiftly, in-house analysis needs to be done to calculate on-time performance.

Scale of Data: Route level. Data could also be broken out by 'block' between scheduled points along a route.

Data Update Frequency: Variable

Threshold: MTA uses a threshold for bus on-time performance of 2 minutes early to 7 minutes late for local buses; beyond those thresholds, buses are considered either early or late. For Commuter Bus and Express BusLink, early arrivals to drop-off zones are viewed as on-time.

Data Collection Method: Request a Swiftly API key via MDOT MTA. Use Swiftly's 'active blocks' tool via API to measure schedule adherence. It may be used for all transit modes including Bus, MARC, Light Rail, Metro SubwayLink and Mobility Link. Data are also available from MDOT MTA for commuter rail by line, minutes of delay, and delay reason (host railroad forced delay, safety incidents, track maintenance, etc.). RTA information is also available via Swiftly.

Methodology: An API call for the Swiftly active blocks tool for a particular transit route and block returns multiple attributes like start time, end time, vehicle ID and schedule adherence. The schedule adherence is stored under 'schAdhStr' and includes the duration by which the vehicle is delayed/arriving early, for e.g., "7.0 minutes (late)". The percentage of active block routes that arrive within a threshold bandwidth of the scheduled arrival is the measure of transit on-time performance. To measure the on-time performance of a particular route, make similar API requests for historic blocks on the same route in a fixed time period (e.g., day/week/month). The 'schAdhStr' value from each request can be stored in an excel sheet. The percentage of route blocks that arrived within a threshold bandwidth of the scheduled arrival is the measure of on-time transit performance of the individual route.

Level of effort: Medium, requires making API calls or conducting in-house analysis.

Other Potential Metrics:

Other potential metric that could be used as a supplement to LOTTR is **planning time index (PTI)**. PTI is another measure of vehicle travel time reliability, calculated based on the 95th percentile travel time compared to the free flow travel time. This measure is useful for estimating how much extra time travelers must budget to ensure an on-time arrival and for describing near-worst-case conditions on urban facilities.[2] For instance, a PTI of 2.0 indicates a 20-minute free-flow trip will take 40 minutes on one of the worst travel days (the 95th percentile time). Planning time index can be calculated for individual road segments using the Performance Summaries tool from RITIS NPMRDS. On the performance summaries tool page, select the Baltimore Urbanized area zone (UZA) or enter a list of all the TMC codes in the 'select roads' section. Select the time period(s) for which performance metric is to be measured. Select any/all of 'NPMRDS (Passenger vehicles)'/'HERE'/'INRIX'/'Tom-Tom' as the data source(s). Upon submission, export the resulting data to an excel readable format. The value of planning time index can be directly found in the 'Planning time index' field. The figures could be reported based on the highest values for each analysis period, or separate PTI values could be reported for weekdays and weekends.

Objective 4: Improve freight reliability

1. Truck travel time reliability (TTTR) index

Rationale: This metric addresses the reliability on freight travel time, which is important for reducing production and distribution costs and ensuring on-time delivery. It aligns with the state as well as federal objectives of improving freight travel time reliability. It is calculated as the ratio of the 95th percentile travel time to the 50th percentile ("normal") travel time for trucks for the following 5 time periods:

- 6 AM – 10 AM, weekdays
- 10 AM – 4 PM, weekdays
- 4PM – 8 PM, weekdays
- 6 AM – 8 PM, weekends
- 8 PM – 6 AM, all days

Caveats: No significant caveats, except that the concept can be difficult to communicate. A higher TTTR value reflects a worse level of truck travel time reliability.

Data Source: RITIS PDA / NPMRDS Suite

[2] SHRP 2 – L08: Incorporation of Travel Time Reliability into the HCM

Scale of Data: TMC or roadway segment

Data Update Frequency: Monthly

Threshold: For each segment, TTTR values can be presented on a scale reflecting the highest (worst) TTTR value for any of the five periods, such as above 3.0, above 2.5, above 2.0, above 1.5, and below 1.5. There is no defined figure to consider truck travel time unreliable under the federal performance metrics.

Data Collection Method: TTTR index can be calculated for individual road segments using the MAP -21 tool by RITIS PDA suite . On the tool page, select the BMC Metropolitan Planning Area (MPA) as the geography. Select 'truck travel time reliability index' as the measure. Select the year for which analysis is being done. Create a map with the following selection and further download the data as a GIS shapefile or an XML file. The tutorial video can provide further guidance on using the MAP-21 tool.

As BMC has access to the PDA Suite, it is recommended to use the INRIX data from the analysis to be consistent with other traffic analysis performed by BMC.

Methodology: The TTTR index values for each road segment for different time periods are directly available in the downloaded data under the field names 'TTTR_AMP', 'TTTR_MIDD', 'TTTR_PMP', 'TTTR_WE' and 'TTTR_OVN' respectively. The final TTTR index value is considered as the maximum of the five values and is stored under the field 'tttr'.

Level of effort: Low; data are directly available from RITS NPMRDS.

Other Potential Metrics:

In addition to the metric above, analysis of traffic congestion and travel time reliability could be conducted for designated critical **urban freight corridors**. These include segments such as portions of Broening Highway, O'Donnell Street, Boston Street, Martin Luther King, Jr. Blvd, MD-175, U.S. 1, among others. Specifically, analysis could be conducted using metrics presented above under Objective 2 and Objective 3, such as **travel time index** (ratio of peak-period to free flow), **level of travel time reliability** (LOTTR), or **planning time index** (PTI) focused specifically on these corridors.

Objective 5: Enhance travel choices, including access to transit, safe and convenient bicycling and walking, and other alternatives to driving alone

1. Non-single occupancy vehicle (SOV) mode share

Rationale: The non-SOV mode share is an important multimodal planning measure, and reflects how well infrastructure, policies, investments and land-use patterns support different types of travel to work. It is also one of the federal performance measures for the Congestion Mitigation and Air Quality Improvement (CMAQ) Program.

Caveats: Non-SOV mode share is an outcome of many different factors. This measure itself may not be particularly valuable to identify congestion/mobility problems or needs at a local scale. However, it provides an indicator of how people are responding to the available choices, or lack of travel options.

Data Source: American Community Survey (ACS) by US Census Bureau

Scale of Data: Census tract level

Data Update Frequency: 1 year

Threshold: Not applicable. For each geographic area, non-SOV mode shares can be presented on a scale, such as under 5%, 5-10%, 10-15%, 15-20%, 20-25%, etc.

Data Collection Method: Download the 5-year ACS table DP03 - Selected Economic Characteristic from the US Census Bureau website for all census tracts in Baltimore UZA boundary. The most recent data available is 2017 ACS 5-year estimates.

Methodology: The downloaded data includes the count of commuters using different modes of travel for each census tract. To measure the count of commuters using non-SOV modes, sum the number of people that commute to work using all modes other than 'car, truck, or van – drove alone'. This ratio of this sum to the number of total commuters gives the value of non-SOV mode share.

Level of effort: Low, directly available from the US Census data.

2a. Transit network extent and frequency

Rationale: Availability of proximate and frequent transit service is key to improving access to transit. Network extent is a spatial measure and headway is a measure for frequency. Together, they help provide an indication of transit accessibility and "usability" (recognizing that transit at 15-minute headways during peak periods, for instance, is very different than transit at 30- or 45-minute headways).

Caveats: No significant caveats. However, rather than showing total number of buses over the course of a day, it may be valuable to break into segments, such as early morning, AM peak and PM peak, mid-day, evening/night, and weekends to show average headways or number of trips per day. This adds more complexity to the analysis.

Data Source: MDOT MTA GTFS data feeds and Swiftly
Note: Swiftly currently has agreements with MDOT MTA and RTA. For agencies that do not have an agreement with Swiftly, in-house analysis needs to be done from the agency schedules in the GTFS feeds.

Scale of Data: Service type by route level

Data Update Frequency: Variable

Threshold: Not applicable. Frequency can be shown on a scale for different periods of the day, such as better than every 10 minutes, every 10 to 15 minutes, every 15 to 30 minutes, every 30 to 45 minutes, or less than every 45 minutes. In order to synthesize the information into a single map, thresholds can be developed for weekdays and weekends, breaking services into different categories, such as: "very frequent/all day service", "frequent/all day service", "frequent/peak only service", "moderate/all day service", "moderate/peak only service", etc.

Data Collection Method: : Request a Swiftly API key via MDOT Maryland Transit Administration (Maryland MTA). Get access to the GTFS data feeds for the MTA train network directly from Maryland MTA website, and for all other transit networks using Swiftly. Use the 'frequencies' dataset in the GTFS feeds.

Methodology: The 'frequencies' dataset includes four variables – the trip ID, start time, end time and headway. The 'trip_id' field represents each service type on each route in the individual transit networks. The headways for each service type-route combination can be found in the corresponding 'headway_secs' variable. The headway value is in seconds. More information about accessing and understanding the GTFS data feeds can be found here.

Level of effort: Medium, involves making API requests. Alternatively, may be low if can collect data directly from MDOT MTA based on schedules.

2b. Access to frequent transit (secondary)

Rationale: This analysis builds on the information on the coverage and frequency of transit services and involves mapping the geographic area within a typical walking distance for transit services: 0.5 mile for rail stations and 0.25 mile for bus stops. Rather than just showing lines on a map, this analysis shows geographic areas within these walking distances to different levels of frequency of transit.

Caveats: It is important to note that walking distances to transit may be impacted by natural or physical barriers, availability of sidewalks, and connectivity of the network. Some transit services (such as commuter rail, and some subway, and light-rail stations) are used significantly by drivers who part at the stations, and so the catchment area is much larger than a 0.5 mile radius. Moreover, bicycling options can also influence the local service area for a station.

Data Source: Maryland DOT GTFS data feeds and Swiftly
Note: For agencies that do not have an agreement with Swiftly, in-house analysis needs to be done from the agency schedules in the GTFS feeds.

Scale of Data: Geographic area (around transit stops)

Data Update Frequency: Variable

Threshold: 0.5-mile radius for rail stations; 0.25-mile radius for bus stops. The geographic areas would then be specified based on level of transit service for each of these areas using thresholds determined for the transit network headways/frequency metric above.

Data Collection Method: Use the data collected in the earlier performance measure (2a), which includes the transit extent and headways in a GIS accessible format, e.g. shapefile.

Methodology: Use a GIS software to create radial buffers with the threshold radius around every bus and/or rail transit stop. Color code the buffer areas depending upon the frequency of transit at the corresponding transit stop. Thus, each color on the final map represents the total geographical area that has access to a similar frequency transit.

Level of effort: Medium, requires GIS analysis on previously collected data, which can be done relatively simply using standard buffer areas; would be more complex to account for barriers and actual walksheds.

3. Bicycle network extent

Rationale: The availability of bike lanes and bicycle facilities provides options for using bicycles as an option for accessing jobs, recreation, shopping, and other opportunities. An increase in the bicycle network reduces the demand for motorized vehicles and in turn help reduce traffic congestion, and also provides additional access options for those without vehicles.

Caveats: The availability of a bike lane or other facilities does not necessarily signify that people will use the facilities; connectivity of the network to destinations, available space for bicycle parking, and other factors may be important.

Data Source: BMC’s Regional Bicycle Facilities data

Scale of Data: Roadway (e.g., bike lane) or path segment

Data Update Frequency: Annual

Threshold: Not applicable

Data Collection Method: Use the regional bicycle facilities dataset made available by BMC here.

Methodology: The collected data can be directly used on the online GIS viewer or can be downloaded and used with a GIS software.

Level of effort: Low, data are directly available.

4. Bicycle Level of Traffic Stress

Rationale: Level of Traffic Stress (LTS) index measure the stress levels associated with biking due to the surrounding traffic and physical and traffic conditions. A stress-free biking environment promotes the demand for use of non-motorized vehicles and in turn helps reduce traffic congestion.

Caveats: The LTS measurement is determined only by the physical attributes of the road segment. The preliminary LTS network, when combined with other considerations like crash rates gives a more meaningful measure of bicycling stress.

Data Source: MDOT data – a combination of One Maryland One Centerline geodatabase and an independent layer of shared-paths that are not on the roadway.

Scale of Data: Roadway or path segment

Data Update Frequency: The database is currently being developed. It will be potentially updated on an annual basis in the future.

Threshold: Thresholds reflect different ranks for level of stress. See below for 0 through 5 different stress levels, based on specific characteristics of the road network.

Data Collection Method: Maryland statewide data is directly made available by MDOT.

Methodology:

- Select data for the BMC region from the MDOT LTS database. The classification is a modified version of the Accessibility Observatory LTS methodology developed by the University of Minnesota. MDOT's preferred method of evaluation is based on 8 characteristics:
    - Presence of multi-use trails or protected bike lanes
    - Presence and quality of bike lanes (no parking)
    - Traffic Volumes
    - Traffic Speeds
    - Shoulder Presence and Width
    - Buffer Width (between roadways and bicycle facilities)
    - Traffic Calming
    - Access Control

- A sample LTS classification methodology is as below.

General Roadway Attributes	LTS Rank
• Shared-use paths that allow bicycles	LTS 0
• Separated cycletracks • Roadways with a bike lane, 1 lane each way, and speed limit ≤ 25 mph and AADT <2500 • Roadways with speed limit ≤ 25 mph if lanes not specified. Roadway has traffic calming features	LTS 1
• Shared lanes with speed limit ≤ 25 mph & AADT 2500-9999 and no parking • Roadways with a bike lane, 1 lane each way, and speed limit ≤ 30 mph & AADT 2500-9999 and no parking • Roadways with a bike lane, 2 lanes each way, and speed limit ≤ 25 mph& AADT 2500-9999 and no parking • Roadways with speed limit ≤ 25 mph if lanes not specified	LTS 2
• Shared bike and busways • Roadways with a bike lane, 1 lane each way, and speed limit > 30 mph, AADT is between 10,001 – 15,000, no on-street parking • Roadways with a bike lane, 2 lanes each way, and speed limit > 25 mph, AADT is between 10,001 – 15,000, no on-street parking	LTS 3
• Roadways with < 3 lanes and speed limit ≤ 25 mph • Roadways with a bike lane or bikeable shoulder, > 2 lanes each way, and speed limit ≤ 35 mph • Roadways with > 3 lanes and speed limit ≤ 25 mph • Roadways with a bike lane, > 2 lanes each way, and speed limit ≥ 35 mph • If none of the above rules apply	LTS 4
• Functional Class is “interstate” • Access Control is “prohibited”	LTS 5

Source: MDOT

- To create a map of LTS, label each roadway on the map with a specific color for each LTS classification. Use color schemes to label roadways with poorer LTS ranks (e.g., LTS 4) as lesser comfortable segments for biking.

Level of effort: Low, data will be directly available.

5. Park and ride utilization

Rationale: Commuter park and ride lots provide an opportunity for commuters to join together in carpools to share a ride, or to access express bus services or transit rail. Park and ride utilization provides an indication of whether a facility it near or at capacity and might need expansion or whether other facilities may be needed.

Caveats: Park and ride lot utilization is affected by a wide variety of factors, including the availability and frequency of transit serving the facility.

Data Source: MDOT SHA Park and Ride dataset

Scale of Data: Park and ride facility

Data Update Frequency: 6 months

Threshold: Not applicable. For each facility, percent utilization can be shown using thresholds such as over 90%, 80-90%, 70-80%, 60-70%, 50-60%, and under 50%.

Data Collection Method: The data are available at the MDOT SHA website.

Methodology: Gather data directly from MDOT SHA database. The utilization rate for each park and ride facility is stored in the 'Average Daily Occupancy' field. In addition to showing utilization percent, total number of spaces can be shown based on the size of a circle or symbol on a map.

Level of effort: Low; data are directly available.

Other Potential Metrics:

In addition to the metrics above, other possible metrics could include **transit ridership** by route, or **average ridership per transit vehicle**, as a measure of crowding. The ridership metric is an outcome of many factors, including transit service coverage, frequency, and land use, and may not be as useful as other measures such as coverage and frequency of transit in order to identify mobility needs.

Objective 6: Reduce traffic incidents that contribute to traveler delays and loss of life or injury

1. Number of crashes

Rationale: Traffic incidents and crashes are a major contributor to traffic delays as well as cause damage to life and property. Reducing traffic crashes would reduce traveler delays and improve traffic safety.

Caveats: The total number of crashes is influenced by many factors, including the amount of traffic, speeds, and external factors such as weather events.

Data Source: Maryland Statewide Vehicle Crashes database by the Department of Maryland State Police.

Scale of Data: Crash level (point location, or aggregated by roadway segment)

Data Update Frequency: Quarterly

Threshold: Not applicable

Data Collection Method: The required data can be made available from the Maryland Statewide Vehicle Crashes data sheet at Maryland's Open Data Portal. The data dictionary can be used to understand the value of each code/column name used in the data. The data can be exported as a GIS software-readable shapefile.

Methodology: Open the file in a GIS software and filter out the crashes for Baltimore by selecting the crashes for which 'COUNTY_NO' field is '3'. The field can be found in the attribute table of the shapefile.

Level of effort: Low; data directly available.

2. Number of pedestrian/bicycle crashes

Rationale: Number of pedestrian / bicycle crashes indicates how safe are these modes of travel. Higher number of pedestrian/ bicycle crashes could mean that there is need of improvement in the walking/ biking infrastructure, especially in places where there is a high demand of these modes.

Caveats: Lower number of pedestrian/ bicycle crashes could mean that the walking /biking infrastructure is safe or there is a very low usage of these modes. While comparing the performance metrics across different geographies, care should be taken to understand the usage of these modes.

Data Source: Maryland Statewide Vehicle Crashes database by the Department of Maryland State Police.

Scale of Data: Crash level (point location, or aggregated by roadway segment)

Data Update Frequency: Quarterly

Threshold: Not applicable

Data Collection Method: The required data can be made available from the Maryland Statewide Vehicle Crashes data sheet at Maryland's Open Data Portal. The data dictionary can be used to understand the value of each code/column name used in the data. The data can be exported as an excel-readable CSV format or as a GIS software-readable shapefile.

Methodology: Open the file in a GIS software and filter out the crashes for Baltimore by selecting the crashes for which 'COUNTY_NO' field value is '3'. To select the pedestrian/bicycle crashes, use an additional filter where the 'HARM_EVENT_CODE2' field values are either '03' or '04'.

Level of effort: Low, data directly available

Other Potential Metrics:

In addition to the metrics above, additional analysis could be conducted to compare crash frequency with average frequency for different types of roadways in order to identify those with higher than typical crash rates.

Objective 7: Enhance interjurisdictional coordination to optimize transportation system performance

As noted above, no quantitative performance metrics have been proposed for this objective since this objectives addresses institutional processes associated with implementing the CMP, rather than system performance outcomes that will be measured on the CMP network to assess problems or needs. Ways of measuring progress toward this objective will be discussed separately in a technical memo on implementation of the CMP.