Congestion Management Process: A Case Study

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Wilmington Area Planning Council

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The Wilmington Area Planning Council (WILMAPCO) follows a seven-step Congestion Management Process (CMP) consisting of (1) system analysis and definition, (2) congestion performance measures, (3) strategy evaluation, (4) Regional Transportation Plan project pipeline and needs inventory, (5) project and problem prioritization, (6) project implementation and programming, and (7) system monitoring and project effectiveness. This process is conducted annually and is closely tied to the project selection process of the Transportation Improvement Program (TIP). WILMAPCO gathers data from a variety of sources and uses them to analyze congestion in the region, identify potential mitigation strategies, identify high-priority project locations, and inform the public through various media (reports, static and interactive maps, and Web site).

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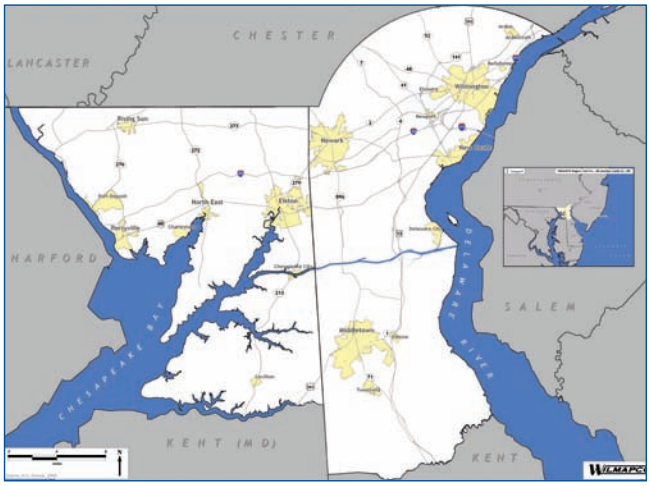


Source: WILMAPCO

Background on WILMAPCO

WILMAPCO is the regional transportation planning agency for Cecil County, MD, and New Castle County, DE, also known as the Wilmington metropolitan region. As the federally designated metropolitan planning organization (MPO), WILMAPCO is charged with planning and coordinating the many transportation investments proposed for the region. WILMAPCO has nine members:

- Delaware and Maryland departments of transportation (DOTs)
- Delaware Transit Corporation
- New Castle and Cecil counties
- Appointee of the Delaware Governor
- City of Wilmington
- Municipal representatives from New Castle and Cecil counties

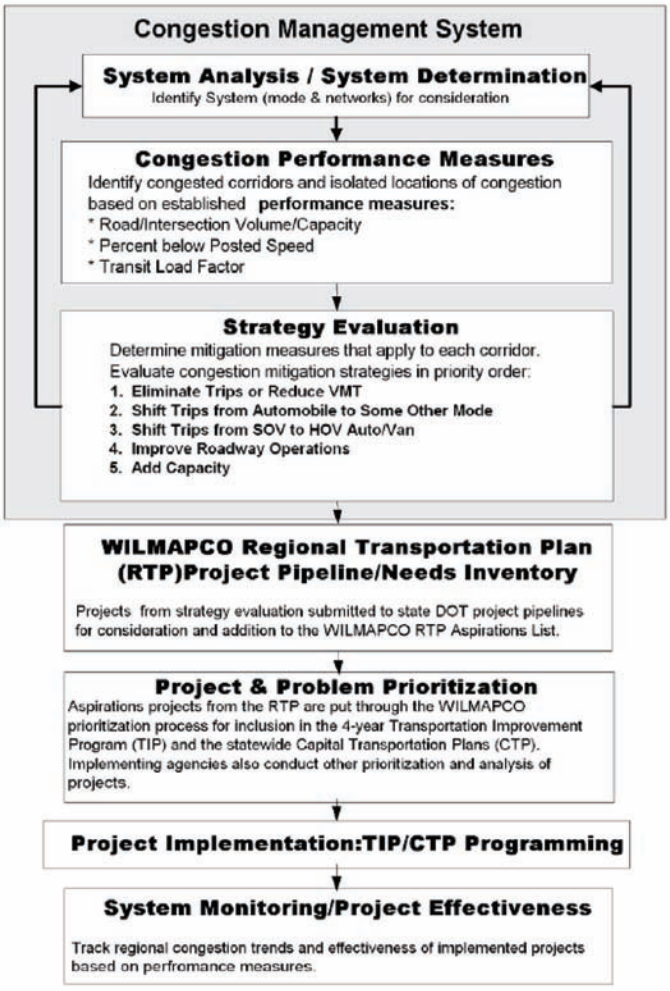
The WILMAPCO region has a total area of 744 square miles (396 in New Castle County and 348 in Cecil County) and a 2005 population of 620,804. Although the square mileage of the counties is fairly similar, their population figures are quite disparate: Cecil County had a 2005 population of 97,796, while New Castle County had 523,008. New Castle County is urbanized, with a density of 1,229 persons per square mile, while Cecil County is largely rural, with 282 persons per square mile.

CMP Process Model

WILMAPCO has developed a CMP process, which the MPO calls the Congestion Management System (CMS), that consists of seven steps (see figure 1). The first three steps are the core of the independent CMP process, while the last four represent ways in which the CMP interacts with other elements of the overall planning process at WILMAPCO. This CMP is updated on an annual basis, to be consistent with the annual update cycle for the WILMAPCO TIP, and results in an annual *CMS Report* that contains information on the data collection, analysis, strategy recommendations, and project prioritization results for that year. The CMP at WILMAPCO is very closely tied to the TIP and has been designed to feed pertinent data for the decisions that must be made as part of that process, but it is also connected to the metropolitan transportation plan (MTP) and local planning process.

WILMAPCO has a staff of only six planners, three of whom work on the CMP in some way. The primary CMP staff member spends about 15–20 percent of his time on the CMP, with the other two each committing only 5 percent of their time. Summer interns also contribute a limited amount of time toward the CMP. Due to these limitations, the CMP relies heavily on outside agencies, including the Delaware and Maryland DOTs, Delaware Transit Corporation, and University of Delaware, for data resources. MPO staff members focus their time on the analysis of collected data and performance measures. The CMS Advisory Committee, composed of members representing State and local agencies and a member of the MPO Citizens Advisory Committee, is very active in making decisions in the CMP process, such as designation of congested corridors and selection of appropriate congestion mitigation strategies within each corridor.

Figure 1: CMS Integration into the Planning Process



Source: WILMAPCO, *2009 WILMAPCO Congestion Management System Summary*, 2009

WILMAPCO's annual CMP cycle typically begins in October, following delivery of the previous year's collected travel time data (data collected one year is typically delivered to WILMAPCO in the summer of the following year). Over the winter, the collected data are organized and translated into performance measures. The bulk of CMP activities take place in the spring, when the CMS Committee works to define the congested corridors, recommend appropriate strategies, and identify funding priorities. The annual *CMS Report* is typically adopted by the WILMAPCO Council in July.

The following sections outline the individual steps involved in the WILMAPCO CMP process.

Step 1 – System Analysis/System Determination

WILMAPCO has a two-tiered CMP network. The first tier, for data collection, includes all roads within the MPO area that are functionally classified as minor arterials or a higher class. This set of roads constitutes about 15 percent of the network within the MPO, but accounts for about 75 percent of vehicle miles traveled. The network is only updated when there are changes in functional classification designations, which typically occurs every 10 years following the census re-designation of urbanized area boundaries. The second tier of the CMP network is a set of congested corridors for which detailed management strategies are developed—these corridors are identified in step 3, following collection and analysis of data.

Step 2 – Congestion Performance Measures

WILMAPCO uses three standard performance measures in its CMP every year, with an additional fourth measure that has varied over the years. The three standard measures are daily roadway volume-to-capacity ratio, peak-hour intersection level of service (LOS), and peak-hour observed speed as a percentage of posted speed. These measures were selected for several reasons, including the fact that they are user-friendly and relatively easy for the average citizen to understand. These measures also create a consistent scale of measurement that allows comparisons of data from year to year, and are all based on standard, technically defensible measures in common use around the country.

The fourth CMP performance measure, which has varied over time (including years when no fourth measure was included), has generally measured one of two things: crashes or transit usage. Crash rates have been the more prominent measure and are intended to identify areas with recurrent instances of incident-caused nonrecurring congestion. WILMAPCO spent a great deal of time and effort working with the Delaware Department of Transportation (DelDOT) to get its crash data in a format that would be usable for the CMP—DelDOT now provides an annual geographic information system (GIS) file containing the point locations of all crashes in the State. So far WILMAPCO has not been able to get similar data from Maryland, partly due to the decentralized nature of crash data collection there. WILMAPCO uses standards of 2 times and 3 times the average crash rate in the region to determine high crash locations for the CMP. The second type of performance measure, transit load factors, has been a point of contention within the MPO—there has been disagreement over whether high transit load factors (indicating high transit usage, close to vehicle capacity) are positive or negative. After considerable debate, the decision was made to focus on transit in the strategy identification phase of the CMP rather than trying to create a transit performance measure, while still collecting the necessary data on transit usage to make informed decisions about potential transit strategies.

WILMAPCO gathers data on its full CMP network annually, with the goal of gathering data that are both regional in scope and available on a regular basis. When WILMAPCO was first developing its CMP process, DelDOT had just begun working with the University of Delaware to collect travel time information on major roadways on an annual basis. These data have formed the core of the data that WILMAPCO uses in its CMP. When the MPO expanded to include a county in Maryland, WILMAPCO provided funding to the University of Delaware to collect the same data in that county. These travel time data are collected using in-vehicle global positioning system (GPS) equipment.

Another important source of CMP data is turning movement information at intersections. WILMAPCO provides funding for a consultant to collect turning movement counts at about 30 intersections every year, with the raw data provided to DelDOT for LOS analysis. These counts are supplemented by counts available from other sources, including county development applications (which were originally the primary source of these data, but these depend on development activity) and previous years' data collection. Every year, WILMAPCO identifies the intersections most in need of updated counts, primarily based on the age and availability of existing turning movement counts along major corridors.

WILMAPCO also receives information on transit usage from DART First State, which provides transit service in the region. WILMAPCO contracts with the University of Delaware to collect information on park-and-ride lot utilization annually. GIS files showing crash locations (for Delaware only) are provided by DelDOT annually. WILMAPCO and DelDOT have also been working recently to improve the sharing of Intelligent Transportation System (ITS) and operations data (especially signal timing data), which could be a future source of CMP information.

Step 3 – Strategy Evaluation

Following the collection of data and analysis of performance measures, WILMAPCO defines a set of corridors that constitute the areas where congestion is considered to be a major problem. These corridors are selected by the CMP Advisory Committee, using the performance measures to identify facilities with multiple or severe deficiencies. Maps are developed that use color and line weight to show the facilities that scored poorly on one or more performance measures, ranging from minor to significant.

After selecting the CMP corridors, the committee develops a list of strategies that are considered appropriate for application within each corridor. This decision is made based on group consensus among the committee members. To facilitate this group discussion, MPO staff develop corridor profiles containing the gathered data for each corridor, including traffic volumes, travel times, transit usage, park-and-ride usage, truck volumes, demographic information, environmental justice/transportation justice concerns, activity center locations, historic and projected trends, employment, and crash data. This information is intended to help the committee make informed decisions on potential strategies and provide some insight about possible sources of congestion in the corridor.

The committee develops a matrix denoting the strategies (from a list of potential strategies) that are potentially appropriate for use in mitigating congestion on each of the identified CMP corridors. This matrix is viewed more as a screening tool than as an assessment of the technical feasibility or usefulness of each identified strategy. WILMAPCO acknowledges this is an area it would like to improve in the future by performing more detailed technical analysis to support the committee's decisionmaking. MPO staff are currently developing a technical approach for potential use of a benefit-cost analysis tool to aid in this process.

Important to note is that WILMAPCO has developed a tiered process for recommending strategies. The list of all potential congestion management strategies is divided into five groups, put in order of priority. The groups, listed from highest to lowest priority, are (1) strategies to eliminate trips or reduce vehicle-miles traveled (VMT), (2) strategies to shift trips from automobiles to other modes, (3) strategies to shift trips from single-occupancy vehicles to high-occupancy vehicles and vanpools, (4) strategies to improve roadway operations, and (5) strategies to add roadway capacity. Capacity-adding projects are considered to be the last option. WILMAPCO hopes the benefit-cost analysis method it plans to implement in the future will provide more technical information to aid decisionmaking, especially regarding the appropriateness of capacity-adding projects in certain corridors.

Step 4 – WILMAPCO Regional Transportation Plan Project Pipeline/ Needs Inventory

WILMAPCO maintains a list of potential projects that it identifies through its CMP and includes it in the MTP as part of its Aspirations List, a list of projects that are needed but not included in the list of funded projects in the MTP. These lists are also provided to DelDOT for its project pipeline list and the Maryland State Highway Administration (MSHA) for its highway needs inventory. In theory, this list of pipeline projects would then translate into funded MTP projects and eventually TIP projects, creating a revolving list of projects in need of funding; however, in recent years there have been backlogs of previously identified TIP projects still in need of funding, and projects have not been able to move from the MTP pipeline list onto the TIP. Similarly, DelDOT has not updated its project pipeline list in several years for the same reason. When these funding backlogs eventually clear, it is intended that this process will allow project needs identified through the CMP to proceed to more detailed study and implementation.

One area where WILMAPCO has had success at implementing project needs identified in the CMP is through the development approval process at the county level. County planners have successfully used the CMP as a tool to require developers to include improvements such as sidewalks, shared driveways, and minor roadway improvements when these strategies are recommended along a CMP corridor.

Step 5 – Project and Problem Prioritization

WILMAPCO has a mathematical process for assigning scores to proposed projects, which is used to develop a prioritized list of projects for funding. The score is divided among many different policy areas and goals (based on the MTP goals), with congestion management making up the largest single share of the score (28 percent). The congestion management score is based entirely on the CMP, with points awarded to projects located in CMP corridors (after checking that the type of improvement planned is consistent with the strategies outlined in the CMP). Additional points are awarded to projects based on the trip volumes in the project corridor (both roadway and transit volume), as a way to give additional weight to major corridors where congestion mitigation is likely to have a greater public benefit. The final scoring/ranking of projects based on these criteria is then applied to the overall project prioritization scoring process, and the results are documented in the CMP report.

Step 6 – Project Implementation: TIP/CTP Programming

This step is a procedural step that involves the final policy decisions on which projects will be programmed for funding. The decisions made at this step are heavily influenced by the technical project prioritization process discussed under step 5, but also allow for changes due to political or practical considerations. WILMAPCO develops a new TIP every year to coincide with Delaware's Capital Transportation Plan (CTP) and annual transportation bond bill. TIP amendments are made as needed to account for funding decisions made in the Maryland portion of the MPO, which typically has far fewer projects. The annual CMP update cycle has been developed to optimize schedule coordination between development of the CMP and annual adoption of the TIP.

Step 7 – System Monitoring/ Project Effectiveness

WILMAPCO tracks system performance over time as part of its annual CMP report development. Because there is a consistent set of CMP data available annually, it allows an easy analysis of changes in performance measures over time. This is typically performed by developing a series of maps showing changes in the three main performance measures over time. Assuming crash rates continue to be a standard performance measure in the future, this type of analysis will be possible using that data as well. This analysis approach is useful as a regional snapshot of congestion trends, showing general areas where conditions are improving or degrading. In addition, the annual CMP report contains maps and data showing truck volumes, transit ridership, transit performance, nonmotorized facilities, Intelligent Transportation Systems (ITS), park-and-ride lots, and transportation management activities.

Development of a method for monitoring the effectiveness of implemented CMP strategies is noted as a future action item on WILMAPCO's current CMP document, which states:

> *Work with state DOTs to better coordinate data needed to conduct better analysis of completed congestion mitigation projects and the effects (positive or negative) it had. Using travel time, volume/capacity, crash statistics, and other data sources, begin to measure more accurately true benefits of transportation improvements. For example, as part of the CMP, a document should be created to review recently completed projects to gauge which ones have had a greater impact on reducing congestion. Once this analysis is completed, comparisons can be made on the effectiveness of various congestion mitigation types (or a combination of) that give the most benefit versus the cost of the project.*

MPO staff have identified several obstacles that must be overcome before this project effectiveness monitoring can occur. The first and largest obstacle is funding and resources to collect the necessary before-and-after data—ideally, this data could be collected by the State DOTs at the time projects are implemented, but WILMAPCO would need to effectively convey the value this extra effort would provide to encourage these agencies to participate. A second obstacle is the

difficulty in isolating the effect caused by implementation of a particular strategy when there are additional changes (such as development, business closures, and signal retiming) that also occur regularly, often without the MPO's knowledge. This is especially true of traffic signal retimings, which occur regularly and could have a major impact on measured congestion. MPO staff considered using the travel demand model to estimate the benefits of congestion management strategies, but decided against that method in favor of one that would be more grounded in current measurable data.

Integration With Other Processes

The WILMAPCO CMP is very closely connected to development of the TIP, but also shares connections with the MTP, freight planning, operations planning, and local planning efforts.

Metropolitan Transportation Plan

The chief connection between the CMP and MTP is at step 4, where the congestion mitigation strategies identified in the CMP are transferred to the MTP Aspirations List as potential future projects. In addition, the criteria used in the TIP project prioritization scoring process, including the congestion management criteria, are derived from the goals and objectives outlined in the MTP.

Transportation Improvement Program (TIP)

The CMP is very closely connected to development of the TIP, with CMP-based criteria forming a large portion (28 percent) of the score for TIP project prioritization, as shown under step 5. The schedule for the CMP is tied to the TIP development schedule, such that they are developed concurrently, with the CMP results feeding directly into the project selection process.

Other Plans and Processes

Data collected for the CMP are used as part of the freight planning process at WILMAPCO, and the information on truck volumes, truck routes, and freight bottlenecks generated through freight planning also serves as an input to the CMP.

Intersection turning movement data collected by WILMAPCO as part of the CMP are shared with DelDOT for its use in operations planning. In return, DelDOT converts the raw count data into an LOS performance measure that WILMAPCO is able to use in its CMP analysis.

The CMP uses turning movement and traffic count data collected by the New Castle County Planning Department as part of its development review process as an input to the CMP. The county then uses the recommended congestion mitigation strategies outlined in the CMP in its exaction negotiations with developers, with the result of requiring these strategies to be implemented at locations with new development.

Reporting and Visualization

Reporting of CMP Data and Analysis Results

WILMAPCO develops a *CMS Report* every year, outlining the process and results from that year's CMP. The report used to be a bulky document containing extensive documentation of the CMP process and requirements, and the full results of data collection. But in recent years the MPO has switched to a more user-friendly overview format that is about 40 pages. The report is broken into four main sections:

- Congestion Performance Measures – This section presents maps and explanatory text showing how all the measured roadways perform with respect to the identified performance measures, and includes a map showing a composite ranking of corridors (based on the performance measures) ranging from minor to severe congestion.

- Strategy Evaluation – This section discusses the "toolbox" of potential CMP strategies, the matrix of appropriate strategies for each CMP corridor, the projects currently programmed along a CMP corridor, and the project prioritization process. This section also includes one-page corridor profiles for each identified corridor (12 corridors in the 2009 report, the most recent available) showing a map of the corridor and statistics on transportation, demographic, and trend information.

- System Monitoring – This section describes the congestion monitoring activities undertaken as part of the CMP, including an analysis of trends in travel speed, traffic volume, freight volume, and crash rates.

- Congestion Mitigation Activities – This section provides data, maps, and explanatory text on the status of various activities/facilities related to congestion management, including transit performance, transit ridership, nonmotorized facilities, ITS, park-and-ride lots, transportation management activities, MPO data collection activities, and future CMP action items.

An appendix includes a glossary, an inventory/priority list of intersections to be counted in next year's CMP cycle, regional crash trend data, and the resolution formally adopting the *CMS Report.*

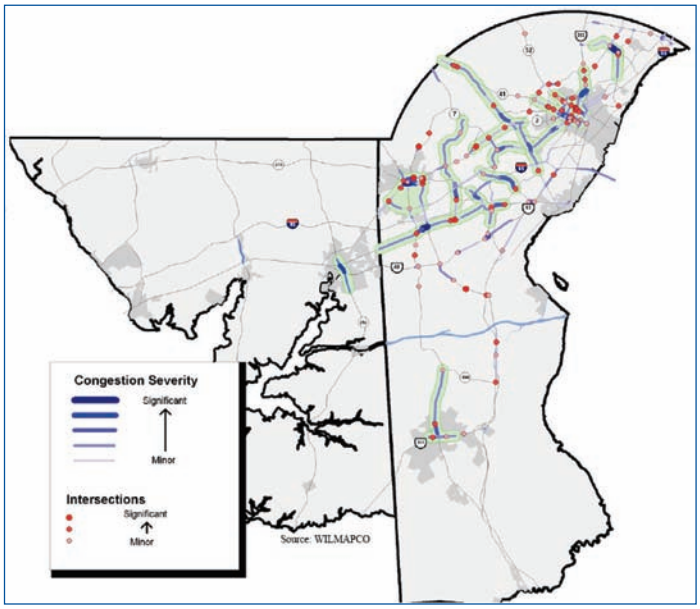
One key element of the report is its focus on graphics (maps, graphs, and tables) and limitation of text. This was done to make the report more reader-friendly and reduce its overall length, while still providing the information that would be most useful to both the public and decisionmakers. A citizen was purposely included on the CMS Committee to help ensure the CMP decisionmaking process and CMP documents would be understandable to the public.

WILMAPCO has a section of its Web site that is devoted to the CMP, with a link to the most recent *CMS Report* available as well as several older documents. The Web site also has links to interactive online versions of the maps that are found in the *CMS Report,* which are described in more detail below.

Visualization Practices

WILMAPCO makes extensive use of maps and charts within the *CMS Report,* including maps of almost every data element or performance measure included in the CMP analysis. The region-wide maps are standardized so that the same area and scale are shown on maps throughout the document, making them easier to understand. The maps are also developed to only show one or two data items each, making them easier to read and understand. Regional and detailed maps are also provided for each of the identified CMP corridors. Graphs are used to show items such as regional travel time and crash rate trends.

Figure 2: Static Map of Congested Corridors



Source: WILMAPCO, 2009 WILMAPCO Congestion Management System Summary, 2009

Figure 3: Interactive Map of Congested Corridors From CMP Web site

Source: WILMAPCO, http://www.wilmapco.org/cms/

The WILMAPCO Web site provides links to interactive maps, developed using Google Maps, which show the same regional performance measure, trend, congested corridor, and mitigation strategy data that can be found in the print report. These maps allow viewers to pan and zoom so they can see the data on either a regional or a detailed scale. For example, users can zoom to the street level in their community or neighborhood to find the specific data for that area. Clicking on features on these maps allows viewers to see the underlying data in a pop-up box. These maps have been very well received by the public.

Lessons Learned and Challenges

The chief lesson learned by WILMAPCO is the necessity of good data. The data used in the CMP must be current, clean, understandable, and above reproach if they are going to be used as a primary determinant of project funding priorities. The relative stability of the data and performance measures used in the CMP at WILMAPCO has helped maintain this data integrity and public understanding of the CMP.

A second key lesson learned is the importance of having a good subcommittee to guide the CMP. The committee tends to keep the process grounded in reality, preventing it from overreaching in terms of the scope of analysis. In particular, a former member of the committee, who has since retired, was very effective at leading the committee and keeping the CMP on task—he was a major proponent of tying the performance measures to existing data sources. Having a member of the Citizens Advisory Committee on the CMS Advisory Committee has also been a very effective way to keep the CMP from being lost in the weeds of technical analysis and data. This citizen representative helps ensure the process remains simple and transparent enough for the public to understand.

The largest challenge WILMAPCO faces with regard to its CMP is measuring the effectiveness of implemented congestion management strategies. The MPO has identified the steps it would like to implement to conduct this type of analysis, but has also identified several obstacles that must be overcome, including data collection needs and isolating specific causal relationships within the collected data.