Congestion Management Process: A Case Study

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

Southwestern Pennsylvania Commission

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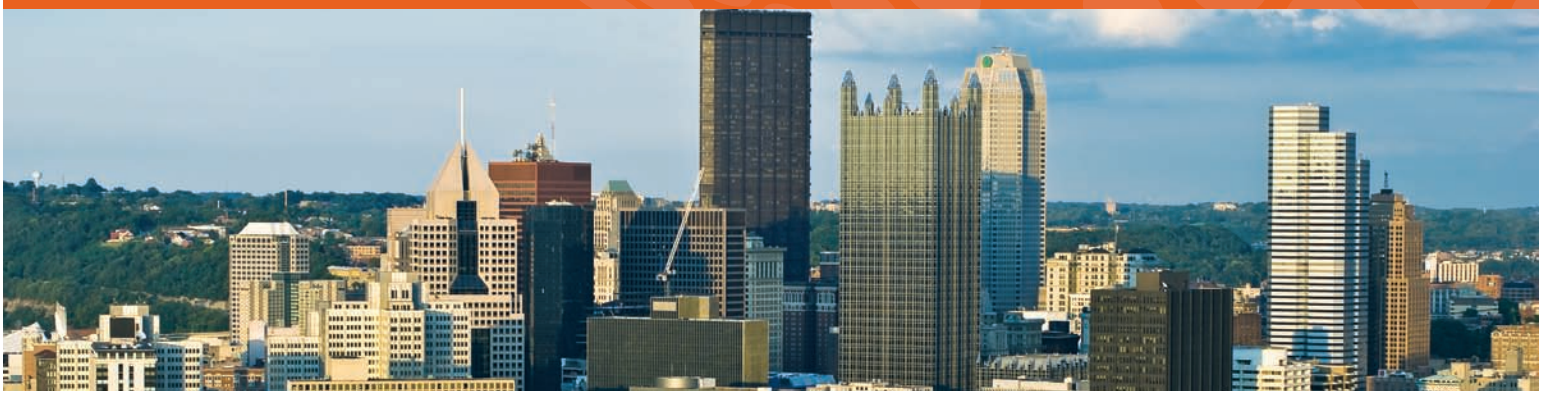


The Congestion Management Process (CMP) at the Southwestern Pennsylvania Commission (SPC) is organized around five key elements: (1) planning and system definition, (2) data collection and analysis, (3) strategy evaluation, (4) strategy implementation and project programming, and (5) monitoring strategy effectiveness. Of particular note in the process are the extensive data collection program, efforts to tie CMP strategies into project selection, use of case studies for monitoring strategy effectiveness and encouraging future projects, and use of the Internet for storing, organizing, and presenting CMP data and analysis products.

Southwestern Pennsylvania Commission

Source: SPC

Background on SPC

Pittsburgh is located at the center of a 10-county region in the southwestern corner of Pennsylvania. SPC is the region's forum for collaboration, planning, and public decisionmaking. As the official Metropolitan Planning Organization (MPO) for the region, which includes 548 municipalities, SPC is responsible for planning and prioritizing use of all State and Federal transportation funds allocated to the region. The Commission has the authority and responsibility to make decisions affecting the region.

CMP Process Model

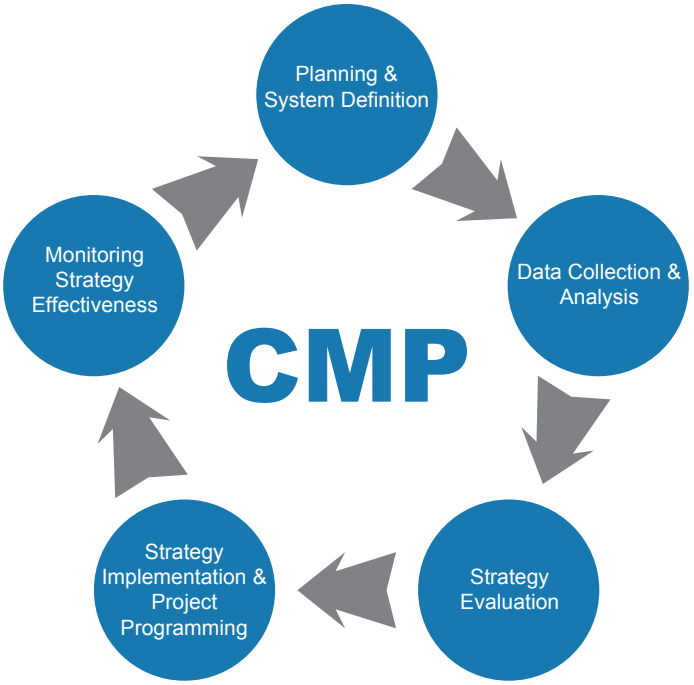
SPC has developed a five-step CMP, as shown in the figure at right. The process is cyclical but can generally be considered to begin at the Planning and System Definition step shown at the top of the diagram. The first two steps in the process, Planning and System Definition and Data Collection and Analysis, have been fully developed and represent the strongest elements in SPC's overall CMP process. However, significant headway has also been made in defining and refining the three remaining steps in the process.

Step 1 – Planning and System Definition

This step begins with definition of the roadway network to be examined in the CMP, and is conducted every 3 years. The goal of this definition process is to create a set of about 100 corridors throughout the region that have congested characteristics. The total number of corridors is limited in this way to ensure there are adequate resources for data collection on all the identified corridors. An effort is made to include at least one congested corridor in each county, and to include corridors in the less urban parts of the region that are locally considered to have congestion even though the scale of the congestion is likely to be much less than that found in the more urban areas.

SPC staff develop a draft list of corridors to be considered at the beginning of each 3-year data collection period, and provides this list to the Operations and Safety Committee, Transit Committee, and Transportation Technical Committee for comments and vetting. Over the years, this process has required less and less effort, as a relatively stable set of corridors has been established and only minor changes are typically necessary when the time comes to update the system. Any major changes that are made in the future will go for approval through the Transportation Technical Committee, which is made up of representatives from the Pennsylvania Department of Transportation (PennDOT) and county planning departments, as well as the other committees. The Operations and Safety Committee and the Transit Committee serve in an advisory role only.

CMP Process Model



Adapted from a graphic provided by Southwestern Pennsylvania Commission (SPC)

As the final element in this step, SPC updates its map products to show the revised network of corridors, including maps on the SPC Web site. Corridors that were previously studied but eliminated from the system have their maps and data archived in a section of the Web site labeled "Retired Corridors."

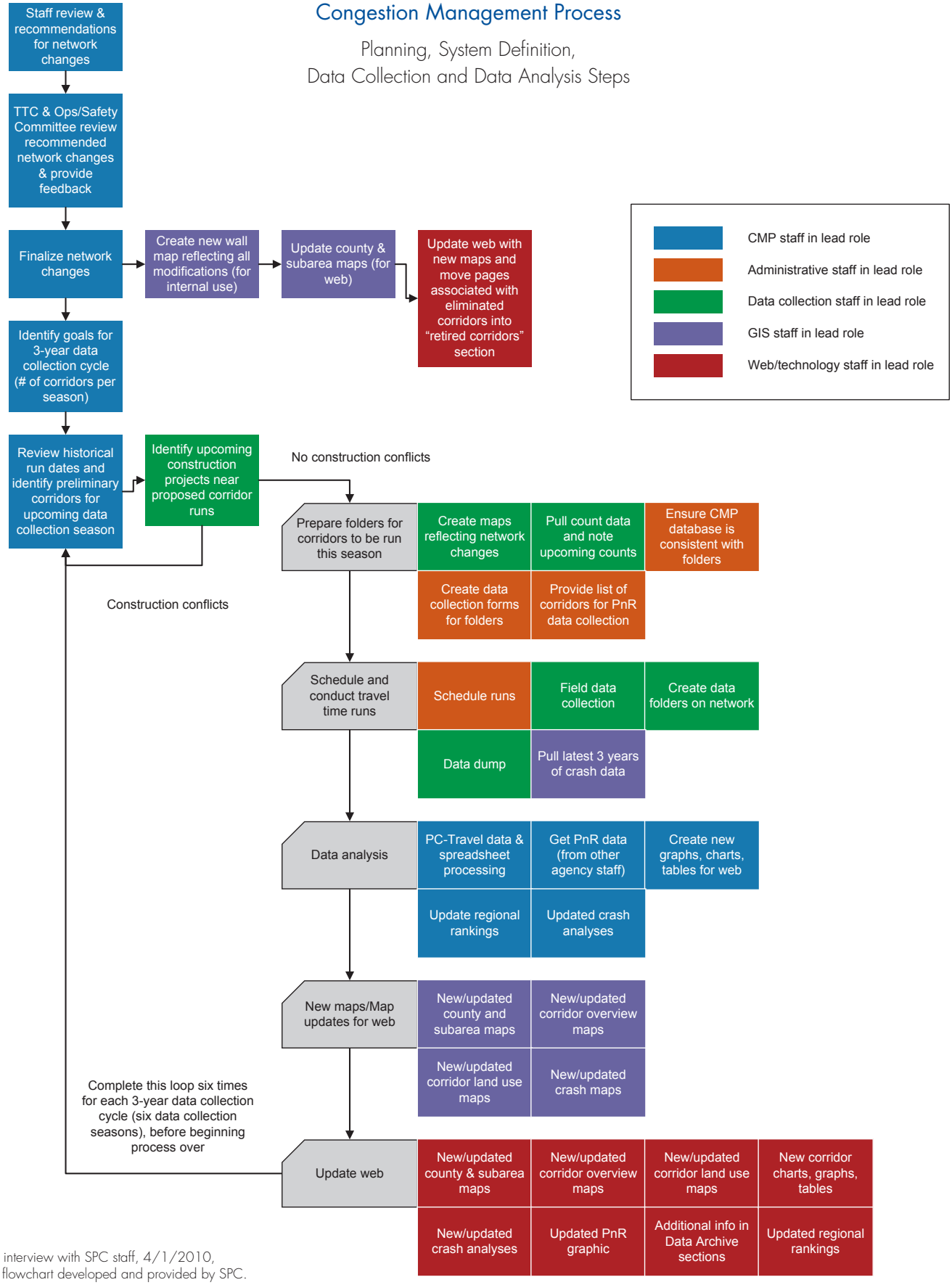
Step 2 – Data Collection and Analysis

This step represents the bulk of technical activity in the CMP. The figure on the next page provides a detailed process map of this step (in addition to step 1).

SPC collects data on travel time, speed, and delay on a 3-year cycle, using in-house staff and equipment. Each year within the cycle is divided into two data collection seasons (spring and fall), creating a total of six seasons over which to spread the entire effort. At the beginning of each cycle, following definition of the CMP roadway network, a plan is developed showing which corridors will have data collected

Congestion Management Process

Planning, System Definition,
Data Collection and Data Analysis Steps



Based on interview with SPC staff, 4/1/2010,
and on a flowchart developed and provided by SPC.

during each season—to the extent possible, this schedule is coordinated with planned construction projects to ensure data will not be collected when construction projects will significantly affect traffic. The schedule is somewhat flexible and can be changed as needs arise. Generally, data are collected on 15–18 corridors each season.

SPC has a data collection staff that consists of three people. CMP data collection is only one of this group's responsibilities, which also include traffic counts and Highway Performance Monitoring System data collection. Collection of CMP data consumes roughly half the time of one member of the data collection staff, in addition to administrative/management tasks performed by the data collection supervisor. In addition, the SPC staff member responsible for conducting the CMP process also collects data on a limited number of corridors. In total, the level of effort required for this data collection is equal to about 1.5 full-time employees during the spring and fall.

SPC has developed an extensive folder system for collecting and storing data on corridors in the CMP network. Each corridor has a folder containing maps, information on time-point nodes along each corridor, sheets for recording travel times and notes, an orientation sheet used to conduct a dry run and collect speed limit and traffic signal data, and traffic count information. This creates a single source of archived information for both the CMP staff and data collection staff to use for reference.

Travel time, speed, and delay information is collected by performing travel time runs along each corridor. Multiple runs are conducted in each direction along each corridor for both the AM and PM peak periods. Runs are generally conducted for about 3 hours each morning and 3 hours each afternoon, with the number of runs completed each day being a function of the length and level of congestion on a corridor.

On most corridors, GPS receivers are used to collect the time and speed data; however, tunnels, valleys, or other features make use of the global positioning system (GPS) impractical on several corridors. On these corridors, data are collected using the On-Board Diagnostics-II (OBD-II) tool, which connects to a vehicle's onboard diagnostic system. SPC originally used OBD-II for all its travel runs, but switched to GPS for most runs for several reasons: the GPS method is safer because it does not require the driver conducting the travel time run to "mark" the time-point nodes (these can be marked later based on the geographic information provided by the GPS unit), and GPS provides a dataset that can easily be integrated with geographic information system (GIS) files. Information from both the GPS and OBD-II systems is fed into the PC-Travel computer program, which compiles the data and calculates the average travel times and speeds along each corridor based on the multiple runs. Spreadsheets are then developed containing this data, as well as the speed limit data collected in the field and the most recent traffic count data available.

In addition to the travel time and traffic count data, two other data sources are used in the CMP process, primarily in an informational role. Crash data, provided by the State, are used as a proxy measure of nonrecurring congestion issues. Park-and-Ride lot utilization data, collected by another group within SPC, are used to help assess transportation demand management (TDM) and transit-related services in the corridors. SPC also has access to Intelligent Transportation System (ITS) data available from PennDOT and traffic flow data available from traffic.com—this information is typically used for traffic counts and before-and-after studies.

One difficulty faced in data collection is collection of transit operations data. There are 10 transit agencies in the region, and consistent, readily accessible boarding or ridership data are generally unavailable. A regional transit smartcard program is in development, and this might enable better data collection and coordination in the future, leading to incorporation of transit data and measures into the CMP.

Following data collection, the next step is data analysis. This step is conducted by a transportation planner who is responsible for overseeing and conducting the CMP. After completion of a full season of data collection, the CMP planner spends about 1 week analyzing the data in terms of performance measures that SPC has chosen to use. The primary performance measures are travel time, speed, and delay, but these are broken into more specific measures such as: (1) delay per vehicle (actual travel time compared with theoretical travel time at posted speed limit), (2) total delay (delay per vehicle factored with traffic volumes), (3) delay per vehicle per mile, and (4) total delay per mile. Each of these performance measures is calculated for a daily, AM, and PM value. The intention of measuring time, speed, and delay

in several different ways is to ensure that different types of congestion are all addressed by the CMP. A policy decision was made to compare the observed travel speeds with the posted speed limits rather than the free-flow travel speed to ensure that this process would not contravene the intentions of the speed limit laws.

As part of the analysis, SPC does not set a specific threshold defining what an acceptable level of congestion is. However, the analysis does result in regional rankings of the level of congestion of each corridor. Rankings of the corridors are created for each of eight performance measures and are broken out by urban street classification so different types of roadways that are not comparable are ranked separately.

After analyzing the data, SPC posts them to its Web site. The CMP has a page on the site with an extensive array of archived and current data and maps. This information is updated about every 6 months, following each data collection season, allowing rapid access to this information for the public and partner agencies. Maps on the Web site are currently static and are updated as necessary when the CMP network is defined at the beginning of each 3-year cycle—however, future plans call for use of Google maps on the site, which could be more interactive and dynamic. Maps of land use in the corridor are also provided as a static informational resource. Crash data on the Web site are updated every 2 years, based on data provided by PennDOT. Data on the Web site are also presented in a variety of tables and graphs.

Step 3 – Strategy Evaluation

The strategy evaluation phase of the CMP is still a work in progress at SPC. Several methods of conducting a strategy evaluation have been tried over the years, with mixed results. This is an area of the CMP process that SPC staff are currently working to improve.

SPC has developed a basic toolbox containing 25 different congestion management strategies that can be applied to corridors within the CMP network. This toolbox of potential strategies serves as the foundation for strategy evaluation and implementation. A two-tier system has been developed for evaluating which strategies are appropriate in each corridor: the first tier assesses how difficult the strategy would be to implement in the corridor, while the second assesses the relative level of congestion relief (benefit) the strategy would provide in the corridor. This two-tier system was developed to replace an initial system that evaluated projects solely on ease of implementation. Each strategy is assigned a letter grade for suitability and ease of implementation (A–C denoting a relative scale of high-to-low suitability and ease of implementation, and D denoting an unsuitable strategy) and a number score of 1–3 denoting the relative level of congestion relief (benefit) the strategy would provide. These scores are then combined to generate a set of high-, medium-, and low-priority strategies for each corridor, as shown in the figure at right.

SPC has tried several methods of evaluating strategies for the CMP. The largest of these efforts was to develop subregional working groups around the 10-county region that would review the data collected in each subregion, help identify the causes of local congestion issues, define thresholds for performance measures, evaluate and select appropriate strategies for implementation, and report on implementation activities occurring at the project level. However, interest in participating in these working groups was very low and the effort was abandoned. Because there was still a need for a baseline evaluation of potential strategies to assist in the strategy implementation and project programming step (step 4), SPC staff have conducted an internal analysis to set baseline

Two-tier system for evaluating strategies

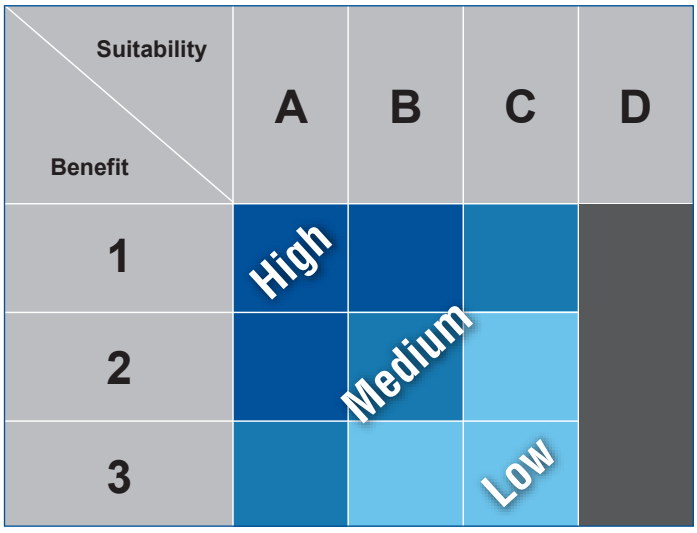


Figure provided by SPC (http://www.spcregion.org)

strategies for each corridor. This analysis was based on the collected travel time data and notes from data collection staff, a site visit by the CMP coordinator, and professional judgment. However, because this internal work has not been confirmed or justified by the State and local government partners, there was some reluctance to rely on the analysis or publish the information on the CMP Web site.

There is desire within SPC to develop a method for evaluating strategies that will involve input and buy-in from the agency partners in addition to staff-level analysis. One way this has been successfully done in the region is by coordinating with other planning efforts that occur at the local level. In Cranberry Township, a growing suburban area, there was interest at the local level in coordinating the CMP with its comprehensive plan, allowing the CMP strategies to be tailored to the specific conditions there. This method has been successful in addressing conditions in localized areas, but is not broad enough to work on a region-wide scale.

Currently, this strategy evaluation step is in flux. The baseline analysis developed by staff is used as an input to the project selection process on an interim basis, but staff are working to determine a better process for this step in the long term. Because of this uncertainty, there is not a set schedule for updating the strategy evaluation for individual corridors.

Step 4 – Strategy Implementation and Project Programming

There are several ways in which the CMP has an impact on the project selection and development process in southwestern Pennsylvania. The most prominent of these is the role that the CMP has in the scoring process used to select projects for funding. For example, the Congestion Mitigation and Air Quality Improvement (CMAQ) program project selection process at SPC involves an open call for projects every 2 years (in conjunction with TIP updates). One of the scoring criteria for CMAQ is whether a project is located on a CMP corridor, and how well the project incorporates the recommended CMP strategies in that corridor. Within the TIP itself, SPC has divided funding into seven investment categories. In the Efficiency and Operations category, priority is given to projects that will implement high- and medium-priority strategies identified as part of the CMP. The "total delay" performance measure developed in the CMP is also a criterion in selection of Efficiency and Operations projects. In recent years, however, very little funding has been available through the traditional TIP process, as a large portion of TIP funding has been focused on bridge replacement and maintenance, and most funding for CMP-related projects has come from CMAQ (including Efficiency and Operations projects). However, SPC staff believe this will be an effective process to use when more funding becomes available in the future.

One unique outgrowth of SPC's CMP process is development of a regional traffic signal program, which is funded through the CMAQ program. Virtually all traffic signals in the SPC region are controlled by municipal governments, and with more than 500 municipalities in the region, this has resulted in difficulty with signal coordination, timing, and upkeep. An SPC staff member is assigned to coordinate the traffic signal program for the region, which assists municipalities through two types of projects: "SINC" projects involve retiming signals to better handle current traffic patterns, while "SINC-UP" projects involve both retiming and updates to traffic control equipment. The traffic signal program does not provide funding for full replacement of obsolete signals or major signal system improvements, only minor upgrades and retiming. Whether a project is located in a CMP corridor and operational improvements are recommended as a CMP strategy is a major element in the selection process for SINC and SINC-UP projects. SPC staff proactively target municipalities where operational improvements are recommended in the CMP, and encourage them to apply for traffic signal program projects.

In addition to the project selection process, the CMP also plays a role in the project development process. PennDOT places strong emphasis on connecting the planning and NEPA processes. As a result, there is coordination between NEPA practitioners at PennDOT and planners at SPC to ensure coordination and consistency, and to share data. All capacity-adding projects are checked to see whether they are located on a CMP corridor. If they are, staff check to ensure that the congestion management strategies identified in the CMP are considered in the NEPA alternatives analysis.

When SPC used to develop paper-based reports for the CMP, part of the report included a table that tracked each single-occupant vehicle (SOV) capacity-adding project in the TIP and

metropolitan transportation plan (MTP) with regard to whether it incorporated the strategies recommended in the CMP. With SPC's migration to a Web-based reporting structure for the CMP and the overall reduction in the number of SOV capacity-adding projects in the region (very few are currently planned), the decision was made to drop this table, as it was unnecessary and burdensome to create. However, SPC does still conduct reviews of SOV capacity-adding projects when requested by PennDOT. Typically, PennDOT will notify SPC of a project and SPC will provide documentation on the strategies recommended in the CMP for coordination and insertion in the NEPA documentation.

Step 5 – Monitoring Strategy Effectiveness

Originally, when SPC developed paper-based reports for the CMP, it included an extensive series of tables that tracked the effectiveness of implementing the strategies outlined in the CMP. This was a very labor-intensive process that required extensive research into the project activities of a very large number of State agencies, local governments, and transit agencies. In addition, the product was only updated every 3 years (at the end of a data collection cycle) and was so long and dense that it was not considered practically useful. As a result, following the final paper report in 2005, this process was abandoned in favor of one that would provide more meaningful insight into the effectiveness of the CMP.

The new process consists of a series of example project case studies that are posted on the CMP Web site. Effort has been made to provide examples of each of the 25 strategies noted in the CMP toolbox (with the exception of strategies that have not yet been implemented in the region). Several of the case studies include before-and-after data to highlight the congestion improvements generated by the project. There have been several benefits to this approach: It is simpler to research, requiring less staff time; it provides tangible local examples of the benefit of implementing CMP strategies, which is helpful in encouraging local officials to pursue these improvements; and it provides information on the effectiveness of all the different types of strategies, not only the handful of strategies that might be covered by a standard large TIP project.

Evans City Traffic Signal Case Study

Evans City is a small community that had a major congestion problem at peak hours. An analysis by SPC, as part of the traffic signal program, found that much of the congestion was attributable to the timing of the signals in town and the practice of stopping traffic to allow vehicles into and out of a school. By retiming the signals, repairing broken signal loop detectors, modifying intersection pavement markings, and working with the police department to allow more vehicle queuing at the school (stopping mainline traffic fewer times), PM peak-hour travel times through Evans City were reduced by 64 percent and delay was reduced by 84 percent. SPC developed a video showing traffic conditions before and after the improvements were made, and this has been a very effective tool for encouraging local governments to participate in the traffic signal program.

Integration With Other Processes

The CMP at SPC is integrated with several other plans and processes, both within and outside the agency. SPC has also identified several points at which improvements could be made to better coordinate CMP efforts with other processes, including the MTP and highway occupancy (driveway) permit (HOP) process.

Metropolitan Transportation Plan

The primary connections between the CMP and the MTP are with objectives and strategies; however, the connections between these processes are not clearly defined in the current CMP. The current process does not specifically address congestion-related objectives, although broad objectives supporting the CMP can be found in the MTP. However, the project selection criteria for Efficiency and Operations projects

are the same for both the TIP and MTP, so that connection applies to the MTP as well. In addition, the MTP incorporates the Regional Operations Plan (ROP) as its operations element, and there are existing and planned connections between the CMP and ROP (discussed).

Transportation Improvement Program

Because many Efficiency and Operations projects are smaller in nature and covered by line items in the MTP rather than being listed as specific projects, the TIP is the primary place where the CMP influences project selection/programming. As discussed under step 4 above, the TIP is divided into six funding categories, each of which has individual project prioritization criteria. The scoring process for the Efficiency and Operations category provides extensive weight to the CMP by giving points to projects that are in CMP corridors and giving more points to projects that include more high-priority CMP implementation strategies. The "total delay" data collected as part of the CMP are also a criterion in selection of Efficiency and Operations projects.

In addition, the CMAQ funding process, which is conducted separately from the TIP process, gives scoring weight to projects that are located in CMP corridors and include recommended CMP strategies. The traffic signal program, which also scores projects based on their alignment with CMP strategies, is also funded under CMAQ.

Project Planning and NEPA Documentation

As part of the project planning process, any projects in the region that will increase SOV capacity must be checked to ensure consistency with the CMP. Typically, when PennDOT identifies a project that fits this category, it contacts SPC to ensure consistency. Most important, if congestion relief is a stated purpose of the project, PennDOT must ensure the project is within one of the identified congested corridors. In addition, SPC provides information on the recommended CMP strategies for that corridor to inform the project development process, including the NEPA process.

With specific regard to NEPA, PennDOT is developing a program encouraging linkages between planning and the NEPA process. As a result, when PennDOT is working on a NEPA document, one of the items on its draft checklist is to find out whether the project is located in a CMP corridor. If it is, the agency would contact SPC to find out what the recommended strategies are in that corridor to ensure the strategies are addressed in the alternatives studied as part of NEPA.

Other Plans and Processes

PennDOT has worked with SPC to develop a ROP, which SPC also uses as the operations component of its MTP. Currently the ROP focuses primarily on ITS, but SPC sees future updates of the plan as an opportunity to broaden its scope and integrate CMP strategies with operations planning. One of the goals of the ROP is to develop regional goals and objectives related to operations, which could then be used as goals and objectives within the CMP process. Another goal of the ROP is to develop region-level performance measures for operations, which would complement the corridor-level performance measures used in the CMP.

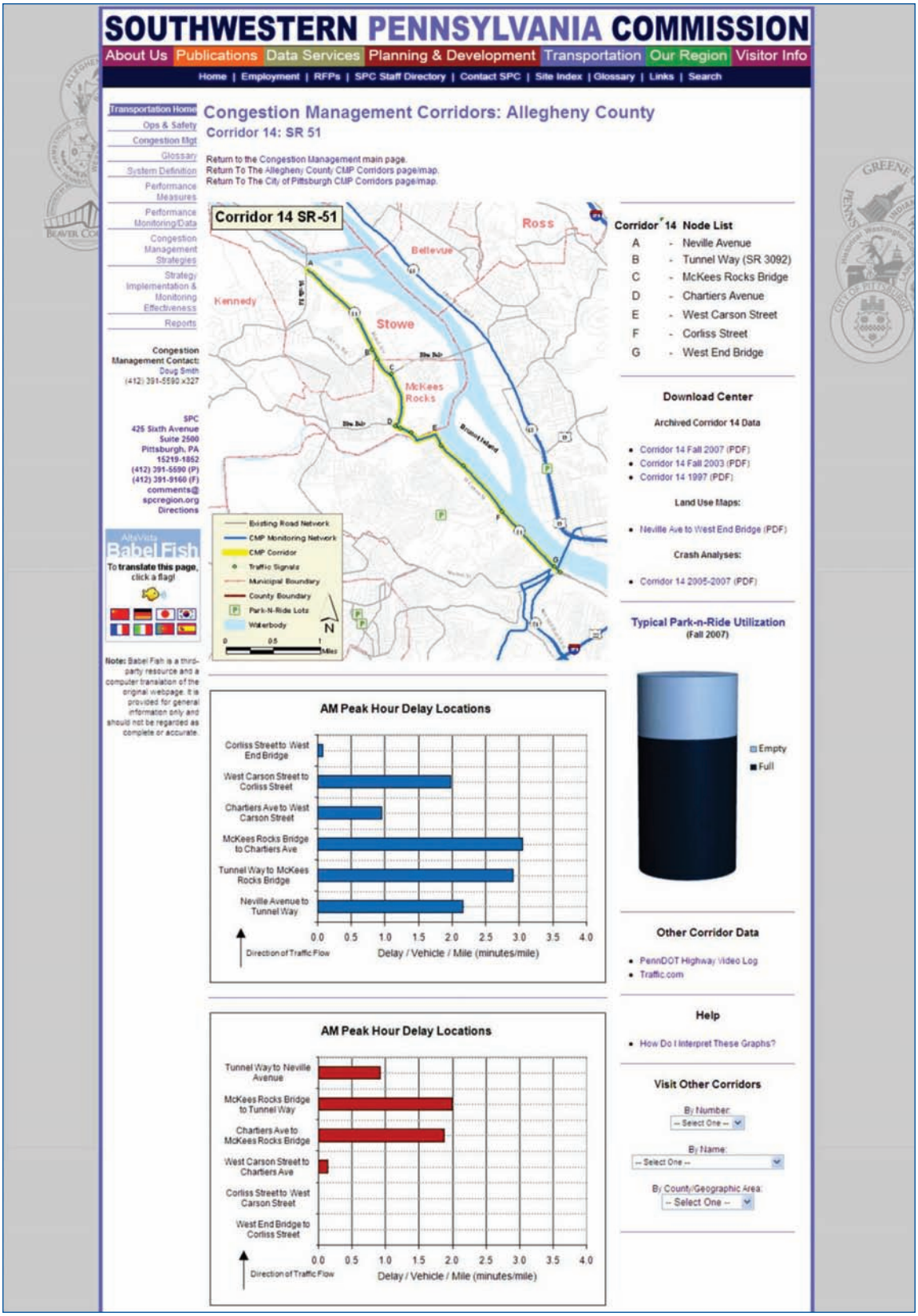
SPC has worked with several local governments to collaborate and coordinate CMP strategies with comprehensive plans and land use plans. Some local governments have also used CMP data and strategies as starting points in development of more detailed corridor studies. PennDOT previously had a Congested Corridor Improvement Program that provided funding for detailed study of congested corridors—SPC has traditionally used the CMP as a tool for nominating project corridors for this program. In addition, SPC has identified the potential for collaboration with PennDOT as part of its HOP process to ensure that CMP strategies are considered when new access points are created along CMP network facilities. The connection with the HOP process is currently only an idea, but may be implemented sometime in the future.

Reporting and Visualization

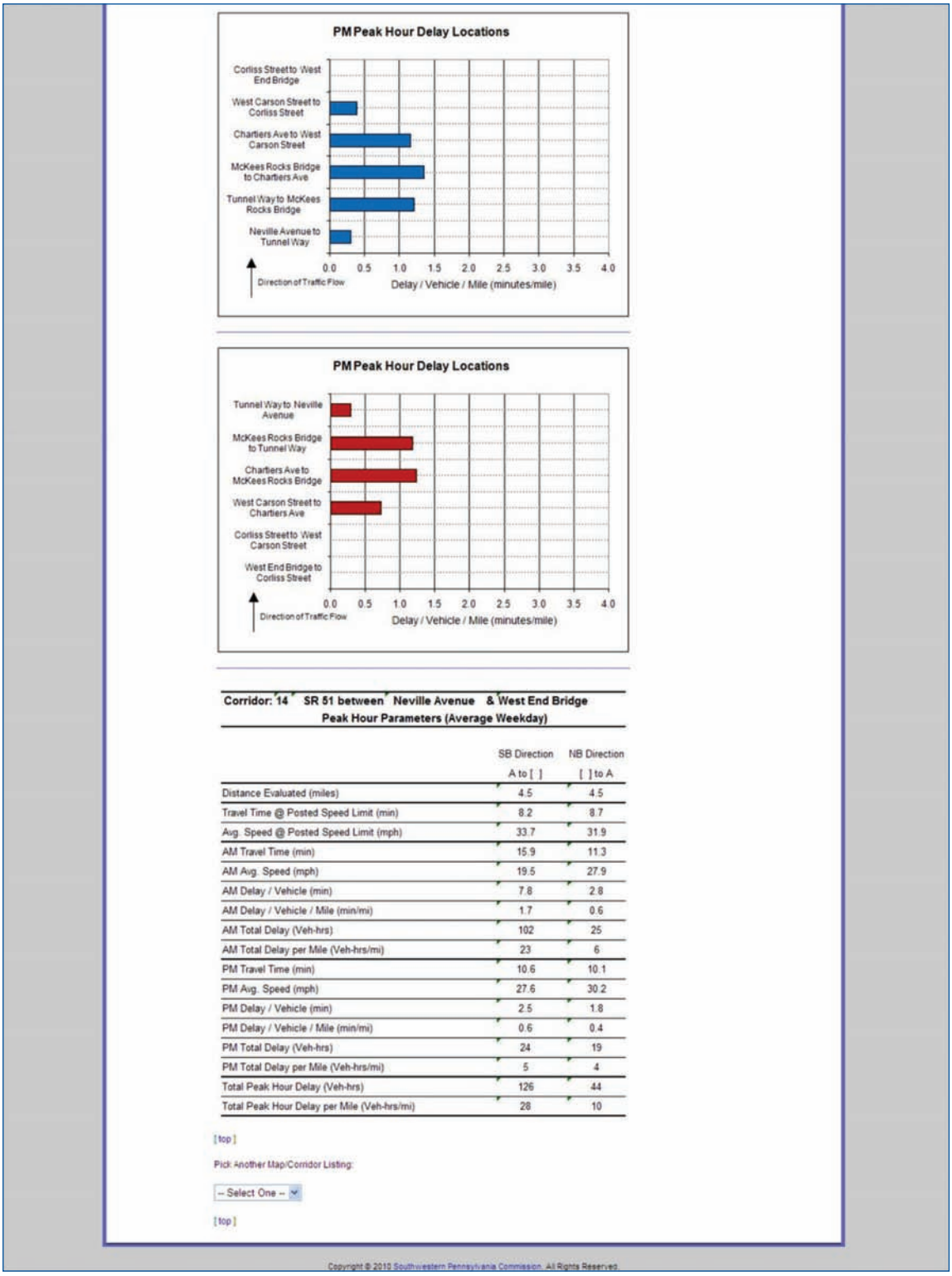
Reporting of CMP Data and Analysis Results

Currently, SPC uses its Web site to provide information about the data collected and analysis performed as part of the CMP. SPC switched to this Web-based reporting system following release of its final paper-based CMP report in 2005. There were several reasons for the change from paper-based reports

Screenshot of SPC Web site, showing data available for a typical CMP corridor (part 1 of 2).



Screenshot of SPC Web site, showing data available for a typical CMP corridor (part 2 of 2).



Corridor: 14 SR 51 between Neville Avenue & West End Bridge
Peak Hour Parameters (Average Weekday)

	SB Direction A to [ ]	NB Direction [ ] to A
Distance Evaluated (miles)	4.5	4.5
Travel Time @ Posted Speed Limit (min)	8.2	8.7
Avg. Speed @ Posted Speed Limit (mph)	33.7	31.9
AM Travel Time (min)	15.9	11.3
AM Avg. Speed (mph)	19.5	27.9
AM Delay / Vehicle (min)	7.8	2.8
AM Delay / Vehicle / Mile (min/mi)	1.7	0.6
AM Total Delay (Veh-hrs)	102	25
AM Total Delay per Mile (Veh-hrs/mi)	23	6
PM Travel Time (min)	10.6	10.1
PM Avg. Speed (mph)	27.6	30.2
PM Delay / Vehicle (min)	2.5	1.8
PM Delay / Vehicle / Mile (min/mi)	0.6	0.4
PM Total Delay (Veh-hrs)	24	19
PM Total Delay per Mile (Veh-hrs/mi)	5	4
Total Peak Hour Delay (Veh-hrs)	126	44
Total Peak Hour Delay per Mile (Veh-hrs/mi)	28	10

[top]

Pick Another Map/Corridor Listing:

-- Select One --

[top]

Source: SPC Web site, http://www.spcregion.org/trans_cong_corr14.shtml

to a Web-based system, including the ability to provide updated data and analysis on a rolling basis as they become available, rather than once every 3 years; the ability to disseminate the information more broadly; and a format that allows more flexibility and customization, and is easier for users to drill down directly to the information they are interested in.

All information related to the CMP is made available on the SPC Web site, including a description of the CMP process, description of the data collection process and method of calculating performance measures, current and archived data and maps for each CMP corridor (including retired corridors), case studies of implemented strategies, and copies of the old paper-based reports. This Web-based format will be easier for SPC staff to update and maintain, and will be more useful as a product both within SPC and for external partners. For example, when PennDOT recently released a request for proposals for a freeway project, SPC received multiple requests for CMP data from potential bidders, and was able to direct these requestors to the Web site to find all the available information.

Visualization Practices

Visualization, primarily in the form of maps, is an important element of SPC's CMP. The CMP Web site uses regional and corridor-level maps in several ways, including reference maps, land use maps, and crash maps. Currently, these are static maps created using GIS and posted to the Web site. In the future, these are likely to be created using Google Maps as the platform, allowing viewers to zoom and customize the maps (SPC has started to experiment with using this format). In addition, SPC has made use of video as part of its monitoring and evaluation process. For example, a video was created to show the flow of traffic in the borough of Evans City before and after implementation of a traffic signal improvement project. This video has been an invaluable tool for educating elected officials and the public about the need for congestion management projects.

Lessons Learned and Challenges

The biggest lesson that SPC has learned as result of conducting the CMP is the importance of a well-documented, step-by-step process. This has created a data collection and analysis system that runs efficiently and has proven very helpful in cases of staff turnover. In addition, the Web-based system for organizing and disseminating CMP information has proven to be much more useful in practice than the previous paper-based CMP reports.

The biggest challenge that must be overcome as part of the CMP process is to make outside partners understand the value of the CMP. Many partners at State and local governments see the CMP as a procedural hurdle that must be overcome before they can fund or implement a project. The challenge for SPC is to educate these partners and help them see the CMP as a value-added service rather than a hurdle. One area where SPC has been successful in this regard is with the PennDOT traffic engineering staff, who often use the CMP as a data reference. Ultimately, to make people understand the importance of the CMP, there must be a stronger connection between it and the project selection process. The role of the CMP in the CMAQ and TIP Efficiency and Operations project selection processes has helped to raise its profile, but it still has relatively little influence on the TIP as a whole. SPC also uses the MPO Operations and Safety Committee, which is an open forum/committee that discusses these issues in an advisory role, as a forum to promote the CMP.