Roadway Safety Data Program

DELAWARE VALLEY REGIONAL PLANNING COMMISSION (DVRPC) INTEGRATING SAFETY INTO THE PLANNING PROCESS AT THE MPO LEVEL

STRATEGIES FOR USING GIS TO ADVANCE HIGHWAY SAFETY

CASE STUDY

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Roadway Safety Data Program

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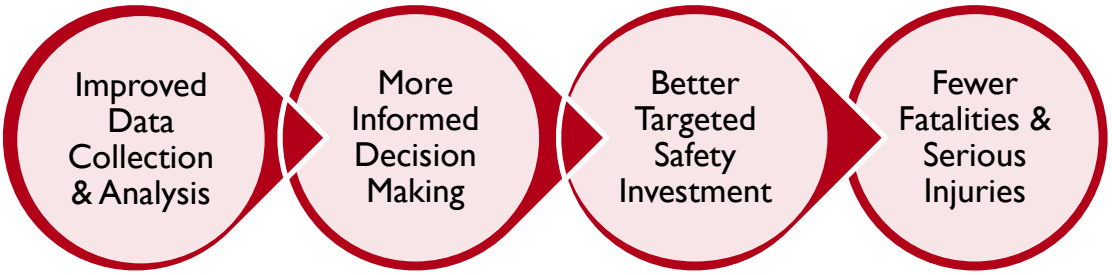

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Safe Roads for a Safer Future
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CASE STUDY OVERVIEW

OBJECTIVE

The main objective of this case study is to illustrate how Delaware Valley Regional Planning Commission (DVRPC) successfully uses GIS to incorporate safety into one or more elements of the transportation-planning process.

BACKGROUND

Transportation planning is a continuous, comprehensive, and cooperative (3C) performance-driven process by which States, metropolitan transportation planning organizations (MPOs), and transit operators determine long- and short-range transportation improvement priorities. In addition to the entities cited, the planning process includes the active involvement of the traveling public, the business community, and other stakeholders.[1]

On December 4, 2015, President Obama signed the Fixing America's Surface Transportation (FAST) Act (Pub. L. No. 114-94) into law—the first federal law in over a decade to provide long-term funding certainty for surface transportation infrastructure planning and investment.[2] The FAST Act continues all of the metropolitan planning requirements that were in effect under MAP-21. Increasing the safety of transportation system for motorized and nonmotorized users was among the eight planning factors for Metropolitan Transportation Planning.[3] The new legislation emphasizes performance management within the Federal-aid highway program and transit programs and requires that State, metropolitan, and nonmetropolitan transportation planners use performance-based approaches—often referred to as performance-based planning and programming (PBPP).[4] With PBPP, transportation entities make decisions based on data and evidence so that transportation investments remain realistic and achievable.

A GIS-based safety analysis will greatly help the data-driven, decision-making process develop various planning documents that address these requirements, as well as prioritize long- and short-range transportation improvements.

KEY ACCOMPLISHMENT

Integrating GIS-based safety analysis into the planning process accomplishes a data-driven, decision-making process, which promotes better safety decision making. It also helps agencies develop performance-based planning and programming to meet requirements for accessing Federal safety funds. The principal output of a data-driven, GIS-based safety analysis is the agency's ability to identify and prioritize high-crash locations and information that is integrated

into various transportation plans along with other planning components, such as congestion, air quality, green design, etc.

TARGET AUDIENCE

This case study discusses how DVRPC's member counties and cities use GIS-based safety analysis tools. The information provided in this case study is useful to any transportation agency staffs including planners, designers, traffic engineers, and highway safety professionals, who are interested in integrating safety into the planning stages of a project using GIS-based analysis techniques.

PROGRAM AND PROCESSES—INTEGRATING DVRPC'S SAFETY ANALYSIS INTO PLANNING

Working closely with the partner agencies from New Jersey and Pennsylvania, the DVRPC developed a systematic, data-driven approach to crash analysis that has become a standard component in much of the DVRPC transportation planning work. The approach includes several GIS-based analyses, which allow the agency to:

1. Weigh the Transportation Improvement Program evaluation criteria (which uses safety as its number two criterion);
2. Update the DVRPC Transportation Safety Action Plan;
3. Identify candidate locations for the DVRPC's safety studies program, which includes road safety audits and other crash data-based studies; and
4. Use GIS-based Web maps to share HSIP-eligible locations with New Jersey county and city partners as they consider project development.

The following section explores these uses for GIS-based analysis.

1. GIS-BASED ANALYSIS TO WEIGH THE TRANSPORTATION IMPROVEMENT PROGRAM (TIP) EVALUATION CRITERIA (WHICH USES SAFETY AS THE NUMBER TWO CRITERION)

Working with the partners, DVRPC developed the Transportation Improvement Program (TIP) evaluation criteria process. The purpose of the TIP evaluation criteria process is use the criteria as indicators of regional benefit related to the goals of the Transportation Long Range Plan and score each project in the plan. The process uses a Web-based, decision-making tool to weigh the criteria. The whole process involves using GIS to compare potential project locations with data layers and assigns a score driven by criteria. The following nine elements of the DVRPC TIP evaluation criteria incorporate safety[5] as the second criterion:

1. Facility/Asset Condition
2. **Safety**
3. Reduce Congestion
4. Invest in Centers
5. Facility/Asset Use
6. Economic Competitiveness
7. Multimodal Bike/Pedestrian
8. Environmental Justice
9. Air Quality/Green Design

The DVRPC Regional Technical Committee, which includes county and transportation agency planners and engineers, uses a series of pairwise comparisons that directly estimate the relative

importance of each criterion weighted in the decision-making tool. Candidate projects can receive a maximum score of one (1) point for each criterion, depending on how well it meets the predefined requirements. Each project receives a total score, which is equal to the sum of the weight times the rating for each criterion. The tool can compare a project's estimated total State and Federal cost to the total score, as a benefit-cost ratio. Other sources of funding that may increase a project's benefit-cost ratio, such as additional local funding beyond match requirements, nontraditional funding grants, and developer or private contributions, will not count toward a project's cost for the benefit-cost ratio. The tool provides a process for ranking projects with the highest benefit-cost ratios. However, while the Regional Technical Committee recommends, ultimately, the DVRPC Board makes the final decisions to determine TIP project selections.

Figure 1 illustrates the safety criteria (used in the TIP evaluation criteria), which incorporates the following rating scale.[5,6]

- Transit Projects: 1.0 point per safety-critical transit project.
- Roadway/Bike/Pedestrian Projects: 0.5 point per safety-improvement/critical safety location (up to one point).
  - The project is in one or more DOT-identified high-crash location.
  - The project incorporates one or more FHWA proven safety countermeasures:
    - Roundabouts
    - Access management
    - Signal backplates with retroreflective borders
    - Longitudinal rumble strips and stripes on two-lane roads
    - Enhanced delineation and friction for horizontal curves
    - Safety edge
    - Medians and pedestrian-crossing islands in urban and suburban areas
    - Pedestrian hybrid beacons
    - Road diets

Two participating States use different process to identify safety projects, which are measured in terms of crashes, severity, and exposure (where available). Each State performs the database analysis in house and then provides the resulting database to DVRPC, which maps the locations for integration into DVRPC programs. The process maps multiple data points for the criteria geospatially and after visualization, performs additional geospatial processes to identify which criteria coincide with each project—this also includes additional calculations involving traffic volumes and project costs. Because the TIP funding is on different schedules for each State, the States conduct these processes separately. Safety is the second-highest weighted criterion, representing 17 percent of the model's decision—behind only Facility/Asset Condition, which represents 19 percent of the decision.

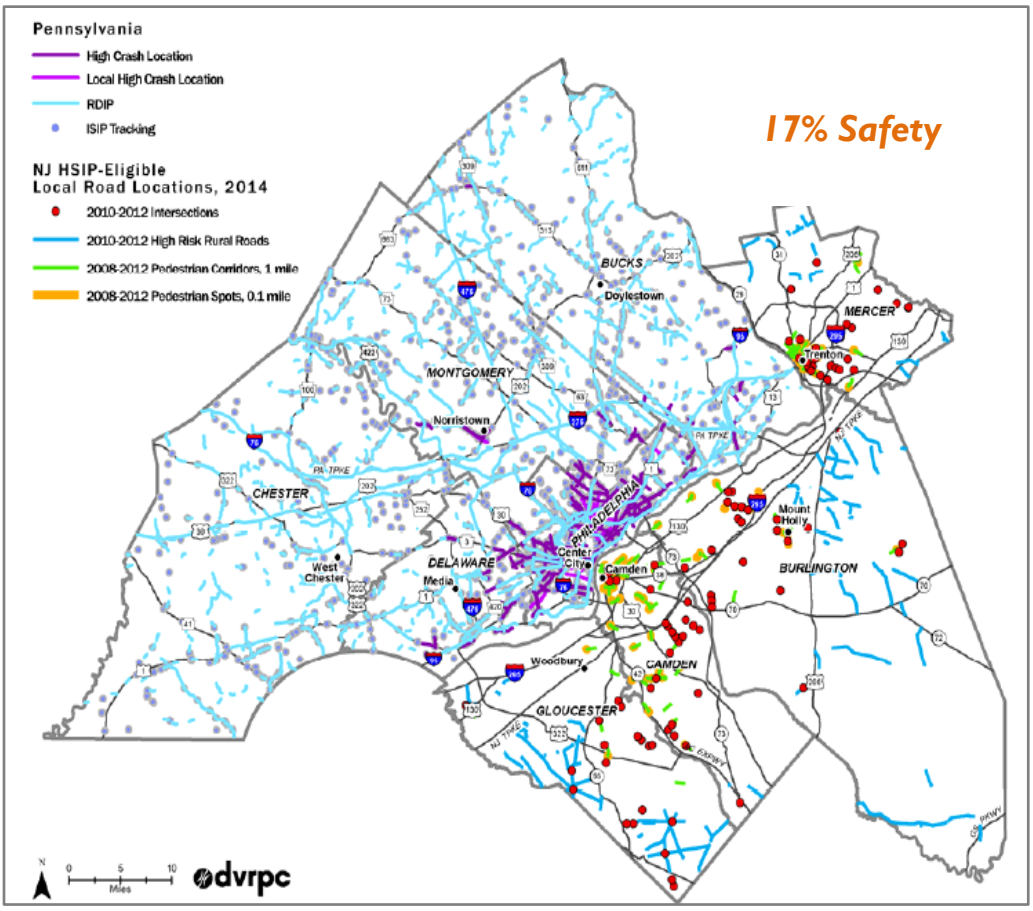

Figure 1: High-Crash Corridors and Intersections within the DVRPC

2. GIS-BASED SAFETY ANALYSIS TO UPDATE THE DVRPC TRANSPORTATION SAFETY ACTION PLAN (TSAP) PROJECT SELECTIONS

DVRPC also uses the Web-based GIS safety analysis tool to update the DVRPC Transportation Safety Action Plan (TSAP).[7] Before updating each TSAP, the each agency prepare a report that provides information about crashes by type of road and by types of crashes and crash severity. The data and analysis findings help highlight specific areas of need to guide effective decision making and improve safety.

Analysis begins with the reportable crash databases maintained by each State DOT and shared with DVRPC for planning purposes; DVRPC then uses the data to map all crashes in the region. The main focus of the TSAP is a data analysis of the 18 AASHTO safety emphasis areas within the nine-county region. These are the same emphasis areas each State uses to develop its Strategic Highway Safety Plan (SHSP), and DVRPC's analysis conforms to each State's criteria for consistency. The result is a list of data-driven hierarchy of the region's emphasis areas based on injuries and fatalities.

3. GIS-BASED SAFETY ANALYSIS TO IDENTIFY CANDIDATE LOCATIONS FOR THE DVRPC SAFETY STUDIES PROGRAM, WHICH INCLUDES ROAD SAFETY AUDITS (RSA) AND RELATED STUDIES

DVRPC also uses the Web-based, GIS-based safety analysis tool to identify candidate locations for the Road Safety Audits (RSA) and other safety studies on New Jersey county routes. The beginning of the process to implement the HSIP implementation requires that each agency complete an RSA or other safety study on an HSIP-eligible location. Agencies typically conduct and RSA only on HSIP funding-eligible locations.

Figure 2 below is a snapshot of the ArcGIS.com Web-mapping application (created using ArcMap 10.1) that contains a layer for each of four data sets and serves as a starting point for identifying RSA candidate locations. The four data sets, as shown by different data layers, include:

1. 3 mi segments recording 150 or more total crashes;
2. 2 mi segments recording 100 or more total crashes;
3. 2 mi segments recording 12 or more hit-fixed-object crashes; and
4. 2/10 mi segments recording 7 or more left-turn and/or U-turn crashes.

Locations that meet at least one of the criteria are included for identifying RSA-candidate locations.

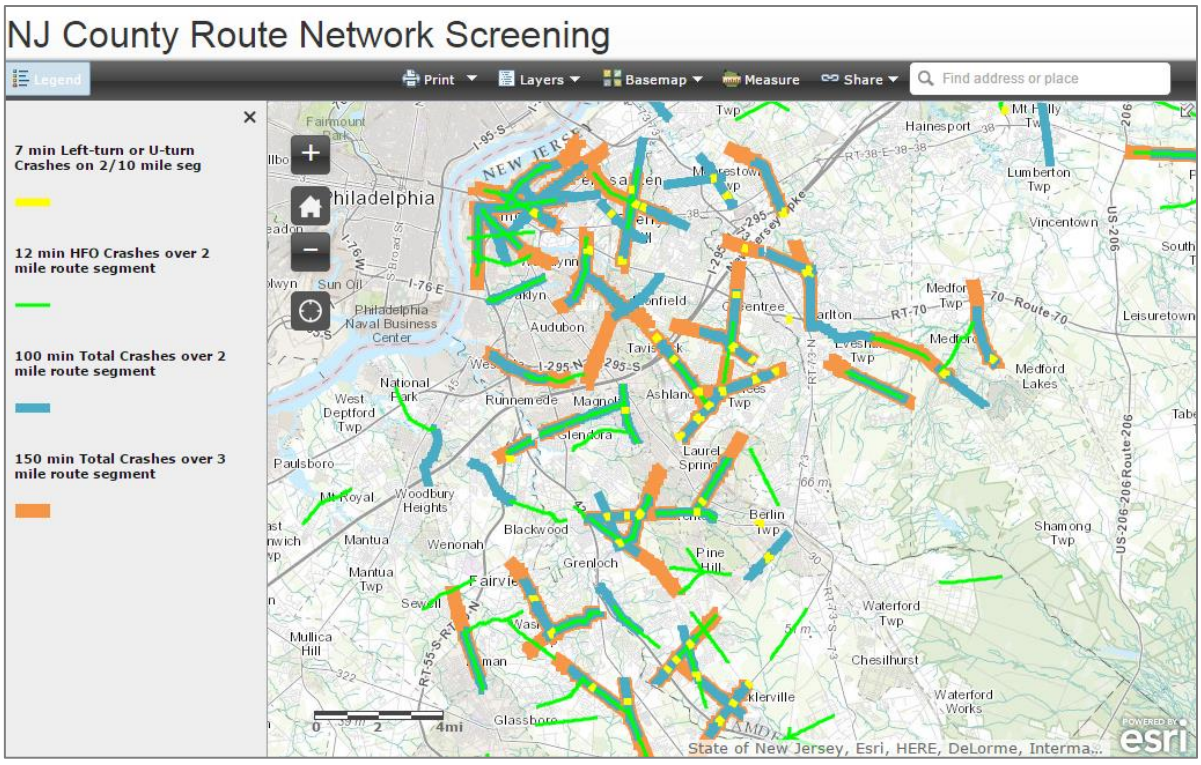

Figure 2: Snapshot of County Route Network Screening for RSA

4. GIS-BASED WEB MAPS FOR SHARING HSIP-ELIGIBLE LOCATIONS WITH NEW JERSEY COUNTY AND CITY PARTNERS WHEN CONSIDERING PROJECT DEVELOPMENT

The NJDOT administers a competitive HSIP Local Safety Program that awards Federal HSIP funds to county and city applicants for projects that score positively on a *Highway Safety Manual* analysis and meet the NJDOT safety professionals' approval.

MPOs facilitate the HSIP Local Safety Program. As part of the application materials, DVRPC developed a Web map of the locations resulting from the HSIP-eligible network screening that applicants use to identify locations on their respective systems. The locations are the starting point for developing safety projects. Figure 3 shows the Web map included in the 2016 solicitation. In addition to the network screening data, the Web application includes layers for safety studies that have conducted (including Road Safety Audits). The purpose is to encourage applicants to develop projects at locations where an analysis is already completed and that also coincide with the network screening lists.

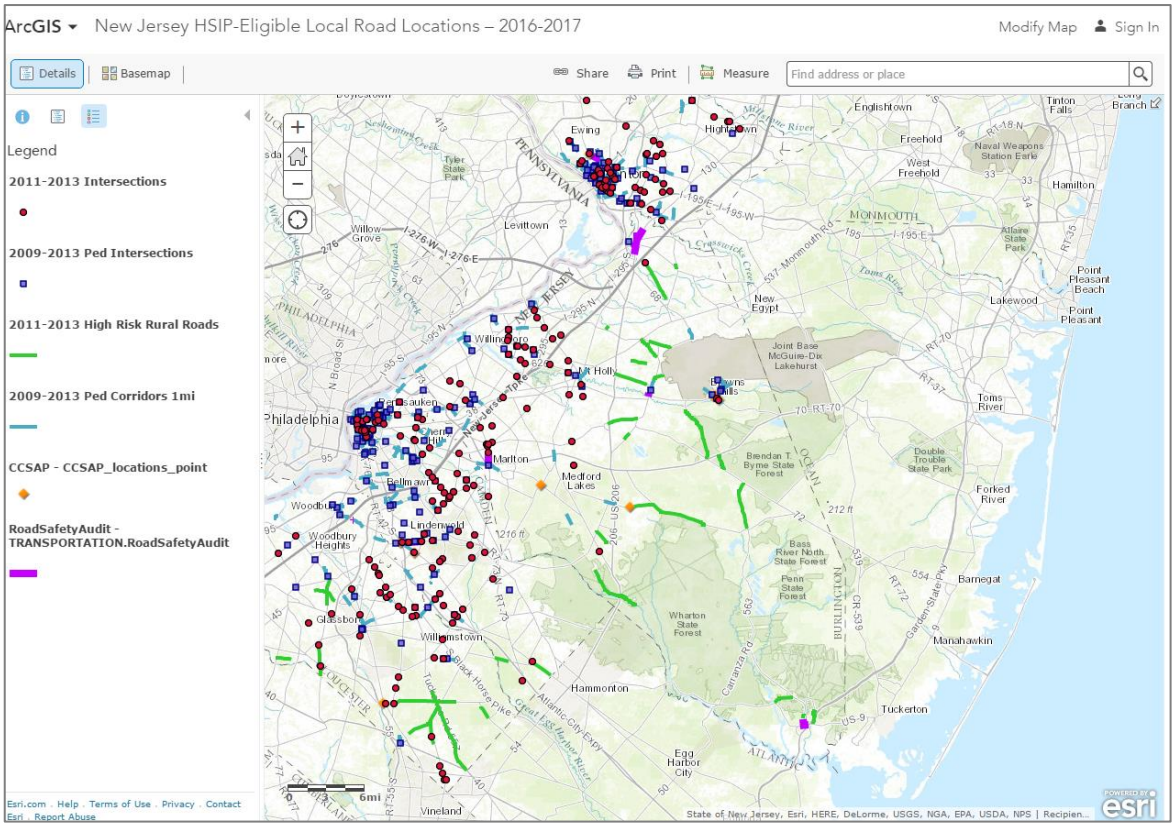

Figure 3: Web map of the Locations Resulting from the HSIP-Eligible Network Screening

SUMMARY

BENEFITS/RESULTS

The major benefit of the DVRPC GIS-based safety analysis/integration process is that it enables a data-driven component—a requirement for accessing Federal safety funds. It also provides an efficient process for analyzing large numbers of potential projects and identifies and ranks those most needed. The process also helped the DVRPC bridge the GIS knowledge gap between different States.

IMPLEMENTATION CHALLENGES

The major challenges DVRPC faced when implementing a GIS-based safety analysis/integration process include:

- Different data formats between the States,
- Different criteria for identifying HSIP-eligible locations between the States, and
- Lack of GIS knowledge among local partners.

LESSONS LEARNED

GIS based safety analysis helps implement a conceptual evaluation framework consistent with the performance requirements of MAP-21 and cutting-edge planning practice. It also provides a better understanding of the safety picture and serves as a decision support tool for prioritizing projects and aligning with various transportation plan goals and objectives. For example, the TIP evaluation criteria process helps decision makers understand whether or not TIP projects promote the goals of the region's long range transportation plan.

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EXPLANATION OF TERMS

AASHTO	–	American Association of State Highway and Transportation Officials
CCSAP	–	Congestion And Crash Site Analysis Program
DVRPC	–	Delaware Valley Regional Planning Commission
FAST Act		Fixing America's Surface Transportation Act
GIS		Geographic Information System
HSIP	–	Highway Safety Improvement Program
MAP-21	–	Moving Ahead for Progress in the 21st Century Act
MPO	–	Metropolitan planning organizations
PBPP	–	Performance-based planning and programming
RSA	–	Road Safety Audit
RTC	–	Regional Technical Committee
SHSP	–	Strategic Highway Safety Plan
SAFETEA-LU	–	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
TIP	–	Transportation Improvement Program
TSAP	–	Transportation Safety Action Plan

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