JACOBS

North Jersey Transportation Planning Authority

FREIGHT RAIL GRADE CROSSING ASSESSMENT STUDY

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NORTH JERSEY TRANSPORTATION PLANNING AUTHORITY FREIGHT RAIL GRADE CROSSING ASSESSMENT STUDY

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I. INTRODUCTION

I.1 Study Purpose and Need

A range of market forces are creating the need to move more and more freight to, from, and through the northern New Jersey region, exerting additional pressure on the transportation system. Increased traffic on the regional rail and roadway networks is manifesting itself in the form of increased delay to motorists, decreased mobility and adverse affects to overall quality of life.

These conditions and issues are perhaps nowhere more apparent than at the points where the rail and roadway network intersect and traffic competes for limited capacity. While recent emphasis on rail safety programs and technologies has served to reduce incidents and crashes, other issues not directly related to safety remain. Increased rail and roadway traffic serves to exacerbate these concerns, particularly at existing grade crossing locations. A thoughtful, methodical investigation of existing and future grade crossing operations and mobility concerns based upon hard data (not perception) is vital to identifying specific issues and their root causes, and selecting the appropriate strategies to manage the transportation infrastructure and ensure mobility, safety, and quality of life within the region. The NJTPA Grade Crossing Assessment Study was designed to do just that…establish a quantitative, objective framework through which existing grade crossings can be evaluated.

The need to develop an objective framework for evaluating grade crossings was predicated upon several key understandings including:

- Lack of an industry-accepted evaluation framework/policy to identify root causes of issues at grade crossings.

- Frequent disconnect between perceived issues/causes and actual root causes.

- Anticipated increases in rail and roadway activity are expected to result in increased gate closure times and associated roadway traffic delays. While the actual increase in activity will depend upon a number of factors such as market demands and available line capacity, daily activity could potentially double on some lines, particularly those with low existing activity levels.

- Understanding that grade separation is not the only option for addressing issues at grade crossings -- there are a range of solutions that can be applied to improve grade crossing conditions that can be tailored to address specific root causes of operational, mobility and quality of life issues.

The primary objective of this study was to create a toolbox that NJTPA can use within and beyond the current study to:

- Identify and Prioritize issues;
- Generate solution sets to address specific issues and concerns;
- Suggest creative financing mechanisms where appropriate for the benefit of all stakeholders and communities through which the subject rail lines run.

This toolbox will continue to serve the NJTPA beyond this study, with a process that will be applicable to any rail corridor throughout the NJTPA region, with the process also being applicable to other jurisdictions throughout the state and the surrounding.

II. INDUSTRY LITERATURE SEARCH

The collection of information for developing evaluation criteria and a scoring tool for prioritizing crossing locations in need of further investigation and potential upgrade began with a web search of relevant freight studies and rail plans to ascertain best practices and methods in the field. This effort focused on studies and reports at state and federal levels, but also included a search for pertinent international sources (i.e. Canada) to fill as many gaps as possible in the knowledge base. A listing of documents reviewed for this investigation is presented in Appendix A. A separate literature search was conducted for each of the following primary components of this study.

- Establish criteria for identifying where needs exist for the purpose of providing an evaluation framework,
- Devise a scoring system to weigh the relative importance of a range of evaluation criteria, and to define the severity of the impact of each issue; and
- Identify a range of potential solution strategies and best practices to address the identified issues.

The survey of national practices revealed both the wide range of evaluation processes employed by state agencies as well as the important characteristics common among the multitude of strategies currently in use. Five general findings were revealed from the search and are listed below:

- States used typically one of two types of collision frequency models. These were either a crash prediction index, an absolute index yielding the expected number of collision over a given time period or a hazard index, representing the relative risk (frequency and/or consequence) of one crossing compared to any other crossing;
- Models most often included information related to operating profiles and capacity (in terms of both quantity and configuration) factors on both the rail and highway environment;
- Indexes generally included a Federal Railroad Administration (FRA) crash history profile extending over study periods varying between 5 and 10 years;
- Formulas that incorporated the effect of traffic control / warning devices at a crossing were commonly employed in the indexing process; and
- Models generally avoided factors for which data were either costly or technically difficult to obtain or forecast.

Due to their widespread usage within the frameworks of nationally accepted practices, the study considered these largely "safety" aspects as critical parts of the foundation for developing an effective methodology for evaluating and prioritizing issues at grade crossings. Therefore, each of these issues was advanced in the assessment for further analysis and review.

The literature search also revealed that the various models currently employed are typically structured to evaluate individual rail lines based on a model or formula with a fixed number of variables. These variables were not often applicable to other rail corridors or regions. Generally missing from the literature search were approaches that would lead to the development of flexible, updateable methodologies that could be applied to any single or group of rail corridor(s), that could account for impacts on surrounding neighborhoods, and regions, and that could be designed for use by state agency/organization staff to perform state-wide evaluations.

The use of a GIS platform can achieve these characteristics. A database can often resolve data collection issues related to uniformity and timeliness that are inherent with data gathering by numerous collection agents. Multiple data sources such as road inventory items, traffic volumes and land use data may pose consistency problems that can limit the quality and depth of analyses. However, information can be easily merged and disseminated via GIS to provide a coherent multi-jurisdictional perspective. For example, the ability to combine crash data with other safety data, such as roadway alignments, traffic control devices deployment, travel demand and land use profiles, permits crashes to be analyzed in the context of the existing surrounding environment.

A computerized mapping system enables multiple data sources to be linked using a common coordinate system and to be displayed graphically. Information can be layered in a GIS to produce detailed descriptions of conditions and to conduct analyses that assess the relationships among variables.

Another aspect not commonly found in the literature search involved the inclusion of community issues as part of the needs assessment process, and use of a Technical Advisory Committees (TAC) to assist in designing various analysis tools. Community and quality of life issues were generally not broadly incorporated into the evaluation criteria process. The inclusion of these issues can expand the base and heighten the interest levels of stakeholders and interested members of the public.

The lack of partnering with a TAC can miss value-added benefits derived from local knowledge, the tapping of relevant databases, and efficiencies related to using state-wide resources. It also misses opportunities to efficiently gather information providing detailed knowledge on site specific conditions, neighborhood conditions, inter-jurisdictional matters, corridor, regional and state highway/rail transportation improvement plans as well as comprehensive land use planning activities throughout the State.

The Project Team gathered from the literature search the range of commonly used factors and analyses that have proven to be effective in designing evaluation tools. Innovative and best practices were also surveyed to ensure that the state-of the art techniques were applied for this study. In addition, an insight was acquired into how potential technical and strategy gaps could be filled to enhance the overall evaluation process.

III. STUDY AREA AND SUBJECT RAIL CORRIDORS

Centered within perhaps the largest consumer market in the nation, ever-increasing demand for consumer goods and industrial growth are exerting more and more pressure on the region's transportation infrastructure. In response to these increased pressures, activity on the region's roadways and rail lines has increased significantly, with this growth expected to continue well into the future. Emerging technologies such as biodiesel and ethanol production, and fuel products that cannot be transported via pipeline, are further increasing rail activity and highlighting safety concerns, particularly at locations where rail activity interfaces with roadway traffic.

The rail lines of primary interest in this study provide the primary connections between the Port District, the dense petro-chemical operations in Union County, and the national rail network. Hence, the greatest increases in rail activity are expected to occur on these lines. Planned rail network capacity expansions such as the double tracking of portions of the Lehigh Line through New Jersey, and elimination of capacity constraints will serve to eliminate the bottlenecks that meter rail traffic to and from the Northern New Jersey region, and create the potential for increased activity on the local portions of the rail network.

At the same time, the region's population and volume of traffic utilizing the region's roadways are on the rise. Coupled with anticipated growth in rail activity, grade crossings represent an even greater concern as impediments to traffic flow and mobility, as well as overall public safety and quality of life.

In advanced response to these emerging issues, the NJTPA Freight Rail Grade Crossing Assessment Study focused upon development of an objective framework for evaluation of existing grade crossings, identifying specific issues associated with individual crossings, and offering a range of best-practice solution sets to address specific issues and concerns. This study focused upon key freight lines, and did not attempt to address passenger rail lines throughout the region. This analysis was specifically designed to:

- Systematically evaluate a range of roadway/rail grade crossing issues and identify a range of solutions, both engineered and technological management, to maintain mobility and traffic flow, minimize effects on area quality of life, and ensure continued safe operation of the crossings and intersecting roadways.
- Establish evaluation criteria to identify appropriate solutions based upon location-specific issues and need.
- Mitigate delays to vehicular traffic brought about by ever-increasing demand on the freight rail infrastructure.
- Enhance public safety and quality of life.

- Create a toolbox to facilitate extending this analysis to other locations throughout the NJTPA region and beyond as future needs dictate.

Rail Lines Assessed in This Study

This study evaluated a total of 64 grade crossings along five (5) rail corridors serving the area. These rail lines and crossings include:

Rail Line	Public Crossings	
Chemical Coast Secondary Track	**3**	**(3 CR)**
Port Reading Secondary Track	**10**	**(10 CR)**
Trenton Subdivision*	**5**	**(5 CSX)**
Lehigh Line	**24**	**(9CR, 1 CR/NJT, 14NS)**
River Subdivision	**22**	**(2 CR, 3 CSX/NYS&W, 17 CSX)**
TOTAL	**64**	

*** Trenton Subdivision AKA West Trenton Line**

The specific freight rail grade crossings addressed through this study are listed in Table III-1, and are depicted on the Figures III-1 through 7. Appendix B of this report presents an overview of each rail line and rail related impacts at the crossings (i.e.: signal locations, defect detector locations, temporary slow orders, etc.), detailed descriptions of each crossing, and suggestions for low cost, and where applicable, easily implementable measures that can be taken to improve existing conditions.

Table III-1
Study Grade Crossings

Rail Line	Road Crossing	A K A	Owner
CHEMICAL COAST SECONDARY TRACK (CP-PD to WOOD)	School Street	Milos Way	CR
	Woodbridge Avenue		CR
	Woodbridge Turnpike	Mauer Road	CR
PORT READING SECONDARY TRACK (CP-PD to CP-BOUND BROOK)	Blair Road		CR
	Rahway Avenue		CR
	St. George Avenue		CR
	South Street		CR
	Helen Street		CR
	Clinton Avenue		CR
	New Brunswick Avenue		CR
	Washington Avenue		CR
	Bakelite Road	Baekeland Avenue	CR
	Main Street	South Main Street	CR
TRENTON SUBDIVISION (CP PORT READING JUNCTION to HOPEWELL)	Sunnymead Road	Sunnymeade Road	CSX
	Route 601	Blawenburgh Road	CSX
	Hollow Road		CSX
	Spring Hill Road	Possumtown Road	CSX
	Province Line Road	Providence Line Road	CSX
LEHIGH LINE (CLARK to BLOOMSBURY)	Rahway Avenue		CR
	Inman Avenue		CR
	Tingley Road		CR
	Front Street		CR
	Clinton Street	Clinton Avenue	CR
	New Brunswick Avenue		CR
	New Market Road		CR
	Prospect Avenue		CR
	South Avenue		CR
	Cedar Avenue		CR/NJT
	Thirteenth Street	Thirteenth Avenue	NS
	Roycefield Road		NS
	Valley Road		NS
	Auten Road		NS
	Beekmans Lane	Beekman Lane	NS
	Lehigh Road		NS
	Main Street		NS
	Rockafellows Mills Road		NS
	Stanton Station Road		NS
	Kiceniuk Road		NS
	Hamden Road		NS
	Landsdown Road		NS
	Perryville Road		NS
	Still Valley Road		NS
NATIONAL DOCKS BRANCH (CP-CROXTON to UPPER BAY)	Chapel Avenue		CR
	St. Pauls Avenue		CR
	River Street - 69th Street	69th Street	CSX/NYSW
	Bergen Turnpike	Bergen Pike	CSX/NYSW
NORTHERN BRANCH (CP-1 to HACK)	Mt. Vernon Street	Mount Vernon Avenue	CSX/NYSW
	New Bridge Road		CSX
	Clinton Avenue	West Clinton Avenue	CSX
	Main Street	West Main Street	CSX
BERGEN SUBDIVISION (CP-1 to BOGOTA)	Church Street	West Church Street	CSX
	Central Avenue	West Central Avenue	CSX
	Columbia Avenue		CSX
	Madison Avenue	West Madison Avenue	CSX
RIVER SUBDIVISION (BOGOTA to NORTH VALE)	New Milford Avenue		CSX
	Haworth Avenue		CSX
	Durie Avenue		CSX
	Old Hook Road		CSX
	La Roche Avenue		CSX
	Harriet Avenue	Harriot Avenue	CSX
	Laffette Avenue	Lafayette Road	CSX
	Blanche Avenue	Blanch Avenue	CSX
	Broadway		CSX
	Clinton Avenue		CSX

Figure III-1
Chemical Coast Secondary

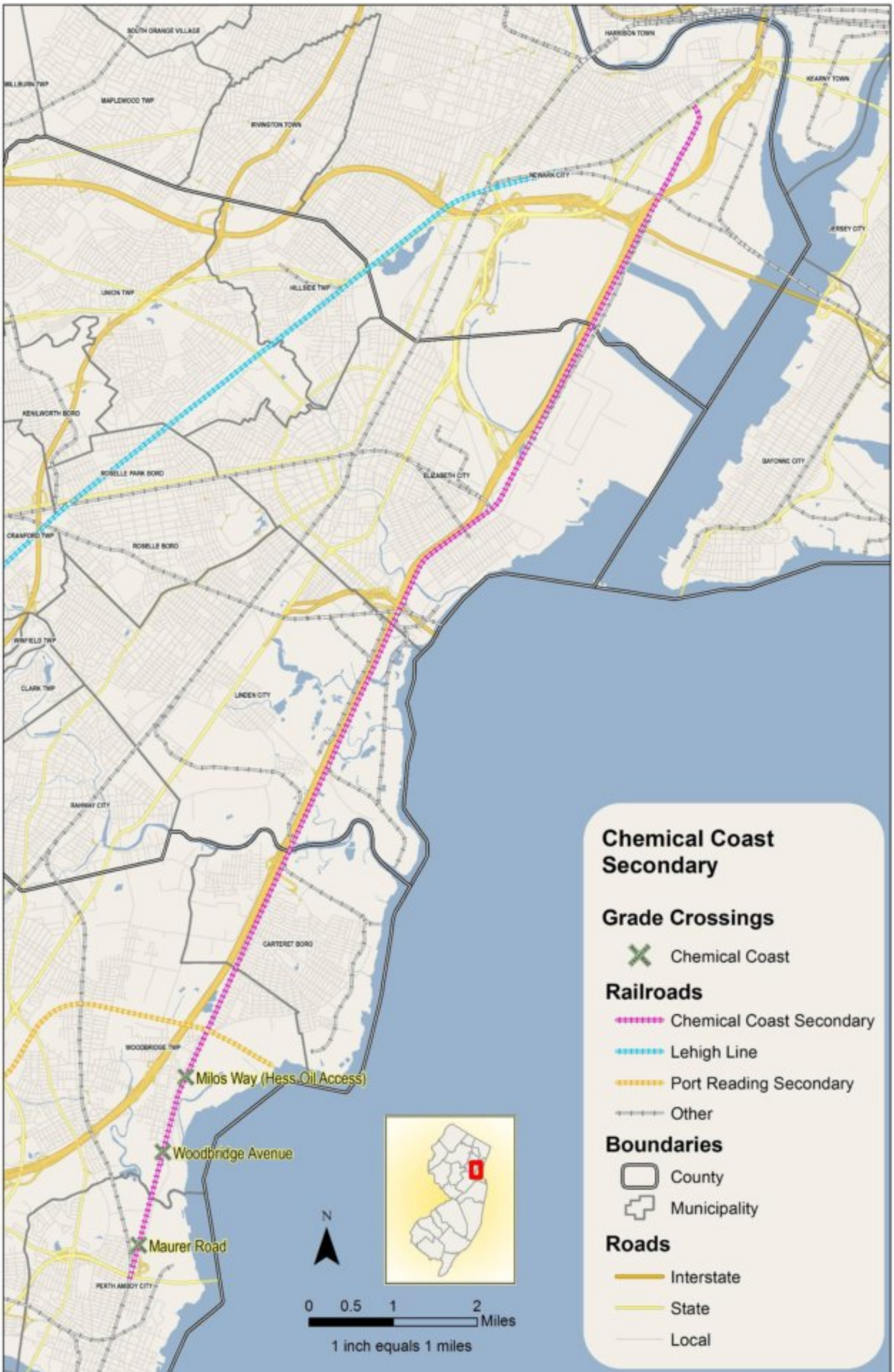


Figure III-2
Port Reading Secondary

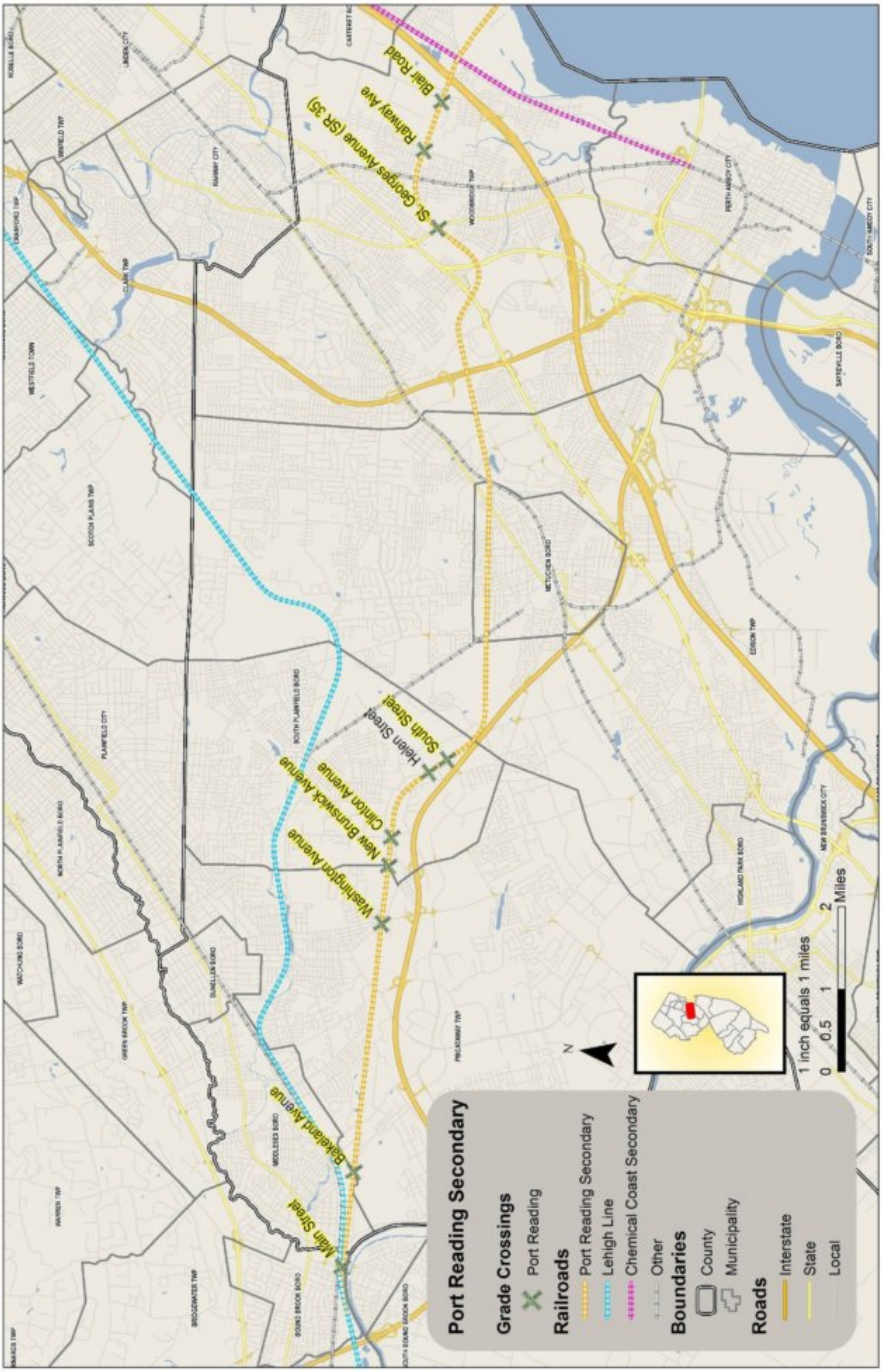


Figure III-3
Trenton Subdivision

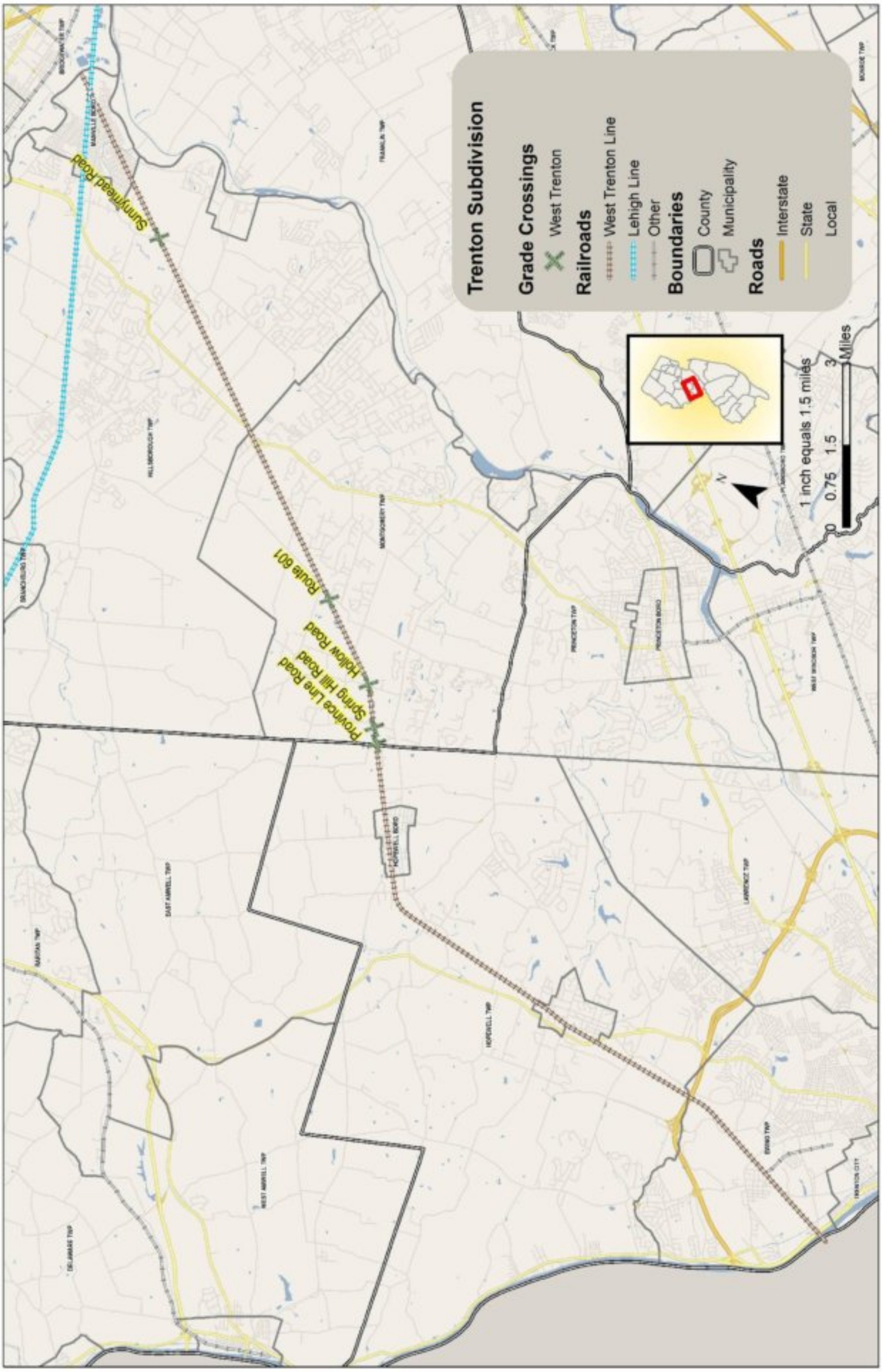


Figure III-4
Lehigh Line (eastern section)

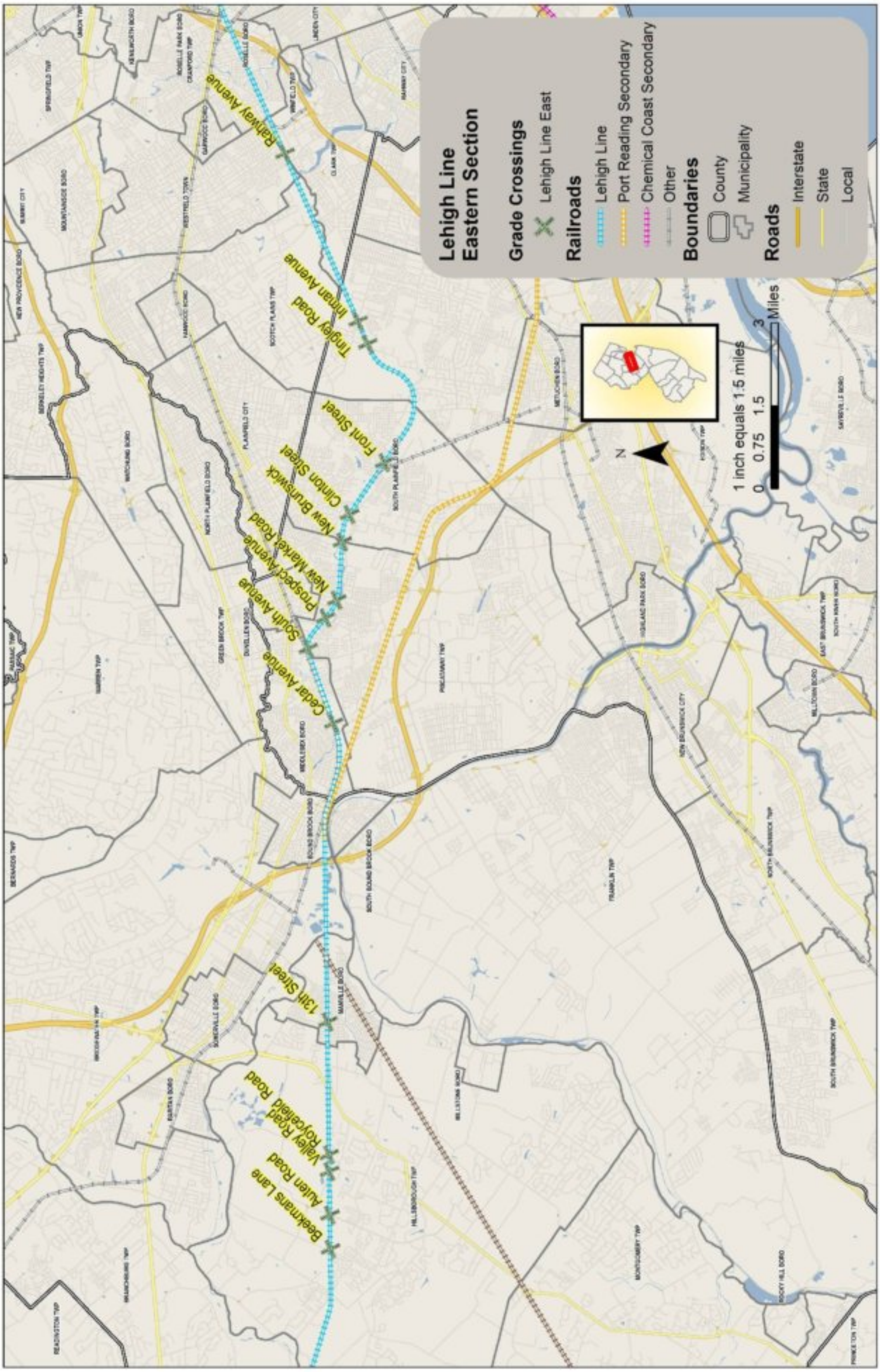


Figure III-5
Lehigh Line (western section)

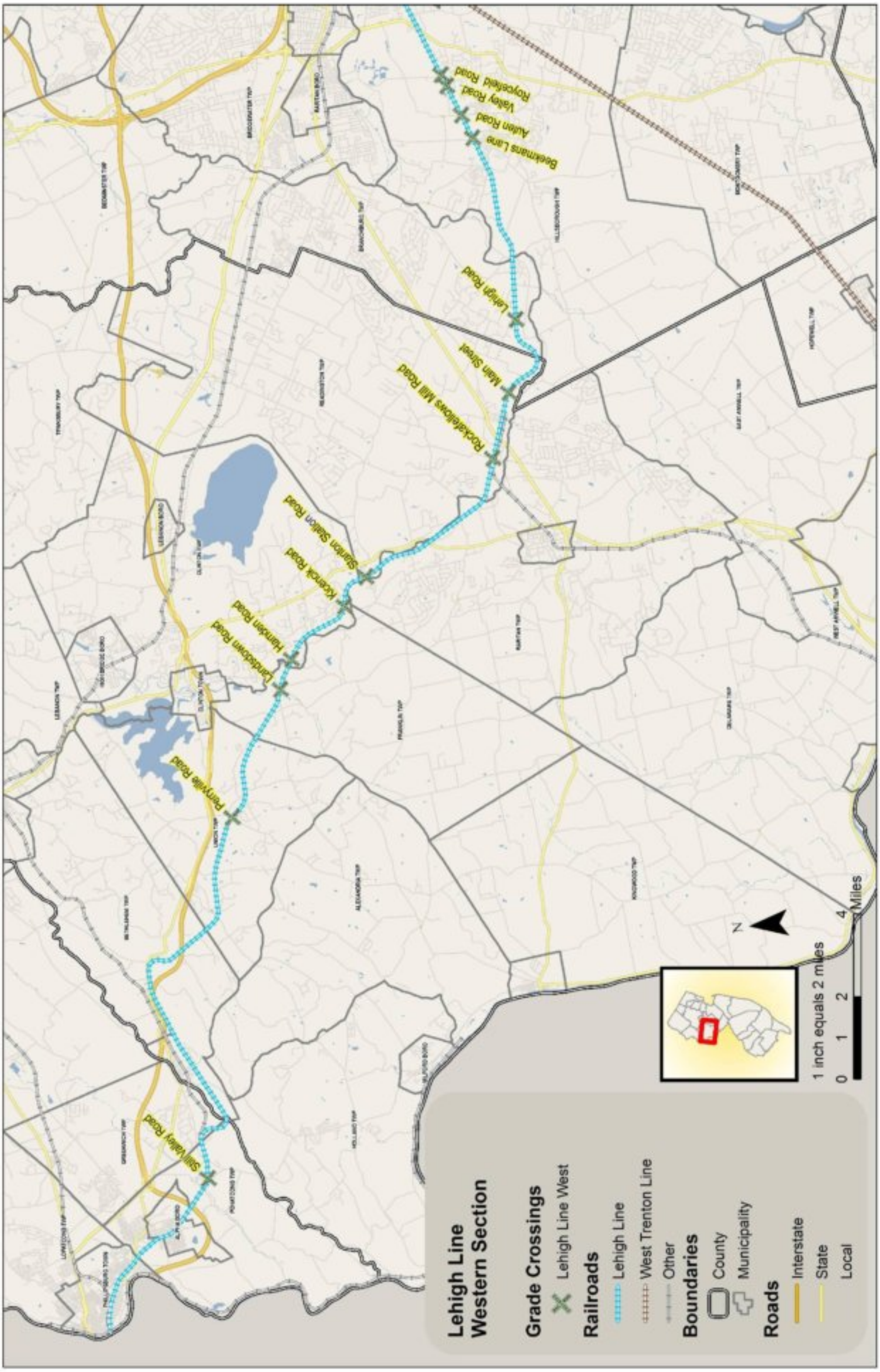


Figure III-6
Northern Branch / River Subdivision (northern section)

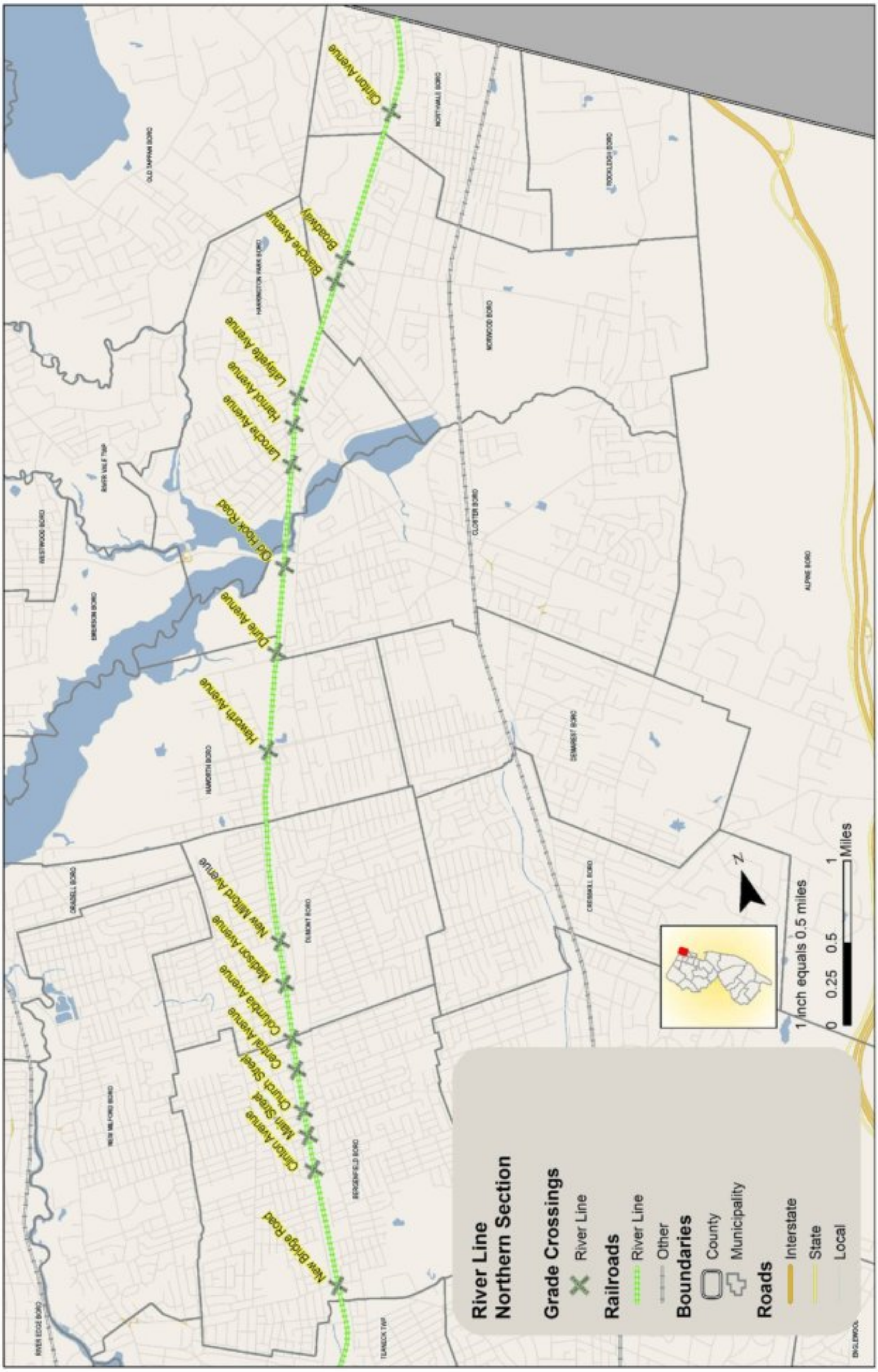
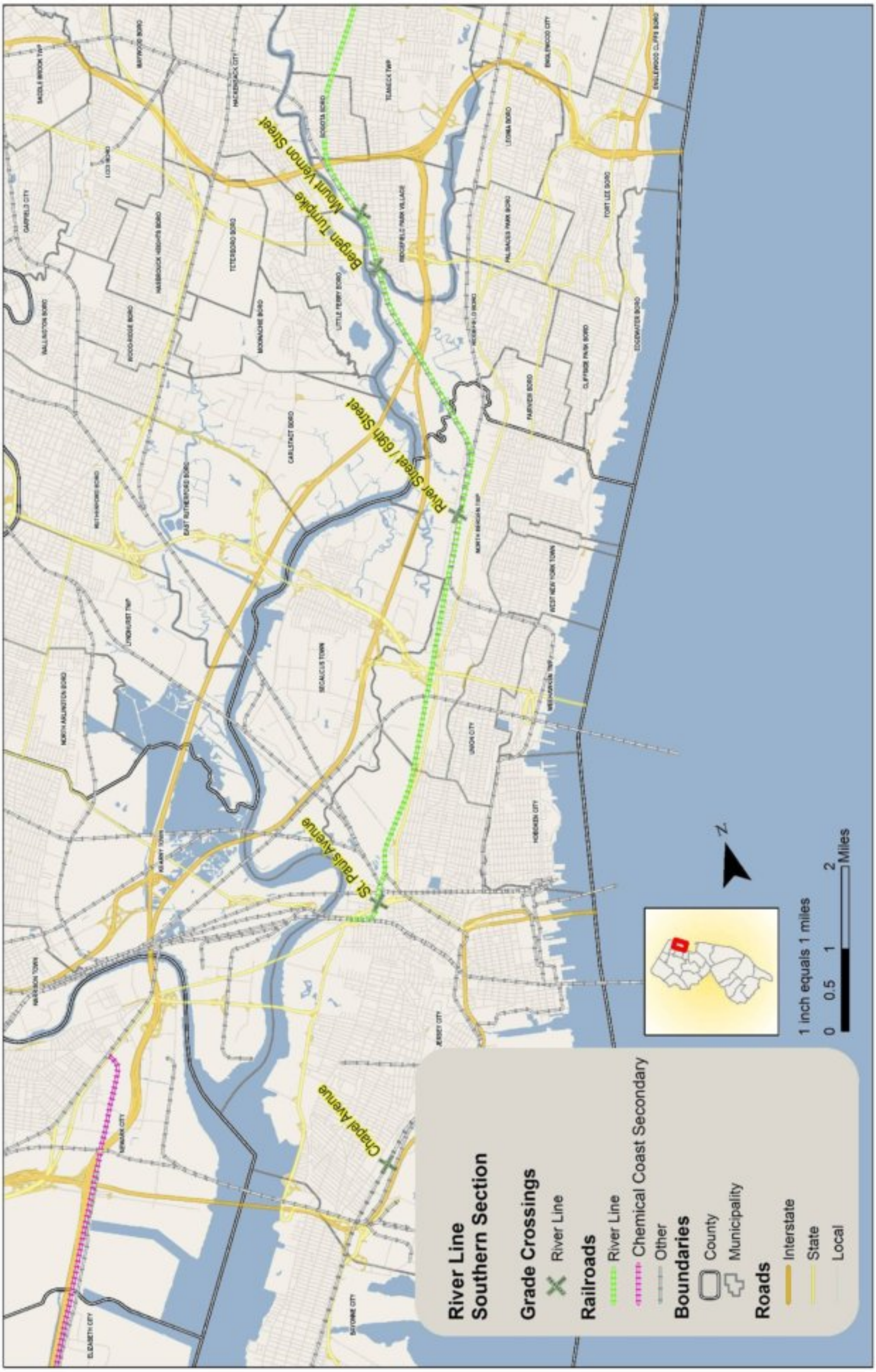


Figure III-7
Northern Branch / River Subdivision (southern section)



IV. DATA COLLECTION PROGRAM

IV.1 FRA Crash History

Crash data were collected from the Federal Railroad Administration's (FRA) crash records data base. Information was examined for the period between 1997 and 2007 at all 64 at-grade crossings on the subject corridors. Table IV-1 summarizes the number, distribution and severity of the reported crashes.

Table IV-1
Crash History – 1997 to 2007

Rail Line	CROSSING		NUMBER OF ACCIDENTS with			
	Street Name	Municipality	Fatalities	Injuries	No Injuries	TOTAL
River Line	Clinton Avenue	Northvale	0	1	0	1
River Line	Old Hook Road	Harrington Park	0	0	1	1
River Line	Columbia Avenue	Dumont	0	0	1	1
River Line	Central Avene	Bergenfield	0	0	1	1
River Line	Church Street	Bergenfield	1	0	0	1
River Line	Clinton Avenue	Bergenfield	0	0	2	2
River Line	New Bridge Road	Bergenfield	1	0	0	1
River Line	Bergen Turnpike	Ridgefield Park	0	0	1	1
National Docs	Chapel Avenue	Jersey City	0	0	2	2
Lehigh Line	Inman Avenue	Edison	0	0	3	3
Lehigh Line	Tingley Lane	Edison	0	1	0	1
Lehigh Line	New Brunswick Ave.	Piscataway	0	0	1	1
Lehigh Line	New Market Road	Piscataway	1	0	1	2
Lehigh Line	Prospect Avenue	Piscataway	2	0	0	2
Lehigh Line	Cedar Avenue	Town of Middlesex	0	0	1	1
Lehigh Line	South Avenue	Town of Middlesex	1	0	1	2
Lehigh Line	Beekman Lane	Bridgewater	0	0	1	1
Lehigh Line	Rahway Avenue	Clark	0	1	0	1
Lehigh Line	Clinton Street	South Plainfield	0	1	0	1
Lehigh Line	Valley Road	Manville	1	0	0	1
Lehigh Line	13th Street	Manville	0	0	1	1
Port Reading	New Brunswick Ave.	South Plainfield	0	0	2	2
TOTAL			**7**	**4**	**19**	**30**

As shown, a total of 30 individual crash incidents were reported at the 64 crossings under investigation. These 30 crashes occurred at 22 of the 64 crossings investigated, with 7 crossings experiencing 2 or more crashes in the ten-year period. Fifteen (15), or one-half of the crashes occurred at seven (7) at-grade crossings, including West Clinton Avenue, Inman Avenue, New Market Road, Prospect Avenue, South Avenue, New Brunswick Avenue, and Chapel Avenue. Of the thirty (30) reported crashes, seven (7) involved a fatality, four (4) involved a physical injury, and the remaining nineteen (19) resulted in neither an injury nor a fatality.

While all of the crossings where a crash was reported had some level of protection and control (cross bucks, lights, etc), five of the crossing sites where crashes were reported were not protected by gates at the time of the crashes. These included New Brunswick Avenue (South Plainfield), Clinton Street, Valley Road, 13th Street, and Chapel Avenue.

Gates have since been installed at all of these crossings with the exception of Chaple Avenue. According to Police Department Crash Reports, the majority of incidence was the result of driver error. Details of the reported crashes are presented in Appendix C of this report.

IV.2 Field Reconnaissance/Inventory of Equipment & Features

To ensure a complete and accurate understanding of the location, context and physical configuration of each grade crossing evaluated in this study, an extensive field reconnaissance program was undertaken. The project team, along with representatives of the NJTPA and the Technical Advisory Committee visited each grade crossing for the purpose of inventorying physical conditions.

The physical conditions inventory took two primary forms: development of a database defining the attributes and conditions of each crossing, and a photographic inventory of each crossing. To facilitate consistency and future data sharing, the physical conditions inventory employed field data collection techniques utilized by the New Jersey Department of Transportation Diagnostic Team – the NJDOT Bureau charged with maintaining and upgrading rail grade crossings throughout the state. The physical inventory identified the type of equipment currently in place, geometric conditions of the rail and roadway alignments, maintenance condition of signage and pavement markings, sight distance constraints, surrounding land uses, adjacent driveways, roadways and traffic control devices, and a range of other attributes that define the crossing. The collected data was assembled into a MS-Access database and incorporated into the Statewide Rail GIS maintained by the NJDOT, with access available through the NJTPA.

IV.3 Rail Activity / Operations at Crossings

Once the physical conditions at each grade crossing were fully defined, the next step in the evaluation process focused upon quantifying and understanding operations on the rail line. Key parameters in this consideration include:

- Average Daily train volumes by line.
- Temporal distribution of train activity by line.
- Speed limits and typical operating speeds by line segment.
- Maximum and average length of trains operating by line.
- Locations of critical junctures such as line merges and switch points, and estimates of the duration of delay per train imparted by these junctures.

- Identification of potentially blocked roadways due to train stoppages, and the duration of the blockages.

- Planned rail infrastructure and capacity increasing projects.

- Comparison of actual train movements vs. rail activity schedules

For purposes of this study, the above data were collected in two ways: download of specific grade crossing train operations data provided by the railroads, and 24-hour observations at key locations conducted by the project team. Figure IV-1 depicts the locations where data was provided by the railroads, and where 24-hour observations were conducted. Details of the existing rail operations including the number of crossings per day, the temporal distribution of the crossings, minimum / maximum / average and total duration of gate closures over a 24-hour period, and other key parameters are presented in Appendix D of this report.

IV.4 Roadway Activity at Crossings

The third data element required in the evaluation of grade crossing operations is the level of activity along the roadways at the crossing. These traffic volume data are one of the factors utilized in the calculation of the Grade Crossing Hazard Index. While hazard indices are calculated in a variety of ways, the most prevalent calculation is a straight multiplication of the 24-hour traffic volume at the crossing, the number of trains per day at the crossing and a protection factor. The protection factor is typically one of three values incorporated to define the type of equipment installed to control the crossing. Crossings controlled by gates, lights and bells are assigned a protection factor of 0.1. Crossings with lights and bells only are assigned a protection factor of 0.6. Crossings controlled by signage and pavement markings alone are assigned a protection factor of 1.0.

Traffic volumes and the calculated hazard index at each of the study crossings are summarized in Appendix E.

Figure IV-1
Rail Operations Data Collection Locations

V. GIS DATABASE DEVELOPMENT

While not strictly required in the development or application of the grade crossing evaluation process, the extensive volume and variety of data assembled as part of this study strongly suggested the need to develop a repository, or library, for organization of the information. The New Jersey Department of Transportation maintains a statewide rail GIS database that maps and defines all of the rail infrastructure within the State of New Jersey.

The NJDOT authorized utilization of this database for assembly and storage of the grade crossing data developed as part of this study. This is in keeping with the envisioned usage of the database as a routinely expandable/updatable framework and tool for evaluating rail operations within the state and facilitating investment decisions related to the statewide rail network. Figures V-1 thru 4 depict several aspects of the GIS database enhancements developed through this study, including aerial depictions of the crossing locations, FRA Grade Crossing Inventory data, NJDOT Diagnostic Team Grade Crossing Inventory data and a sample of the photographic inventory developed for the 64 crossings evaluated in this study.

Figure V-1
Statewide Rail and Grade Crossing GIS Database - Aerial Imagery

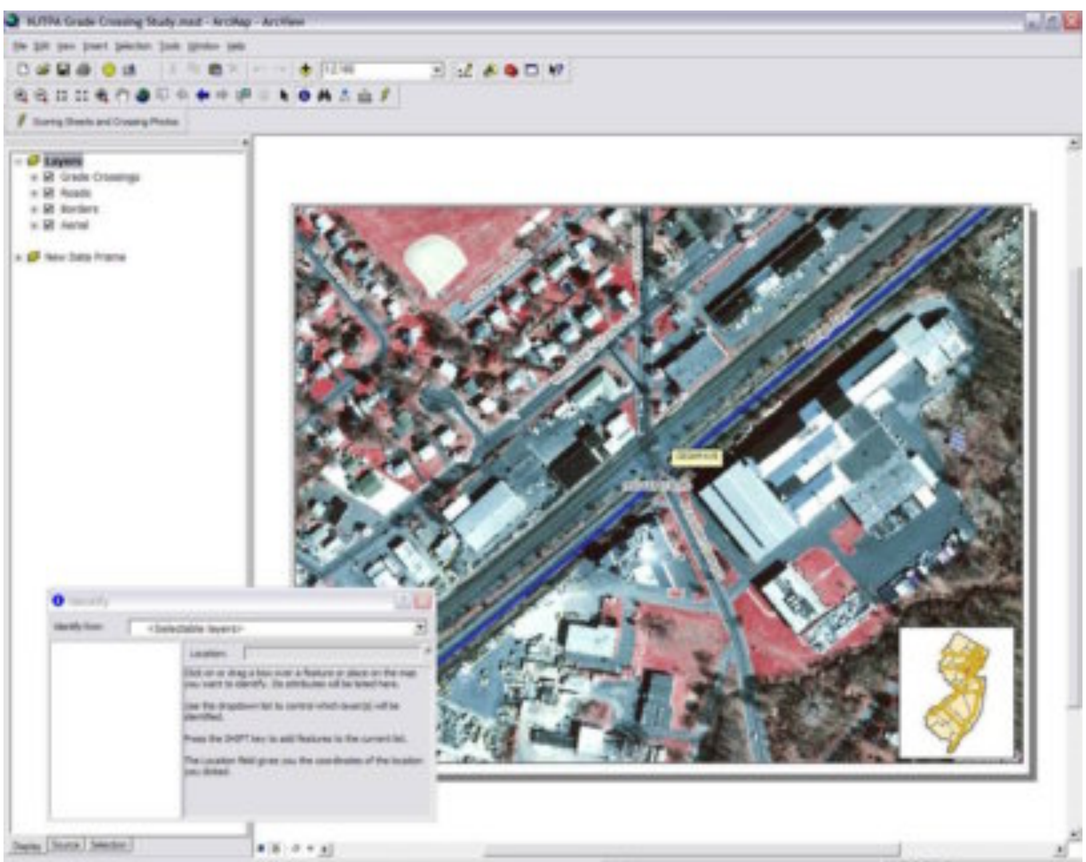


Figure V-2
Statewide Rail and Grade Crossing GIS Database
FRA Inventory Database

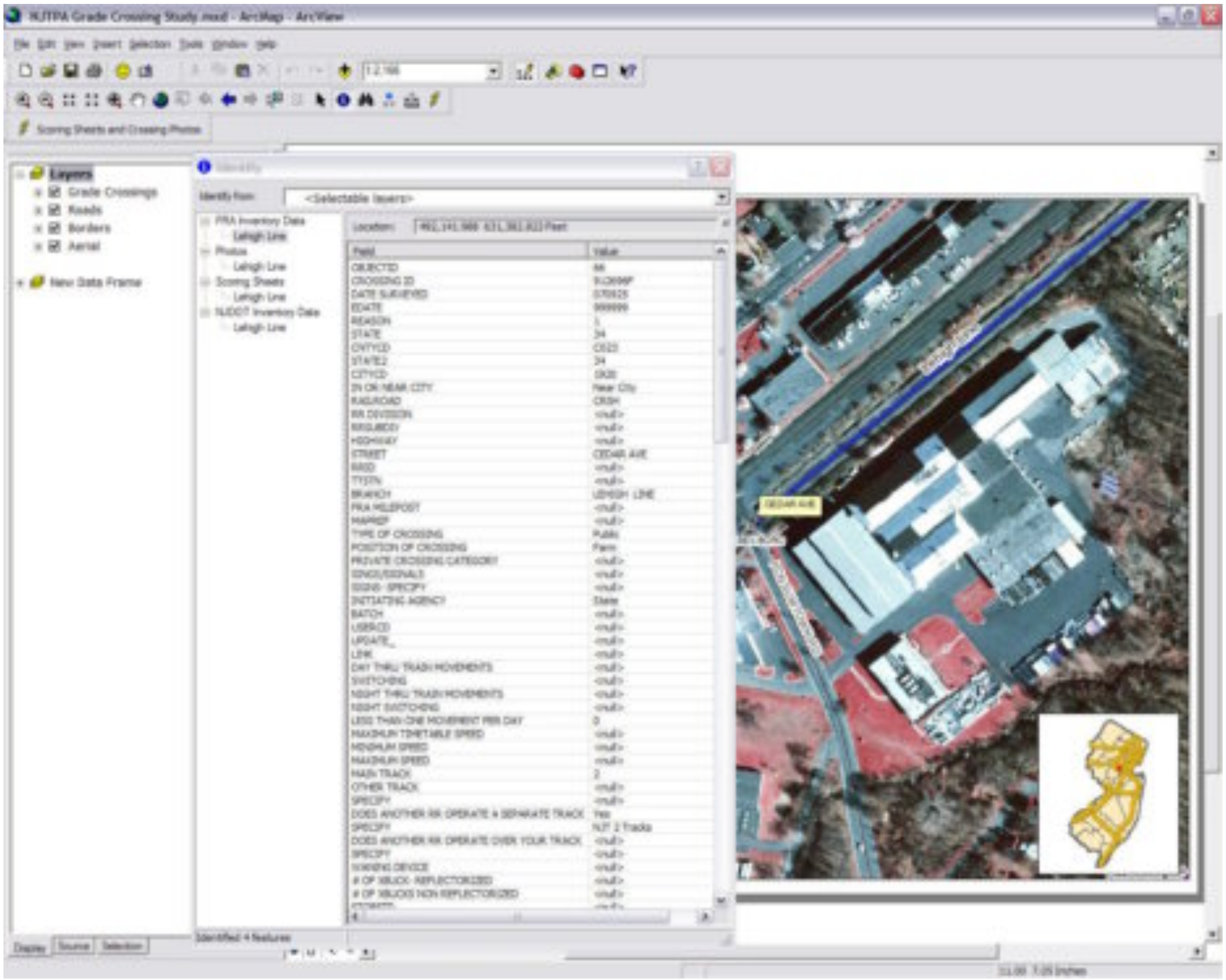


Figure V-3
Statewide Rail and Grade Crossing GIS Database
NJDOT Diagnostic Team Inventory Database

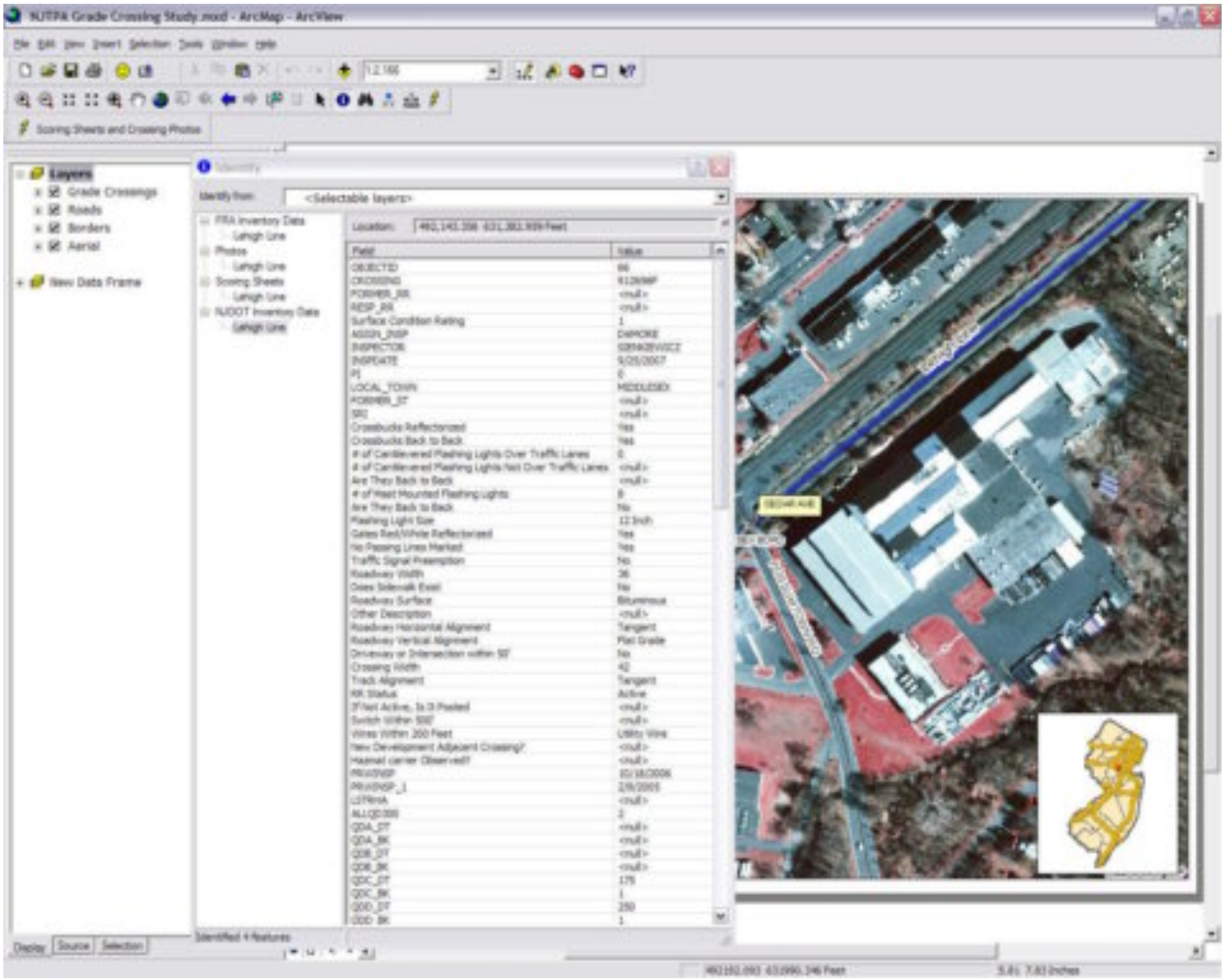
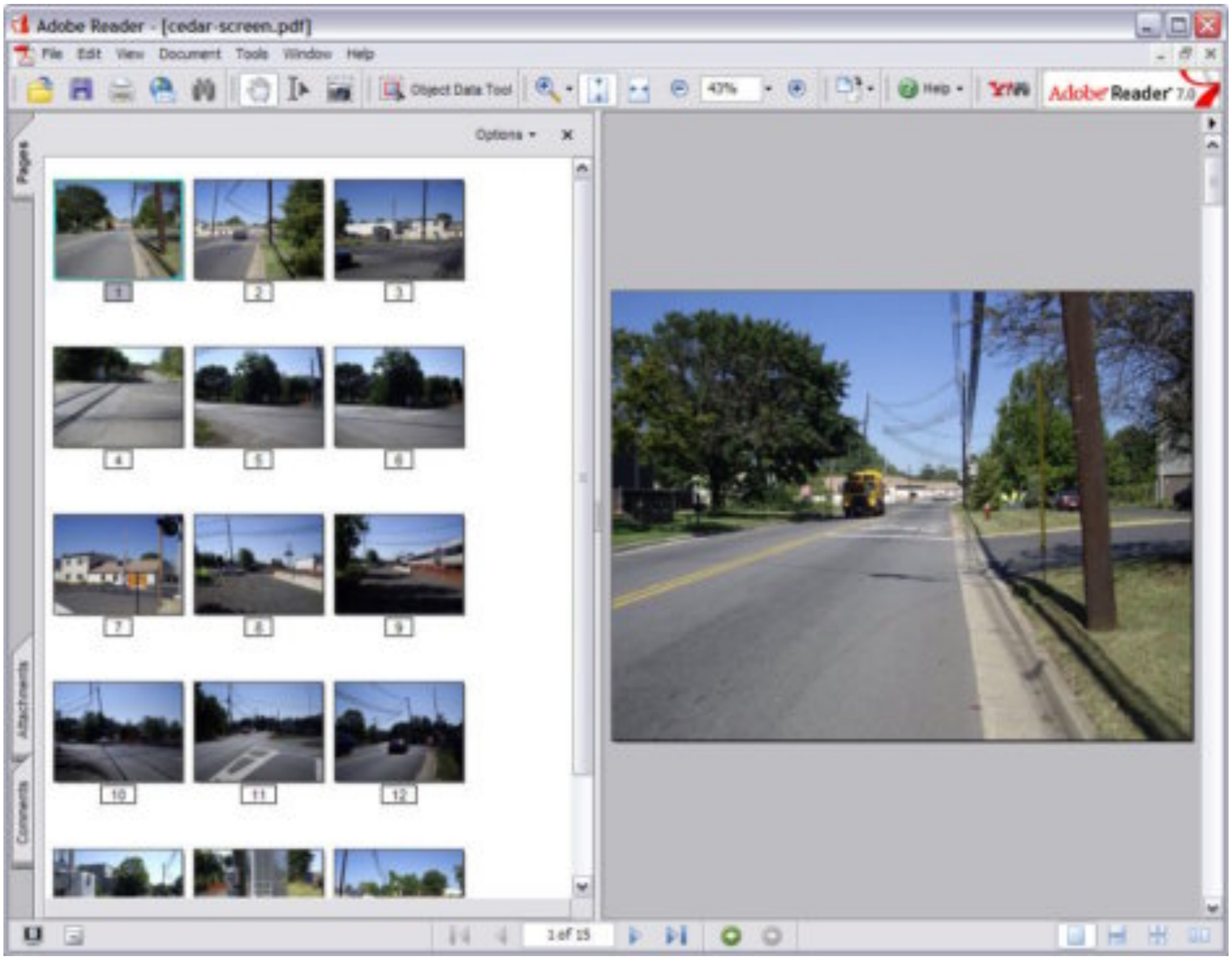


Figure V-4
Statewide Rail and Grade Crossing GIS Database
Sample Photo Inventory



VI. STAKEHOLDER AND PUBLIC INVOLVEMENT

VI.1 Overview

Freight projects, particularly ones that have already attracted public attention, such as rail grade crossings, require a unique approach to stakeholder and public involvement. The subject is complex, the issues often extend beyond the local communities, and discussions and meetings can become heated. Yet, the potential to mitigate impacts, address community goals and quality of life concerns and maintain freight operations exists.

Accordingly, the involvement effort for this project was specifically designed to maximize input and idea sharing, stimulate open and meaningful discussion, and create a common foundation for moving forward. Key to the success of this effort was the development of a sound understanding of the issues and facts, possible solutions and context for the discussion.

There were four components to the involvement effort:

- An active Technical Advisory Committee (TAC);
- "One-on-one" meetings with the municipalities and sub regions where the five top ranked grade crossing issues are located;
- Involvement of the NJTPA's Freight Initiatives Committee members and others for a broad stakeholders' meeting; and
- A Public Information Center evening.

VI.2 Technical Advisory Committee (TAC)

The NJTPA created a TAC for this project with a wide range of stakeholders. The stakeholders included:

- The sub regions where the rail lines operated – Union, Middlesex, Hunterdon, Hudson, Somerset and Bergen Counties.
- Agencies involved with rail operations – the New Jersey Department of Transportation (including the NJDOT Diagnostics Team and Rail Freight Planning staff), New Jersey Transit and the Port Authority of New York and Jersey.
- The Class I railroads – Conrail, CSX and Norfolk Southern.

TAC meetings were planned to coincide with key decision points in the project. Each meeting had specific objectives, discussion topics, decision elements and an agreement on next steps.

The first meeting was at the start of the project and designed to be an orientation to the tasks and role of the TAC. In subsequent meetings, results of the field work, literature/internet searches, and consultant products were discussed in detail.

The TAC was actively involved in the project from inception to completion. TAC members were invited to join with the team on the field visits to the 64 grade crossings. Staff from Somerset and Bergen Counties, NJTPA, NJ Transit and CSX were among those who participated in the field visits. The TAC played a crucial role in the development of the selection considerations process, defining/refining the individual considerations, establishing the weights for each consideration and reviewing the outcomes of the process.

VI.3 "One-on-one" meetings with the municipalities and sub regions

Once the grade crossings were ranked, NJTPA and the team met individually with the municipalities and sub regions where five top ranked crossings were located. The objectives of these meetings were to gather additional relevant facts related to the specific grade crossings and the surrounding area, relate information learned through the project to the municipalities (including road and rail traffic information, gate closure times, key observations, and potential areas for further analysis), and discuss the grade crossing and next steps.

These meetings occurred in and were facilitated by staff from Bergen, Middlesex and Somerset Counties. Maps, aerials, photos, and information were developed and present at these meetings, with copies provided for municipalities (thus building the common base of information).

VI.4 Stakeholder Meeting

The project's findings were presented at a special meeting of the NJTPA's Freight Initiatives Committee members and other interested parties on April 1, 2008. The meeting was designed to obtain additional input and ideas, as well as provide an overview of the facts and information that have been developed for the NJTPA's new grade crossing database.

VI.5 Public Information Center

The Public Information Center was held on April 17, 2008 in the evening to provide an additional opportunity for individuals and organizations who could not attend the stakeholder meeting to participate in the dialogue and learn more about the project. Maps, photos and information were made available to attendees. A group discussion, followed by more individualized discussions with attendees, took place at the event.

Summaries of each meeting conducted as part of the stakeholder and public involvement process are presented in Appendix F of this report.

VII. GRADE CROSSING EVALUATION CRITERIA

A series of evaluation criteria were identified through the literature search and discussions with the Technical Advisory Committee for use in evaluating specific grade crossings. While safety is certainly a highly important consideration, it is only one of a number of criteria that characterize a crossing and its operations/impact on mobility and the surrounding community. For purposes of this study, the identified criteria were grouped into four (4) categories:

- Safety history and profile,
- Physical location, configuration and control considerations,
- Rail, roadway and pedestrian operational characteristics, and
- Community/quality of life considerations.

Following is a discussion of each selected criteria, and its relevance in the performance rating of an at-grade crossing.

VII.1 Evaluation Criteria – Description, Context and Importance

Safety History and Profile

FRA Crash History

The crash history at a crossing site is a critical aspect of the needs assessment process. First, it functions as a screening tool, highlighting a selected group of locations where significant problems require priority remedial action. Further, it describes ground conditions that existed at the time of the crash. This allows for an analysis of physical, operational, and behavioral patterns as well as variability of settings which may potentially contribute to a crash and which can guide mitigation strategies.

Hazard Index

The Hazard Index is a product that measures exposure by considering roadway and rail traffic traversing the at-grade crossing. Higher levels of either roadway or rail traffic will increase the crash potential at a site. In addition, this index modifies the crash potential depending on the presence or lack of various traffic control devices.

Physical Features and Controls at the Crossing

Functional Class of Roadway

Functional Class describes operations on an individual facility within the overall context of the street system. This criterion is a surrogate for roadway traffic exposure measured by travel demand and travel speed in relative terms. Greater levels of traffic activity traveling at higher speeds result in a greater potential for mishaps. The classifications vary between local streets which carry low volume traveling at low speed and expressways which carry high volume traveling a high speeds. In between are minor collector, major collector and arterial categories which represent facilities characterized by increasingly higher volume and travel speed.

Active vs. Passive Controls at Grade Crossings

Traffic control devices (TCD) directly addresses safety-related issues. National research shows that the presence of active TCD at grade crossings reduces the potential for crashes. Vehicle gates are particularly effective in reducing the risk of incidents. The most commonly used active controls include gates, flashing lights, and train horn activation equipment. Commonly used passive controls include cross-bucks and railroad crossing pavement markers.

Proximate/Adjacent Driveways and Roadways

Driveways and roadway intersections produce conflicting traffic movements which can result in “stopping” maneuvers within the upstream traffic flow. These conflicts can produce queues extending back across the tracks, resulting in a stopped vehicle(s) on the tracks.

Proximate/Adjacent Traffic Signals

Traffic signals can potentially result in queues forming and extending across the tracks during the red phase of the signal’s cycle.

Vertical Curves

Vertical curves in the vicinity of an at-grade crossing can not only restrict available sight distances necessary for observing oncoming trains but can also cause larger vehicles to slow down to avoid striking the pavement, thus increasing the potential for rear end collisions or queuing over the tracks.

Horizontal Curves

Horizontal curves in the vicinity of an at-grade crossing can restrict sight lines necessary for observing oncoming trains. This alignment condition can be exacerbated at locations where vehicle gates are not present or where the posted travel speed is relatively high.

Proximity to Other Rail Crossings

The presence of multiple active tracks causes an additional issue for roadway vehicles crossing a rail corridor. It is difficult for a driver, whose attention is absorbed by an oncoming train, to focus on another train approaching the at-grade crossing at the same time. In addition, train horn warning device from the second rail vehicle may be mistakenly confused by a driver as being activated by the first train.

Proximity to Other Grade Crossings on Same Rail Line

A number of grade crossings located within the same municipality can affect the social fabric of a community. Rail corridors, particularly ones containing a grade-separated crossing, may function as a barrier isolating neighborhoods from each other. For at-grade crossings in close proximity to one another, an incident at one location may result in rail cars spilling back across upstream crossings, resulting in an impact on community residents and mobility of emergency vehicles.

Sight Distance

Sight distance is a critical safety aspect. Unrestricted visibility is a crucial condition for reducing the potential for collisions at rail crossing locations. Sight distance can be restricted as a result numerous conditions including track curvature, roadway curvature, man-made objects, and vegetation.

Rail, Roadway and Pedestrian Operational Characteristics

Local Rail Operations/Switching at the Grade Crossing

This criterion affects the grade crossing environment by increasing the number of potential conflicts between rail and roadway vehicles. Additionally, various train maneuvers such as backing up, and the presence of multiple tracks may add additional confusion for the driver approaching the intersection. Slow speed switching near grade crossings can affect the length of time gates are down or lights flash before a train appears at a grade crossing, adding to driver uncertainty.

Frequency of Activity (Trains per Day)

Higher train volumes will increase the potential for conflicts at grade crossing sites.

Duration of Closure

Longer closure times result in higher levels of inconvenience and delay for area residents. It also increases the adverse impact on response time of emergency vehicles.

Projected Change in Rail Traffic

This criterion relates to the issue of exposure. Future increases in rail traffic will increase the potential for vehicle and pedestrian conflicts at the crossing site.

School Buses Using Crossing

School buses are exposed to the same hazards as other vehicles in the traffic stream. Higher levels of school bus crossings increase the exposure to conflicts at rail crossing sites.

Roadway Volume

Higher roadway volumes will increase the potential for conflicts at grade crossing sites. This problem may be exacerbated if roadway volumes increase to a level requiring additional roadway capacity. Additional travel lanes facilitate the maneuver to drive around activated crossing gates, increasing the risk of an incident.

Prevailing Travel Speed

Higher roadway travel speeds approaching at-grade crossings increases the potential for a crash as a result of greater distances that are required for a vehicle to stop. Safety issues related to higher travel speeds are exacerbated at locations where gates are not present and where sight distance is restricted.

Projected Change in Roadway Traffic

This criterion relates to the issue of exposure. Future increases in vehicular traffic will increase the potential for conflicts at the crossing site.

Pedestrian Activity

Higher levels of pedestrian activity will increase the potential for pedestrian related incidents at crossing sites. Pedestrian activity is particularly prevalent at crossings proximate to dense residential developments, schools and retail centers. The presence of sidewalks generates a safety benefit related to organizing pedestrian activity across a path that facilitates efficient and swift movement, however, the installation of sidewalks generally occurs to meet pedestrian travel demand which increases the potential for incidents.

Level of Pedestrian Accommodation and Control

The installation of safety features such as pedestrian gates, flashing lights, and fences restricting access across tracks, oriented in the direction facing primary paths of travel improves safety at crossing sites.

Proximity to Adjacent Grade Separated Crossings and Alternate Routes

If an at-grade crossing is closed, proximity to a grade separated crossing that is easily accessible ameliorates adverse effects on issues related to response times for emergency vehicles, economic loss to business activity associated with the cost of vehicular delay, and the general inconvenience experienced by area residents.

Community/quality of life considerations

Proportion of Activations during Peak Roadway Activity

This criterion is a measure of exposure to potential rail vehicle and roadway vehicle conflicts. Higher levels of activations during peak period roadway activity increase the potential for conflicts between rail and roadway traffic.

Emergency Response Constraint

Blockages occurring at crossing sites can limit emergency access to neighborhood sections within a community. This condition is exacerbated if travel paths to alternative crossing sites are circuitous, discontinuous, lengthy or consist of sections of road that are low on the functional class hierarchy structure such minor streets. These conditions adversely affect emergency service operations by increasing the length of emergency response times

Proximity to Schools

Schools generate and concentrate school-age children pedestrian activity and drop-off and pick-up vehicle trips along the transportation infrastructure surrounding the school facility. Schools near at-grade crossings potentially result in higher levels of pedestrians and vehicles traversing the rail crossing site, thereby increasing the exposure to vehicle and pedestrian strikes. Further, increased popularity and use of portable electronic and entertainment devices such as cell phones and MP3 players, tend to increase pedestrian inattention.

Adjacent Sensitive Land Uses (residential, parks, etc.)

Railroad corridors running adjacent to sensitive land uses can affect a number of quality of life issues including land use compatibility, noise and vibration, traffic circulation patterns, street network connectivity, aesthetic and visual compatibility , and community cohesion impacts associated with bifurcation of neighborhoods.

Overnight Noise

Overnight train noise can affect the quality of life with neighborhoods surrounding rail corridors and disrupt sleeping patterns of residents living in these areas, and is a common complaint. Overnight noise from train whistles and operation of the train itself may be considered a detriment to quality of life for those residing near an at-grade crossing.

VII.2 Development of Criteria Weighting Factors

Obviously, not all of the evaluation criteria listed above are equally critical. Additionally, depending upon the specific location and circumstances, as well as the perspective of the individual(s) affected by the crossing differ from location to location. To address this variance in the relative importance of each of the criteria, a weighting factor was developed for each criteria.

As discussed in Section VI.2, a Technical Advisory Committee was formed to review, guide and critique the study process. A key role of the TAC was in the determination of the appropriate weighting factor to be applied to each criteria. The TAC was comprised of a diverse cross-section of backgrounds and interests ranging from rail operators, public agencies, county planning officials, NJDOT, NJ Transit and Port Authority of New York and New Jersey staff.

In this effort, a total of fourteen (14) TAC members provided their input on the appropriate weighting factors. Each TAC member was asked to rate each criteria on a scale of 1 to 5, with 1 being minimally important, and 5 being significantly important. Table VII-1 summarizes the individual criteria, as well as pertinent statistics related to the recommendations for weight factor assignment, including minimum and maximum recommendations, average weight, and standard deviation.

Table VII-1
Evaluation Criteria Weighting Factors

Criteria	High	Low	Average	Standard Deviation	Assigned Weight
FRA/FHWA Quantitative Considerations					
FRA crash history	5.00	1.00	4.93	0.27	5.00
Hazard Index	5.00	2.00	4.29	1.07	4.25
Location, Configuration and Control Considerations					
Functional Class of Roadway (see below)	5.00	1.00	2.77	1.74	2.75
Active vs. Passive Control at grade crossing (1=full active, 3=combination, 5=passive)	5.00	1.00	3.07	1.21	3.00
Proximate/Adjacent driveways and roadways (existing and anticipated)	4.00	1.00	2.64	0.84	2.75
Proximate/Adjacent traffic signals (existing and anticipated)	5.00	1.00	3.31	1.10	3.25
Existence/Severity of Vertical curvature (crest and/or sag)	5.00	1.00	3.29	1.20	3.25
Existence/Severity of Horizontal curvature	5.00	1.00	3.21	1.37	3.25
Proximity to other rail crossings (NJ Transit, shortline, active spurs)	5.00	1.00	3.43	1.22	3.50
Proximity to other grade crossings on same rail line (bisected community)	5.00	1.00	3.29	1.27	3.25
Sight distance	5.00	1.00	3.45	1.44	3.50
Operational Considerations -- Roadway, Rail, Pedestrian					
Rail – Local rail operations/switching involving the grade crossing (0=non-existant, 5=exists)	5.00	1.00	2.86	1.29	2.75
Frequency of Activity - Activations/Trains per day (see below)	5.00	2.00	4.14	1.17	4.25
Duration of closure - Average time (see below)	5.00	1.00	3.50	1.40	3.50
Projected Change in Rail Traffic (0=none, 3=moderate, 5=significant)	5.00	2.00	3.43	0.94	3.50
School Buses Using Crossing (0=none, 3=minor use, 5=major use)	5.00	1.00	3.07	1.21	3.00
Roadway - volume level	3.00	1.00	3.00		3.00
Roadway - Prevailing Travel Speed	5.00	1.00	2.29	1.20	2.25
Roadway - Projected Change in Roadway Traffic (0=low, 3=moderate, 5=high)	5.00	1.00	3.00	1.18	3.00
Pedestrian -- level of activity (0=none, 1=sidewalks exist, 3=modest, 5=significant)	5.00	1.00	3.79	1.19	3.75
Pedestrian -- level of accommodation and control (5=none, 3=modest, 0=extensive)	5.00	1.00	3.07	1.27	3.00
Proximity to Adjacent Grade Separated Crossings and Alternate Routes (see below)	5.00	1.00	3.00	1.30	3.00
Community Considerations					
Proportion of Actuations during peak roadway activity periods	N/A	N/A	N/A	N/A	3.00
Emergency Response Constraint	5.00	1.00	4.21	1.25	4.25
Proximity to School	5.00	3.00	3.64	0.63	3.75
Adjacent Sensitive Land Use (i.e.: residential, school, park, etc)	5.00	1.00	3.07	0.92	3.00
Overnight Noise	5.00	1.00	2.43	1.65	2.50

VIII. ANALYSIS / SCORING OF GRADE CROSSINGS

VIII.1 Impact Scoring Methodology

Subsequent to the determination of the appropriate weighting factors to apply to the individual criteria, each crossing in the study was evaluated, with numerical scores applied to each criteria. Scores were applied ranging from "0" to "5", with "0" representing a non-issue, and "5" representing a significant issue at the location in question. For each criterion, an impact or severity score was assigned to measure the level of significance of a particular issue.

To facilitate perspective when reviewing the resulting scores, it is important to understand the theoretical maximum score that could be assigned to a specific crossing location. **If all of the criteria were scored as a "5", the total score assigned to the crossing subsequent to application of the weighting factors, would be 446.25. It is unlikely, if not impossible, that any crossing would be assigned such a score.** However, it is important to keep this figure in mind when reviewing the ranked scores applied to the study crossings.

Various measuring procedures were employed to determine values for each criteria, with the procedure of choice dependent upon the nature of the criterion under investigation. The first method assigns a "sliding" score based on location-specific data that can be quantified. As an illustration, a crossing site with a crash history of zero incidents would be scored a "0", whereas, another site where multiple crashes occurred would be assigned a relatively higher score.

The second method ranks certain criteria as low, medium or high, based on the presence of a specific characteristic(s). For example, the "School Bus Crossing Usage" criterion would be given a score of "0" for low usage, "3" for moderate usage and "5" for intensive usage.

A third method assigns a score based upon a pre-determined scale. For example, a prevailing travel speed falling within a range of 26 mph to 35 mph is assigned a score of "2" while higher speed ranges are assigned higher scores.

This impact score is one of two factors, the other being the weight score described in Chapter 6, that was included in the calculation that yielded a "Total Weighted Score" for each issue. These "Total Weighted Scores" were the basis for the project selection ranking process as discussed in subsequent sections of this report. The following section discusses the methodology for application of a specific score for each evaluation criteria.

VIII.2 Impact Scoring Measures by Criterion

- FRA Crash History

Scoring was based on location-specific data. Sites where one (1) crash with no injuries occurred between the period 1997 and 2007 were assigned a score of 1. Sites where two (2) crashes occurred with no injuries were assigned a score of 2. Sites with three (3) or more crashes with no injuries were assigned a score of 3. If one or more injuries resulted from a crash, a site's score was increased by 1. If one or more fatalities occurred, a site's score was increased by 2. If significant recent improvements were made at a site since the crash occurrence, its score was reduced by 1.

- Hazard Index

Scoring was based on a combination of location-specific data and a pre-determined scale. The index is the product of three factors including the vehicle average daily traffic (ADT), the number of daily (24 hours) train crossings, and a protection factor.
A site score is assigned by placing this product within one of 5 pre-determined ranges. The ranges include 0 to 14,999 (1 Score), 15,000 to 24,999 (2 Score), 25,000 to 39,999 (3 Score), 40,000 to 59,999 (4 Score), 60,000 and greater (5 Score).

The protection factor is based on active safety devices available at the crossing site. The protection factor is 0.1 for a site with fully automated crossing gates, lights and cross bucks, 0.6 for a site with no gates but with lights and cross bucks, and 1.0 for a passive site.

- Functional Class of Roadway

Scoring was based on a pre-determined scale. Roadway classes carrying greater traffic levels were assigned higher scores. Specifically, the Local Street Class was assigned a score of 1, the Minor Collector Class was assigned a score of 2, the Major Collector Class was assigned a score of 3, the Minor Arterial Class was assigned a score of 4, and the Principal Arterial Class was assigned a score of 5.

- Active vs. Passive Control at Crossing

Scoring was based on specific site characteristics. A fully activated at-grade crossing was assigned a score of 1. A crossing site with a combination of active and passive traffic control devices, excluding crossing gates, was assigned a score of 3, and a passive crossing site was assigned a score of 5.

- Proximate/Adjacent Driveways and Roadways (Existing and Anticipated)

The existence of a local property access driveway or public street in close proximity to the crossing was scores based upon the distance from the crossing. Industrial and business driveways are often located in close proximity to a rail grade crossing, and tend to serve some level of truck activity. The increased size and lessened agility of large trucks (as compared to automobiles) using these driveways make this a particularly pertinent consideration when addressing and managing roadway, rail and pedestrian activity at a grade crossing.

- Proximate/Adjacent Traffic Signals (Existing and Anticipated)

Traffic signals in close proximity to a crossing were evaluated based upon the distance from the crossing, relative traffic volumes along the roadway, and potential for formation of vehicle queues that would extend to, or even across, the grade crossing.

- Existence /Severity of Vertical Curve (Crest and or Sag)

Vertical curvature of the roadway was scored based upon the likelihood that a driver's sight distance would be impeded to the point where safe stopping would not be possible when approaching the crossing. The score applied was a function of the available sight distance as well as the prevailing travel speed along the roadway.

- Existence/Severity of Horizontal Curve

Similar to vertical roadway curvature, horizontal curvature of the roadway was scored based upon the likelihood that a driver's sight distance would be impeded to the point where safe stopping would not be possible when approaching the crossing. The score applied was a function of the available sight distance as well as the prevailing travel speed along the roadway.

- Proximity to Other Rail Crossings (NJ Transit, Shortline, Active Spurs)

Activity at an adjacent rail crossing holds the potential to generate vehicle queuing that could reach, or cross, the subject crossing, in a manner similar to a proximate traffic signal. Existence of adjacent crossings was evaluated based upon the distance from the crossing, relative traffic volumes along the roadway, and potential for formation of vehicle queues.

- Proximity to Other Grade Crossings on Same Rail Line (Bisected Community)

This criteria was employed as a general measure of adequacy and convenience of alternate routes utilizing the most proximate grade separated crossing. The score was based upon a set range of additional distances traveled along the alternative route using the adjacent grade separated crossing. 1= <0.25 mi, 2= <0.5 mi, 3=<0.75 mi, 4= <1.0 mi, 5= >1.0 mi.

- Local Rail Operations/Switching Involving the Grade Crossing

Scoring was based on specific site characteristics. A score of 5 was assigned to a site where local rail operations and switching activities occurred. A score of 0 was assigned to a site where these activities did not occur.

- Frequency of Activity -Activations/Trains Per Day

Scoring was based on a pre-determined scale defined by ranges. The ranges for numbers of activations and trains per day included 0 to 5 (1 Score), 6 to 10 (2 Score), 11 to 20 (3 Score), 21 to 40 (4 Score), and greater than 40 (5 Score).

- Duration of Closure – Average Time

Scoring was based on a pre-determined scale defined by ranges in seconds. The ranges included 0 to 60 (1 Score), 61 to 120 (2 Score), 121 to 180 (3 Score), 181 to 240 (4 Score), and greater than 240 (5 Score).

- Projected Change in Rail Traffic

Scoring was based on specific site characteristics. A score of “0” was assigned to a location where changes in rail traffic in the future were not expected, “3” where rail traffic projections show a moderate increase, and “5” where rail traffic projections show a significant increase.

- School Buses Using Crossing

Scoring was based on specific site characteristics. Scores were assigned as follows; “0” where no crossings occurred, “3” where minor use of the crossing occurred, and “5” where major use of a crossing occurred.

- Prevailing Travel Speed

Scoring was based on a pre-determined scale defined by ranges with the higher speed regimes generating the greater impact. The ranges included 25 mph or less (1 Score), 26 mph – 35 mph (2 Score), 36 mph – 40 mph (3 Score), 41 mph – 50 mph (4 Score), and greater than 50 mph (5 Score).

- Projected Changes in Roadway Traffic

Scoring was based on specific site characteristics. A score of “0” was assigned to a location where increases in roadway traffic are not projected, “3” where roadway traffic projections show a moderate increase, and “5” where roadway traffic projections show a significant increase.

- <u>Pedestrian Level of Activity</u>

Scoring was based on specific site characteristics. A score of “0” was assigned to a location where pedestrian activity was low, “3” where pedestrian activity was moderate and “5” where pedestrian activity was significant. At locations where sidewalks existed, the minimum score assigned was “1”.

- <u>Level of Accommodation and Control for Pedestrian</u>

Scoring was based on specific site characteristics. A score of “0” was assigned to a site where the level of control was extensive and included pedestrian crossing gates. A score of “3” was assigned to a site where the level of control was modest and where crossing gates were not available. A score of “5” was assigned to a site where pedestrian controls and accommodations were absent.

- <u>Proximity to Adjacent Grade Separated Crossings and Alternate Routes</u>

This criterion measures in general terms the existence, adequacy and convenience of alternate routes using the most proximate grade separated crossing. Scoring was based on a pre-determined scale defined by ranges. The distance along the rail line to the nearest grade separated crossing ranged between a study site and the nearest grade separated crossing included 0.24 mile or less (“1” Score), “0.25” and 0.49 miles (“2” Score), 0.50 mile and 0.74 mile (“3” Score), 0.75 mile and 0.99 mile (“4” Score), and 1 mile or greater (“5” Score).

- <u>Proportion of Actuations during Peak Roadway Activity Periods</u>

Actuations (crossings) during peak commuter periods hold a greater likelihood of significant roadway queuing simply due to the increased volume of traffic on the roadways during these times of day. The score applied to this evaluation criteria is generally equivalent to the percentage of crossings during the 6 heaviest roadway travel periods divided by 2. For example, if 40 percent of the crossings occur during the peak periods, then the score applied would be a 2.

- <u>Emergency Response Constraints</u>

This evaluation criterion is somewhat subjective in that it takes into account the proximity of emergency responder origins or destinations such as fire stations and medical centers, and the potential for the affected roadway to be a primary route to the medical center. It also accounts for the availability of an alternative travel path for use by emergency responders. In a setting where a closely spaced grid of roadways exists for use as alternate travel paths with minimal additional travel time and distance, impediments to emergency access would receive a score of “1”. In a rural setting, where the roadway is the only travel way available and alternate routes would require extensive additional travel time/distance, a score of “5” would be assigned.

- Proximity to School

While a school located in close proximity to a grade crossing does not automatically present an issue, it does increase the likelihood of young people walking along the roadway and crossing the rail line. In addition, after-school activities such as cross-country running could potentially interact with the crossing. Scoring for this criteria is assigned based upon the linear distance between the crossing and the school property. Locations with a school immediately adjacent are assigned a score of “5”, while a location with no school along the subject roadway or in the immediately surrounding area is assigned a score of “0”.

- Adjacent Sensitive Land Uses (i.e. residential, schools, parks, etc.)

Some land uses, such as residential dwellings and hospitals are more sensitive to issues such as noise and vibration than others. The proximity of existing land uses, and sensitivity to noise related issues, is reflected in the evaluation under this criteria. Crossings in an industrial or commercial setting, or those in rural areas surrounded by undeveloped open space, are assigned a score of “0”. Crossings in a residential setting, or with sensitive land uses directly adjacent to the crossing, are assigned a score of “5”. Intermediate scores are assigned based upon the type, density and proximity of the sensitive uses.

- Overnight Noise

Overnight noise is an issue generally associated with rail activity through or proximate to a residential community. Crossings that are not part of a quiet zone, and are abutted by residential uses are assigned a score of “5”. Locations without any proximate residential land uses or overnight rail activity are assigned a score of “1”.

IX. RANKING AND PRIORITIZATION OF CROSSINGS

Prior to presenting the findings of the scoring process on a crossing by crossing basis, it bears restating that, as discussed previously, the theoretical maximum score that could be applied to any crossing location based upon the defined criteria, weighting factors, and range of possible scores totals 446.25. The highest score assigned to an individual crossing in this study totaled 258.75. Final scores applied to each of the study crossings are presented in Appendix G of this report. Table VIII-1 summarizes the 64 study crossings, and the assigned scores.

Table VIII-1
Grade Crossing Scores and relative Rankings

Line	Crossing	Weighted Score	Rank
Lehigh	Inman Avenue	258.75	1
Lehigh	Cedar Avenue	246.75	2
River Line	River Street - 69th Street *	242.00	3
River Line	Old Hook Road	227.50	4
West Trenton	Route 601	226.50	5
Port Reading	St. George Avenue	221.50	6
River Line	New Bridge Road	216.50	7
River Line	West Clinton Avenue	208.75	8
Lehigh	Rahway Avenue	206.25	9
River Line	Durie Avenue	203.00	10
River Line	New Milford Avenue	202.00	11
Lehigh	New Market Road	200.50	12
Lehigh	South Avenue	200.50	13
River Line	La Roche Avenue	197.25	14
Lehigh	Main Street	196.25	15
River Line	West Madison Avenue	195.00	16
Lehigh	Prospect Avenue	192.25	17
Port Reading	Blair Road	191.75	18
River Line	Haworth Avenue	188.75	19
River Line	Clinton Avenue	188.25	20
River Line	St. Pauls Avenue	187.50	21
National Docks	Chapel Avenue	187.00	22
Port Reading	Rahway Avenue	184.50	23
River Line	Columbia Avenue	183.00	24
River Line	West Church Street	182.25	25
River Line	Bergen Turnpike	180.00	26
River Line	West Central Avenue	179.75	27
Lehigh	Thirteenth Street	177.00	28
Port Reading	South Main Street	175.75	29
Lehigh	Tingley Road	175.50	30

Table VIII-1 (continued)
Grade Crossing Scores and relative Rankings

Line	Crossing	Weighted Score	Rank
River Line	Broadway	171.50	31
Lehigh	Auten Road	170.00	32
Lehigh	Valley Road	169.25	33
River Line	West Main Street	167.75	34
River Line	Laffette Avenue	167.75	35
River Line	Harriet Avenue	167.50	36
River Line	Mt. Vernon Street	166.50	37
Lehigh	New Brunswick Avenue	164.25	38
River Line	Blanche Avenue	164.25	39
Port Reading	Washington Avenue	161.50	40
Lehigh	Front Street	155.75	41
Lehigh	Lehigh Road	154.75	42
Chemical Coast	Woodbridge Avenue	146.50	43
Port Reading	New Brunswick Avenue	146.50	44
Lehigh	Stanton Station Road	141.00	45
Lehigh	Perryville Road	140.00	46
Lehigh	Still Valley Road	139.00	47
Port Reading	Baekeland Road	137.50	48
Lehigh	Hamden Road	137.50	49
Lehigh	Kiceniuk Road	133.50	50
Lehigh	Landsdown Road	133.50	51
Chemical Coast	Mauer Road	130.25	52
Lehigh	Roycefield Road	128.00	53
Lehigh	Beekmans Lane	123.25	54
Port Reading	Helen Street	122.25	55
Chemical Coast	Milos Way	121.00	56
Lehigh	Clinton Street	118.25	57
West Trenton	Province Line Road	117.00	58
West Trenton	Sunnymead Road	114.00	59
West Trenton	Spring Hill Road	113.00	60
West Trenton	Hollow Road	103.50	61
Port Reading	South Street	101.75	62
Port Reading	Clinton Avenue	93.50	63
Lehigh	Rockafellows Mills Road	91.25	64

* River Street-69th Street grade separation already in design.

X. ISSUES / SOLUTIONS MATRIX

Simply ranking within the top 5 highest scoring locations **DOES NOT** automatically imply that there exists a safety concern at the subject crossing. As discussed throughout this report, there are numerous factors and considerations that define the impact a grade crossing has on not just safety, but on area mobility and overall quality of life. Ranking near the top of the relative score list simply means that further investigation is warranted to identify specific solutions(s) that would be appropriate for addressing the specific issues that contributed most significantly to the higher score. Often, while grade separation may be the first thought to come to mind, a more thorough investigation will often identify measures that can be undertaken in a shorter time frame, at lower cost, and with fewer residual impacts to proximate properties and land uses. A range of lower cost, easily implementable measures that can be taken at specific crossings investigated in this study are discussed in Appendix B of this report, and include such measures as rehabilitation of pavement markings and signage, removal of sight distance constraints and installation of sidewalks.

X-1 Development of the Issues and Solutions Matrix

To facilitate identification of a specific solution to a specific issue, the study undertook to develop an "Issues and Solutions" matrix as a tool to facilitate discussions regarding grade crossings. Through the field work, literature/internet reviews, and previous experience, the consultant team recognized that each grade crossing is different – different in terms of road, rail and pedestrian movements, different in terms of geometries, different in terms of surrounding land uses, different in terms of the current operations and equipment at the crossing, etc. These varying characteristics generate different issues and considerations for each crossing. Similarly, a wide range of potential options existed to address the issues.

In the National Cooperative Highway Research Program report, *Integrating Freight Facilities and Operations with Community Goals*, best practices identified during the project were arrayed in a table by freight mode and issue.[1] This table has moved into widespread use to facilitate discussions and resolve issues. The team envisioned a similar one page tool for grade crossing issues and potential solutions.

The team developed the matrix by first identifying and listing the grade crossing issues. Four issue categories were identified and then populated by more specific issue topics:

- ***Roadway issues*** – visibility, road congestion/blockage, road geometries, and truck "bottoming out" (roadway crest within the crossing).

[1] A. Strauss-Wieder, *Integrating Freight Facilities and Operations with Community Goals*, National Cooperative Highway Research Program, Synthesis 320, 2003, pp. 15-16.

- ***Pedestrian issues*** – visibility and lack of sidewalks/walking surfaces within the crossing.

- ***Rail operations issues*** – visibility, train speed restrictions and local switching in the immediate area of the crossing.

- ***Community issues*** – general safety concerns, noise, and emergency response/access or times.

Similarly, solution sets potentially suitable for further investigation were identified and categorized including:

- ***Modification of the crossing –*** quiet zones, wayside horn installation/use, crossing equipment upgrades and modifications, enhancement of crossing signage at and within the crossing, trimming trees and shrubs in the immediate vicinity of the crossing, grade separating the crossing and installing median/raised barrier medians.

- ***Modification of the roadway at or in the vicinity of the crossing*** – reconfiguration of the roadway, modification/addition of road signage, installation/modification/preemption of traffic signals, elimination/closure of the road, and implementations of turn prohibitions (e.g., right turn only permitted from a nearby driveway).

- ***Modification of rail operations*** – increase train speed, elimination/re-routing of the rail line, relocation of train signals/modification of train controls, and modification of train operations (e.g., change train times).

- ***Modifications for pedestrians at or in the vicinity of the crossing*** – addition of pedestrian gates, widen pavement to match adjacent sidewalks, "herd" pedestrians to designated crossing locations, grade separation of pedestrian crossings (e.g., create over- or underpasses for pedestrians), and elimination of pedestrian movements at the crossing.

- ***Implementation and augmentation of community-wide programs*** – Conducting "Operation Lifesaver" education programs (education programs designed to elevate knowledge regarding rail crossings and rights of way and promote safe practices), relocation of rail-using businesses to other sites, and shifting emergency response routes to other roadways.

Having identified the range of issues and potential solution sets as the columns and rows in the matrix, the team then checked the boxes where particular solution sets could be further investigated for specific issues. The draft issues and solutions matrix was then provided to the project's Technical Advisory Group for review and comment.

The comments included modifications and suggestions for issues, potential solutions and boxes to be checked.

The resulting issues and solutions matrix is shown in Figure X-1. The matrix was subsequently used in the meetings with towns on the five top ranked grade crossings and discussed at the Public Information Center for the project.

Figure IX-1
Grade Crossing Issues / Solutions Matrix

Potential Solution Sets for Further Investigation		Roadway Issues				Pedestrian Issues		Rail Operations Issues			Community Issues		
		Visibility	Road Congestion/ Blockage	Road Geometries	"Truck Saturating Out" Roadway Crest within Crossing	Visibility	Lack of Sidewalks/ Walking Surface	Visibility	Train Speed Restrictions	Train Switching In Area	Noise	Emergency Response Access or Times	General Safety Concerns
Crossing Modification	Quiet Zones										✓		
	Wayside Horns										✓		
	Crossing Equipment Upgrade/ Mod/Sensor Relocation		✓			✓			✓	✓		✓	✓
	Enhance Crossing Signage - At/Within Crossing		✓			✓							✓
	Trim Trees/Shrubs	✓				✓		✓					✓
	Grade Separation	✓	✓	✓		✓		✓	✓		✓	✓	✓
	Median - Raised Barrier		✓	✓				✓					
Roadway Modification	Roadway Reconfiguration	✓	✓	✓	✓			✓				✓	✓
	Road Signage - Advance and Special Condition		✓	✓									✓
	Install/ Mod/ Preempt Traffic Signals		✓									✓	✓
	Eliminate/Close Road	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Implement Turn Prohibitions	✓	✓	✓				✓					✓
Rail Modification	Increase Train Speed		✓						✓			✓	
	Rail Line Rerouted (Rail Eliminated)	✓	✓				✓	✓	✓		✓	✓	✓
	Move Train Signals/Mod Train Control		✓						✓	✓			
	Modify Train Operations (Change Train Times)		✓						✓		✓	✓	✓
Pedestrian Modification	Add Ped Gates					✓							✓
	Widen Pavement to Match Sidewalks						✓						✓
	"Herd" Pedestrians to Designated Crossing Sites					✓	✓						✓
	Grade Separate Pedestrian Crossing					✓	✓						✓
	Eliminate Pedestrian Crossing					✓	✓						✓
Community Wide Program	Operation Lifesaver - Educational Programs												✓
	Move Rail-Using Businesses to Other Locations		✓						✓	✓	✓		
	Shift Emergency Response Routes to Other Streets											✓	

X-2 Applying the Issues and Solutions Matrix

The issues and solutions matrix is designed to be an on-going tool that can be used for additional grade crossing assessments and discussions beyond this project. The process for utilization/application of the issues/solutions matrix may be summarized as follows.

- ***Identify the characteristics and potential issues –*** Prior to and during discussions, the characteristics and potential issues specific to a grade crossing or set of grade crossings are identified. The grade crossing field inventory sheets developed by the New Jersey Department of Transportation Diagnostics team and used by the consultant team for the NJTPA project can be used to identify the existing characteristics. The matrix provides an additional base list of potential issue areas and items that can be observed during the field visits. Note that safety protocols should be followed for all field visits.

- ***Review the potential solution sets*** – Next, the group can review and discuss the potential solutions sets related to the identified issues by going down the relevant columns in the matrix and seeing the checked boxes.

- ***Identify potential solution sets for further investigation*** – The resultant understanding of the issues and potential solutions can then be used to develop a problem statement for the further investigation of the crossing(s) and resolution of the identified issues.

XI. PROBLEM STATEMENTS

The final step in this study was the application of the evaluation tool and issues/solutions matrix to the five locations that received the highest score in the evaluation process. These locations included:

1.	**Inman Avenue**	**Lehigh Line**	**Score:**	**258.75**
2.	**Cedar Avenue**	**Lehigh Line**	**Score:**	**246.75**
3.	**Old Hook Road**	**River Line**	**Score:**	**227.50**
4.	**Route 601**	**West Trenton Line**	**Score:**	**226.50**
5.	**St. George Avenue**	**Port Reading**	**Score:**	**221.50**

As summarized in Section IX, the crossing of River Street-69th Street was ranked third on the list of 64 crossings evaluated This crossing was dropped from further consideration in this study since a grade separation project is currently well into the design stages, and is expected to be completed in the near future.

As discussed in Section VI, meetings were held with representatives of the municipalities within which these crossings reside. These meetings were intended to accomplish several things: validate the scoring process as applied to the subject crossing; solicit additional input related to operational issues or concerns that did not arise from the evaluation process; and commence a dialogue that will serve as a starting point in subsequent investigations and selection/implementation of a solution to the specific issues identified. Summaries of the municipal meetings are presented in Appendix F of this report.

Subsequent to these discussions, formal problem statements were prepared as a segue into next steps in further investigating the need for, and nature of, solutions to be implemented at the five (5) highest scoring at-grade crossing locations. These problem statements are presented in Appendix H of this report.

XII. HIGH-SPEED GRADE SEPARATED RAIL CORRIDOR ASSESSMENT

While not directly related to assessment of a specific grade crossing and determination of the need for improvements, a preliminary assessment was made of the potential for, and value of, creating a high speed rail corridor to move trains between the port district and the National Rail Network that is fully grade separated within New Jersey. While on the surface this may appear to have significant merit, there are a number of related issues that bear consideration when determining whether or not this concept should be pursued.

XII-1 Primary Routes between Port District/Surrounding Area and Hinterlands

There are three (3) primary corridors, or routes, that are currently, or could be utilized for moving trains between the port district and out-of-state locations on the National Rail Network. Two of these routes are operated by CSX, while the third route is operated by Norfolk-Southern. The rail corridors assessed in the grade crossing assessment study comprise the majority of these rail routes within New Jersey.

The River Line is operated by CSX, and is a primary route for movements to and from the north, as well as providing connections to points in the Midwest via the national Network. Subsequent to leaving New Jersey and entering New York State, service continues along the former New York Central Railroad Water Level Route, heading west through New York and Pennsylvania and into Ohio in the Cleveland/Canton vicinity.

The Lehigh Line is run by Norfolk Southern, and traverses New Jersey from the Port District into Pennsylvania in the vicinity of Easton, PA. The route traverses Pennsylvania, running along the Pennsylvania railroad and enters Ohio and passes through the Cleveland/Canton area.

The third route, which is not currently utilized for direct container rail service between the port and out-of-state destinations is operated by CSX, and utilizes the West Trenton Line for service to Philadelphia, heading south through northern Delaware, where it turns west across Maryland via the B&O railroad, entering Ohio and passing through the Cleveland/Canton area.

As can be seen, these three routes service distinctly different regions and market segments, and do not re-converge until reaching the eastern Ohio area. These routes are operated by different entities, and would require extensive consolidation of rail activity along a single service corridor to allow all operators fair and equivalent access to the right of way. In addition, this would only prove fruitful for goods movements that are destined to travel through the Cleveland Ohio area. All other national destinations would not be equivalently served.

XII-2 Order of Magnitude Cost

While detailed alignments and preliminary engineering has not been undertaken in the evaluation of a high-speed, grade separated rail corridor through New Jersey, it is reasonable to anticipate that the cost of such a corridor would be considerable. Depending upon the route selected, the distance between the Port District and the New Jersey borders ranges from 25 miles to the New York State line, to 55 miles to the Pennsylvania State Line. Even further distances would be required in the route were to head in a southerly direction.

Regardless of the alignment selected, extensive right of way acquisition would be required. This level of land acquisition would likely result in additional adjacent land use access impacts requiring extensive mitigation. Environmental impacts would serve to further increase the cost, assuming that mitigation measures could be identified and determined to be feasible.

As a comparison, the Alameda Corridor is a 20-mile long grade separated corridor, with approximately ½ of its length in a 33 foot deep, 50 foot wide trench. Construction of the Alameda Corridor cost approximately $2.4 billion in the late 1990's thru 2002. Escalating construction costs would likely put this figure somewhere in the neighborhood of $4 billion dollars today. This equates to an average cost of approximately $200 million dollars per mile (in 2008 dollars). It is important to not that the Alameda Corridor was generally constructed along an existing rail right of way, and did not require extensive property acquisition. Considering the increased distanced required to traverse New Jersey, the cost of a similar initiative (not including property acquisition) would likely range from $5 billion to $11 billion dollars, with increased costs anticipated for construction at some point in the future.

XII-3 Limited Utility of a single corridor, and impact on competitive rail pricing.

As discussed above, there are three routes serving distinctly different markets traversing New Jersey from the Port District. Not all of these routes would be equally served by selection of one of the routes for the grade separated corridor. This would likely have an adverse effect of competitive rail pricing in the Port District, and would prove to be a detriment to maintaining a competitive edge for attracting shippers to the Port of Newark/Elizabeth. Further, these three primary routes serve distinctly different markets and shippers in the markets served by the two routes not selected as the high speed, grade separated corridor would be economically disadvantaged by changes in operating economics on those two lines as a result of the diversion of the intermodal traffic

Port related traffic is by no means the only rail traffic utilizing the freight rail corridors in the region. Port related traffic comprises less than 10 percent of the rail activity in the region, with local moves, deliveries and switching operations contributing significantly to the current (and anticipated future) rail activity. These activities would not be served by a grade-separated, high speed corridor in any location.