North Jersey Transportation Planning Authority
Guidelines for the
FY 2020 Local Safety and High Risk Rural Roads Programs

I. Introduction

The North Jersey Transportation Planning Authority (NJTPA) Board of Trustees is working with the Federal Highway Administration (FHWA), New Jersey Department of Transportation (NJDOT), subregions and other state and local agencies to make travel a safer and more reliable experience. Since 2004, the NJTPA has provided federal funds annually to address documented safety problems within its region utilizing the Highway Safety Improvement Program (HSIP).

The latest federal surface transportation law, Fixing America's Surface Transportation (FAST) Act of 2015, continues the Highway Safety Improvement Program as a core Federal-aid program with the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads, including non-State-owned public roads. Highway Safety Improvement projects must be consistent with the State's Strategic Highway Safety Plan (SHSP) (https://www.state.nj.us/transportation/about/safety/pdf/2015strategichighwaysafetyplan.pdf) and are selected on the basis of supportive crash data. Highway safety improvement projects intend to correct or improve a hazardous location or feature or to address a safety problem.

The **Local Safety Program (LSP)** was established by the NJTPA in 2004 in conjunction with NJDOT as a competitive program. The purpose of this program is to advance safety improvements on county and local roadway facilities within its region. To date, over $145 million in projects have been selected for the program.

The **High Risk Rural Roads Program (HRRRP)** provides the NJTPA region with funds to advance safety improvements on rural roadways that have been identified as high risk. These roadways are functionally classified as a rural major or minor collector or as a rural local roads and have crash rates that exceed the NJTPA region's average for those functional classes of roadways. Since its inception in 2009, over $20 million in projects have been selected for the program.

Projects are recommended for either program by a Technical Review Committee comprised of NJTPA and NJDOT staff including Division of Local Aid and Economic Development, Bureau of Environmental Program Resources, and the Office of Bicycle and Pedestrian Programs. Recommendations require the approval of the NJTPA Board of Trustees. The technical review committee will evaluate the complexity of each application submitted for each program and determine the year best suited for project advancement. Projects to be advanced in the FY 2021 fiscal year for construction authorization must have all environmental approvals, local approvals, and right-of-way acquisition completed and a full set of plans, specifications, and cost estimate (PS&E) documents submitted to the Local Aid office no later than April 15, 2021 and federal authorization to construct must be obtained no later than September 1, 2021.

Eligibility requirements for both programs:

- Only NJTPA member subregions are eligible to submit applications to the NJTPA for this program (the 13 member counties and the cities of Newark and Jersey City). Municipalities located within the subregions may make a request through their respective county to sponsor an application. **The project sponsor will become the responsible charge and is thus responsible for managing the federal funding process**.
- Each subregion may submit two (2) applications to the Local Safety program for consideration. There is no limitation on the number of applications that can be submitted for the High Risk Rural Roads program;
- Both programs continue to fund the construction phase of work; projects selected to either program will also have the option of using federal funds to cover the cost of construction inspection;
- In 2013, the NJTPA initiated the Engineering Assistance Program which provides consultant support for the completion of the requisite plans, specifications and estimates (PS&E) for projects selected for either of the programs. This support will continue for projects advancing in the FY 2020 LSP/HRRRP.
- The following types of projects are NOT eligible for either program: Routine maintenance/ replacement projects, roadway capacity enhancements (road widening), improvements involving State, U.S. and Interstate highways including any improvements at intersections with such facilities and aesthetic improvements along the right-of-ways;
- The federal National Environmental Policy Act (NEPA) regulations must be followed. As such, projects should have minimal or no environmental and cultural resource impacts;
- Projects must be advertised for construction within 60 days of receiving federal construction authorization;
- Projects must be completed within 24 months of receiving federal authorization;

II. Local Safety Program

Local Safety Program projects typically address NJTPA/NJDOT-derived high priority crash locations. Projects must be supported with detailed crash data, and will be in a construction-ready state at the time federal authorization is received. Proposals must demonstrate a location's crash history (using multi-year data) and clearly show a relationship between the types of crashes and the proposed improvements (e.g., pedestrian countdown signals will address a history of pedestrian crashes).

Program Examples

Some examples of improvement previously selected for the Local Safety Program include:

- Modern roundabouts;
- Road Diets;
- Pedestrian or bicyclist safety improvements such as curb extensions, refuge islands, high visibility crosswalk striping and ADA compliant curb ramps;
- Intersection improvements including traffic signal upgrades, modified signal operations, left-turn bays, striping and pedestrian countdown signal heads;
- Improvements to roadway signage and pavement markings including reflective pavement markings;
- Installation or upgrade of traffic control or other warning devices to improve a documented safety hazard including traffic signals, pedestrian countdown signals, over-height vehicle detectors and signage;
- Installation of warning devices such as rumble strips/rumble stripes along high frequency crossover and/or roadway departure locations;
- Installation of a skid-resistant surface treatment at curves or locations with a high frequency of crashes;
- Protected bike lanes

Eligible improvements also include any of the FHWA Proven Safety Countermeasures (See **Attachment D** for details).

Priority Locations

Crash prone locations within the NJTPA region have been identified by NJDOT. Crash prone locations were identified for the most current 3-year or 5-year time period of available data. These locations are eligible for funding under the Local Safety or High Risk Rural Roads programs. Tables/lists were created for the following:

- Intersections (2014-2016)
- Regional corridors (2014-2016)
- Pedestrian Intersections (2012-2016)
- Pedestrian corridors (2012-2016)
- Pedestrian-Bicycle intersections (2012-2016)
- Pedestrian-Bicycle corridors (2012-2016)

A network screening was used to determine high crash locations for each list. All lists have been ranked, assigning a fatal crash the same weight as an incapacitating injury crash and using the monetary value of a Complaint of Pain injury as the base value (K=A, no Property Damage only (PDO)).

Equivalent Property Damage Only (ePDO) Score Weights

Crash Severity	*KABCO Scale*	*2016 Dollars**	*ePDO**Value (K=A)*
Fatal	K	$11,295,400	55.0420
Incapacitating	A	$655,000	55.0420
Non-incapacitating	B	$198,500	16.6807
Possible Injury	C	$125,600	10.5546
Property Damage Only	PDO	$11,900	1.0000

**Based on Highway Safety Manual Comprehensive Crash Costs*

***$ePDO_{TOTAL}$=[K]*[$ePDO_K$]+[A]*[$ePDO_A$]+[B]*[$ePDO_B$]+[C]*[$ePDO_C$]+[PDO]*[$ePDO_{PDO}$]*

Top 50 locations (by weighted severity) have been created for each table and are provided in **Attachment A**. Tables include roadway segment mileposts, lengths, injury types, total crashes, and weighted severity/EPDO ranking. In addition, comprehensive crash lists have been created for each Subregion. These lists are available on the NJTPA website at: https://www.njtpa.org/Projects-Programs/Local-Programs/Local-Safety-Program.aspx Improvements along State, U.S. and/or Interstate highways are not eligible and have been excluded from these lists. In addition, if a roadway segment listed in **Attachment A** includes an intersection or intersections with such facilities, improvements at these specific intersections are also **NOT** eligible for funding. If a project location from this list is being considered that does not have a high EPDO ranking (within the top 20 locations), further justification for prioritizing the selection should be included in the application.

For more detail and information regarding a particular roadway segment, see NJDOT's straight line diagrams at http://www.state.nj.us/transportation/refdata/sldiag/.

Safety Voyager

Safety Voyager is a software application that was designed to provide a quick and easy visual perspective of crash data. By providing 2D and 3D graphical displays, Safety Voyager can quickly show a comparative view of crashes within a defined area, municipality or county as determined by the user. In addition, various filters are available to create detailed user defined queries. The program is free to use, but only available to federal, state and local government agencies to help them with the crash analysis. Go to https://www.state.nj.us/transportation/refdata/accident/crashdatasearch.shtm for more information.

The Safety Voyager Crash Mapping module only includes crashes that could be coded to a county, municipality or SRI. All crashes that could not be geocoded and mapped statewide can be found on the Voyager website under Updates and Tutorials: Unmatched Crash Data Records or by running a query by county, exporting to Excel and sorting by municipality. Instructions on this methodology are provided in **Attachment J.**

Programmatic Improvements

Proposals can be submitted with a single type of improvement applied to multiple locations, with supportive crash data and are encouraged under both programs. An example would be pedestrian countdown signals proposed at multiple intersections identified as having high frequency of crashes involving pedestrians. Another example would be centerline rumble strips applied along roadway segments in multiple corridors where centerline crossover crashes are occurring. While projects may be programmatic, all projects must identify documented safety concerns at specific locations in order to be eligible. **See Section IV and Attachment D for details regarding FHWA Proven Safety Countermeasures.** Several of these countermeasures can be applied systemically and have been funded under these programs.

Proposal Evaluation

A Technical Review Committee, consisting of NJTPA and NJDOT staff including Division of Local Aid and Economic Development, Bureau of Environmental Program Resources, Office of Bicycle and Pedestrian Programs, determines project eligibility and then evaluates proposals for the LSP on a competitive basis using the following criteria:

- Identified crash prone locations and the EPDO ranking
- Type of improvements proposed and the potential safety benefits (including the benefit/cost ratio)
- Construction readiness, scope and feasibility

The technical review committee will evaluate the complexity of each application submitted for each program and determine the year best suited for construction authorization. Federal regulations require improvements be evaluated after implementation to determine whether crashes have been reduced. Therefore, only proposals that can reasonably be expected to have an impact on reducing the number and/or severity of crashes will be considered for funding.

It is important for applicants to document specific safety issues with the most recent available crash data, even when the location of the proposed project is identified as a high priority, and to explain exactly how the proposed improvement will reduce the quantity and/or severity of crashes. Extra consideration will be given to proposals that clearly demonstrate the location's crash history (using multiple-year data) and show the relationship between the crashes and the proposed improvements. An accident location diagram to demonstrate accident patterns should be provided (See **ATTACHMENT B** for a sample diagram). Other documentation of a significant safety problem by the applicant may be acceptable at the discretion of the Technical Review Committee.

Construction readiness includes minimal or no environmental, cultural resource and/or Right of Way impacts. Projects should eligible for a programmatic/certified Categorical Exclusion (CE) from the NJ Department of Transportation. **ATTACHMENT E** provides a list of CE Categories and **ATTACHMENT F** provides a list of useful websites for Environmental Screenings.

III. High Risk Rural Roads Program

The **High Risk Rural Roads Program** (HRRRP) provides federal funds for construction improvements to address safety problems and opportunities on county and local roadways that are functionally classified as a rural major or minor collector or as rural local roads with a crash rate that exceeds the NJTPA region's average for those functional classes of roadways. **Only road segments identified in ATTACHMENT A are eligible for HRRRP funding.** In addition, comprehensive crash lists have been created for each Subregion with HRRR segments. These lists are available on the NJTPA website at: https://www.njtpa.org/Projects-Programs/Local-Programs/High-Risk-Rural-Roads.aspx

High Risk Rural Roads continue to be defined as any roadway functionally classified as a rural major or minor or rural local road -

- on which the accident rate for fatalities and incapacitating injuries exceeds the statewide average for those functional classes of roadway; or
- that will likely have increases in traffic volume that are likely to create an accident rate for fatalities and incapacitating injuries that exceeds the statewide average for those functional classes of roadway

During this 3-year period (2014-2016), there have been 33 fatalities and 40 incapacitating injuries on these high risk rural roads.

While the list of HRRRP road segments provides the basic eligibility parameters, project sponsors must complete the entire application and all projects must identify documented safety concerns at specific locations in order to be considered. HRRRP proposals undergo the same Technical Review Committee evaluation process as LSP candidate projects. It is possible that a project location is identified on both the HRRR segments list and the LSP crash-prone locations. If this is the case, it will be considered for the HRRR program first.

Program Examples

Some examples of improvements previously selected for the High Risk Rural Roads Program include:

- Skid-resistant surface treatment, enhanced signage, pavement markings, guiderails w/reflectors
- Corrections to super elevations along curves
- High reflectivity pavement markings and signage, safety edge, rumble strips
- Microsurfacing, pavement markings, striping, flexible delineators, regulatory warning signs, bicycle safety grates

Eligible improvements also include any of the FHWA Proven Safety Countermeasures (See **Attachment D** for details).

Programmatic Improvements

Proposals can be submitted with a single type of improvements applied to multiple locations, with supportive crash data. For example, reflective pavement markings, rumble strips and/or rumble strips along multiple HRRR segments. While projects may be programmatic, all projects must identify documented safety concerns at specific locations in order to be eligible. **See Section IV and Attachment D for details regarding FHWA Proven Safety Countermeasures.**

Proposal Evaluation

A Technical Review Committee, consisting of NJTPA and NJDOT staff, determines project eligibility and then evaluates proposals for the LSP on a competitive basis using the following criteria:

- Type of improvements proposed and the potential safety benefits
- Construction readiness, scope and feasibility

The technical review committee will evaluate the complexity of each application submitted for each program and determine the year best suited for project advancement. For projects to be advanced in the FY 2021 fiscal year, all environmental approvals, local approval, and right-of-way acquisition must be completed and a full set of plans, specifications, and cost estimate (PS&E) documents submitted to the Local Aid office no later than **May 15, 2021** and federal authorization to construct must be obtained no later than September 1, 2021.

IV. FHWA Office of Safety

The FHWA Office of Safety has a Safety Website replete with information:

http://safety.fhwa.dot.gov/

This website includes information on the HSIP as well as many safety topics including:

- Local safety and rural roads
- Intersections
- Pedestrian and bicycles
- Roadway departures
- Speed Management
- Proven Safety Countermeasures
- Focused Approach to Safety
- Road Safety Audits
- Links to research and partners (such as NTSA)

The Office of Safety has also developed several manuals for Local Rural Road Owners (http://safety.fhwa.dot.gov/local_rural/training/) including:

- Local Rural Road Owner's Manual
- Roadway Departure Safety
- Intersection Safety
- Speed Management
- Non-Motorized User Safety

V. Consideration of FHWA Proven Safety Countermeasures

In September 2017, FHWA issued a "Guidance Memorandum on Promoting and Implementing the Updated Proven Safety Countermeasures". This guidance takes into consideration the latest safety research to advance a group of countermeasures that have shown great effectiveness in improving safety. Applicants are encouraged to consider incorporating these improvements in project proposals where crash types relate to these countermeasures. Several have been utilized and/or proposed in previously selected LS & HRRR projects, while others should be considered where appropriate. (See **ATTACHMENT D** for more detailed information regarding these measures).

VI. The Highway Safety Manual (AASHTO)

The Highway Safety Manual (HSM) provides tools and techniques for transportation professionals to quantify the safety-related effects of proposed improvements. The 1st edition of the HSM was released in 2010 and includes the following four parts:

Part A – Introduction, Human Factors and Fundamentals
Part B – Roadway Safety Management Process
Part C – Predictive Method
Part D – Crash Modification Factors

The HSM can assist in selecting countermeasures and quantifying effectiveness for projects in the Local Safety and High Risk Rural Roads programs. HSM tools include:

- Methods for evaluating safety effectiveness proposed locations and countermeasures
- Predictive average crash frequency as a function of traffic volume and roadway characteristics
- Crash Modification factors (CMF) that quantify the average crash frequency of geometrical or operational modifications

An HSM and Cost Benefit analysis is required for each application to quantify the effectiveness of proposed locations and countermeasures. The NJTPA Consultant Assistance Program for Local Safety and High Risk Rural Roads Programs will be available to provide assistance with HSM calculations during the application process.

VI. The Application Process

The following is a tentative schedule for the FY 2020 LSP & HRRRP program solicitation:

- Solicitation for both programs (LSP & HRRRP) sent to subregions: **July 15, 2019**
- Applicants deadline for both programs: **December 5, 2019**
- TRC review & project selection: **January, 2020**
- TRC recommendation to the NJTPA Project Prioritization Committee: **February 19, 2020**
- NJTPA Board of Trustees approval of the FY 2020 program: **May 11, 2020**

Applicants will be informed by letter if the submitted project(s) will or will not be recommended by the Technical Review Committee to the NJTPA Project Prioritization Committee and full Board of Trustees for inclusion in the programs. **Approval by the NJTPA Board <u>does not</u> constitute an authorization to proceed with project construction.**

VI. Federal Authorization Process

Once Local Safety Program and High Risk Rural Roads Program projects are selected and approved for funding by the NJTPA Board of Trustees, applicants must work directly with NJDOT, Division of Local Aid and Economic Development, to fulfill all requirements for federal authorization. The timeframe generally needed to complete the environmental approval process and to prepare the requisite plans, specifications and estimate (i.e. PS&E documents) for this program is approximately 1 year for applicants not using design assistance and 3 years for those that do request assistance.

- For projects in the FY 2020 program that will not be using design assistance, the project sponsor agency must obtain environmental approval and submit the Final PS&E package to Local Aid no later than **April 15, 2021** in order to allow sufficient time for NJDOT review and for Federal Highway Administration-NJ Division office processing. Missing this submission deadline may jeopardize the ability to obtain federal funding authorization by the end of Fiscal Year 2021 as required, and therefore result in the potential loss of funding.
- Advertising and construction cannot commence until federal authorization is obtained. Project sponsors must also follow federal regulations for a competitive bid process. Funds may be forfeited if construction occurs prior to federal authorization.
- Projects must be fully constructed within two (2) years of receiving this authorization.

VII. Local Safety Engineering Assistance Program

Since 2013, the NJTPA's Local Safety Engineering Assistance Program (LSEAP) has allocated more than $19 million for the design of projects in the Local Safety and High Risk Rural Roads Programs. Through LSEAP, Engineering consultants assist the subregions with design and advancement through the construction authorization process. Once projects are selected for each program, NJTPA staff initiates the consultant selection process for design assistance and enters into the contracts with the consulting firms. This program will continue in FY 2020. Note, acceptance into the LSEAP requires additional NJDOT and FHWA authorizations which will extend the project timeline as illustrated in **ATTACHMENT H.**

VIII. Federal Funds Reporting Requirements

There are additional administrative requirements that accompany the use of federal funds. Project sponsors are required to report progress to the NJDOT on a quarterly basis. Quarterly reports shall be in writing (by letter or e-mail to the program manager(s) specified at the time) and include technical and financial progress. The NJTPA project manager shall be copied on all formal communications regarding these products. For more details on the federal aid process, see the NJDOT web page on Federal Aid - http://www.state.nj.us/transportation/business/localaid/fedaid.shtm.

IX. To Apply for Funding

Subregions must submit **six (6) copies** of the completed application with all supplementary material to the address below. A copy of completed application **should also be submitted** by e-mail (pdf preferred) to pnewton@njtpa.org. The application, guidelines and attachments can be downloaded from the Local Safety Program & High Risk Rural Roads Program page of the NJTPA Website at:

https://www.njtpa.org/Projects-Programs/Local-Programs/Local-Safety-Program.aspx

NJTPA Local Safety Program & High Risk Rural Roads Program
North Jersey Transportation Planning Authority
1 Newark Center, 17th floor
Newark, NJ 07102
Attention: Patricia Newton

APPLICATION DEADLINE: Thursday, December 5, 2019

Questions or comments may be directed to:
Christine Mittman, Project Manager, Safety Programs
(973) 639-8448 cmittman@njtpa.org

Patricia Newton, Project Lead, Safety Programs
(973) 877-8128 pnewton@njtpa.org

ATTACHMENT A

LOCAL SAFETY PROGRAM

- **TOP 25 CRASH PRONE LOCATIONS IN THE NJTPA REGION For Intersections, Pedestrian Corridors, and Pedestrian Hot Spots**

- **Comprehensive list of HSIP eligible intersections and segments in each Subregion for Intersections, Pedestrian Corridors, and Pedestrian Hot Spots**

- **High Risk Rural Segments in the NJTPA Region**

All available on the NJTPA website at:

https://www.njtpa.org/Projects-Programs/Local-Programs/Local-Safety-Program.aspx

ATTACHMENT B

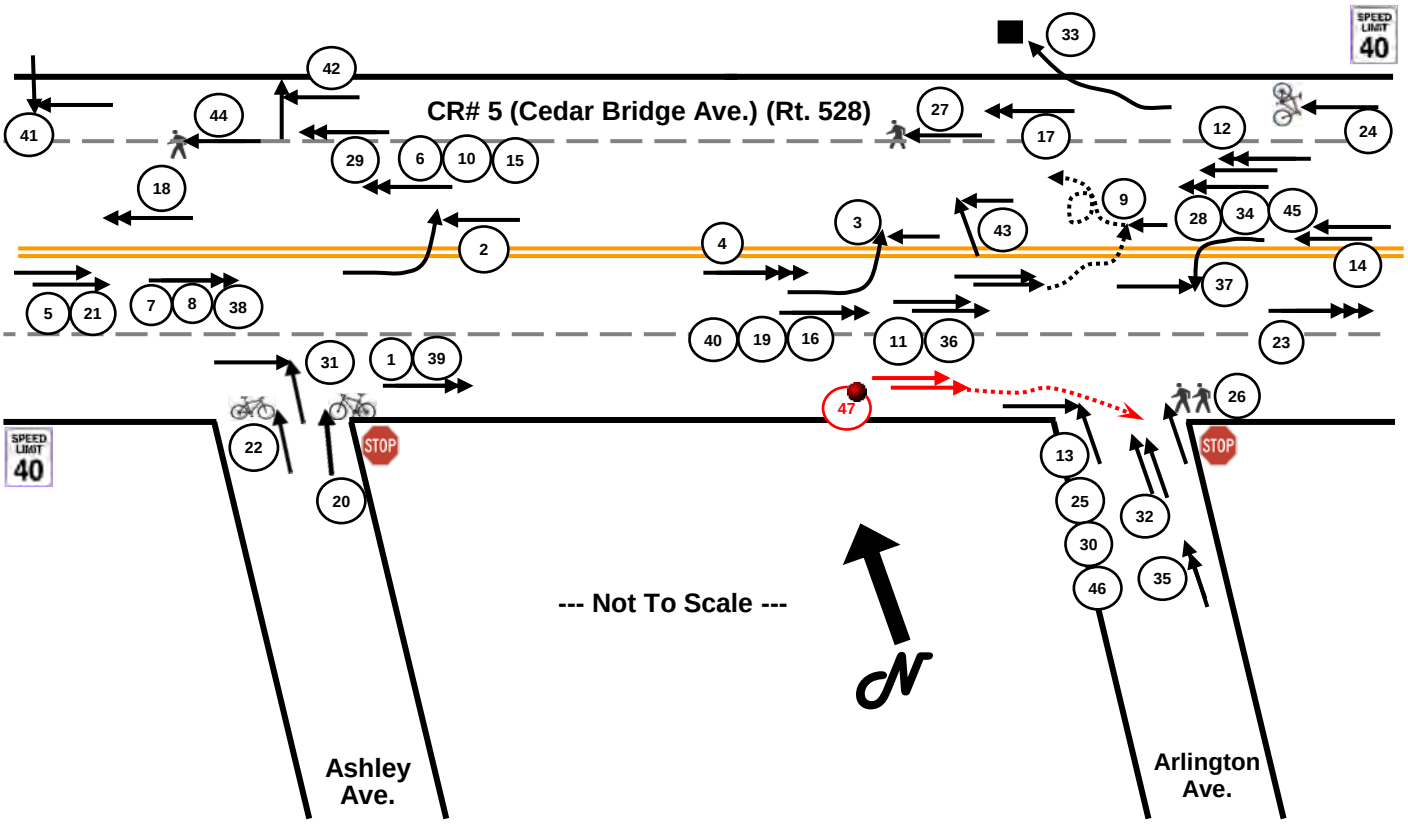
SAMPLE CRASH DIAGRAM

Location CR# 5 (Cedarbridge Ave.) between Ashley Ave. & Arlington Ave.

Municipality Lakewood Township

Date August 22, 2014 **By** Craig B. Sneddon

Crashes From August 1, 2011 **to** August 12, 2014



Day

1-	Sun	5	Thur
2-	Mon	6	Fri
3-	Tue	7	Sat
4-	Wed	*	Holiday

Light Condition

1-	Daylight
2-	Dawn
3-	Dusk
4-	Dark (St. Lights off)
5-	Dark (No St. Lights)
6-	Dark (St Lights On, Cont.)
7-	Dark (St Lights On, Spot)

Crash Type

1-	Same Direction (Rear-end)		
2-	Same Direction (Sideswipe)		
3-	Right Angle		
4-	Opposite Direction (Head-on/ Angular)		
5-	Opposite Direction (Sideswipe)		
6-	Parked Vehicle		
7-	Left Turn / U Turn		
8-	Backing	13-	Pedestrian
9-	Encroachment	14-	Pedalcycle
10-	Overturned	15-	Non-fixed Object
11-	Fixed Object	16-	Railcar-vehicle
12-	Animal	99-	Other

Environmental Conditions

1-	Clear	6-	Sleet/Hail/Freezing Rain
2-	Rain	7-	Blowing Snow
3-	Snow	8-	Blowing Sand/Dirt
4-	Fog/Smog/Smoke	9-	Severe Crosswinds
5-	Overcast		

Road Surface Conditions

1-	Dry	5-	Slush
2-	Wet	6-	Water (Standing/ Moving
3-	Snowy	7-	Sand, Mud, Dirt
4-	Icy	8-	Oil

ATTACHMENT C

HIGHWAY SAFETY MANUAL

- INTRODUCTION TO THE HSM
- HSM SPREADSHEETS

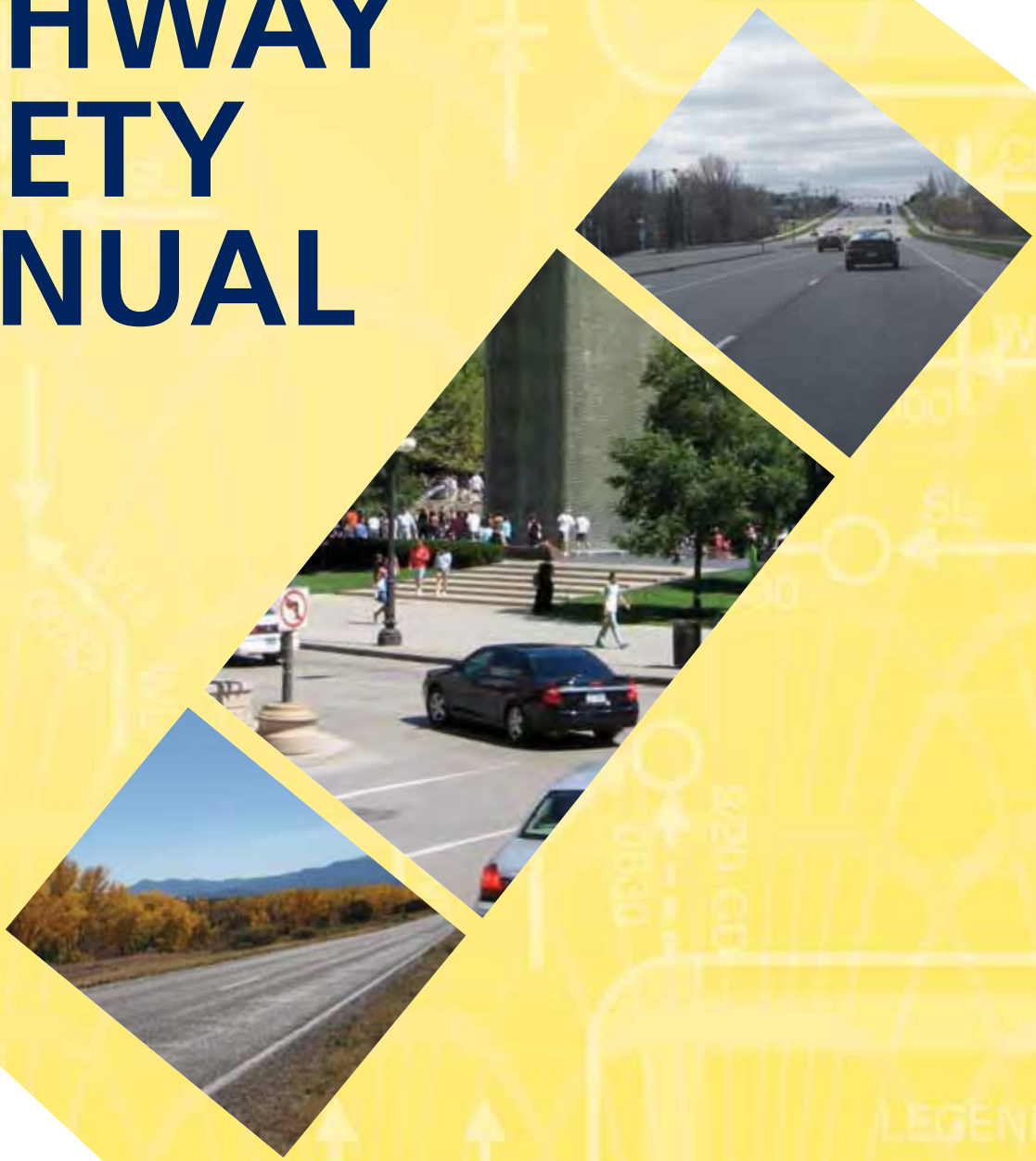
  Available on the NJTPA website at:

  https://www.njtpa.org/Projects-Programs/Local-Programs/Local-Safety-Program.aspx

  - Urban & Suburban Arterial Intersections
  - Rural 2-Lane, 2-way Roadway
  - Rural Intersection
- SAMPLE HSM CALCULATIONS
- SAMPLE HSM SUMMARY OF RESULTS
- SAMPLE BENEFIT/COST ANALYSIS

An Introduction to the

HIGHWAY SAFETY MANUAL



HSM
Highway Safety Manual
AASHTO

American Association of State Highway and Transportation Officials
AASHTO
The Voice of Transportation

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Section 1: HSM Overview

What is the Highway Safety Manual?

The Highway Safety Manual (HSM) introduces a science-based technical approach that takes the guesswork out of safety analysis. The HSM provides tools to conduct quantitative safety analyses, allowing for safety to be quantitatively evaluated alongside other transportation performance measures such as traffic operations, environmental impacts, and construction costs.

For example, the HSM provides a method to quantify changes in crash frequency as a function of cross-sectional features. With this method, the expected change in crash frequency of different design alternatives can be compared with the operational benefits or environmental impacts of these same alternatives. As another example, the costs of constructing a left-turn lane on a two-lane rural road can be compared to the safety benefits in terms of reducing a certain number of crashes.

The HSM provides the following tools:

- Methods for developing an effective roadway safety management program and evaluating its effects. A roadway safety management program is the overall process for identifying sites with potential for safety improvement, diagnosing conditions at the site, evaluating conditions and identifying potential treatments at the sites, prioritizing and programming treatments, and subsequently evaluating the effectiveness at reducing crashes of the programmed treatments. Many of the methods included in the HSM account for regression to the mean and can result in more effectively identifying improvements to achieve a quantifiable reduction in crash frequency or severity. Safety funds can then be used as efficiently as possible based on the identified locations.
- A predictive method to estimate crash frequency and severity. This method can be used to make informed decisions throughout the project development process, including: planning, design, operations, maintenance, and the roadway safety management process. Specific examples include screening potential locations for improvement and choosing alternative roadway designs.
- A catalog of crash modification factors (CMFs) for a variety of geometric and operational treatment types, backed by robust scientific evidence. The CMFs in the HSM have been developed using high-quality before/after studies that account for regression to the mean.

The HSM emphasizes the use of analytical methods to quantify the safety effects of decisions in planning, design, operations, and maintenance. The first edition does not address issues such as driver education, law enforcement, and vehicle safety, although these are important considerations within the broad topic of improving highway safety.

The HSM is written for practitioners at the state, county, metropolitan planning organization (MPO), or local level.

Regression to the mean is the natural variation in crash data. If regression to the mean is not accounted for, a site might be selected for study when the crashes are at a randomly high fluctuation, or overlooked from study when the site is at a randomly low fluctuation.

A Crash Modification Factor (CMF) is a factor estimating the potential changes in crash frequency or crash severity due to installing a particular treatment. The CMFs in the HSM have been developed based on a rigorous and reliable scientific process.

As an example, a 0.70 CMF corresponds to a 30 percent reduction in crashes. A 1.2 CMF corresponds to a 20 percent increase in crashes.

How is the HSM Applied?

The HSM provides an opportunity to consider safety quantitatively along with other typical transportation performance measures. The HSM outlines and provides examples of the following applications:

- Identifying sites with the most potential for crash frequency or severity reduction;
- Identifying factors contributing to crashes and associated potential countermeasures to address these issues;
- Conducting economic appraisals of potential improvements and prioritizing projects;
- Evaluating the crash reduction benefits of implemented treatments; and
- Estimating potential effects on crash frequency and severity of planning, design, operations, and policy decisions.

The HSM can be used for projects that are focused specifically on responding to safety-related questions. In addition, the HSM can be used to conduct quantitative safety analyses on projects that have not traditionally included this type of analysis, such as corridor studies to identify capacity improvements and intersection studies to identify alternative forms of traffic control. The HSM can also be used to add quantitative safety analyses to multidisciplinary transportation projects.

What is the Value of Using the HSM?

The HSM provides methods to integrate quantitative estimates of crash frequency and severity into planning, project alternatives analysis, and program development and evaluation, allowing safety to become a meaningful project performance measure. As the old adage says, "what gets measured gets done." By applying the HSM tools, improvements in safety will "get done."

Further, from a legislative perspective, the HSM will support states' progress toward federal, state, and local safety goals to reduce fatalities and serious injuries. As public agencies work toward their safety goals, the quantitative methods in the HSM can be used to evaluate which programs and project improvements are achieving desired results; as a result, agencies can reallocate funds toward those that are having the greatest benefit.

The HSM methods can be applied to all transportation projects—not just those specifically focused on responding to safety needs.

Section 2: HSM Contents

The HSM is organized into four parts:

PART A Introduction, Human Factors, and Fundamentals

Part A describes the purpose and scope of the HSM, explaining the relationship of the HSM to planning, design, operations, and maintenance activities. Part A also includes fundamentals of the processes and tools described in the HSM. Chapter 3 (Fundamentals) provides background information needed to apply the predictive method, crash modification factors, and evaluation methods provided in Parts B, C, and D of the HSM.
The chapters in Part A are:

- Chapter 1 – Introduction and Overview
- Chapter 2 – Human Factors
- Chapter 3 – Fundamentals

PART B Roadway Safety Management Process

Part B presents suggested steps to monitor and reduce crash frequency and severity on existing roadway networks. It includes methods useful for identifying improvement sites, diagnosis, countermeasure selection, economic appraisal, project prioritization, and effectiveness evaluation. As shown in Figure 1, the chapters in Part B are:

- Chapter 4 – Network Screening
- Chapter 5 – Diagnosis
- Chapter 6 – Select Countermeasures
- Chapter 7 – Economic Appraisal
- Chapter 8 – Prioritize Projects
- Chapter 9 – Safety Effectiveness Evaluation

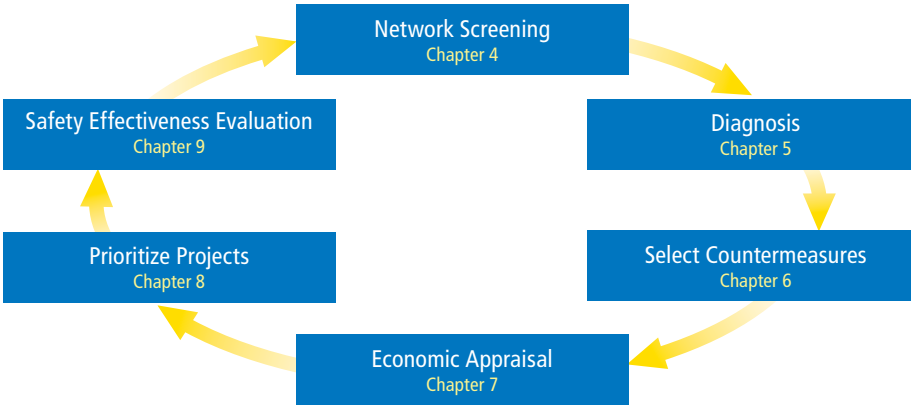


Figure 1 Chapters in Part B

Highlights of this part of the manual are advances in network screening methods and safety evaluation methods. In Chapter 4 (Network Screening), several new network screening performance measures are introduced to shift the safety analysis focus away from traditional crash rates. The major limitation associated with crash rate analysis is the incorrect assumption that a linear relationship exists between traffic volume and the frequency of crashes. As an alternative analysis tool, a focus on expected crash frequency can account for regression to the mean when developing performance measures for network screening. This analysis will provide a more stable list of locations that might respond to safety improvements than lists prepared with traditional methods. This, in turn, will result in a more effective spending of improvement funds.

Chapter 9 (Safety Effectiveness Evaluation) provides methods for evaluating the effectiveness of an individual treatment, a series of treatments, or an overall program, and for calculating a crash modification factor (CMF). Evaluating safety investments is often an overlooked element of the roadway safety management process. The HSM brings a focus back to this step in the process.

PART C Predictive Method

Part C provides a predictive method for estimating expected average crash frequency of a network, facility, or individual site, and it introduces the concept of safety performance functions (SPFs). As shown in Table 1, the chapters in Part C provide the predictive method for segments and intersections for the following facility types:

Safety Performance Functions (SPFs) are equations that estimate expected average crash frequency as a function of traffic volume and roadway characteristics (e.g., number of lanes, median type, intersection control, number of approach legs). Their use enables the correction of short-term crash counts.

- Chapter 10 – Rural Two-Lane, Two-Way Roads
- Chapter 11 – Rural Multilane Highways
- Chapter 12 – Urban and Suburban Arterials

Predicting expected average crash frequency as a function of traffic volume and roadway characteristics is a new approach that can be readily applied in a variety of ways, including design projects, corridor planning studies, and smaller intersections studies. The approach is applicable for both safety specific studies and as an element of a more traditional transportation study or environmental analysis.

Table 1 Facility Types with Safety Performance Functions

HSM Chapter	Undivided Roadway Segments	Divided Roadway Segments	Intersections			
			Stop Control on Minor Leg(s)		Signalized	
			3-Leg	4-Leg	3-Leg	4-Leg
10 Rural Two-Lane, Two-Way Roads	✔		✔	✔		✔
11 Rural Multilane Highways	✔	✔	✔	✔		✔
12 Urban and Suburban Arterials	✔	✔	✔	✔	✔	✔

PART D Crash Modification Factors

For each facility type, prediction models for set base conditions are found. CMFs quantify the change in expected average crash frequency as a result of geometric or operational modifications to a site that differs from set base conditions. As shown in Table 2, Part D provides a catalog of treatments organized by site type:

- Chapter 13 – Roadway Segments
- Chapter 14 – Intersections
- Chapter 15 – Interchanges
- Chapter 16 – Special Facilities
- Chapter 17 – Road Networks

The CMFs will be readily applicable to any design or evaluation process where optional treatments are being considered. The CMFs will also be a valuable addition to the documentation of design exceptions. Table 2 provides an example of a CMF.

Table 2 Sample Crash Modification Factors

Potential Crash Effects of Providing a Median on Multilane Roads

Treatment	Setting (Road Type)	Traffic Volume	Accident Type (Severity)	CMF	Std. Error
Provide a median	Urban (Arterial Multilane)	Unspecified	All types (Injury)	0.78	0.02
			All types (Non-injury)	1.09	0.02
	Rural (Multilane)		All types (Injury)	0.88	0.03
			All types (Non-injury)	0.82	0.03

Base Condition: Absence of raised median

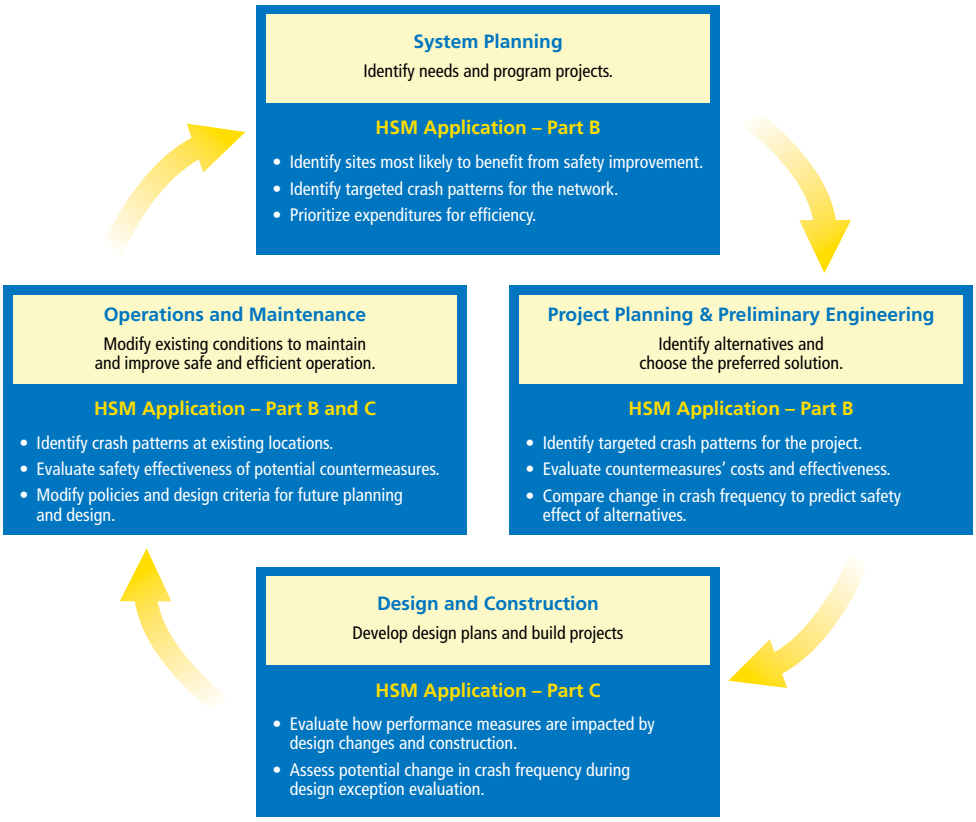
The HSM provides a catalog of Crash Modification Factors for a variety of facility types.

The HSM methods can be applied in each step of the project development process.

Section 3: Integrating the HSM with the Project Development Process

The project development process outlines the typical stages of a project from planning to post-construction operations and maintenance activities. The HSM can be applied in each step of the process. Figure 2 shows the relationship between a generalized project development process and the HSM.

Figure 2 Applications of the HSM in the Project Development Process



Section 4: Data Needs

In general, there are three categories of data needed to apply the HSM: crash data, traffic volume data, and roadway characteristics data. The crash data needs are limited to crash data by date (year), location, type, severity level, relationship to intersection (at-intersection, intersection related, not intersection related), and distance from the intersection. The traffic volume data requirement for roadway segments is the annual average daily traffic (AADT). For intersections, the traffic volume requirement is the major and minor street entering AADT.

The roadway characteristics data requirements change as a function of the facility type (e.g., two-lane, two-way rural road, multilane rural highway, urban/suburban arterial) and whether an intersection or segment is under consideration. Table 3 provides a summary of the roadway characteristics data requirements.

Table 3 Site Characteristics and Traffic-Volume Variables Used in HSM Safety Predictions

Variables	Chapter 10 Rural Two-Lane, Two-Way Roads	Chapter 11 Rural Multilane Highways	Chapter 12 Urban and Suburban Arterials
Roadway Segments			
Area type (rural/suburban/urban)	✓	✓	✓
Annual average daily traffic volume	✓	✓	✓
Length of roadway segment	✓	✓	✓
Number of through lanes	✓	✓	✓
Lane width	✓	✓	
Shoulder width	✓	✓	
Shoulder type	✓	✓	
Presence of median (divided/undivided)		✓	✓
Median width		✓	
Presence of concrete median barrier		✓	
Presence of passing lane	✓		
Presence of short four-lane section	✓		
Presence of two-way left-turn lane	✓		✓
Driveway density	✓		
Number of major commercial driveways			✓
Number of minor commercial driveways			✓
Number of major residential driveways			✓
Number of minor residential driveways			✓
Number of major industrial/institutional driveways			✓
Number of minor industrial/institutional driveways			✓
Number of other driveways	✓		
Horizontal curve length	✓		
Horizontal curve radius	✓		
Horizontal curve superelevation	✓		
Presence of spiral transition	✓		
Grade	✓		
Roadside hazard rating	✓		
Roadside slope		✓	
Roadside fixed-object density			✓
Roadside fixed-object offset			✓
Percent of length with on-street parking			✓
Type of on-street parking			✓
Presence of lighting			✓
Intersections			
Area type (rural/suburban/urban)	✓	✓	✓
Major-road average daily traffic volume	✓	✓	✓
Minor-road average daily traffic volume	✓	✓	✓
Number of intersection legs	✓	✓	✓
Type of intersection traffic control	✓	✓	✓
Left-turn signal phasing (if signalized)			✓
Presence of right turn on red (if signalized)			✓
Presence of red-light cameras			✓
Presence of median on major road		✓	
Presence of major-road left-turn lane(s)	✓	✓	✓
Presence of major-road right-turn lane(s)	✓	✓	✓
Presence of minor-road left-turn lane(s)		✓	
Presence of minor-road right-turn lane(s)		✓	
Intersection skew angle	✓	✓	
Intersection sight distance	✓	✓	
Terrain (flat vs. level or rolling)		✓	
Presence of lighting		✓	✓

NCHRP Research Results Digest 329: HSM Data Needs Guide, 2008. Data requirements are for Part C only.

Data needs for applying the HSM methods change by the type of facility.

Section 5: Example Applications

PART B Network Screening Example (Chapter 4)

Chapter 4 of the *Highway Safety Manual* presents 13 optional performance measures for network screening. This sample application illustrates a network screening process for prioritizing spending at six intersections within a community using the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment method. Network screening is the process of evaluating a network of facilities for sites likely to respond to safety improvements. The Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment performance measure combines predictive model crash estimates with historical crash data to obtain a more reliable estimate of crash frequency. This method also accounts for bias due to regression to the mean.

Data Requirements

The data required for the application of this method are:

- Historical crash data by severity and location
- Traffic volume (AADT for segments; AADT for major and minor roads for intersections)
- Basic site characteristics (e.g., roadway cross-section, intersection control)
- Calibrated Safety Performance Functions (SPFs) and over-dispersion parameters

Sample Application

The basis for the Excess Expected Average Crash Frequency with EB Adjustment performance measure is that each site is evaluated as a function of how much the predicted average crash frequency for the site differs from the long-term EB adjusted expected average crash frequency for the same site. This difference is referred to as the "Excess" value (see Table 4). Sites with a high "Excess" value are most likely to respond to safety improvements because they are theoretically experiencing more crashes than other similar sites. An advantage of this method is that it may be used as a performance measure to evaluate a mix of facility types and traffic volumes in a single ranking. The basic procedure is as follows:

1 For each site, calculate the Predicted Average Crash Frequency using the methods and predictive formulas presented in Part C of the HSM.

2 For each site, calculate the Expected Average Crash Frequency using the EB method presented in the Part C Appendix.

3 Estimate an "Excess" value using the following formula:

$$Excess_y = (N_{expected,\ n(PDO)} - N_{predicted,\ n(PDO)}) + (N_{expected,\ n(FI)} - N_{predicted,\ n(FI)})$$

$$Excess_{intersection\ 1} = (1.7 - 0.9) + (1.2 - 0.5) = 1.50$$

Where:
$Excess_y$ = Excess expected crashes for year
$N_{expected,\ n}$ = EB-adjusted expected average crash frequency for year
$N_{predicted,\ n}$ = SPF predicted average crash frequency for year

Network screening is the process of evaluating a network of facilities for sites likely to respond to safety improvements.

Table 4 Predicted Average Crash Frequency

Int.	Int. Type	Major Street Volume (AADT)	Minor Street Volume (AADT)	Observed Average Crash Frequency (FI)	Observed Average Crash Frequency (PDO)	SPF Predicted Average Crash Frequency (FI)[1]	SPF Predicted Average Crash Frequency (PDO) [1]	EB-Adjusted Expected Average Crash Frequency (FI)	EB-Adjusted Expected Average Crash Frequency (PDO)	Excess $(N_{EB} - N_{SPF})_{PDO} + (N_{EB} - N_{SPF})_{FI}$
1	3-Leg Signal (Urban Arterial)	8,885	6,313	2.8	3.4	0.5	0.9	1.2	1.7	1.50
2	4-Leg Signal (Urban Arterial)	18,447	2,569	2.8	5.0	1.3	2.6	1.7	3.6	1.49
3	4-Leg Signal (Urban Arterial)	16,484	2,041	1.4	2.0	1.1	2.2	1.2	2.1	0.03
4	4-Leg Signal (Urban Arterial)	23,793	7,700	4.4	4.0	2.2	4.4	2.9	4.2	0.61
5	4-Leg Signal (Urban Arterial)	19,726	10,084	1.4	8.8	1.8	3.9	1.7	6.1	2.05
6	3-Leg Signal (Urban Arterial)	25,559	1,440	2.6	6.6	1.0	1.8	1.5	3.5	2.22

[1] In this example, the local geometric conditions are the same as the geometric conditions for the SPF; therefore, all CMFs = 1.0.
AADT = Average Annual Daily Traffic
FI = Fatal-and-Injury Crashes
PDO = Property-Damage-Only Crashes

Results:

In this sample application, the final ranking of the intersections is determined based on the resulting "Excess" value (see Table 5). The intersection most likely to benefit from safety improvements in this example is Intersection 6, which has an "Excess" value of 2.22. Diagnosis and selection of treatment will be required to establish the potential for such improvement.

Table 5 Ranking of "Excess" Value

Intersection	Excess
6	2.22
5	2.05
1	1.50
2	1.49
4	0.61
3	0.03

This predictive method example demonstrates the quantitative safety analysis of design alternatives.

PART C Predictive Method Example

Background, Issues, and Objectives

The Main Street corridor is 1.5 miles long, connecting residential and industrial uses across a river to the downtown business district. It is an important vehicle and bicycle commuter route. The average daily traffic volume along this route ranges from 20,000 to 25,000 vehicles per day. The corridor has received funding for major geometric improvements. This study was conducted to evaluate the traffic operations and safety impacts of various design alternatives for the entire corridor. Several options were considered as part of the project, including converting the 2- or 3-lane roadway to a 5-lane road, or converting the roadway to a 3-lane road. Each case would include a mix of traffic signals and roundabouts at the intersections. This project example demonstrates the quantitative safety analysis of two alternatives on a small portion of the corridor.

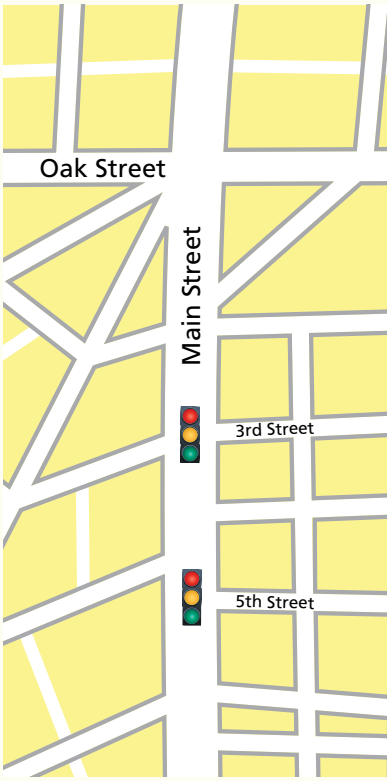
Data Requirements

Segments

- Segment Length (miles)
- Through Lanes (number)
- Median Type (divided/undivided)
- Median Width (feet)
- On-Street Parking (yes/no)
- Fixed Object Density (obj/mile)
- Average Offset of Fixed Objects (feet)
- Roadway Lighting (yes/no)
- Speed Limit (mph)
- Traffic Volume (veh/day)
- Number/Types of Driveways

Intersections

- Number of Intersection Legs
- Traffic Control (signal, stop, roundabout)
- Left-Turn Lanes and Phasing (protected, permitted, protected/permitted)
- Right-Turn Lanes and Control of Right Turn (permitted on red, prohibited on red)
- Lighting (yes/no)
- Maximum Number of Traffic Lanes Crossed by Pedestrians (number)
- Nearby Bus Stops, Schools, and Alcohol Sales Establishments (number)
- Entering Traffic Volumes (veh/day)
- Pedestrian Activity (yes/no)



Analysis Methodology Overview

The crash frequency for each segment and intersection is predicted using an iterative 18-step method in Chapter 12, "Urban and Suburban Arterials." In summary, this method consists of initially calculating multiple- and single-vehicle fatal-and-injury and property-damage-only crashes; these values are added to obtain base predicted vehicle crashes. The next step is to adjust the base predicted vehicle crashes with crash modification factors (CMFs) based on the roadway characteristics. Finally, this value is added to predicted bicycle and pedestrian crashes. If a calibration factor was available, or historical data was available to apply the Empirical Bayes method, these two steps would be included. A sample calculation using the base equation for predicted average crash frequency is shown below, Equation 1 illustrates the base equation. Sample calculations are shown for the Main Street/3rd Street intersection no-build conditions.

Equation 1

$$N_{bi} = N_{spf\ int} \times (CMF_{1i} \times CMF_{2i} \times ... \times CMF_{6i}) \times C$$

$$N_{bi} = 12.97 \times (.066 \times 0.96 \times 0.88 \times 1.00 \times 0.91 \times 1.00) \times 1.00 = 6.63 \text{ crashes/year}$$

Where:

N_{bi} = Predicted average crash frequency for an intersection

$N_{spf\ int}$ = Predicted average crash frequency for base conditions ($N_{spf\ int}$ = 12.97, see below)

$CMF_{1i} \ldots CMF_{6i}$ = Crash modification factors for left-turn lanes (CMF_{1i} = 0.66), left-turn phasing (CMF_{2i} = 0.96), right-turn lanes (CMF_{3i} = 0.88), right turn on red (CMF_{4i} = 1.00), lighting (CMF_{5i} = 0.91), and red-light camera (CMF_{6i} = 1.00).

C = Calibration factor (C = 1.00)

Note, as this is a multi-step process there are multiple equations that are used to calculate $N_{spf\ int}$, (e.g., by crash severity, by mode), these steps are not detailed in this example. An interim equation used in that process for the Main Street/3rd Street intersection no-build condition is illustrated as Equation 2.

Equation 2

$$N'_{bimv(FI)} = exp(a + b \times ln(AADT_{maj}) + c \times ln(AADT_{min}))$$

$$N'_{bimv(FI)} = exp(-13.14 + 1.18 \times ln(33{,}910) + 0.22 \times ln(25{,}790)) = 4.07 \text{ crashes/year}$$

Where:

$N'_{bimv(FI)}$ = Multiple vehicle intersection fatal/injury crashes

a, b, and c = Regression coefficients (–13.14, 1.18, and 0.22 for 4-leg signalized intersections)

$AADT_{maj}$ = Annual average daily traffic on major road (33,910)

$AADT_{min}$ = Annual average daily traffic on minor road (25,790)

Table 6 Forecast Crash Frequency

	2035 Forecast Crash Frequency (Crashes/Year)								
	No-Build			Alternative 1 (Mix 3- and 5-Lane)			Alternative 2 (5-Lane)		
Intersection/ Segment[1]	Facility	AADT[2]	Crashes/ Year	Facility	AADT[2]	Crashes/ Year	Facility	AADT[2]	Crashes/ Year
Int: Main & Oak	Stop	35,730/ 3,650	3.26	Roundabout	35,730/ 3,650	1.67	Signal	39,080/ 5,280	6.93
Seg: Oak to 3rd St.	3-Lane	34,580	8.30	3-Lane	34,580	5.74	5-Lane	38,150	9.32
Int: Main & 3rd	Signal	33,910/ 25,790	6.63	Roundabout	33,910/ 25,790	3.43	Roundabout	36,900/ 29,400	3.86
Seg: 3rd to 5th	5-Lane	33,270	5.05	5-Lane	33,270	1.51	5-Lane	37,310	1.74
Int: Main & 5th	Signal	33,200/ 5,940	6.40	Roundabout	33,200/ 5,940	3.32	Roundabout	37,860/ 7,230	3.99
Total Prediction	29.6 crashes/year			15.7 crashes/year			25.8 crashes/year		
Change Relative to No-Build				47% Decrease			13% Decrease[3]		

[1] For the purposes of presenting the results, crashes estimated for minor street intersections along the two segments (Oak St. to 3rd St. and 3rd St. to 5th St.) were added into the segment crash totals.
[2] Major Street AADT/Minor Street AADT for intersections.
[3] Under the 5-lane scenario, the corridor has more capacity; therefore more regional traffic is drawn to this corridor. The decrease shown is for overall crashes, so a normalized analysis would show a slightly greater decrease.

Results (see Table 6):

- Changes in crash frequencies are quantified and compared to the no-build scenario. The resulting forecast crash frequencies for Alternatives 1 and 2, 15.7 and 25.8 crashes respectively, are compared to the no-build crash frequency, 29.6. The difference is quantified as a percentage.
- The change in crash frequency can now be considered as one of the trade-offs similar to traffic operations, environmental impacts, and pedestrian and bicycle mobility.

Agencies can take these steps to begin using the HSM.

Section 6: Getting Started

Highway agencies interested in using the HSM methodologies in their safety management and project development processes should consider taking the following next steps toward implementation.

Purchase the HSM

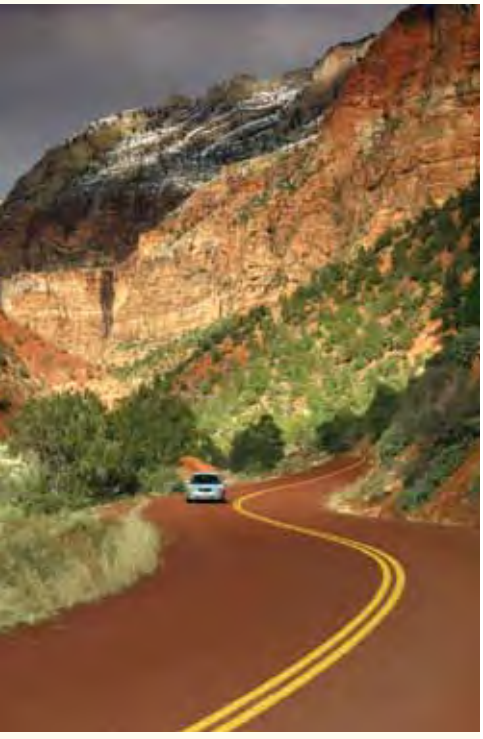
The HSM is currently available for purchase from AASHTO for $325 for AASHTO members and $390 for non-members. Discounts are available for those states taking HSM training. Both hard copy and electronic versions are available. To purchase, visit http://bookstore.transportation.org and search under code HSM-1.

Develop an Agency Training Plan

The HSM methodologies may necessitate some changes in the way highway agencies analyze data, screen their network, and review alternatives for projects. In order to fully understand the methods of the HSM, it will be important for agency personnel to pursue training. NCHRP Project 17-38 is currently underway to develop an HSM overview training course (NHI 380106). In addition, a number of training opportunities available through the National Highway Institute (NHI) are identified in Section 7. The NHI courses can assist agencies in understanding how to apply the HSM methods to the agency's program and in using the safety analysis tools that execute HSM methodology.

Review Software Tools

A number of software programs have been developed to support practitioners' use of the HSM methodologies.



- ***SafetyAnalyst*** provides a set of software tools used by state and local highway agencies for highway safety management. It incorporates state-of-the-art safety management approaches into computerized analytical tools for guiding the decision-making process to identify safety improvement needs and develop a systemwide program of site-specific improvement projects. *SafetyAnalyst* is applicable to Part B of the HSM. The *SafetyAnalyst* software is available through AASHTO, and additional information can be found at www.safetyanalyst.org.
- The ***Interactive Highway Safety Design Model (IHSDM)*** is a suite of software analysis tools for evaluating safety and operational effects of geometric design decisions on highways. It checks existing or proposed highway designs against relevant design policy values and provides estimates of a design's expected safety and operational performance. The IHSDM performs the predictive method for the facilities in Part C of the first edition of the HSM (i.e., two-lane, two-way rural roads, rural multilane highways, and urban and suburban arterials). The IHSDM website summarizes the capabilities and applications of the evaluation modules and provides a library of the research reports documenting their development. Information is available at the public software website, www.ihsdm.org, where users can register and download the latest release of IHSDM.
- The ***Crash Modification Factors Clearinghouse*** houses a web-based database of CMFs along with supporting documentation to help transportation engineers identify the most appropriate countermeasure for their safety needs. Using this site at www.cmfclearinghouse.org, users are able to search for existing CMFs or submit their own CMFs to be included in the clearinghouse.

Develop an Agency HSM Implementation Plan

Incorporating the HSM into an agency's processes will take a concerted effort that should begin with a plan of action. A number of state DOTs have begun planning for the HSM by developing agency-specific training programs, and incorporation of the software tools previously discussed. The Federal Highway Administration (FHWA) is developing an HSM Implementation Plan Guide for State Highway Agencies to be released in late 2010. It will provide strategies to assist with HSM deployment activities at the state level.

Assess Crash Data

An agency should assess its crash data to see if assistance is needed to prepare it for the rigors of HSM analysis. FHWA will provide technical assistance and support to states in evaluating their data systems against data requirements in Part B of the Manual. A technical support staff with intimate knowledge of Part C is also available to answer questions through the FHWA Geometric Design Lab.

Stay Updated

The most up-to-date information on training, technical support, and marketing materials is available at AASHTO's Highway Safety Manual website, www.highwaysafetymanual.org.

Section 7: Resources

- Highway Safety Manual website: www.highwaysafetymanual.org
- Purchase the HSM: http://bookstore.transportation.org. Search under code HSM-1.
  - Cost: $325 (Members), $390 (Non-members)
  - Discounts are available for those states taking HSM training
- IHSDM website: http://www.ihsdm.org
- SafetyAnalyst website: http://www.safetyanalyst.org
- Crash Modification Factors Clearinghouse: http://www.cmfclearinghouse.org
- NCHRP Research Results Digest 329: www.trb.org/Publications/Blurbs/Highway_Safety_Manual_ Data_Needs_Guide_159984.aspx
- Training courses available at http://nhi.fhwa.dot.gov
  - New Approaches to Highway Safety Analysis (NHI-380075)
  - HSM Practitioners Guide to Two-Lane Rural Roads (NHI-380070A)
  - HSM Practitioners Guide to Multilane Urban/Suburban Highways (NHI-380070B)
  - HSM Application to Intersections (NHI-380105*)
  - HSM Workshop (NHI-380106*)
  - Application of Crash Reduction Factors (NHI-380093)
  - Science of Crash Reduction Factors (NHI-380094)
  - Interactive Highway Safety Design Model (IHSDM) (NHI-380071, NHI-380100* web-based)

**Course under development*

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For more information, visit the *Highway Safety Manual* website:
www.highwaysafetymanual.org

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AASHTO

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		Location Information	
Analyst	JAF	Roadway	WASHINGTON AVE (CR 529)
Agency or Company	SOMERSET COUNTY ENG.	Intersection	MP 8.1 TO 8.5
Date Performed	05/09/14	Jurisdiction	GREEN BROOK TWP, SOMERSET COUNTY
		Analysis Year	2013

Input Data		Base Conditions	Site Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)		--	4SG
AADT $_{major}$ (veh/day)	$AADT_{MAX}$ = 67,700 (veh/day)	--	21,000
AADT $_{minor}$ (veh/day)	$AADT_{MAX}$ = 33,400 (veh/day)	--	6,000
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	0
Number of major-road approaches with right-turn lanes (0,1,2)		0	0
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	0
Type of left-turn signal phasing for Leg #1		Permissive	Permissive
Type of left-turn signal phasing for Leg #2		--	Permissive
Type of left-turn signal phasing for Leg #3		--	Permissive
Type of left-turn signal phasing for Leg #4 (if applicable)		--	Permissive
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	4
Intersection red light cameras (present/not present)		Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			37
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	4
Number of bus stops within 300 m (1,000 ft) of the intersection		0	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	0

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	0.92	0.91	1.00	0.84

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.99	1.07	0.23	0.39	5.258	1.000	5.258	0.84	1.00	4.417
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	1.678	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.331	1.743	0.84	1.00	1.464
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	3.385	$(5)_{TOTAL}-(5)_{FI}$ = 0.669	3.515	0.84	1.00	2.953

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	1.464	1.000	2.953	4.417
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	0.659	0.483	1.426	2.085
Head-on collision	0.049	0.072	0.030	0.089	0.160
Angle collision	0.347	0.508	0.244	0.721	1.229
Sideswipe	0.099	0.145	0.032	0.094	0.239
Other multiple-vehicle collision	0.055	0.081	0.211	0.623	0.704

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.335	1.000	0.335	0.84	1.00	0.281
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.086	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.260	0.087	0.84	1.00	0.073
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.246	$(5)_{TOTAL}-(5)_{FI}$ = 0.740	0.248	0.84	1.00	0.208

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	$(9)_{FI}$ from Worksheet 2E	from Table 12-13	$(9)_{PDO}$ from Worksheet 2E	$(9)_{PDO}$ from Worksheet 2E
Total	1.000	0.073	1.000	0.208	0.281
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.002	0.000	0.002	0.000	0.001
Collision with fixed object	0.744	0.054	0.870	0.181	0.236
Collision with other object	0.072	0.005	0.070	0.015	0.020
Other single-vehicle collision	0.040	0.003	0.023	0.005	0.008
Single-vehicle noncollision	0.141	0.010	0.034	0.007	0.017

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	1.00	--
Fatal and injury (FI)	--	--	--	--	1.00	--

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
1.00	1.00	1.00	1.00

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.019	1.00	1.00	0.019
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.019

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	4.417	0.281	4.698	0.015	1.00	0.070
Fatal and injury (FI)	--	--	--	--	1.00	0.070

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
	MULTIPLE-VEHICLE		
Rear-end collisions (from Worksheet 2D)	0.659	1.426	2.085
Head-on collisions (from Worksheet 2D)	0.072	0.089	0.160
Angle collisions (from Worksheet 2D)	0.508	0.721	1.229
Sideswipe (from Worksheet 2D)	0.145	0.094	0.239
Other multiple-vehicle collision (from Worksheet 2D)	0.081	0.623	0.704
Subtotal	1.464	2.953	4.417
	SINGLE-VEHICLE		
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.001
Collision with fixed object (from Worksheet 2F)	0.054	0.181	0.236
Collision with other object (from Worksheet 2F)	0.005	0.015	0.020
Other single-vehicle collision (from Worksheet 2F)	0.003	0.005	0.008
Single-vehicle noncollision (from Worksheet 2F)	0.010	0.007	0.017
Collision with pedestrian (from Worksheet 2G or 2I)	0.019	0.000	0.019
Collision with bicycle (from Worksheet 2J)	0.070	0.000	0.070
Subtotal	0.162	0.208	0.370
Total	1.626	3.161	4.787

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	4.8
Fatal and injury (FI)	1.6
Property damage only (PDO)	3.2

Sample
HSM Urban and Suburban Arterial Predictive Method

Existing Condition
Segment 1

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	JAF	Roadway	WASHINGTON AVE (CR 529)
Agency or Company	SOMERSET COUNTY ENG.	Roadway Section	MP 8.1 TO 8.5
Date Performed	05/09/14	Jurisdiction	GREEN BROOK TWP, SOMERSET COUNTY
		Analysis Year	2013

Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	4U
Length of segment, L (mi)		--	0.4
AADT (veh/day)	$AADT_{MAX}$ = 40,100 (veh/day)	--	21,000
Type of on-street parking (none/parallel/angle)		None	None
		--	0
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	1
Minor commercial driveways (number)		--	15
Major industrial / institutional driveways (number)		--	1
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	3
Other driveways (number)		--	0
Speed Category		--	Posted Speed Greater than 30 mph
Roadside fixed object density (fixed objects / mi)		0	31
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	2
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.23	1.00	0.92	1.00	1.13

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-11.63	1.33	1.01	1.994	1.000	1.994	1.13	1.00	2.250
Fatal and Injury (FI)	-12.08	1.25	0.99	0.574	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.301	0.600	1.13	1.00	0.677
Property Damage Only (PDO)	-12.53	1.38	1.08	1.334	$(5)_{TOTAL}-(5)_{FI}$ = 0.699	1.394	1.13	1.00	1.573

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{brmv\ (PDO)}$ (crashes/year)**	**Predicted N $_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.677	1.000	1.573	2.250
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.511	0.346	0.506	0.796	1.142
Head-on collision	0.077	0.052	0.004	0.006	0.058
Angle collision	0.181	0.122	0.130	0.205	0.327
Sideswipe, same direction	0.093	0.063	0.249	0.392	0.455
Sideswipe, opposite direction	0.082	0.055	0.031	0.049	0.104
Other multiple-vehicle collision	0.056	0.038	0.080	0.126	0.164

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-7.99	0.81	0.91	0.430	1.000	0.430	1.13	1.00	0.485
Fatal and Injury (FI)	-7.37	0.61	0.54	0.109	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.239	0.103	1.13	1.00	0.116
Property Damage Only (PDO)	-8.50	0.84	0.97	0.348	$(5)_{TOTAL}-(5)_{FI}$ = 0.761	0.327	1.13	1.00	0.369

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{brsv\ (PDO)}$ (crashes/year)**	**Predicted N $_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.116	1.000	0.369	0.485
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.612	0.071	0.809	0.298	0.369
Collision with other object	0.020	0.002	0.029	0.011	0.013
Other single-vehicle collision	0.367	0.042	0.161	0.059	0.102

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	1	0.182	1.172	0.270	
Minor commercial	15	0.058	1.172	1.291	
Major industrial/institutional	1	0.198	1.172	0.294	
Minor industrial/institutional	0	0.026	1.172	0.000	--
Major residential	0	0.096	1.172	0.000	
Minor residential	3	0.018	1.172	0.080	
Other	0	0.029	1.172	0.000	
Total	--	--	--	1.934	0.81

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL} * (3)$	(6) from Worksheet 1B		(4)*(5)*(6)
Total	1.934	1.000	1.934	1.13	1.00	2.183
Fatal and injury (FI)	--	0.342	0.662	1.13	1.00	0.746
Property damage only (PDO)	--	0.658	1.273	1.13	1.00	1.436

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	2.250	0.485	2.183	4.918	0.009	1.00	0.044
Fatal and injury (FI)	--	--	--	--	--	1.00	0.044

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	2.250	0.485	2.183	4.918	0.002	1.00	0.010
Fatal and injury (FI)	--	--	--	--	--	1.00	0.010

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.346	0.796	1.142
Head-on collisions (from Worksheet 1D)	0.052	0.006	0.058
Angle collisions (from Worksheet 1D)	0.122	0.205	0.327
Sideswipe, same direction (from Worksheet 1D)	0.063	0.392	0.455
Sideswipe, opposite direction (from Worksheet 1D)	0.055	0.049	0.104
Driveway-related collisions (from Worksheet 1H)	0.746	1.436	2.183
Other multiple-vehicle collision (from Worksheet 1D)	0.038	0.126	0.164
Subtotal	1.423	3.010	4.433
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.071	0.298	0.369
Collision with other object (from Worksheet 1F)	0.002	0.011	0.013
Other single-vehicle collision (from Worksheet 1F)	0.042	0.059	0.102
Collision with pedestrian (from Worksheet 1I)	0.044	0.000	0.044
Collision with bicycle (from Worksheet 1J)	0.010	0.000	0.010
Subtotal	0.170	0.369	0.539
Total	1.593	3.379	4.972

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	5.0	0.40	12.4
Fatal and injury (FI)	1.6	0.40	4.0
Property damage only (PDO)	3.4	0.40	8.4

Worksheet 4A -- Predicted Crashes by Collision and Site Type and Observed Crashes Using the Project-Level EB Method for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Collision type / Site type	**Predicted crashes**			**Observed crashes, $N_{observed}$** (crashes/year)	**Overdispersion Parameter, k**	**$N_{predicted\ w0}$** Equation A-8 $(6)*(2)^2$	**$N_{predicted\ w1}$** Equation A-9 sqrt((6)*(2))	**W_0** Equation A-10	**N_0** Equation A-11	**w_1** Equation A-12	**N_1** Equation A-13	**$N_{expected/comb}$** Equation A-14
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)									
ROADWAY SEGMENTS												
Multiple-vehicle nondriveway												
Segment 1	2.250	0.677	1.573	--	1.010	5.114	1.508	--	--	--	--	--
Single-vehicle												
Segment 1	0.485	0.116	0.369	--	0.910	0.214	0.664	--	--	--	--	--
Multiple-vehicle driveway-related												
Segment 1	2.183	0.746	1.436	--	0.810	3.859	1.330	--	--	--	--	--
INTERSECTIONS												
Multiple-vehicle												
Intersection 1	4.417	1.464	2.953	--	0.390	7.609	1.312	--	--	--	--	--
Single-vehicle												
Intersection 1	0.281	0.073	0.208	--	0.360	0.029	0.318	--	--	--	--	--
COMBINED (sum of column)	9.616	3.076	6.540	8	--	16.824	5.132	0.364	8.588	0.652	9.054	8.821

Worksheet 4B -- Predicted Pedestrian and Bicycle Crashes for Urban and Suburban Arterials

(1)	(2)	(3)
Site Type	**N_{ped}**	**N_{bike}**
ROADWAY SEGMENTS		
Segment 1	0.044	0.010
INTERSECTIONS		
Intersection 1	0.019	0.070
COMBINED (sum of column)	0.063	0.080

Worksheet 4C -- Project-Specific EB Method Summary Results for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)
Crash severity level	**$N_{predicted}$**	**N_{ped}**	**N_{bike}**	$N_{expected\ (vehicle)}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 4A	$(2)_{COMB}$ from Worksheet 4B	$(3)_{COMB}$ from Worksheet 4B	$(13)_{COMB}$ Worksheet 4A	(3)+(4)+(5)
	9.6	0.1	0.1	8.8	9.0
Fatal and injury (FI)	$(3)_{COMB}$ from Worksheet 4A	$(2)_{COMB}$ from Worksheet 4B	$(3)_{COMB}$ from Worksheet 4B	$(5)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$	(3)+(4)+(5)
	3.1	0.1	0.1	2.8	3.0
Property damage only (PDO)	$(4)_{COMB}$ from Worksheet 4A	--	--	$(5)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$	(3)+(4)+(5)
	6.5	0.0	0.0	6.0	6.0

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		Location Information	
Analyst	JAF	Roadway	WASHINGTON AVE (CR 529)
Agency or Company	SOMERSET COUNTY ENG.	Intersection	MP 8.1 TO 8.5
Date Performed	05/09/14	Jurisdiction	GREEN BROOK TWP, SOMERSET COUNTY
		Analysis Year	2013

Input Data		Base Conditions	Site Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)		--	4SG
AADT $_{major}$ (veh/day)	$AADT_{MAX}$ = 67,700 (veh/day)	--	21,000
AADT $_{minor}$ (veh/day)	$AADT_{MAX}$ = 33,400 (veh/day)	--	6,000
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	0
Number of major-road approaches with right-turn lanes (0,1,2)		0	0
Data for signalized intersections only:		--	--
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	4
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		--	0
Type of left-turn signal phasing for Leg #1		Permissive	Protected / Permissive
Type of left-turn signal phasing for Leg #2		--	Protected / Permissive
Type of left-turn signal phasing for Leg #3		--	Protected / Permissive
Type of left-turn signal phasing for Leg #4 (if applicable)		--	Protected / Permissive
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0	4
Intersection red light cameras (present/not present)		Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only			37
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--	4
Number of bus stops within 300 m (1,000 ft) of the intersection		0	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0	0

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF 1i	*CMF 2i*	*CMF 3i*	*CMF 4i*	*CMF 5i*	*CMF 6i*	*CMF $_{COMB}$*
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.66	0.99	1.00	0.92	0.91	1.00	0.55

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bimv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bimv}**
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.99	1.07	0.23	0.39	5.258	1.000	5.258	0.55	1.00	2.886
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	1.678	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.331	1.743	0.55	1.00	0.957
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	3.385	$(5)_{TOTAL}-(5)_{FI}$ = 0.669	3.515	0.55	1.00	1.929

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bimv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bimv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bimv\ (TOTAL)}$ (crashes/year)**
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.957	1.000	1.929	2.886
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Rear-end collision	0.450	0.430	0.483	0.932	1.362
Head-on collision	0.049	0.047	0.030	0.058	0.105
Angle collision	0.347	0.332	0.244	0.471	0.803
Sideswipe	0.099	0.095	0.032	0.062	0.156
Other multiple-vehicle collision	0.055	0.053	0.211	0.407	0.460

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**			**Overdispersion Parameter, k**	**Initial N_{bisv}**	**Proportion of Total Crashes**	**Adjusted N_{bimv}**	**Combined CMFs**	**Calibration Factor, C_i**	**Predicted N_{bisv}**
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL}$*(5)	(7) from Worksheet 2B		(6)*(7)*(8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.335	1.000	0.335	0.55	1.00	0.184
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.086	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.260	0.087	0.55	1.00	0.048
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.246	$(5)_{TOTAL}-(5)_{FI}$ = 0.740	0.248	0.55	1.00	0.136

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{bisv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{bisv\ (PDO)}$ (crashes/year)**	**Predicted N $_{bisv\ (TOTAL)}$ (crashes/year)**
	from Table 12-13	$(9)_{FI}$ from Worksheet 2E	from Table 12-13	$(9)_{PDO}$ from Worksheet 2E	$(9)_{PDO}$ from Worksheet 2E
Total	1.000	0.048	1.000	0.136	0.184
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.002	0.000	0.002	0.000	0.000
Collision with fixed object	0.744	0.036	0.870	0.118	0.154
Collision with other object	0.072	0.003	0.070	0.010	0.013
Other single-vehicle collision	0.040	0.002	0.023	0.003	0.005
Single-vehicle noncollision	0.141	0.007	0.034	0.005	0.011

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{pedi}**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16		(4)*(5)*(6)
Total	--	--	--	--	1.00	--
Fatal and injury (FI)	--	--	--	--	1.00	--

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF_{1p}	CMF_{2p}	CMF_{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
1.00	1.00	1.00	1.00

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections

(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**SPF Coefficients**					**Overdispersion Parameter, k**	**$N_{pedbase}$**	**Combined CMF**	**Calibration factor, C_i**	**Predicted N_{pedi}**
	from Table 12-14						from Equation 12-29	(4) from Worksheet 2H		(4)*(5)*(6)
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.019	1.00	1.00	0.019
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.019

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Predicted N_{bimv}**	**Predicted N_{bisv}**	**Predicted N_{bi}**	**f_{bikei}**	**Calibration factor, C_i**	**Predicted N_{bikei}**
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17		(4)*(5)*(6)
Total	2.886	0.184	3.070	0.015	1.00	0.046
Fatal and injury (FI)	--	--	--	--	1.00	0.046

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)
	Fatal and injury (FI)	**Property damage only (PDO)**	**Total**
Collision type	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.430	0.932	1.362
Head-on collisions (from Worksheet 2D)	0.047	0.058	0.105
Angle collisions (from Worksheet 2D)	0.332	0.471	0.803
Sideswipe (from Worksheet 2D)	0.095	0.062	0.156
Other multiple-vehicle collision (from Worksheet 2D)	0.053	0.407	0.460
Subtotal	0.957	1.929	2.886
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 2F)	0.036	0.118	0.154
Collision with other object (from Worksheet 2F)	0.003	0.010	0.013
Other single-vehicle collision (from Worksheet 2F)	0.002	0.003	0.005
Single-vehicle noncollision (from Worksheet 2F)	0.007	0.005	0.011
Collision with pedestrian (from Worksheet 2G or 2I)	0.019	0.000	0.019
Collision with bicycle (from Worksheet 2J)	0.046	0.000	0.046
Subtotal	0.112	0.136	0.248
Total	1.069	2.066	3.135

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	**Predicted average crash frequency, $N_{predicted\ int}$ (crashes/year)**
	(Total) from Worksheet 2K
Total	3.1
Fatal and injury (FI)	1.1
Property damage only (PDO)	2.1

Sample
HSM Urban and Suburban Arterial Predictive Method

Proposed Condition
Segment 1

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	JAF	Roadway	WASHINGTON AVE (CR 529)
Agency or Company	SOMERSET COUNTY ENG.	Roadway Section	MP 8.1 TO 8.5
Date Performed	05/09/14	Jurisdiction	GREEN BROOK TWP, SOMERSET COUNTY
		Analysis Year	2013

Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	3T
Length of segment, L (mi)		--	0.4
AADT (veh/day)	$AADT_{MAX}$ = 32,900 (veh/day)	--	21,000
Type of on-street parking (none/parallel/angle)		None	None
		--	0
Median width (ft) - for divided only		15	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	1
Minor commercial driveways (number)		--	15
Major industrial / institutional driveways (number)		--	1
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		--	0
Minor residential driveways (number)		--	3
Other driveways (number)		--	0
Speed Category		--	Posted Speed Greater than 30 mph
Roadside fixed object density (fixed objects / mi)		0	31
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		30	2
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
CMF 1r	*CMF 2r*	*CMF 3r*	*CMF 4r*	*CMF 5r*	*CMF comb*
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.21	1.00	0.93	1.00	1.13

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brmv}**	**Proportion of Total Crashes**	**Adjusted N_{brmv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brmv}**
	from Table 12-3		from Table 12-3	from Equation 12-10		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-12.40	1.41	0.66	2.047	1.000	2.047	1.13	1.00	2.316
Fatal and Injury (FI)	-16.45	1.69	0.59	0.579	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.286	0.585	1.13	1.00	0.661
Property Damage Only (PDO)	-11.95	1.33	0.59	1.448	$(5)_{TOTAL}-(5)_{FI}$ = 0.714	1.463	1.13	1.00	1.655

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{brmv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{brmv\ (PDO)}$ (crashes/year)**	**Predicted N $_{brmv\ (TOTAL)}$ (crashes/year)**
	from Table 12-4	$(9)_{FI}$ from Worksheet 1C	from Table 12-4	$(9)_{PDO}$ from Worksheet 1C	$(9)_{TOTAL}$ from Worksheet 1C
Total	1.000	0.661	1.000	1.655	2.316
		(2)*$(3)_{FI}$		(4)*$(5)_{PDO}$	(3)+(5)
Rear-end collision	0.845	0.559	0.842	1.394	1.952
Head-on collision	0.034	0.022	0.020	0.033	0.056
Angle collision	0.069	0.046	0.020	0.033	0.079
Sideswipe, same direction	0.001	0.001	0.078	0.129	0.130
Sideswipe, opposite direction	0.017	0.011	0.020	0.033	0.044
Other multiple-vehicle collision	0.034	0.022	0.020	0.033	0.056

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	**SPF Coefficients**		**Overdispersion Parameter, k**	**Initial N_{brsv}**	**Proportion of Total Crashes**	**Adjusted N_{brsv}**	**Combined CMFs**	**Calibration Factor, Cr**	**Predicted N_{brsv}**
	from Table 12-5		from Table 12-5	from Equation 12-13		$(4)_{TOTAL}$*(5)	(6) from Worksheet 1B		(6)*(7)*(8)
	a	b							
Total	-5.74	0.54	1.37	0.277	1.000	0.277	1.13	1.00	0.314
Fatal and Injury (FI)	-6.37	0.47	1.06	0.074	$(4)_{FI}/((4)_{FI}+(4)_{PDO})$ = 0.274	0.076	1.13	1.00	0.086
Property Damage Only (PDO)	-6.29	0.56	1.93	0.195	$(5)_{TOTAL}-(5)_{FI}$ = 0.726	0.202	1.13	1.00	0.228

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	**Proportion of Collision Type$_{(FI)}$**	**Predicted N $_{brsv\ (FI)}$ (crashes/year)**	**Proportion of Collision Type $_{(PDO)}$**	**Predicted N $_{brsv\ (PDO)}$ (crashes/year)**	**Predicted N $_{brsv\ (TOTAL)}$ (crashes/year)**
	from Table 12-6	$(9)_{FI}$ from Worksheet 1E	from Table 12-6	$(9)_{PDO}$ from Worksheet 1E	$(9)_{TOTAL}$ from Worksheet 1E
Total	1.000	0.086	1.000	0.228	0.314
		$(2)*(3)_{FI}$		$(4)*(5)_{PDO}$	(3)+(5)
Collision with animal	0.001	0.000	0.001	0.000	0.000
Collision with fixed object	0.688	0.059	0.963	0.220	0.279
Collision with other object	0.001	0.000	0.001	0.000	0.000
Other single-vehicle collision	0.310	0.027	0.035	0.008	0.035

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	**Number of driveways, n_j**	**Crashes per driveway per year, N_j**	**Coefficient for traffic adjustment, t**	**Initial N_{brdwy}**	**Overdispersion parameter, k**
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15{,}000)^t$	from Table 12-7
Major commercial	1	0.102	1.000	0.143	
Minor commercial	15	0.032	1.000	0.672	
Major industrial/institutional	1	0.110	1.000	0.154	
Minor industrial/institutional	0	0.015	1.000	0.000	--
Major residential	0	0.053	1.000	0.000	
Minor residential	3	0.010	1.000	0.042	
Other	0	0.016	1.000	0.000	
Total	--	--	--	1.011	1.10

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	**Initial N_{brdwy}**	**Proportion of total crashes (f_{dwy})**	**Adjusted N_{brdwy}**	**Combined CMFs**	**Calibration factor, C_r**	**Predicted N_{brdwy}**
	$(5)_{TOTAL}$ from Worksheet 1G	from Table 12-7	$(2)_{TOTAL} * (3)$	(6) from Worksheet 1B		(4)*(5)*(6)
Total	1.011	1.000	1.011	1.13	1.00	1.144
Fatal and injury (FI)	--	0.243	0.246	1.13	1.00	0.278
Property damage only (PDO)	--	0.757	0.765	1.13	1.00	0.866

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{pedr}**	**Calibration factor, C_r**	**Predicted N_{pedr}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8		(5)*(6)*(7)
Total	2.316	0.314	1.144	3.774	0.013	1.00	0.049
Fatal and injury (FI)	--	--	--	--	--	1.00	0.049

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	**Predicted N_{brmv}**	**Predicted N_{brsv}**	**Predicted N_{brdwy}**	**Predicted N_{br}**	**f_{biker}**	**Calibration factor, C_r**	**Predicted N_{biker}**
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9		(5)*(6)*(7)
Total	2.316	0.314	1.144	3.774	0.007	1.00	0.026
Fatal and injury (FI)	--	--	--	--	--	1.00	0.026

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)
Collision type	**Fatal and injury (FI)**	**Property damage only (PDO)**	**Total**
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.559	1.394	1.952
Head-on collisions (from Worksheet 1D)	0.022	0.033	0.056
Angle collisions (from Worksheet 1D)	0.046	0.033	0.079
Sideswipe, same direction (from Worksheet 1D)	0.001	0.129	0.130
Sideswipe, opposite direction (from Worksheet 1D)	0.011	0.033	0.044
Driveway-related collisions (from Worksheet 1H)	0.278	0.866	1.144
Other multiple-vehicle collision (from Worksheet 1D)	0.022	0.033	0.056
Subtotal	0.939	2.521	3.460
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 1F)	0.059	0.220	0.279
Collision with other object (from Worksheet 1F)	0.000	0.000	0.000
Other single-vehicle collision (from Worksheet 1F)	0.027	0.008	0.035
Collision with pedestrian (from Worksheet 1I)	0.049	0.000	0.049
Collision with bicycle (from Worksheet 1J)	0.026	0.000	0.026
Subtotal	0.161	0.228	0.389
Total	1.101	2.749	3.850

Sample
HSM Urban and Suburban Arterial Predictive Method

Proposed Condition
Segment 1

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	**Predicted average crash frequency, $N_{predicted\ rs}$ (crashes/year)**	**Roadway segment length, L (mi)**	**Crash rate (crashes/mi/year)**
	(Total) from Worksheet 1K		(2) / (3)
Total	3.8	0.40	9.6
Fatal and injury (FI)	1.1	0.40	2.8
Property damage only (PDO)	2.7	0.40	6.9

Worksheet 4A -- Predicted Crashes by Collision and Site Type and Observed Crashes Using the Project-Level EB Method for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Collision type / Site type	**Predicted crashes**			**Observed crashes, $N_{observed}$** (crashes/year)	**Overdispersion Parameter, k**	**$N_{predicted\ w0}$** Equation A-8 $(6)*(2)^2$	**$N_{predicted\ w1}$** Equation A-9 sqrt((6)*(2))	**W_0** Equation A-10	**N_0** Equation A-11	**w_1** Equation A-12	**N_1** Equation A-13	**$N_{expected/comb}$** Equation A-14
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)									
ROADWAY SEGMENTS												
Multiple-vehicle nondriveway												
Segment 1	2.316	0.661	1.655	--	0.660	3.542	1.236	--	--	--	--	--
Single-vehicle												
Segment 1	0.314	0.086	0.228	--	1.370	0.135	0.656	--	--	--	--	--
Multiple-vehicle driveway-related												
Segment 1	1.144	0.278	0.866	--	1.100	1.439	1.122	--	--	--	--	--
INTERSECTIONS												
Multiple-vehicle												
Intersection 1	2.886	0.957	1.929	--	0.390	3.249	1.061	--	--	--	--	--
Single-vehicle												
Intersection 1	0.184	0.048	0.136	--	0.360	0.012	0.257	--	--	--	--	--
COMBINED (sum of column)	6.844	2.030	4.814		--	8.376	4.332	0.450	3.078	0.612	4.191	3.634

Worksheet 4B -- Predicted Pedestrian and Bicycle Crashes for Urban and Suburban Arterials

(1)	(2)	(3)
Site Type	**N_{ped}**	**N_{bike}**
ROADWAY SEGMENTS		
Segment 1	0.049	0.026
INTERSECTIONS		
Intersection 1	0.019	0.046
COMBINED (sum of column)	0.068	0.072

Worksheet 4C -- Project-Specific EB Method Summary Results for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)
Crash severity level	**$N_{predicted}$**	**N_{ped}**	**N_{bike}**	$N_{expected\ (vehicle)}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 4A	$(2)_{COMB}$ from Worksheet 4B	$(3)_{COMB}$ from Worksheet 4B	$(13)_{COMB}$ Worksheet 4A	(3)+(4)+(5)
	6.8	0.1	0.1	3.6	3.8
Fatal and injury (FI)	$(3)_{COMB}$ from Worksheet 4A	$(2)_{COMB}$ from Worksheet 4B	$(3)_{COMB}$ from Worksheet 4B	$(5)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$	(3)+(4)+(5)
	2.0	0.1	0.1	1.1	1.2
Property damage only (PDO)	$(4)_{COMB}$ from Worksheet 4A	--	--	$(5)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$	(3)+(4)+(5)
	4.8	0.0	0.0	2.6	2.6

COUNTY OF SOMERSET
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

County Administration Building
20 Grove Street
P.O. Box 3000
Somerville, New Jersey 08876-1262
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PAUL L. McCALL
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ADAM H. SLUTSKY

Facilities & Services Director
CARL MEMOLI

Supervisor of Roads & Bridges
VINCENZO RUSSO

Director of Planning
ROBERT P. BZIK

Recycling Superintendent
JOHN T. KENDZULAK, JR.

Transportation Director
YVONNE C. MANFRA

Vehicle Maintenance Supervisor
MICHAEL F. ROMANELLO

Somerset Union Soil Conservation
District Manager
FRANK CALO

MEMORANDUM

TO: MATTHEW LOPER, COUNTY ENGINEER

FROM: JOSEPH FISHINGER, PRINCIPAL ENGINEER (TRAFFIC)

RE: HIGHWAY SAFETY MANUAL ANALYSIS
WASHINGTON AVENUE (CR 529) SAFETY IMPROVEMENTS

DATE: MAY 29, 2014

Introduction

As part of the preparation of the FY 2015 Local Safety Program grant process administered by NJTPA, I have completed a before and after Highway Safety Manual (HSM) analysis for the proposed Washington Avenue (CR 529) Safety Improvements. The HSM analysis utilizes accepted crash research to determine a predicted number of crashes for a transportation facility given its geometric and operational characteristics. Improvements to the facility can then be checked using the HSM to determine what changes to the predicted number of crashes a given improvement will have. Utilizing available estimates for the societal value of a crash, a cost benefit analysis can then be performed to evaluate the benefits of a given improvement.

Baseline Conditions

The Washington Avenue corridor is an approximately 0.4 mile corridor consisting of two travel lanes in each direction with no shoulders, median or on-street parking. The posted speed limit along the corridor is 40 mph and the AADT is approximately 21,000 vehicles per day (2013 values). There is one signalized intersection along the corridor at Greenbrook Road (CR 634) and no un-signalized intersections. There are approximately 19 driveways along the corridor (16 commercial, 1 institutional, and 3 residential). There are utility poles on both sides of the corridor at approximately 150 foot spacing, with the poles offset less than 2 feet from the edge of traveled way.

The intersection of Washington Avenue and Greenbrook Road is a four way signalized intersection operating on a two phase, semi-actuated traffic signal. All four approaches consist of two approach lanes, a shared left/through and a shared through/right. AADT is 21,000 vpd on Washington Avenue and approximately 6,000 vpd on Greenbrook Road (2013 volumes). No turn on red signs are posted on all four corners of the intersection

and red light running cameras are not present. Pedestrian volumes (sum of all crossings) was observed at 37 crossings per day. There are no bus stops, liquor stores or schools within 1,000 feet of the intersection.

Existing Conditions HSM Analysis

Based on the information identified above, an HSM analysis was performed for the corridor under baseline conditions. The analysis was conducted using the Urban and Suburban Arterial model and looked at Washington Avenue as a single segment with the intersection of Washington Avenue and Greenbrook Road broken out as a separate intersection. The HSM analysis indicates that the corridor (including the signal) will experience predicted crash rates of 3.076 injury/fatal crashes and 6.540 property damage crashes per year under current conditions for a total predicted crash rate of 9.616 crashes per year. Copies of the HSM worksheets detailing the analysis are attached for reference.

Observed Crash Rates

Based on four years of crash data (2010 – 2013, crash diagram attached) the corridor experiences a total of approximately 8.0 crashes per year, with crash types typical for such a corridor, predominately sideswipe crashes along the roadway segments and left turn related crashes at the Washington Avenue and Greenbrook Road signal. A crash diagram and the relevant crash reports are attached for reference.

Proposed Conditions HSM Analysis

The proposed project includes the conversion of Washington Avenue from a four lane section to a three lane section with center turn lanes where appropriate. Also, the intersection of Washington Avenue and Greenbrook Road will be reconfigured to provide a dedicated left turn lane and a shared through/right turn lane in each direction with protected / permitted left turn phasing on all approaches. All other conditions relevant to the HSM analysis (i.e. driveway density, fixed objects, etc) will remain unchanged. A second HSM analysis was conducted, accounting for the changes detailed above and the resulting predicted crash rates were calculated: 2.030 injury/fatal crashes and 4.814 property damage crashes per year under current conditions for a total predicted crash rate of 6.844 crashes per year. Copies of the HSM analysis are again included for reference.

Cost Benefit Analysis

Using FHWA-HRT-05-051, "Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries", October, 2005 as a baseline, the costs associated with a "Fatal and/or Injury" crash and a "Property Damage Only" crash were expanded to a 2016 base year using an assumed discount rate of 4% per year, for a cost of $284,909 and $13,327 respectively (2016 costs) and also expanded at 4% per year for the next 15 years. The crash rates under the existing and proposed conditions determined using the HSM analysis were also projected out to a 2016 base year and for a 15 year service life thereafter, utilizing a 1% per annum growth rate consistent with a principal

arterial in Somerset County using NJDOT Access Permit Annual Background Growth Rate Table, issued April, 2013.

For each year, the dollar values per crash were totaled based on the predicted change in the number of crashes between the existing and proposed conditions. The costs were then converted to present (2016) year values using a 4% discount rate, for a resulting estimated present monetary value of approximately $5.4 million dollars. The project is anticipated to cost approximately $776,000 to construct, for a resulting cost / benefit ratio of approximately 6.9 to 1.

Conclusions

Based on the HSM and cost benefit analysis contained herewith, the Washington Avenue (CR 529) Safety Improvements project, with an estimated cost of $776,000 will have a positive benefit to society resulting in an approximately 6.9 to 1 benefit to cost ratio.

Cc: A. Slutsky
File:20130074

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PROJECT WASHINGTON AVENUE (CR 529) SAFETY IMPROVEMENTS
LOCATION WASHINGTON AVENUE & GREENBROOK ROAD, GREEN BROOK TOWNSHIP, SOMERSET COUNTY, NEW JERSEY
DATE OF ANALYS 6/15/2015

Economic Appraisal Data			
Baseline Data Year	2013	$158,200	Fatal/Injury Cost (2001 Dollars)
Construction Year	2016	$7,400	PDO Cost (2001 Dollars)
Service Life (yrs)	15	$600,000	Project Cost
Annual Traffic Growth	1.0%	$5,377,199	TOTAL CRASH BENEFIT
Discount Rate (i)	4.0%	9.0	Benefit / Cost Ratio

Instructions:
Enter data for cells marked in yellow, resulting crash cost and C/B Ratio will caclulate in green cells.

Expected Average Crash Frequency at Intersection

Year	WITHOUT Countermeasure $N_{Expected\ Before}$			WITH Countermeasure $N_{Expected\ After}$			$\Delta N_{Expected}$			Crash Related Costs							
	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	FI Crash Cost	FI Total Crash Cost	PDO Crash Cost	PDO Total Crash Cost	TOTAL Crash Cost	Years in service life (y)	(P/F,i,y)	Present Value
2013	9.6	3.1	6.5	6.8	2.0	4.8	2.8	1.0	1.7	$0	$0	$0	$0	$0	0	$ -	$ -
2014	9.7	3.1	6.6	6.9	2.1	4.9	2.8	1.1	1.7	$0	$0	$0	$0	$0	0	$ -	$ -
2015	9.8	3.1	6.7	7.0	2.1	4.9	2.8	1.1	1.8	$0	$0	$0	$0	$0	0	$ -	$ -
2016	9.9	3.2	6.7	7.1	2.1	5.0	2.9	1.1	1.8	$0	$0	$0	$0	$0	0	$ -	$ -
2017	10.0	3.2	6.8	7.1	2.1	5.0	2.9	1.1	1.8	$296,306	$322,521	$13,860	$24,894	$347,414	1	$ 1.0	$ 334,052
2018	10.1	3.2	6.9	7.2	2.1	5.1	2.9	1.1	1.8	$308,158	$338,776	$14,414	$26,148	$364,923	2	$ 1.9	$ 337,392
2019	10.2	3.3	6.9	7.3	2.2	5.1	2.9	1.1	1.8	$320,484	$355,849	$14,991	$27,466	$383,316	3	$ 2.8	$ 340,766
2020	10.3	3.3	7.0	7.3	2.2	5.2	3.0	1.1	1.9	$333,304	$373,785	$15,591	$28,851	$402,636	4	$ 3.6	$ 344,175
2021	10.4	3.3	7.1	7.4	2.2	5.2	3.0	1.1	1.9	$346,636	$392,624	$16,214	$30,304	$422,928	5	$ 4.5	$ 347,616
2022	10.5	3.4	7.2	7.5	2.2	5.3	3.0	1.1	1.9	$360,501	$412,411	$16,863	$31,832	$444,244	6	$ 5.2	$ 351,092
2023	10.6	3.4	7.2	7.6	2.2	5.3	3.1	1.2	1.9	$374,921	$433,197	$17,537	$33,436	$466,632	7	$ 6.0	$ 354,602
2024	10.7	3.4	7.3	7.6	2.3	5.4	3.1	1.2	1.9	$389,918	$455,030	$18,239	$35,122	$490,152	8	$ 6.7	$ 358,149
2025	10.8	3.5	7.4	7.7	2.3	5.4	3.1	1.2	1.9	$405,515	$477,964	$18,968	$36,891	$514,855	9	$ 7.4	$ 361,730
2026	10.9	3.5	7.4	7.8	2.3	5.5	3.2	1.2	2.0	$421,735	$502,053	$19,727	$38,751	$540,803	10	$ 8.1	$ 365,347
2027	11.1	3.5	7.5	7.9	2.3	5.5	3.2	1.2	2.0	$438,605	$527,357	$20,516	$40,704	$568,060	11	$ 8.8	$ 369,001
2028	11.2	3.6	7.6	7.9	2.4	5.6	3.2	1.2	2.0	$456,149	$553,935	$21,337	$42,756	$596,691	12	$ 9.4	$ 372,691
2029	11.3	3.6	7.7	8.0	2.4	5.6	3.3	1.2	2.0	$474,395	$581,854	$22,190	$44,910	$626,763	13	$ 10.0	$ 376,418
2030	11.4	3.6	7.7	8.1	2.4	5.7	3.3	1.2	2.0	$493,371	$611,179	$23,078	$47,174	$658,353	14	$ 10.6	$ 380,183
2031	11.5	3.7	7.8	8.2	2.4	5.8	3.3	1.3	2.1	$513,105	$641,982	$24,001	$49,551	$691,533	15	$ 11	$ 383,984
2032	11.6	3.7	7.9	8.3	2.5	5.8	3.3	1.3	2.1	$0	$0	$0	$0	$0	0	$ -	$ -
2033	11.7	3.8	8.0	8.4	2.5	5.9	3.4	1.3	2.1	$0	$0	$0	$0	$0	0	$ -	$ -
2034	11.9	3.8	8.1	8.4	2.5	5.9	3.4	1.3	2.1	$0	$0	$0	$0	$0	0	$ -	$ -
2035	12.0	3.8	8.1	8.5	2.5	6.0	3.5	1.3	2.1	$0	$0	$0	$0	$0	0	$ -	$ -
2036	12.1	3.9	8.2	8.6	2.6	6.1	3.5	1.3	2.2	$0	$0	$0	$0	$0	0	$ -	$ -
2037	12.2	3.9	8.3	8.7	2.6	6.1	3.5	1.3	2.2	$0	$0	$0	$0	$0	0	$ -	$ -
2038	12.3	3.9	8.4	8.8	2.6	6.2	3.6	1.3	2.2	$0	$0	$0	$0	$0	0	$ -	$ -
2039	12.5	4.0	8.5	8.9	2.6	6.2	3.6	1.4	2.2	$0	$0	$0	$0	$0	0	$ -	$ -
2040	12.6	4.0	8.6	9.0	2.7	6.3	3.6	1.4	2.3	$0	$0	$0	$0	$0	0	$ -	$ -
																TOTAL CRASH BENEFIT	$5,377,199

Societal Crash Costs by Severity, (2001 Dollars)
Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries, FHWA-HRT-05-051, October 2005

Injury Severity		Estimated Cost 2001
Fatal	(K)	$4,008,900
Fatal and/or Injury	(K/A/B/C)	$158,200
Injury	(A/B/C)	$82,600
Disability Injury	(A)	$216,000
Evident Injury	(B)	$79,000
Possible Injury	(C)	$44,900
Property Damage Only	(O)	$7,400

PROJECT HIGH RISK RURAL ROADS - CR 539
LOCATION GSP to HORICON
DATE OF ANALYS 5/30/2014

Economic Appraisal Data			
Baseline Data Year	2010	$158,200	Fatal/Injury Cost (2001 Dollars)
Construction Year	2015	$7,400	PDO Cost (2001 Dollars)
Service Life (yrs)	10	$9,283,000	Project Cost
Annual Traffic Growth	1.0%	**$41,787,857**	TOTAL CRASH BENEFIT
Discount Rate (i)	4.0%	**4.5**	Benefit / Cost Ratio

Instructions:
Enter data for cells marked in yellow, resulting crash cost and C/B Ratio will caclulate in green cells.

Expected Average Crash Frequency at Intersection

Year	WITHOUT Countermeasure $N_{Expected\ Before}$			WITH Countermeasure $N_{Expected\ After}$			$\Delta N_{Expected}$			Crash Related Costs							
	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	FI Crash Cost	FI Total Crash Cost	PDO Crash Cost	PDO Total Crash Cost	TOTAL Crash Cost	Years in service life (y)	(P/F,i,y)	Present Value
2010	77.6	24.9	52.7	38.7	12.4	26.3	38.9	12.5	26.4	$0	$0	$0	$0	$0	0	$ -	$ -
2011	78.4	25.1	53.2	39.1	12.5	26.6	39.3	12.6	26.7	$0	$0	$0	$0	$0	0	$ -	$ -
2012	79.2	25.4	53.8	39.5	12.6	26.8	39.7	12.8	26.9	$0	$0	$0	$0	$0	0	$ -	$ -
2013	80.0	25.7	54.3	39.9	12.8	27.1	40.1	12.9	27.2	$0	$0	$0	$0	$0	0	$ -	$ -
2014	80.8	25.9	54.8	40.3	12.9	27.4	40.5	13.0	27.5	$0	$0	$0	$0	$0	0	$ -	$ -
2015	81.6	26.2	55.4	40.7	13.0	27.6	40.9	13.1	27.7	$0	$0	$0	$0	$0	0	$ -	$ -
2016	82.4	26.4	55.9	41.1	13.2	27.9	41.3	13.3	28.0	$284,909	$3,780,458	$13,327	$373,478	$4,153,936	1	$ 1.0	$ 3,994,169
2017	83.2	26.7	56.5	41.5	13.3	28.2	41.7	13.4	28.3	$296,306	$3,971,002	$13,860	$392,299	$4,363,300	2	$ 1.9	$ 4,034,116
2018	84.0	27.0	57.1	41.9	13.4	28.5	42.1	13.5	28.6	$308,158	$4,171,137	$14,414	$412,059	$4,583,196	3	$ 2.8	$ 4,074,445
2019	84.9	27.2	57.6	42.3	13.6	28.8	42.5	13.7	28.9	$320,484	$4,381,358	$14,991	$432,840	$4,814,197	4	$ 3.6	$ 4,115,196
2020	85.7	27.5	58.2	42.7	13.7	29.1	43.0	13.8	29.2	$333,304	$4,602,187	$15,591	$454,665	$5,056,852	5	$ 4.5	$ 4,156,364
2021	86.6	27.8	58.8	43.2	13.8	29.3	43.4	13.9	29.5	$346,636	$4,834,135	$16,214	$477,561	$5,311,697	6	$ 5.2	$ 4,197,911
2022	87.4	28.1	59.4	43.6	14.0	29.6	43.8	14.1	29.7	$360,501	$5,077,769	$16,863	$501,644	$5,579,413	7	$ 6.0	$ 4,239,895
2023	88.3	28.3	60.0	44.0	14.1	29.9	44.3	14.2	30.0	$374,921	$5,333,688	$17,537	$526,911	$5,860,599	8	$ 6.7	$ 4,282,282
2024	89.2	28.6	60.6	44.5	14.3	30.2	44.7	14.4	30.3	$389,918	$5,602,509	$18,239	$553,483	$6,155,991	9	$ 7.4	$ 4,325,118
2025	90.1	28.9	61.2	44.9	14.4	30.5	45.2	14.5	30.6	$405,515	$5,884,879	$18,968	$581,361	$6,466,240	10	$ 8.1	$ 4,368,360
2026	91.0	29.2	61.8	45.4	14.5	30.8	45.6	14.7	31.0	$0	$0	$0	$0	$0	0	$ -	$ -
2027	91.9	29.5	62.4	45.8	14.7	31.1	46.1	14.8	31.3	$0	$0	$0	$0	$0	0	$ -	$ -
2028	92.8	29.8	63.0	46.3	14.8	31.5	46.5	15.0	31.6	$0	$0	$0	$0	$0	0	$ -	$ -
2029	93.7	30.1	63.7	46.8	15.0	31.8	47.0	15.1	31.9	$0	$0	$0	$0	$0	0	$ -	$ -
2030	94.7	30.4	64.3	47.2	15.1	32.1	47.5	15.3	32.2	$0	$0	$0	$0	$0	0	$ -	$ -
2031	95.6	30.7	64.9	47.7	15.3	32.4	47.9	15.4	32.5	$0	$0	$0	$0	$0	0	$ -	$ -
2032	96.6	31.0	65.6	48.2	15.4	32.7	48.4	15.6	32.9	$0	$0	$0	$0	$0	0	$ -	$ -
2033	97.6	31.3	66.3	48.7	15.6	33.1	48.9	15.7	33.2	$0	$0	$0	$0	$0	0	$ -	$ -
2034	98.5	31.6	66.9	49.1	15.7	33.4	49.4	15.9	33.5	$0	$0	$0	$0	$0	0	$ -	$ -
2035	99.5	31.9	67.6	49.6	15.9	33.7	49.9	16.0	33.9	$0	$0	$0	$0	$0	0	$ -	$ -
2036	100.5	32.3	68.3	50.1	16.1	34.1	50.4	16.2	34.2	$0	$0	$0	$0	$0	0	$ -	$ -
2037	101.5	32.6	68.9	50.6	16.2	34.4	50.9	16.4	34.5	$0	$0	$0	$0	$0	0	$ -	$ -
																TOTAL CRASH BENEFIT	$41,787,857

Societal Crash Costs by Severity, (2001 Dollars)
Crash Cost Estimates by Maximum Police-Reported Injury Severity within Selected Crash Geometries, FHWA-HRT-05-051, October 2005

Injury Severity		Estimated Cost 2001
Fatal	(K)	$4,008,900
Fatal and/or Injury	(K/A/B/C)	$158,200
Injury	(A/B/C)	$82,600
Disability Injury	(A)	$216,000
Evident Injury	(B)	$79,000
Possible Injury	(C)	$44,900
Property Damage Only	(O)	$7,400

MULTIPLE YEAR ECONOMIC APPRAISAL

General Information		
Project Name	Garden Road & Mill Road Traffic Signalization	
Project Description	SJTPO Local Safety Program Application	
Reference Number	FY 2015	
Analyst	J. Marandino	
Agency/Company	SJTPO	
Contact Email	jmarandino@sjtpo.org	
Contact Phone	(856) 794-1941	
Date Completed	10/30/2014	
Economic Appraisal Information		
Baseline Data Year	2010	
Construction Year	2009	
Service Life (yrs)	10	Installation of new traffic signal 10-15 years; per Sophia Azam, NJDOT 10/29/2014 confirmed with Maintanence Manager
Annual Traffic Growth (%)	2.00%	NJDOT Access Permit, Annual Background Growth Rate Table = Burlington County, Rural, Major Collector
Discount Rate (i)	4.00%	Assumed
Selected Countermeasure(s) Information		
Description	Conversion of stop-controlled intersection into single-lane roundabout	
Reference	http://www.cmfclearinghouse.org/study_detail.cfm?stid=46	
CMF Total	0.56	Rural Crashes: All; Severity: All
Standard Deviation	0	
CMF Fatal/Injury	0.18	Rural Crashes: All; Severity: Serious injury,Minor injury
Standard Deviation	0	

Required user input data

Modified dependent upon Baseline Year
http://www.bls.gov/data/inflation_calculator.htm

Calculated Results

Injury Severity	Estimated Cost 2001*	2013
Fatal (K)	$4,008,900	$4,008,900.00
Fatal and/or Injury (K/A/B/C)	$158,200	$158,200.00
Injury (A/B/C)	$82,600	$82,600.00
Disability Injury (A)	$216,000	$216,000.00
Evident Injury (B)	$79,000	$79,000.00
Possible Injury (C)	$44,900	$44,900.00
Property Damage Only (O)	$7,400	$7,400.00

* *Societal Crash Costs by Severity, FHWA-HRT-05-051, October 2005*

$2,000,000	Project Cost
$5,675,508	TOTAL CRASH BENEFIT
2.84	Benefit / Cost Ratio

	Expected Average Crash Frequency at Intersection									*Annual Monetary Value of Change in Crashes*					*Conversion to Present Value*		
Year	WITHOUT Countermeasure $N_{Expected\ Before}$			WITH Countermeasure $N_{Expected\ After}$			$\Delta N_{Expected}$			FI Crash Cost	FI Crash Cost Benefit	PDO Crash Cost	PDO Crash Cost Benefit	Total Crash Cost Benefit	Years in service life (y)	(P/F,i,y)	Present Value Crash Cost Benefit
	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO								
2010	10.4	5.2	5.2	5.8	0.9	4.9	4.6	4.3	0.3	$158,200	$680,260	$7,400	$2,220	$682,480	1	1.0	$ 656,231
2011	10.5	5.3	5.2	5.9	1.0	4.9	4.6	4.3	0.3	$158,200	$680,260	$7,400	$2,220	$682,480	2	1.9	$ 630,991
2012	10.5	5.3	5.2	5.9	1.0	4.9	4.6	4.3	0.3	$158,200	$680,260	$7,400	$2,220	$682,480	3	2.8	$ 606,722
2013	10.6	5.4	5.2	5.9	1.0	4.9	4.7	4.4	0.3	$158,200	$696,080	$7,400	$2,220	$698,300	4	3.6	$ 596,910
2014	10.7	5.4	5.3	6.0	1.0	5.0	4.7	4.4	0.3	$158,200	$696,080	$7,400	$2,220	$698,300	5	4.5	$ 573,952
2015	10.7	5.4	5.3	6.0	1.0	5.0	4.7	4.4	0.3	$158,200	$696,080	$7,400	$2,220	$698,300	6	5.2	$ 551,877
2016	10.8	5.5	5.3	6.0	1.0	5.0	4.8	4.5	0.3	$158,200	$711,900	$7,400	$2,220	$714,120	7	6.0	$ 542,673
2017	10.9	5.5	5.4	6.1	1.0	5.1	4.8	4.5	0.3	$158,200	$711,900	$7,400	$2,220	$714,120	8	6.7	$ 521,800
2018	11.0	5.5	5.5	6.2	1.0	5.2	4.8	4.5	0.3	$158,200	$711,900	$7,400	$2,220	$714,120	9	7.4	$ 501,731
2019	11.0	5.6	5.4	6.2	1.0	5.2	4.8	4.6	0.2	$158,200	$727,720	$7,400	$1,480	$729,200	10	8.1	$ 492,621
2020			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2021			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2022			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2023			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2024			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2025			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2026			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2027			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2028			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2029			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2030			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2031			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2032			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2033			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2034			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2035			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2036			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
2037			0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0	$0	$0	$0	$0	0	0.0	$ -
															TOTAL CRASH BENEFIT		$5,675,508

ATTACHMENT D

FWHA Proven Safety Countermeasures

https://safety.fhwa.dot.gov/provencountermeasures/fhwasa18029/

ATTACHMENT E
CATEGORICAL EXCLUSIONS

According to an existing agreement between NJDOT and FHWA, only the following (38) activities in PART 1 may be designated as Categorical Exclusions without further approval provided that they do not cause any impacts listed in PART 2.

PART 1

(1) Activities which do not involve or lead directly to construction, such as planning and research activities; grants for training; engineering to define the elements of a proposed action or alternatives so that social, economic, and environmental effects can be assessed; and Federal-aid system revisions which establish classes of highways on the Federal-aid system.

(2) Approval of utility installations along or across a transportation facility.

(3) Construction of bicycle and pedestrian lanes, paths, and facilities.

(4) Activities included in the State's highway safety plan under 23 U.S.C. § 402.

(5) Transfer of Federal lands, pursuant to 23 U.S.C. § 107(d) and/or 23 U.S.C. § 317 when the land transfer is in support of an action that is not otherwise subject to FHWA review under NEPA.

(6) The installation of noise barriers or alterations to existing publicly owned buildings to provide for noise reduction.

(7) Landscaping.

(8) Installation of fencing, signs, pavement markings, small passenger shelters, traffic signals, and railroad warning devices where no substantial land acquisition or traffic disruption will occur.

(9) The following actions for transportation facilities damaged by an incident resulting in an emergency declared by the Governor of the State and concurred in by the Secretary, or a disaster or emergency declared by the President pursuant to the Robert T. Stafford Act (42 U.S.C. § 512):
   (i) Emergency repairs under 23 U.S.C. § 125; and
   (ii) The repair, reconstruction, restoration, retrofitting, or replacement of any road, highway, bridge, tunnel, or transit facility (such as a ferry dock or bus transfer station), including ancillary transportation facilities (such as pedestrian/bicycle paths and bike lanes), that is in operation or under construction when damaged and the action:
      (A) Occurs within the existing right-of-way and in a manner that substantially conforms to the preexisting design, function, and location as the original (which may include upgrades to meet existing codes and standards as well as upgrades warranted to address conditions that have changed since the original construction); and
      (B) Is commenced within a two (2)-year period beginning on the date of the declaration.

(10) Acquisition of scenic easements.

(11) Determination of payback under 23 U.S.C. § 156 for property previously acquired with Federal-aid participation.

(12) Improvements to existing rest areas and truck weigh stations.

(13) Ridesharing activities.

(14) Bus and rail car rehabilitation.

(15) Alterations to facilities or vehicles in order to make them accessible for elderly and handicapped persons.

(16) Program administration, technical assistance activities, and operating assistance to transit authorities to continue existing service or increase service to meet routine changes in demand.

(17) The purchase of vehicles by the applicant where the use of these vehicles can be accommodated by existing facilities or by new facilities which themselves are within a CE.

(18) Track and railbed maintenance and improvements when carried out within the existing right-of-way.

(19) Purchase and installation of operating or maintenance equipment to be located within the transit facility and with no significant impacts off the site.

(20) Promulgation of rules, regulations, and directives.

(21) Deployment of electronics, photonics, communications, or information processing used singly or in combination, or as components of a fully integrated system, to improve the efficiency or safety of a surface transportation system or to enhance security or passenger convenience. Examples include, but are not limited to, traffic control and detector devices, lane management systems, electronic payment equipment, automatic vehicle locaters, automated passenger counters, computer-aided dispatching systems, radio communications systems, dynamic message signs, and security equipment including surveillance and detection cameras on roadways and in transit facilities and on buses.

(22) Projects, as defined in 23 U.S.C. § 101, that would take place entirely within the existing operational right-of-way as fully defined in 23 CFR 771.117 (c) 22. Existing operational right-of-way (ROW) refers to ROW that has been disturbed for an existing transportation facility or is maintained for a transportation purpose.

(23) Federally-funded projects:
(i) That receive less than $5,000,000 of Federal funds; or
(ii) With a total estimated cost of not more than $30,000,000 and Federal funds comprising less than 15 percent of the total estimated project cost.

(24) Localized geotechnical and other investigation to provide information for preliminary design and for environmental analyses and permitting purposes, such as drilling test bores for soil sampling; archeological investigations for archeology resources assessment or similar survey; and wetland surveys.

(25) Environmental restoration and pollution abatement actions to minimize or mitigate the impacts of any existing transportation facility (including retrofitting and construction of stormwater treatment systems to meet Federal and State requirements under Sections 401 and 402 of the Federal Water Pollution Control Act (33 U.S.C. §§ 1341-1342} carried out to address water pollution or environmental degradation.

(26) Modernization of a highway by resurfacing, restoration, rehabilitation, reconstruction, adding shoulders, or adding auxiliary lanes (including parking, weaving, turning and climbing lanes), if the action meets the constraints in Section IV(A)(1)(b) of this Agreement.

(27) Highway safety or traffic operations improvement projects, including the installation of ramp metering control devices and lighting, if the project meets the constraints in Part 2.

(28) Bridge rehabilitation, reconstruction, or replacement or the construction of grade separation to replace existing at-grade railroad crossings, if the actions meet the constraints in Part 2.

(29) Purchase, construction, replacement, or rehabilitation of ferry vessels (including improvements to the ferry vessel safety, navigation, and security systems) that would not require a change in the function of the ferry terminals and can be accommodated by existing facilities or by new facilities which themselves are within a CE.

(30) Rehabilitation or reconstruction of existing ferry facilities that occupy substantially the same geographic footprint, do not result in a change in their functional use, and do not result in a substantial increase in the existing facility's capacity. Example actions include work on pedestrian and vehicle transfer structures and associated utilities, buildings, and terminals.

(31) Transportation corridor fringe parking facilities.

(32) Construction of new truck weigh stations or rest areas.

(33) Approvals for disposal of excess right-of-way or for joint or limited use of right-of-way, where the proposed use does not have significant adverse impacts.

(34) Construction of new bus storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and located on or near a street with adequate capacity to handle anticipated bus and support vehicle traffic.

(35) Rehabilitation or reconstruction of existing rail and bus buildings and ancillary facilities where only minor amounts of additional land are required and there is not a substantial increase in the number of users.

(36) Construction of bus transfer facilities (an open area consisting of passenger shelters, boarding areas, kiosks, and related street improvements) when located in a commercial area or other high activity center in which there is adequate street capacity for projected bus traffic.

(37) Construction of rail storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and where there is no significant noise impact on the surrounding community.

(38) Acquisition of land for hardship or protective purposes.

PART 2

A PROPOSED PROJECT MUST BE INDIVIDUALLY APPROVED BY FHWA IF THE PROJECT:

(1) Involves acquisitions that result in residential or non-residential displacements;

(2) Results in capacity expansion of a roadway by addition of through lanes;

(3) Involves the construction of temporary access, or the closure of existing road, bridge, or ramps, that would result in major traffic disruptions;

(4) Involves changes in access control;

(5) Results in a determination of adverse effect on historic properties pursuant to Section 106 of the National Historic Preservation Act;

(6) Requires the use of properties protected by Section 4(f) of the Department of Transportation Act {49 U.S.C. § 303) that cannot be documented with an FHWA de minimis determination, or a programmatic Section 4(f) evaluation other than the programmatic evaluation for the use of historic bridges;

(7) Requires the acquisition of lands under the protection of Section 6(f) of the Land and Water Conservation Act of 1965, the Federal Aid in Fish Restoration Act, the Federal Aid in Wildlife Restoration Act, or other unique areas or special lands that were acquired in fee or easement with public-use money and have deed restrictions or covenants on the property;

(8) Requires a U.S. Army Corps of Engineers Section 404 permit other than a Nationwide Permit or a General Permit;

(9) Requires a U.S. Coast Guard bridge permit;

(10) Involves floodplain encroachment pursuant to Executive Orders 11988 and 13690 other than functionally dependent uses (e.g., bridges, wetlands) or actions that facilitate open space use (e.g., recreational trails, bicycle and pedestrian paths);

(11) Requires construction in, across, or adjacent to a river designated as a component of, or proposed for inclusion in, the National System of Wild and Scenic Rivers published by the U.S. Department of the Interior/U.S. Department of Agriculture;

(12) Is defined as a "Type I project" per 23 CFR 772.5 and any NJDOT noise manual for purposes of a noise analysis;

(13) Involves a finding of, "may affect, likely to adversely affect" federally listed or candidate species, or proposed or designated critical habitat, or projects with impacts subject to the conditions of the Bald and Golden Eagle Protection Act;

(14) Includes acquisition of land for hardship or protective purposes, or early acquisition pursuant to a Federal acquisition project (23 U.S.C. § l08(d));

(15) Does not conform to the State Implementation Plan which is approved or promulgated by the U.S. Environmental Protection Agency in air quality nonattainment areas;

(16) Is not included in or is inconsistent with the statewide transportation improvement program, and in applicable urbanized areas, the transportation improvement program; or

(17) Is not consistent with the State's Coastal Zone Management Plan.

Additional information on programmatic agreements between the FHWA and state departments of transportation can be found on the FHWA website below:

https://www.environment.fhwa.dot.gov/nepa/programmatic_ce.aspx

ATTACHMENT F
LIST OF USEFUL WEBSITES FOR ENVIRONMENTAL SCREENINGS

Website Name	Website Link	Environmental Concern
NJDEP Land Use	http://www.state.nj.us/dep/landuse/index.html	Useful links for various NJ environmental permitting issues (CAFRA, FWWL, Waterfront Development, Stream Encroachment, etc.)
NJDEP Landscape Project	http://www.state.nj.us/dep/fgw/ensp/landscape/	General information about NJDEP's Landscape Project (habitat mapping)
NJDEP GIS	http://www.state.nj.us/dep/gis/	Downloadable environmental data layers for users of GIS software
NJPDES Construction Activity Stormwater Permitting	https://www.state.nj.us/dep/dwq/njpdes.htm	Information regarding NJPDES construction stormwater permitting
NJ Stormwater	http://njstormwater.org/	Information and links regarding NJ stormwater permitting and management programs
NJDEP Surface Water Quality Classifications	https://www.state.nj.us/dep/wms/bears/swqs.htm	Lists and describes surface water quality classifications for Category One Waters, Trout Maintenance Waters, and Trout Production Waters in NJ. List is towards the end of the document.
USFWS ~ Consultation Process	https://www.fws.gov/midwest/endangered/section7/section7.html	General information about Section 7 consultation, threatened and endangered species information, and other useful links
USFWS ~ List of Municipalities	https://www.fws.gov/northeast/njfieldoffice/pdf/munlist.pdf	List of NJ municipalities, by county, with known occurrence of federally listed threatened and endangered species
NOAA Greater Atlantic Regional Office	https://www.greateratlantic.fisheries.noaa.gov/	Guide to Essential Fish Habitat (EFH) designations in the Northeast US with other useful links
NOAA Greater Atlantic Regional Office (Maps)	https://www.greateratlantic.fisheries.noaa.gov/hcd/index2a.htm	Maps of EFH Designations in the Northeast US with additional links to EFH descriptions
ACOE New York District	https://www.nan.usace.army.mil/Missions/Regulatory/	Links to ACOE permitting information
ACOE Philadelphia District	https://www.nap.usace.army.mil/Missions/Regulatory/	Links to ACOE permitting information
US Coast Guard	https://www.atlanticarea.uscg.mil/Our-Organization/District-9/Ninth-District-Staff/Prevention-Division/Bridge-Administration/	Laws & Regulations, and links that contain information about permitting
NJDEP Historic Preservation Office	http://www.state.nj.us/dep/hpo/1identify/nrsr_lists.htm	All properties listed on the NJ and National Registers of Historic Places by County and Municipality and any properties found eligible for listing in the National Register; links to state and federal regulations and resources pertinent to historic properties

NJDOT Historic Bridge Survey	https://www.state.nj.us/transportation/works/environment/HistBrIntro.shtm	Bridge on and off the state system built prior to 1945 with an evaluation of their individual eligibility for listing in the National Register of Historic Places by county and structure number; eligibility as part of an historic district is discussed when information is available.
Topozone	http://www.topozone.com/default.asp	Interactive mapping website that allows you to print topographic maps
National Wild & Scenic Rivers	https://www.nps.gov/orgs/1912/partnership-wild-and-scenic-rivers.htm	Links to national wild & scenic rivers by state
NJDEP Shellfish	https://nj.gov/dep/bmw/nsspho me.html	Links to maps of shellfish classifications of NJ's coastal waters
NJDEP Vernal Pools	http://www.state.nj.us/dep/fgw/ensp/vernalpool.htm	General information about vernal pools
Rutgers University Vernal Pools	https://crssa.rutgers.edu/projects/raritan/images/maps_VernalPools.jpg	Maps of potential/certified vernal pools
EPA Sole Source Aquifers	https://www.epa.gov/dwssa	Map of EPA sole source aquifers with links to support documents for each
D&R Canal Commission	https://www.nj.gov/dep/drcc/regulatory.html	Information regarding the D&R Canal Commission's regulatory program
Delaware River Basin Commission	http://www.state.nj.us/drbc/	General information and useful links
Highlands	https://www.nj.gov/dep/landuse/highlands.html	Highlands Act information and mapping
NJ Meadowlands Commission (now under NJSEA)	https://www.nj.gov/dep/landuse/lu_hm.html https://www.njsea.com/regulations/	Links to guidelines and procedures, maps, and other general information
NJDEP Tidelands Program	https://www.state.nj.us/dep/landuse/tl_main.html	General information about the tidelands program and useful links
Pinelands	http://www.state.nj.us/pinelands/	General Pinelands information and mapping
NJDEP Green Acres	http://www.state.nj.us/dep/greenacres/	General information about the Green Acres Program
NJDEP Green Acres ROSI	http://www.state.nj.us/dep/greenacres/openspace.html	Recreation and Open Space Inventory (ROSI)
USEPA Greenbook	https://www.epa.gov/green-book	Non-attainment and maintenance areas for air quality
NJDEP Site Remediation & Waste Management	http://www.state.nj.us/dep/srp/kcs-nj/	Contains the known Contaminated Sites in New Jersey (KCS-NJ) report, which contains basic information on approximately 14,000 contaminated sites
NJDEP Data Miner	https://www13.state.nj.us/DataMiner	NJDEP's comprehensive listing of environmental data, including know contaminated sites

ATTACHMENT G

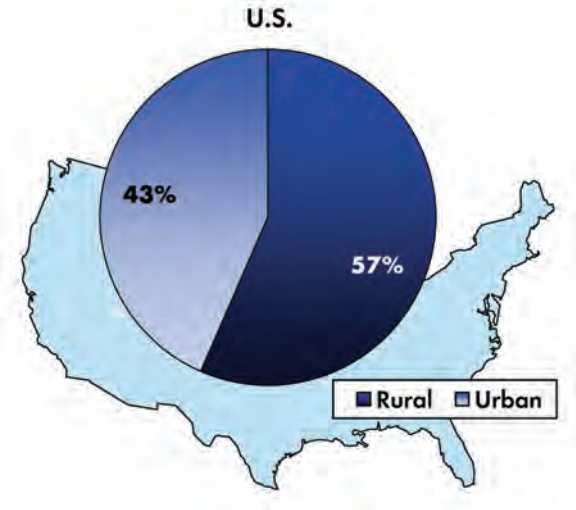
SYSTEMIC IMPROVEMENTS

A Systemic Approach to Safety

Using Risk to Drive Action

The systemic approach to safety involves improvements that are widely implemented based on high-risk roadway features correlated with particular severe crash types. As the figure on the right illustrates, 57 percent of fatal crashes occur on rural roads, which are often part of the local system. Because these crashes are not evenly distributed across the many miles of rural roadways, it is often difficult to isolate high-crash locations for safety improvements. The systemic approach answers the question:

> ***Do all systems and crash types present equal opportunities for crash reduction, or do specific parts of the system and certain crash types offer a greater opportunity to save lives?***



Source: Cambridge Systematics, Inc.

The Benefits of a Systemic Approach

Several agencies implementing systemic improvements have reported staggering results in crash reductions. The systemic approach:

Solves an Unmet Need in Transportation Safety

A significant number of severe crashes are spread out over a wide area, particularly on rural and local roadways, and for specific crash types such as those involving vulnerable road users. These crashes are rarely identified through the traditional site analysis approach because it is difficult to isolate high-crash locations. The systemic approach provides state, regional, and local agencies an alternative method to address these crash types and fulfill a previously unmet need.

Source: Cambridge Systematics, Inc.

Uses a Risk-Based Approach to Prevent Crashes

Systemic starts with a different premise for identifying safety problems, leading to a different set of projects. The systemic approach looks at crash history on an aggregate basis to identify high-risk roadway characteristics. While the traditional site analysis approach results in safety investments at high-crash locations, the systemic approach leads to widespread implementation of projects to reduce the potential for severe crashes.

Results in a Comprehensive Road Safety Program

The systemic approach does not replace the site analysis approach. It is a complementary technique intended to supplement site analysis and provide a more comprehensive and proactive approach to safety management efforts. Reducing crashes at individual locations clearly requires continued attention. At the same time, the systemic approach aims to reduce the risk of and the potential for the occurrence of future crashes.

Advances a Cost-Effective Means to Address Safety Concerns

The systemic approach considers multiple locations with similar risk characteristics. When examining the system as a whole, a particular roadway element may have a high-crash experience, and it is more cost-effective to correct the problem on a systemwide basis rather than by individual high-crash location.

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives

http://safety.fhwa.dot.gov

How to Utilize the Systemic Approach

The systemic approach is iterative and intended to be flexible and easy to apply to a variety of systems, locations, and crash types. Similar to the site analysis approach and most common safety management processes, the systemic planning approach involves problem identification, countermeasure identification, and project prioritization.

Identify Target Crash Types/Risk Factors

Review systemwide data and location characteristics to focus on specific crash types and associated risk factors.

For example:

Crash Type – Roadway departure crashes on rural two-lane highways various roadway features.

Risk Factors – Average daily traffic volumes, curve density, access density.

Source: Cambridge Systematics, Inc.

Screen and Prioritize Candidate Locations

Use the risk factors to screen the network and prioritize candidate locations for safety investments that will reduce the potential for future severe crashes.

Select Countermeasures

Evaluate countermeasures such to select those that address roadway departures on roads with the identified risk factors.

For example:

Rumble strips, cable median barriers, or advanced curve delineation.

Prioritize Projects

Prioritize safety projects for implementation based on the risk-based assessment, available funding, other programmed projects, time to develop projects, and other considerations.

Forging Ahead

> "The systemic approach has offered the State of Minnesota another opportunity to further improve safety on our roadways by proactively addressing at-risk elements not typically identified through traditional approaches. This has given us a way to fund and build safety projects in rural Minnesota, which in the past did not qualify for safety investments due to the lack of identified "high-crash" locations."
>
> *– Sue Groth, State Traffic Engineer, MnDOT*

The Federal Highway Administration is currently developing a systemic safety project selection tool intended to outline a step-by-step process to conduct systemic safety planning and analysis; present a decision-making framework to balance investments for systemic safety improvements and spot safety improvement projects; and establish a mechanism to quantify benefits of systemic safety improvements. The tool is expected to be available in the spring of 2013. In the meantime, visit the FHWA Office of Safety web site at http://safety.fhwa.dot.gov/ or contact Karen Scurry at karen.scurry@dot.gov, (609) 637-4207 for additional information.

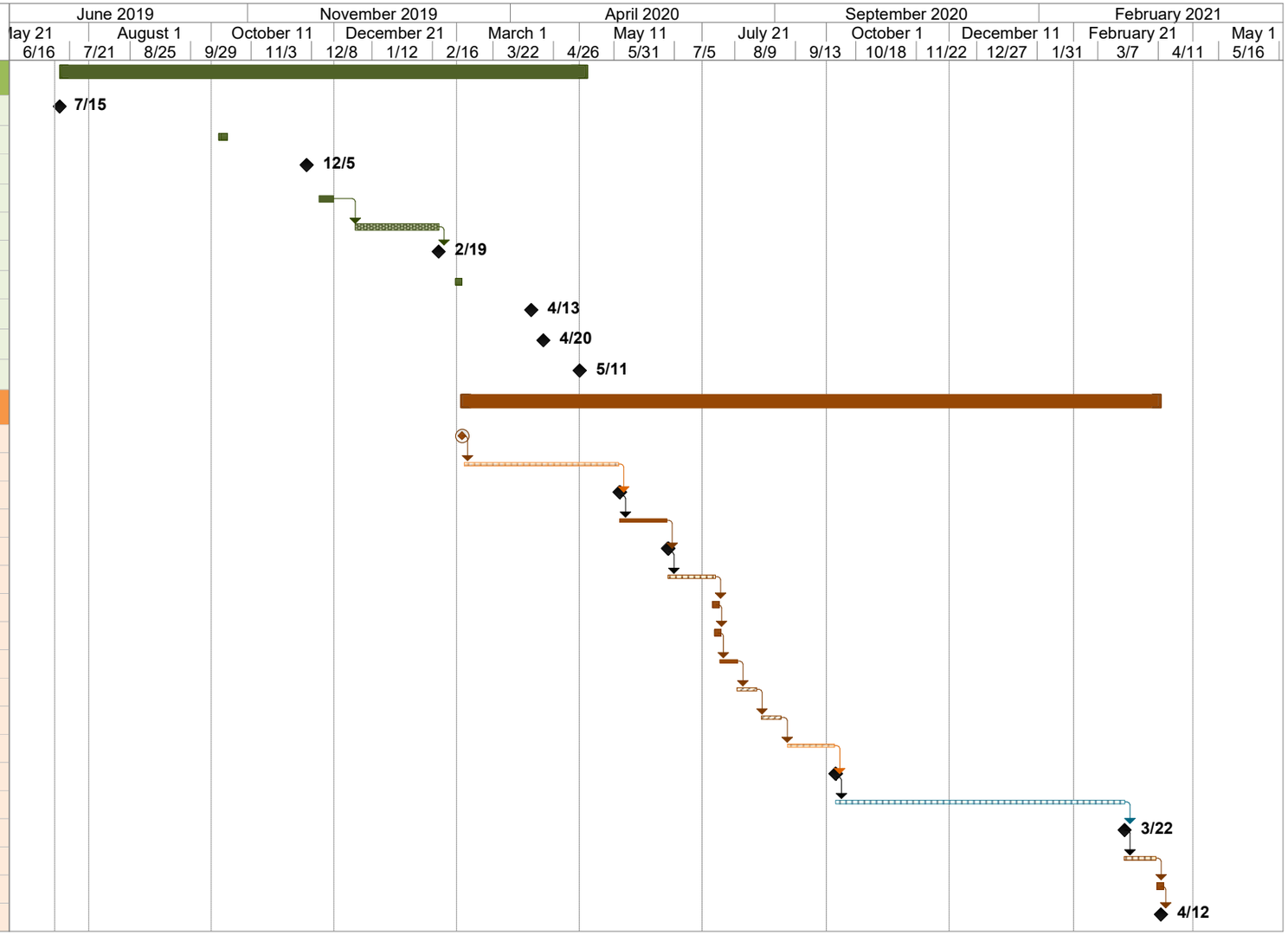
FHWA-SA-12-025

ATTACHMENT H

SCHEDULE

FY 2020 LOCAL SAFETY AND HIGH RISK RURAL ROADS PROGRAMS/LOCAL PRELIMINARY ENGINEERING ASSISTANCE PROGRAM SCHEDULE

Task Name	Duration	Start	Finish
FY 2020 LSP/HRRRP Solicitation	44 wks	Mon 7/15/19	Fri 5/15/20
Solicitation Released	0 days	**Mon 7/15/19**	Mon 7/15/19
HSM Analysis Workshop	2 days	Thu 10/17/19	Fri 10/18/19
Applications Due	0 days	Thu 12/5/19	Thu 12/5/19
Applications Reviewed for completeness	7 days	Thu 12/12/19	Fri 12/20/19
TRC Applications Review	7 wks	Thu 1/2/20	Wed 2/19/20
TRC Meeting	0 days	Wed 2/19/20	Wed 2/19/20
NJTPA Internal Meeting to review proposed program	1 day	Mon 3/2/20	Mon 3/2/20
RTAC	0 days	Mon 4/13/20	Mon 4/13/20
PPC	0 days	Mon 4/20/20	Mon 4/20/20
Board Approval	0 days	**Mon 5/11/20**	Mon 5/11/20
FY 2020 LSEAP Consultant RFP, Selection and Award	58 wks	Tue 3/3/20	Mon 4/12/21
RFP draft to F & A for Review	1 day	Wed 3/4/20	Wed 3/4/20
F & A reviews RFP	12 wks	Thu 3/5/20	Tue 6/2/20
RFP release	1 day	**Wed 6/3/20**	Wed 6/3/20
Proposal advertisement	4 wks	Wed 6/3/20	Tue 6/30/20
Proposal due date	1 day	Wed 7/1/20	Wed 7/1/20
CSC reviews proposals	4 wks	Wed 7/1/20	Tue 7/28/20
CSC Meeting	1 day	Wed 7/29/20	Wed 7/29/20
Consultant interviews and open cost proposals	1 day	Thu 7/30/20	Thu 7/30/20
Negotiated w/Consultants	7 days	Fri 7/31/20	Mon 8/10/20
Consultants revise cost proposals	2 wks	Mon 8/10/20	Fri 8/21/20
Consultants revise and submit final proposals	2 wks	Mon 8/24/20	Fri 9/4/20
F & A reviews draft authorization documents	4 wks	Tue 9/8/20	Mon 10/5/20
Authorization request sent to NJDOT	1 day	Tue 10/6/20	Tue 10/6/20
NJDOT review/FHWA request	24 wks	Tue 10/6/20	Mon 3/22/21
NJDOT/FHWA Letter to Incur Cost	0 days	Mon 3/22/21	Mon 3/22/21
F & A reviews Board Exec Committee approval documents	3 wks	Mon 3/22/21	Fri 4/9/21
F & A requests Board Exec Committee approval	1 day	Mon 4/12/21	Mon 4/12/21
Letter to Incur Costs and Consultant Begins Preliminary Engineering	0 days	**Mon 4/12/21**	Mon 4/12/21



Project: Program Solicitation Schedule
Date: Fri 7/12/19

Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Progress
Deadline

ATTACHMENT I

SAMPLE ROAD SAFETY AUDIT RECOMMENDATIONS

B – Improve safe Vehicle Flow at West Market Street and 12th Avenue Intersections

Issue #	Issue	Cost	Safety Benefit
	Short Term		
B-1	Schedule the realignment of the pedestrian push buttons in conformance with the MUTCD.	$	Low
B-2	Evaluate the signal timing (including pedestrian signals), and consider revising the timing to improve traffic operations.	$	Medium
B-3	Consider the installation of backplates with retroreflective borders. PSC: Backplates with retroreflective borders **CMF**=0.85 for "All" crashes; Add 3-inch yellow retroreflective sheeting to signal backplates http://www.cmfclearinghouse.org/study_detail.cfm?stid=85	$	Medium
B-6	Paint "No Parking" on the street east of intersection **CMF** 153=0.8 for serious and minor injury; **CMF** 154=0.73 for PDO; Prohibit on-street parking http://www.cmfclearinghouse.org/detail.cfm?facid=153	$	Medium/ High
B-20	Re-time signals between Central Street and West Market Street for coordination of traffic flow.	$	Low
	Medium Term		
B-7	Consider upgrading the signal heads to 12" LED. **CMF** 1430 & 1434=0.93 for all crashes and all severity, Improve visibility of signal heads; http://www.cmfclearinghouse.org/study_detail.cfm?stid=83; **CMF** 1411=0.69 for all crash type and severity, Add additional signal and upgrade to 12-inch lenses http://www.cmfclearinghouse.org/detail.cfm?facid=1411	$	Medium
B-9	Review the current change and clearance intervals – and if applicable, increase to meet current standards. **CMF** 4211= 0.798 for all crashes and all severity, Increase all red clearance interval http://www.cmfclearinghouse.org/detail.cfm?facid=4211	$	Medium
B-11	Install signage prior to curve at West Market Street to alert motorists to potential pedestrian presence	$$	Low/ Medium
B-13	Define and narrow the travel Bergen Street SB lane, possibly by extending the bike lane that currently ends on 1st Street just north of West Market Street **PSC**: Road Diet; **CMF** 4656=0.944 for all crashes and all severity, Install bike lanes http://www.cmfclearinghouse.org/detail.cfm?facid=4656	$$	High
B-14	A lane drop marking to caution drivers that a lane drop is occurring further down the road.	$$	Low/ Medium
B-15	Add "Do Not Block the Box" sign at intersection and provide enforcement	$	Low

B-16	Consult access agreement and consider installing a "No Left Turn" sign at the McDonald's entrance on West Market Street and in possibly in the long run, construct a concrete median there if motorists ignore the signage **CMF** 391=0.32 for all crash type and severity, Prohibit left-turns with "No Left Turn" sign http://www.cmfclearinghouse.org/detail.cfm?facid=391	$	Medium
Long Term			
B-22	Road Diet on Bergen NB before McDonalds	$$	High
B-23	Head to head left turns at West Market Street offer a protected movement that may reduce shadow issues **CMF** 4576=0.01 for left turn and all severity crashes, Change left-turn phase to protected phasing on one or more approaches http://www.cmfclearinghouse.org/detail.cfm?facid=4576	$$$	High

Concerns Addressed:	
7	Non-compliant pedestrian push buttons
9	Queuing during periods of heavy traffic
10	Mismatched lanes through intersections
12	Blocked intersection box
15	Illegal parking near intersections
16	Vehicles leaving driveways causing shadow crashes
17	Left turn is not protected
18	Yellow and red times not sufficient
19	Abandoned utilities
23	Sign clutter or lack of signage
25	Sun glare

ATTACHMENT J

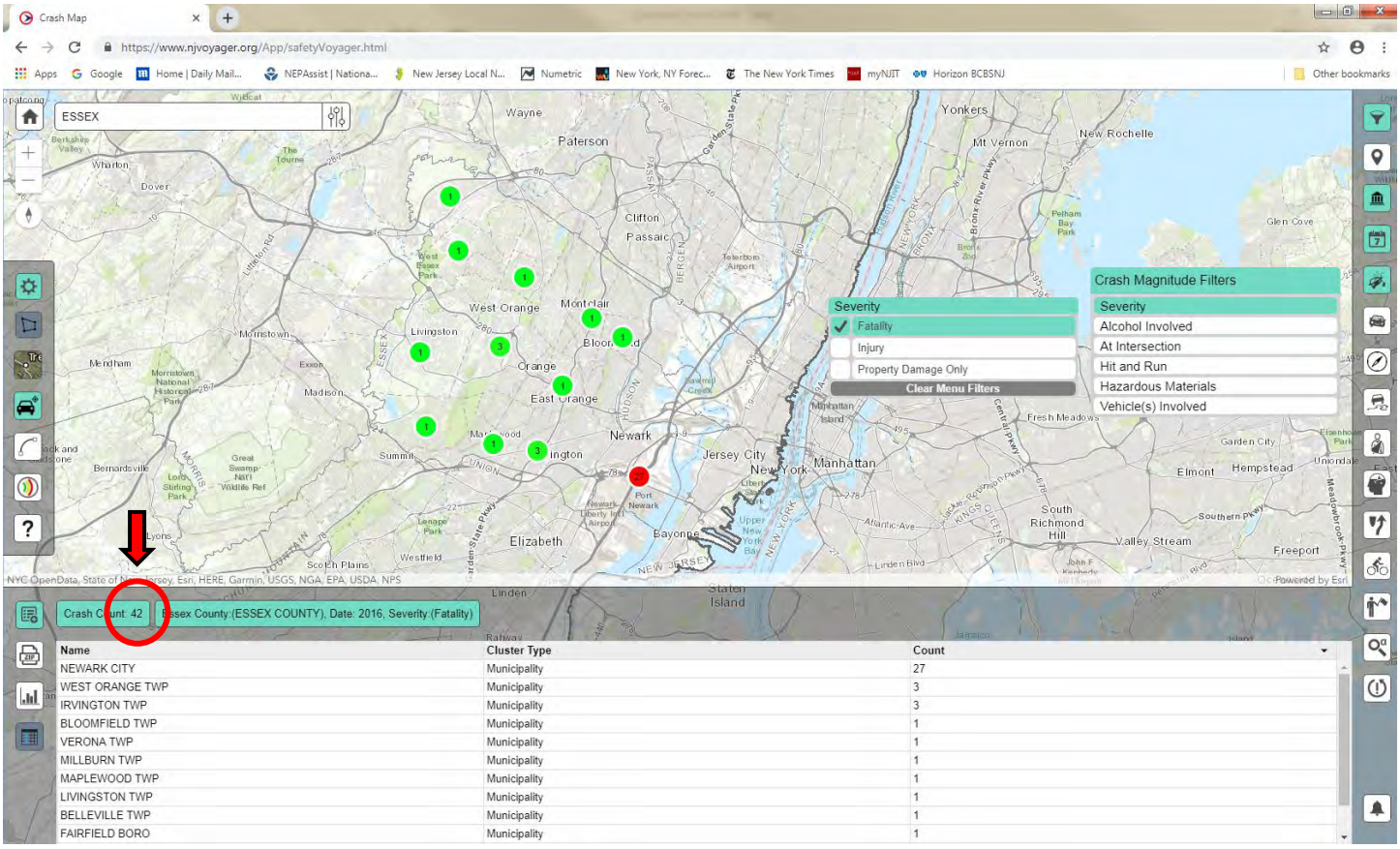
SAFETY VOYAGER METHODOLOGY

The Safety Voyager Crash Mapping module only include crashes that could be coded to a county, municipality or SRI. All crashes that could not be geocoded and mapped statewide can be found on the Voyager website under Updates and Tutorials: Unmatched Crash Data Records or by running a query by county, exporting to Excel and sorting by municipality.
For example:

- A query for Mercer County, Ewing township shows 20 crashes on the map. However, the export file contains 25 crashes
- Result -> There are 20 crashes that can be geocoded to a specific geographical location. There are five crashes that can be coded only to Mercer county and Ewing township.

The data set was recently refreshed by NJDOT (5/3/19), so queries should be refreshed to check for additional crashes. The following is the methodology I use to view all crashes (mapped and unmapped) in tabular form.

Query 1: Essex – 2016 - Fatalities



Query:

Essex

2016

Severity: Fatality

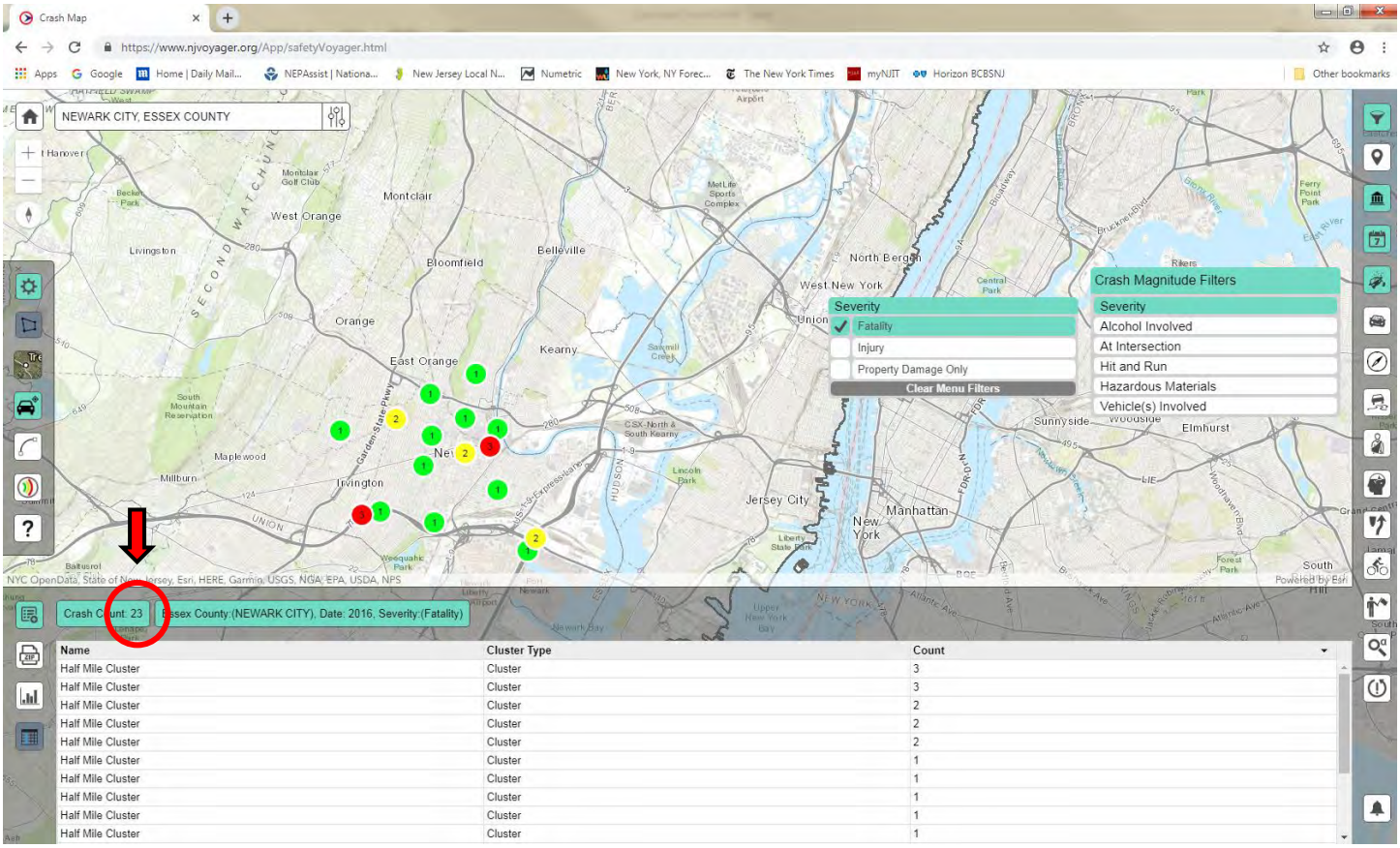
Results:

42 Total Crashes which **includes** pedestrians and pedcyclist identified crash types, **and** unmapped crashes grouped into municipal counts

Next Steps:

1. Export this data to Excel and pull together the relevant columns
2. Sort by Municipality
3. Identify crashes that have not been mapped (see Table 1)

Query 2: Newark – 2016 - Fatalities



Query:

Newark

2016

Severity: Fatality

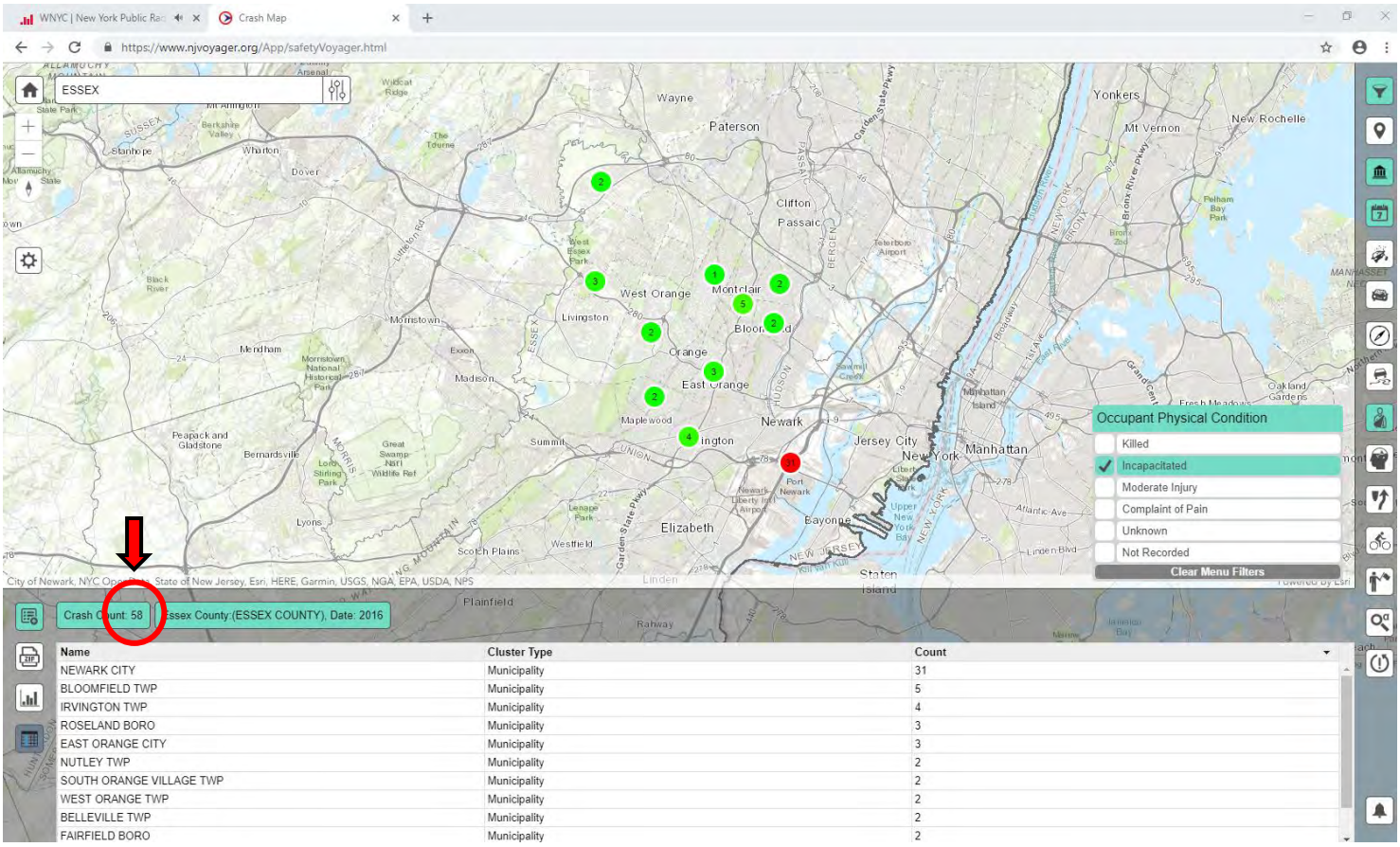
Results:

23 crashes mapped, but exported data includes **all** 27 crashes

To obtain a comprehensive list:

1. Export the data to Excel and pull together the relevant columns
2. Identify crashes that have not been mapped (see Table 2)

Query 3: Essex – 2016 - Incapacitated Injuries



Name	Cluster Type	Count
NEWARK CITY	Municipality	31
BLOOMFIELD TWP	Municipality	5
IRVINGTON TWP	Municipality	4
ROSELAND BORO	Municipality	3
EAST ORANGE CITY	Municipality	3
NUTLEY TWP	Municipality	2
SOUTH ORANGE VILLAGE TWP	Municipality	2
WEST ORANGE TWP	Municipality	2
BELLEVILLE TWP	Municipality	2
FAIRFIELD BORO	Municipality	2

Query:

Essex

2016

Occupant Physical Condition: Incapacitated Injury

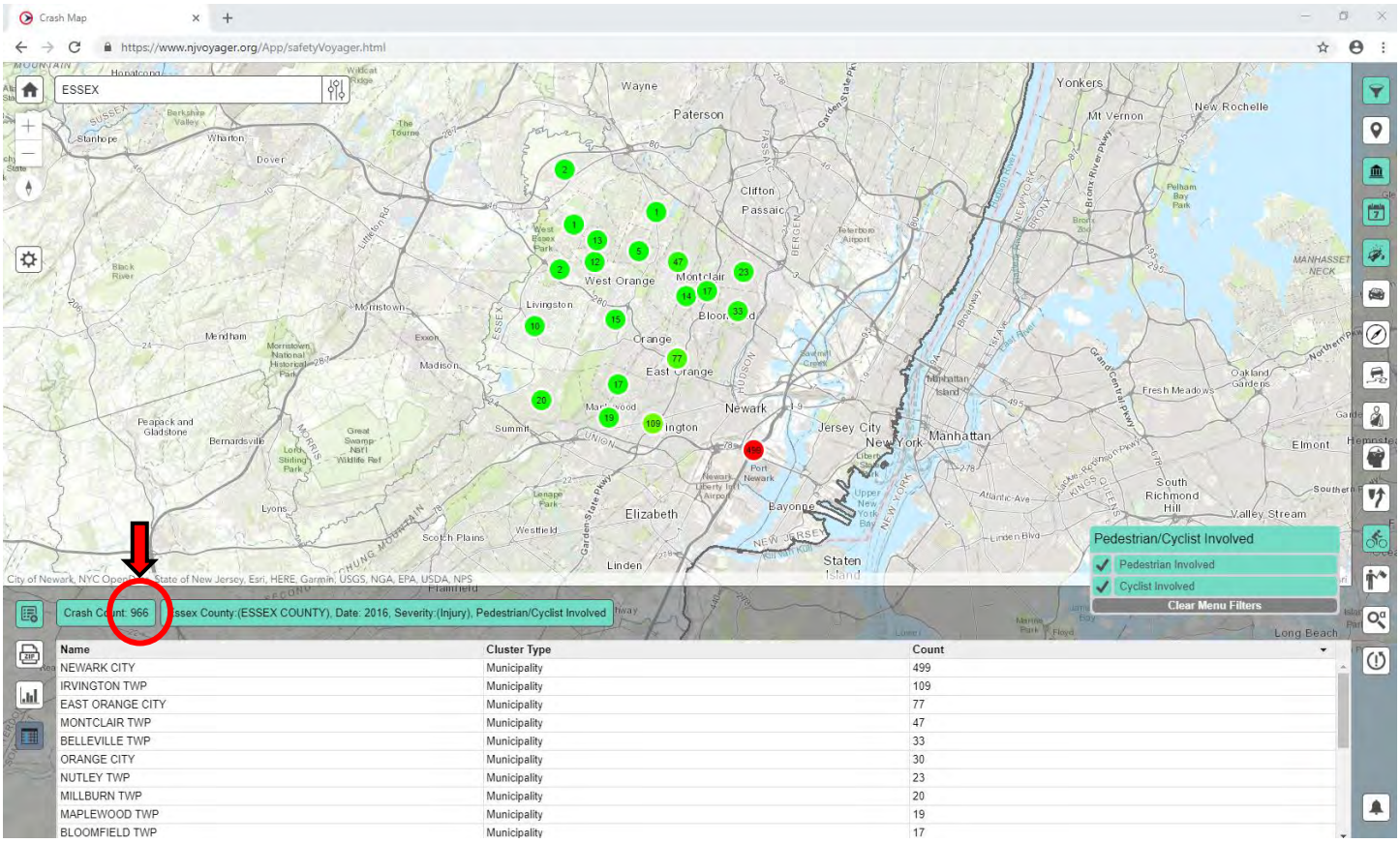
Results:

58 crashes which **does not** include pedestrians and pedcyclist identified crash types, but **does** include unmapped crashes grouped into municipal counts

Next Steps:

1. Export this data to Excel and pull together the relevant columns
2. Sort by Municipality
3. Identify crashes that have not been mapped
4. Run a 2nd query for Pedestrian and Cyclist involved crashes with injuries (Query 4)

Query 4: Essex – 2016 – Severity - Injuries, Pedestrian Involved, Cyclist Involved



Name	Cluster Type	Count
NEWARK CITY	Municipality	499
IRVINGTON TWP	Municipality	109
EAST ORANGE CITY	Municipality	77
MONTCLAIR TWP	Municipality	47
BELLEVILLE TWP	Municipality	33
ORANGE CITY	Municipality	30
NUTLEY TWP	Municipality	23
MILLBURN TWP	Municipality	20
MAPLEWOOD TWP	Municipality	19
BLOOMFIELD TWP	Municipality	17

Query:

Essex

2016

Severity: Injury

Pedestrian Involved and Cyclist Involved

Results:

966 Total Crashes including unmapped crashes grouped into municipal counts

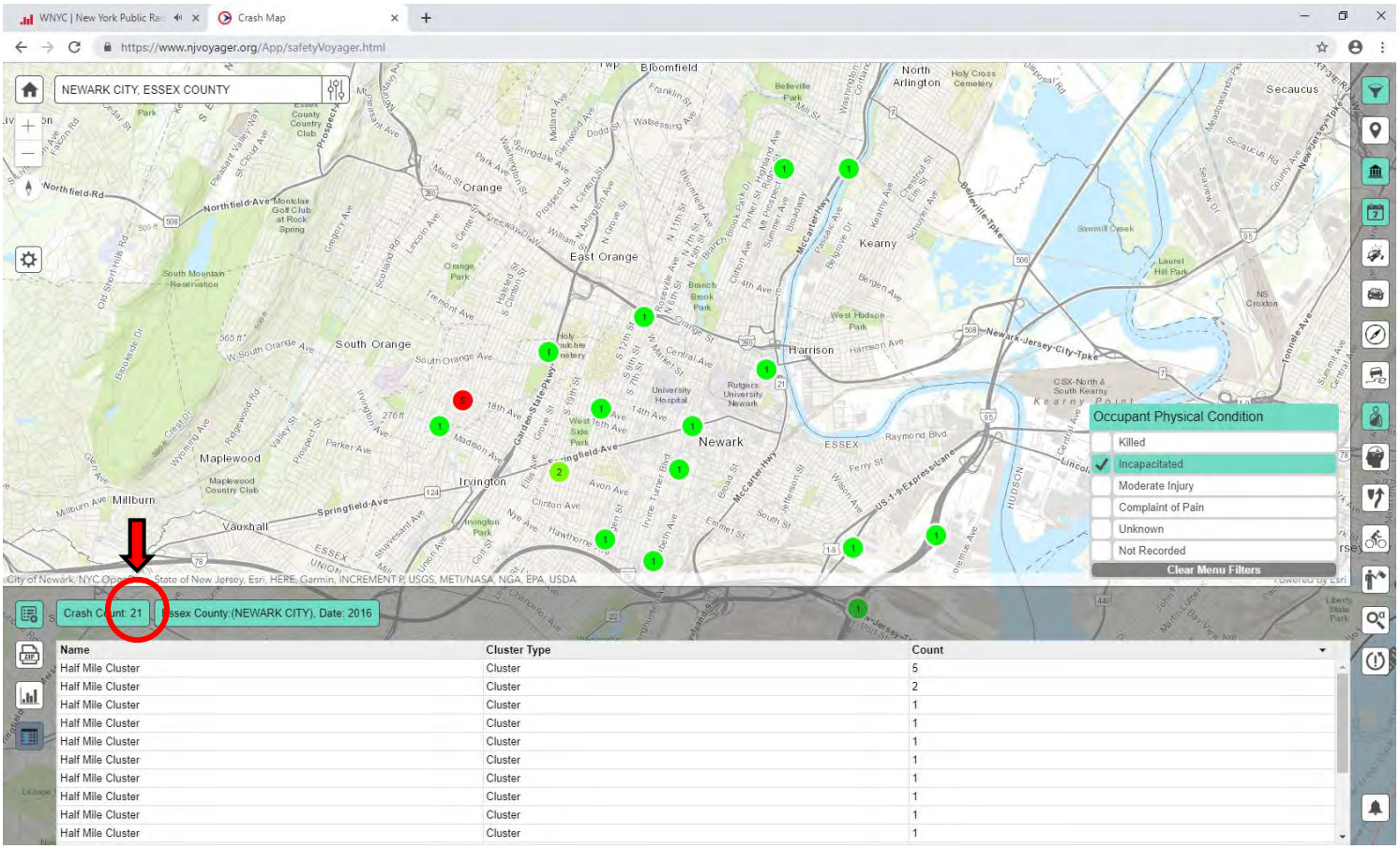
Next Steps:

1. Export this data to Excel and pull together the relevant columns (selecting the same columns as query 3)
2. Sort by severity rating code and isolate incapacitating injuries
3. Identify crashes that have not been mapped
4. Combine with query 3 data for the total incapacitated injuries (see Table 3)

Results:

84 Total crashes resulting in 93 total incapacitating injuries with 16 of the crashes unmapped.

Query 5: Newark – 2016 - Incapacitated Injuries



Query:

Newark

2016

Occupant Physical Condition: Incapacitated Injury

Results:

21 Total Crashes which **excludes** unmapped crashes **and** pedestrian and cyclist involved crashes

To obtain a comprehensive list:

1. Run the query for Essex County for incapacitating injuries (it will include unmapped crashes)
2. Export the data to Excel and sort by municipality
3. Delete non-Newark crashes
4. Run a second query for pedestrian involved and cyclist involved crashes with severity: injury
5. Export the data of excel, sort by severity rating code and isolate incapacitating injuries
6. Combine the data from the two queries, select relevant columns and identify crashes that have not been mapped (see Table 4)

Results:

45 Total crashes resulting in 52 total incapacitating injuries with 12 of the crashes unmapped.

TABLE 1 - SAFETY VOYAGER EXPORT DATA: ESSEX - 2016 - FATALITIES

		Case Number	Year	County	Municipality	Occurrence Date	Severity	Severity Rating Code	Occupant Physical Condition: Killed (Count)	Pedestrian Physical Condition: Killed (Count)	Total Killed	Pedestrians Killed	Pedestrian Involved	Cyclist Involved	Hit and Run Accident	Crash Type	Standard Route Identifier	Milepost Number	Location Text	Cross Street Intersection	Cross Street Name	Distance to Cross Street	Cross Street Direction	Alcohol Involved	Latitude	Longitude
1		I-2016-015994	2016	ESSEX	BELLEVILLE TWP	5/27/2016	Fatality	Killed	1		1	0				Opposite Direction (Head On	00000506__	9.53	ROUTE 506	Yes	COTTAGE ST			No	40.791818	-74.168489
2		16-38757	2016	ESSEX	BLOOMFIELD TWP	6/2/2016	Fatality	Killed	1		1	0				Right Angle	00000509__	19.80	ROUTE 509	Yes	CR 643 / ALEXANDER AVE			No	40.846043	-74.182631
3		16-25464	2016	ESSEX	FAIRFIELD BORO	9/2/2016	Fatality	Killed	1		1	0				Left Turn/U Turn	07000613__	5.68	ESSEX COUNTY 613	Yes	CR 615 / LITTLE FALLS RD			No	40.888635	-74.273368
4		I-2016-019681	2016	ESSEX	IRVINGTON TWP	2/26/2016	Fatality	Killed		1	1	1	2			Pedestrian	07000603__	1.39	ESSEX COUNTY 603	Yes	BRUEN AVE			No	40.72758072	-74.22339638
5		E040-2016-03281A	2016	ESSEX	IRVINGTON TWP	8/18/2016	Fatality	Killed	1		1	0				Overturned	00000444__	144.80	GARDEN STATE PARKWAY	No				No	40.727579	-74.225319
6		I-2016-117242	2016	ESSEX	IRVINGTON TWP	12/16/2016	Fatality	Killed	1		1	0				Opposite Direction (Head On	07000603__	1.74	ESSEX COUNTY 603	No				No	40.729040	-74.216945
7		B060-2016-04089A	2016	ESSEX	LIVINGSTON TWP	12/10/2016	Fatality	Killed	1	1	2	1	1			Pedestrian	00000280__	6.50	I-280	No				No	40.80396583	-74.28339346
8		16-20305	2016	ESSEX	MAPLEWOOD TWP	5/30/2016	Fatality	Killed		1	1	1	1		1	Pedestrian	00000577__	2.52	ROUTE 577	Yes	HICKORY DR		North	No	40.73568558	-74.28543725
9		B130-2016-01413A	2016	ESSEX	MILLBURN TWP	5/3/2016	Fatality	Killed	1		1	0				Fixed Object	00000024__	7.80	NJ 24	No				No	40.734913	-74.356965
10	1	16-000418	2016	ESSEX	NEWARK CITY	1/2/2016	Fatality	Killed		1	1	1	1			Pedestrian	07141895__	2.71	BERGEN ST	No	CR 510	250	East	No	40.7396941	-74.1927912
11	2	P16002564	2016	ESSEX	NEWARK CITY	1/3/2016	Fatality	Killed		1	1	1	2			Pedestrian	00000506S_	3.50	ROUTE 506 SPUR	Yes	MT PROSPECT AVE			No	40.75854105	-74.17518901
12	3	D030-2016-00154A	2016	ESSEX	NEWARK CITY	1/20/2016	Fatality	Killed	1		1	0				Fixed Object	00000095__	59.55	I-95, N.J. TURNPIKE	No				No	40.707195	-74.150761
13	4	B130-2016-00439A	2016	ESSEX	NEWARK CITY	2/6/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000078__	55.10	I-78	No				No	40.71584165	-74.21884464
14	5	D030-2016-00742A	2016	ESSEX	NEWARK CITY	3/28/2016	Fatality	Killed	1		1	0				Struck Parked Vehicle	00000095__	59.65	I-95, N.J. TURNPIKE	No				No	40.708480	-74.149847
15	6	P16089967	2016	ESSEX	NEWARK CITY	4/7/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000021__	2.73	NJ 21	Yes	RECTOR ST			No	40.741604	-74.165790
16	7	P16091278	2016	ESSEX	NEWARK CITY	4/9/2016	Fatality	Killed		1	1	1	1		1	Pedestrian			MARKET ST	Yes	MULBERRY ST			No	40.734800	-74.169290
17	8	P16095242	2016	ESSEX	NEWARK CITY	4/13/2016	Fatality	Killed		1	1	1	1			Pedestrian			JEFFERSON ST	Yes	MALVERN ST			No	40.722500	-74.165700
18	9	P16116615	2016	ESSEX	NEWARK CITY	5/3/2016	Fatality	Killed		1	1	1	1			Other			CHESTNUT ST	No				No		
19	10	I-2016-016936	2016	ESSEX	NEWARK CITY	5/19/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000508__	10.67	ROUTE 508	Yes	LOCK ST			No	40.744686	-74.179684
20	11	P16142490	2016	ESSEX	NEWARK CITY	5/27/2016	Fatality	Killed		1	1	1	1			Pedestrian	07000619__	2.49	ESSEX COUNTY 619	No	LINDSLEY AVE	75	South	No	40.740736	-74.230671
21	12	16-26663	2016	ESSEX	NEWARK CITY	5/28/2016	Fatality	Killed	1		1	0				Other	00000509__	11.73	ROUTE 509	Yes	GRAIN ST			No	40.746316	-74.209279
22	13	ECPOVH#18-2016	2016	ESSEX	NEWARK CITY	6/11/2016	Fatality	Killed	1		1	0				Other			LINCOLN AVENUE	No				No		
23	14	P16162679	2016	ESSEX	NEWARK CITY	6/15/2016	Fatality	Killed	1		1	0				Opposite Direction (Head On	00000027__		NJ 27	No				No		
24	15	B060-2016-02443A	2016	ESSEX	NEWARK CITY	8/6/2016	Fatality	Killed	1		1	0				Same Direction - Rear End	00000280__	13.00	I-280	No				No	40.752807	-74.193815
25	16	D030-2016-02427A	2016	ESSEX	NEWARK CITY	8/9/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000095__	59.25	I-95, N.J. TURNPIKE	No				No	40.703217	-74.153081
26	17	P1622944316-41788	2016	ESSEX	NEWARK CITY	8/16/2016	Fatality	Killed	1		1	0			1	Same Direction - Rear End			BRAGAW AVE	Yes	WILLOUGHBY ST			No	40.715660	-74.214420
27	18	C16042427	2016	ESSEX	NEWARK CITY	8/19/2016	Fatality	Killed			1	1	2			Struck Parked Vehicle			UNIVERSITY AVENUE	No	COURT STREET		South	No	40.732140	-74.178570
28	19	P1623303216-42430	2016	ESSEX	NEWARK CITY	8/19/2016	Fatality	Killed	2		2	0				Opposite Direction (Sideswipe)	07141867__	0.61	RAYMOND BLVD	No	BROAD STREET		North	No	40.737491	-74.171050
29	20	P16240927	2016	ESSEX	NEWARK CITY	8/27/2016	Fatality	Killed		1	1	1	1			Same Direction - Rear End			BROADWAY	No				No		
30	21	P16248152	2016	ESSEX	NEWARK CITY	9/3/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000021__	2.33	NJ 21	Yes	RAYMOND BLVD		South	No	40.735950	-74.165843
31	22	P1625844516-46457	2016	ESSEX	NEWARK CITY	9/12/2016	Fatality	Killed		1	1	0		1		Pedalcyclist	00000510__	28.80	ROUTE 510	Yes	CR 603 / SPRINGFIELD AVE			No	40.736167	-74.180581
32	23	P1626734316-48068	2016	ESSEX	NEWARK CITY	9/21/2016	Fatality	Killed	1		1	0				Fixed Object	00000510__	27.34	ROUTE 510	Yes	S 17TH ST			No	40.742661	-74.206596
33	24	P19310193	2016	ESSEX	NEWARK CITY	11/1/2016	Fatality	Killed		1	1	1	1		1	Pedestrian	07141885__	2.14	18TH AVE	Yes	BERGEN STREET			No	40.730233	-74.196539
34	25	P16317364	2016	ESSEX	NEWARK CITY	11/8/2016	Fatality	Killed	1		1	0			1	Fixed Object			FABYAN PL	No	LYONS AVE		South	No	40.714640	-74.223180
35	26	C16062997	2016	ESSEX	NEWARK CITY	12/18/2016	Fatality	Killed	1		1	0				Fixed Object			SHERMAN AVENUE	Yes	EAST PEDDLE STREET		South	No	40.712460	-74.191480
36	27	P16369549	2016	ESSEX	NEWARK CITY	12/27/2016	Fatality	Killed		1	1	1	1			Pedestrian			FABYAN PL	No	LYONS AVE			No	40.714640	-74.223180
37		I-2016-038190	2016	ESSEX	ORANGE CITY	11/12/2016	Fatality	Killed	3		3	0				Fixed Object	07221877__	0.84	TREMONT AVE	Yes	MOSSWOOD AVE		West	No	40.75682313	-74.24035501
38		16009183	2016	ESSEX	VERONA TWP	6/24/2016	Fatality	Killed		1	1	1	1		1	Pedestrian	00000506__	4.87	ROUTE 506	Yes	HILLCREST TER			No	40.827092	-74.236866
39		I-2016-010415	2016	ESSEX	WEST CALDWELL TWP	7/1/2016	Fatality	Killed	1		1	0				Same Direction - Rear End	07000613__	3.54	ESSEX COUNTY 613	No	FAIRFIELD AVE	400	South	No	40.86104035	-74.28613133
40		16020450	2016	ESSEX	WEST ORANGE TWP	5/26/2016	Fatality	Killed		1	1	1	1			Pedestrian			HARRISON AVE	Yes	MISSISSIPPI AVE			No	40.793480	-74.232780
41		16045138	2016	ESSEX	WEST ORANGE TWP	11/16/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000010__	21.87	NJ 10	Yes	KELLEY DR / MERKLIN AVE			No	40.79319029	-74.28351823
42		B060-2016-04374A	2016	ESSEX	WEST ORANGE TWP	12/31/2016	Fatality	Killed	1		1	0					00000280__	8.50	I-280	No				No	40.794970	-74.249240
								TOTAL	**24**	**22**	**46**	**21**	**24**	**1**	**6**										
														Hit and Run Crashes	**14%**										

# of crashes Not Mapped and cannot locate	**4**	**10%**
# of crashes Not Mapped and can be approximately located by cross street information	**0**	
Total # of crashes not mapped	**4**	
Alchohol Involved Crashes	**0**	

Summary	
Occupant Physical Condition: Fatality	24
Pedestrian Physical Condition: Fatality	21
Pedcyclist Involved: Fatality	1
Total	**46**
Total Severity: Fatality Crashes	**42**

Comparison NJDOT CRU Statistics	
Occupant Physical Condition: Fatality	23
Pedestrian Physical Condition: Fatality	22
Pedcyclist Involved: Fatality	1
Total	**46**
Total Severity: Fatality Crashes	**42**

TABLE 2 - SAFETY VOYAGER EXPORT DATA: NEWARK - 2016 - FATALITIES

	Case Number	Year	County	Municipality	Occurrence Date	Severity	Severity Rating Code	Occupant Physical Condition: Killed (Count)	Pedestrian Physical Condition: Killed (Count)	Total	Killed	Pedestrians Killed	Pedestrian Involved	Cyclist Involved	Hit and Run Accident	Crash Type	Standard Route Identifier	Milepost Number	Location Text	Cross Street Intersection	Cross Street Name	Distance to Cross Street	Cross Street Direction	Alcohol Involved	Latitude	Longitude
1	16-000418	2016	ESSEX	NEWARK CITY	1/2/2016	Fatality	Killed		1	1	1	1			Pedestrian	07141895__	2.71	BERGEN ST	No	CR 510	250	East	No	40.7396941	-74.1927912
2	P16002564	2016	ESSEX	NEWARK CITY	1/3/2016	Fatality	Killed		1	1	1	2			Pedestrian	00000506S_	3.50	ROUTE 506 SPUR	Yes	MT PROSPECT AVE			No	40.75854105	-74.17518901
3	D030-2016-00154A	2016	ESSEX	NEWARK CITY	1/20/2016	Fatality	Killed	1		1	0				Fixed Object	00000095__	59.55	I-95, N.J. TURNPIKE	No				No	40.707195	-74.150761
4	B130-2016-00439A	2016	ESSEX	NEWARK CITY	2/6/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000078__	55.10	I-78	No				No	40.71584165	-74.21884464
5	D030-2016-00742A	2016	ESSEX	NEWARK CITY	3/28/2016	Fatality	Killed	1		1	0				Struck Parked Vehicle	00000095__	59.65	I-95, N.J. TURNPIKE	No				No	40.708480	-74.149847
6	P16089967	2016	ESSEX	NEWARK CITY	4/7/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000021__	2.73	NJ 21	Yes	RECTOR ST			No	40.741604	-74.165790
7	P16091278	2016	ESSEX	NEWARK CITY	4/9/2016	Fatality	Killed		1	1	1	1		1	Pedestrian			MARKET ST	Yes	MULBERRY ST			No	40.734800	-74.169290
8	P16095242	2016	ESSEX	NEWARK CITY	4/13/2016	Fatality	Killed		1	1	1	1			Pedestrian			JEFFERSON ST	Yes	MALVERN ST			No	40.722500	-74.165700
9	P16116615	2016	ESSEX	NEWARK CITY	5/3/2016	Fatality	Killed		1	1	1	1			Other			CHESTNUT ST	No				No		
10	I-2016-016936	2016	ESSEX	NEWARK CITY	5/19/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000508__	10.67	ROUTE 508	Yes	LOCK ST			No	40.744686	-74.179684
11	P16142490	2016	ESSEX	NEWARK CITY	5/27/2016	Fatality	Killed		1	1	1	1			Pedestrian	07000619__	2.49	ESSEX COUNTY 619	No	LINDSLEY AVE	75	South	No	40.740736	-74.230671
12	16-26663	2016	ESSEX	NEWARK CITY	5/28/2016	Fatality	Killed	1		1	0				Other	00000509__	11.73	ROUTE 509	Yes	GRAIN ST			No	40.746316	-74.209279
13	ECPOVH#18-2016	2016	ESSEX	NEWARK CITY	6/11/2016	Fatality	Killed	1		1	0				Other			LINCOLN AVENUE	No				No		
14	P16162679	2016	ESSEX	NEWARK CITY	6/15/2016	Fatality	Killed	1		1	0				Opposite Direction (Head On	00000027__		NJ 27	No				No		
15	B060-2016-02443A	2016	ESSEX	NEWARK CITY	8/6/2016	Fatality	Killed	1		1	0				Same Direction - Rear End	00000280__	13.00	I-280	No				No	40.752807	-74.193815
16	D030-2016-02427A	2016	ESSEX	NEWARK CITY	8/9/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000095__	59.25	I-95, N.J. TURNPIKE	No				No	40.703217	-74.153081
17	P1622944316-41788	2016	ESSEX	NEWARK CITY	8/16/2016	Fatality	Killed	1		1	0			1	Same Direction - Rear End			BRAGAW AVE	Yes	WILLOUGHBY ST			No	40.715660	-74.214420
18	C16042427	2016	ESSEX	NEWARK CITY	8/19/2016	Fatality	Killed		1	1	1	2			Struck Parked Vehicle			UNIVERSITY AVENUE	No	COURT STREET		South	No	40.732140	-74.178570
19	P1623303216-42430	2016	ESSEX	NEWARK CITY	8/19/2016	Fatality	Killed	2		2	0				Opposite Direction (Sideswipe)	07141867__	0.61	RAYMOND BLVD	No	BROAD STREET		North	No	40.737491	-74.171050
20	P16240927	2016	ESSEX	NEWARK CITY	8/27/2016	Fatality	Killed		1	1	1	1			Same Direction - Rear End			BROADWAY	No				No		
21	P16248152	2016	ESSEX	NEWARK CITY	9/3/2016	Fatality	Killed		1	1	1	1			Pedestrian	00000021__	2.33	NJ 21	Yes	RAYMOND BLVD		South	No	40.735950	-74.165843
22	P1625844516-46457	2016	ESSEX	NEWARK CITY	9/12/2016	Fatality	Killed		1	1	0		1		Pedalcyclist	00000510__	28.80	ROUTE 510	Yes	CR 603 / SPRINGFIELD AVE			No	40.736167	-74.180581
23	P1626734316-48068	2016	ESSEX	NEWARK CITY	9/21/2016	Fatality	Killed	1		1	0				Fixed Object	00000510__	27.34	ROUTE 510	Yes	S 17TH ST			No	40.742661	-74.206596
24	P19310193	2016	ESSEX	NEWARK CITY	11/1/2016	Fatality	Killed		1	1	1	1			Pedestrian	07141885__	2.14	18TH AVE	Yes	BERGEN STREET			No	40.730233	-74.196539
25	P16317364	2016	ESSEX	NEWARK CITY	11/8/2016	Fatality	Killed	1		1	0			1	Fixed Object			FABYAN PL	No	LYONS AVE		South	No	40.714640	-74.223180
26	C16062997	2016	ESSEX	NEWARK CITY	12/18/2016	Fatality	Killed	1		1	0				Fixed Object			SHERMAN AVENUE	Yes	EAST PEDDLE STREET		South	No	40.712460	-74.191480
27	P16369549	2016	ESSEX	NEWARK CITY	12/27/2016	Fatality	Killed		1	1	1	1			Pedestrian			FABYAN PL	No	LYONS AVE			No	40.714640	-74.223180
							TOTAL	**12**	**16**	**28**	**15**	**17**	**1**	**4**											
													Hit and Run Crashes	**15%**											

Summary	
Occupant Physical Condition: Fatality	12
Pedestrian Physical Condition: Fatality	15
Pedcyclist Involved: Fatality	1
Total	**28**
Total Severity: Fatality Crashes	**28**

# of crashes Not Mapped and cannot locate	**4**	**15%**
# of crashes Not Mapped and can be approximately located by cross street information	**0**	
Total # of crashes not mapped	**4**	
Alchohol Involved Crashes	**0**	

TABLE 3 - SAFETY VOYAGER EXPORT DATA: ESSEX - 2016 - INCAPACITATED INJURIES (COMBINED QUERIES)

		Case Number	Year	County	Municipality	Occurrence Date	Severity	Severity Rating Code	Occupant Physical Condition: Incapacitated (Count)	Pedestrian Physical Condition: Incapacitated (Count)	Total Injured	Pedestrians Injured	Pedestrian Involved	Cyclist Involved	Hit and Run Accident	Crash Type	Standard Route Identifier	Milepost Number	Location Text	Cross Street Intersection	Cross Street Name	Distance to Cross Street	Cross Street Direction	Alcohol Involved	Latitude	Longitude
1	1	I-2016-000026	2016	ESSEX	BELLEVILLE TWP	1/1/2016	Injury	Incapacitated	1		1	0				Fixed Object			MAIN ST	No				Yes	0.000000	0.000000
2	2	I-2016-015994	2016	ESSEX	BELLEVILLE TWP	5/27/2016	Fatality	Killed	1		2	0				Opposite Direction (Head On	00000506__	9.53	ROUTE 506	Yes	COTTAGE ST			No	40.791818	-74.168489
3	3	16-13629	2016	ESSEX	BLOOMFIELD TWP	2/25/2016	Injury	Incapacitated	1		1	0				Struck Parked Vehicle			SPRUCE STREET	No	LIBERTY STREET	50	South	Yes	40.795280	-74.192790
4	4	16-25649	2016	ESSEX	BLOOMFIELD TWP	4/12/2016	Injury	Incapacitated	1		1	0				Opposite Direction (Head On	00000506S_	1.89	ROUTE 506 SPUR	No	ROUTE 509 / GROVE ST	50	West	No	40.779346	-74.189402
5	5	16-47909	2016	ESSEX	BLOOMFIELD TWP	7/12/2016	Injury	Incapacitated	1		1	0				Same Direction - Rear End	00000506S_	1.99	ROUTE 506 SPUR	Yes	AMPERE PKWY			No	40.778003	-74.188478
6	6	E040-2016-03895A	2016	ESSEX	BLOOMFIELD TWP	9/27/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000444__	149.00	GARDEN STATE PARKWAY	No				No	40.784524	-74.200697
7	7	16-65379	2016	ESSEX	BLOOMFIELD TWP	10/4/2016	Injury	Incapacitated	1		1	0				Fixed Object		0.29	BAY AVENUE	Yes	HOOVER AVENUE			Yes	40.810620	-74.189250
8	8	16-5338	2016	ESSEX	EAST ORANGE CITY	4/20/2016	Injury	Incapacitated	1		3	0				Right Angle			FREEWAY DR	No	S. CLINTON ST	2	South	No	40.763460	-74.215840
9	9	E040-2016-01368A	2016	ESSEX	EAST ORANGE CITY	4/22/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000444__	147.50	GARDEN STATE PARKWAY	No				No	40.763850	-74.205629
10	10	16-10344	2016	ESSEX	EAST ORANGE CITY	7/16/2016	Injury	Incapacitated	1		1	0				Opposite Direction (Sideswipe)			GLENWOOD AVE	Yes	EDGEWOOD ROAD			No	40.778030	-74.212210
11	11	B060-2016-03582A	2016	ESSEX	FAIRFIELD BORO	11/3/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000080__	51.40	I-80	No				Yes	40.893529	-74.294102
12	12	16-32932	2016	ESSEX	FAIRFIELD BORO	11/10/2016	Injury	Incapacitated	1		1	0				Fixed Object	07000628__	0.14	ESSEX COUNTY 628	No	CR 613 / PASSAIC AVE	720	East	Yes	40.872440	-74.275407
13	13	I-2016-024643	2016	ESSEX	IRVINGTON TWP	3/11/2016	Injury	Incapacitated	1		1	0				Fixed Object			LINDEN AVENUE	No				Yes		
14	14	I-2016-035964	2016	ESSEX	IRVINGTON TWP	4/16/2016	Injury	Incapacitated	1		1	0				Same Direction - Sideswipe	07000603__		ESSEX COUNTY 603	No				No		
15	15	I-2016-051658	2016	ESSEX	IRVINGTON TWP	6/3/2016	Injury	Incapacitated	1		1	0				Struck Parked Vehicle	07000665__		ESSEX COUNTY 665	No				No		
16	16	I-2016-109275	2016	ESSEX	IRVINGTON TWP	11/21/2016	Injury	Incapacitated	1		1	0				Same Direction - Rear End	07000601__		ESSEX COUNTY 601	No				Yes		
17	17	16RED1024	2016	ESSEX	MONTCLAIR TWP	9/27/2016	Injury	Incapacitated	1		1	0				Fixed Object	07000623__	0.61	ESSEX COUNTY 623	Yes	CAMBRIDGE RD			No	40.817144	-74.205880
18	18	C-2016-000014	2016	ESSEX	NEWARK CITY	1/2/2016	Injury	Incapacitated	1		1	0			1	Fixed Object			BRANCH BROOK DRIVE EAST	No	ELWOOD AVE	40		No		
19	19	P16006660	2016	ESSEX	NEWARK CITY	1/7/2016	Injury	Incapacitated	2		4	0			2	Same Direction - Rear End	07141891__		ELIZABETH AVE	No				No		
20	20	P16009867/CC#16-17?	2016	ESSEX	NEWARK CITY	1/11/2016	Injury	Incapacitated	2		3	0				Right Angle	07000605__	1.18	ESSEX COUNTY 605	Yes	18TH AVE			No	40.740641	-74.234267
21	21	P16009867	2016	ESSEX	NEWARK CITY	1/11/2016	Injury	Incapacitated	2		4	0				Right Angle	07000605__	1.18	ESSEX COUNTY 605	Yes	18TH AVE			No	40.740641	-74.234267
22	22	D030-2016-00154A	2016	ESSEX	NEWARK CITY	1/20/2016	Fatality	Killed	1		1	0				Fixed Object	00000095__	59.55	I-95, N.J. TURNPIKE	No				No	40.707195	-74.150761
23	23	P16032519	2016	ESSEX	NEWARK CITY	2/1/2016	Injury	Incapacitated	2		3	0				Same Direction - Rear End	00000001__	49.53	US 1	No	DELANCEY ST	100	South	No	40.716561	-74.151800
24	24	16-6246	2016	ESSEX	NEWARK CITY	2/6/2016	Injury	Incapacitated	2		3	0				Same Direction - Rear End	07141865__	1.98	BROAD ST	Yes	BRIDGE ST			Yes	40.744500	-74.169809
25	25	37845-16	2016	ESSEX	NEWARK CITY	2/9/2016	Injury	Incapacitated	1		1	0				Right Angle	07141885__	2.62	18TH AVE	Yes	BROOME ST			No	40.728355	-74.187766
26	26	P16044092	2016	ESSEX	NEWARK CITY	2/20/2016	Injury	Incapacitated	1		1	0				Struck Parked Vehicle			DELAVAN AVE	No				No		
27	27	16-8343	2016	ESSEX	NEWARK CITY	2/20/2016	Injury	Incapacitated	1		1	0			1	Struck Parked Vehicle	07141920__		N 6TH ST	No	DELAVAN ST		South	No		
28	28	P16051188	2016	ESSEX	NEWARK CITY	2/28/2016	Injury	Incapacitated	1		2	0				Right Angle			LENOX ST	No	MEAD STREET		West	No	40.738780	-74.233150
29	29	D030-2016-00519A	2016	ESSEX	NEWARK CITY	3/3/2016	Injury	Incapacitated	1		2	0				Opposite Direction (Head On	00000095__	60.75	I-95, N.J. TURNPIKE	No				Yes	40.718637	-74.134382
30	30	P16077807	2016	ESSEX	NEWARK CITY	3/24/2016	Injury	Incapacitated	1		1	0				Fixed Object			SEYMOUR AVE	No				No		
31	31	P1609183716974	2016	ESSEX	NEWARK CITY	4/9/2016	Injury	Incapacitated	1		2	0				Same Direction - Rear End			VALLEY ST	No	SUNSET AVE			No	40.737670	-74.229230
32	32	P1611567421387	2016	ESSEX	NEWARK CITY	5/2/2016	Injury	Incapacitated	1		2	0				Struck Parked Vehicle	07141926__		MOUNT PROSPECT AVE	No	HELLER PARK WAY			No	40.775500	-74.165830
33	33	P1612265922804	2016	ESSEX	NEWARK CITY	5/9/2016	Injury	Incapacitated	2		2	0				Same Direction - Sideswipe	00000001__		US 1	No			South	No		
34	34	P16136751	2016	ESSEX	NEWARK CITY	5/22/2016	Injury	Incapacitated	1		4	0				Same Direction - Sideswipe	07141891__		ELIZABETH AVE	No	CONCORD STREET		North	No	40.714390	-74.192590
35	35	P1614916027791	2016	ESSEX	NEWARK CITY	6/3/2016	Injury	Incapacitated	1		2	0				Fixed Object	00000021__	5.32	NJ 21	No				No	40.775527	-74.152712
36	36	C-2016-003081	2016	ESSEX	NEWARK CITY	6/20/2016	Injury	Incapacitated	1		1	0				Struck Parked Vehicle			N 5 TH ST	No	2ND AVE WEST	450	South	No		
37	37	P1617175816-31794	2016	ESSEX	NEWARK CITY	6/23/2016	Injury	Incapacitated	1		2	0				Same Direction - Rear End			MAYBAUM AVE	Yes	TREMONT AVENUE			Yes	40.747300	-74.214120
38	38	P1622339916-40777	2016	ESSEX	NEWARK CITY	8/10/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000001__		US 1	No				No		
39	39	P16227728	2016	ESSEX	NEWARK CITY	8/14/2016	Injury	Incapacitated	1		4	0				Left Turn/U Turn	07171203__	2.59	MAIN ST	Yes	GOULD AVE			No	40.752677	-74.194213
40	40	P1623045716-41970	2016	ESSEX	NEWARK CITY	8/16/2016	Injury	Incapacitated	1		1	0				Right Angle	07091883__	0.65	15TH AVE	Yes	S. 12TH STREET			No	40.737872	-74.203542
41	41	P1624595816-44520	2016	ESSEX	NEWARK CITY	9/1/2016	Injury	Incapacitated	1		3	0				Fixed Object	07000603__	3.49	ESSEX COUNTY 603	Yes	BROOME ST		West	No	40.735360	-74.184740
42	42	P1625353216-45672	2016	ESSEX	NEWARK CITY	9/8/2016	Injury	Incapacitated	1		1	0				Right Angle	07141885__	0.31	18TH AVE	Yes	SUNSET AVENUE			No	40.739059	-74.228681
43	43	P1626560016-47689	2016	ESSEX	NEWARK CITY	9/19/2016	Injury	Incapacitated	1		1	0				Fixed Object	07091882__	0.38	AVON AVE	Yes	SOUTH 14TH STREET			No	40.727475	-74.209503
44	44	P1632714816-58016	2016	ESSEX	NEWARK CITY	11/18/2016	Injury	Incapacitated	1		1	0				Overturned	00000001__		US 1	No			South	No		
45	45	P1633024216-58437	2016	ESSEX	NEWARK CITY	11/21/2016	Injury	Incapacitated	1		2	0				Same Direction - Rear End			CHADWICK AVE	No	WEST RUNYON ST	50	South	No	40.717600	-74.202880
46	46	P1633936216-59901	2016	ESSEX	NEWARK CITY	11/30/2016	Injury	Incapacitated	2		2	0				Fixed Object	00000021__		NJ 21	No	CHESTER AVE E		North	No		
47	47	P1635049416-61681	2016	ESSEX	NEWARK CITY	12/10/2016	Injury	Incapacitated	1		2	0				Left Turn/U Turn	07000605__	0.78	ESSEX COUNTY 605	Yes	MT VERNON PL			No	40.735338	-74.237166
48	48	P1636134816-63318	2016	ESSEX	NEWARK CITY	12/19/2016	Injury	Incapacitated	1		2	0				Right Angle	07000603__	1.87	ESSEX COUNTY 603	Yes	S 20TH ST			No	40.729584	-74.214530
49	49	16-43199	2016	ESSEX	NUTLEY TWP	9/10/2016	Injury	Incapacitated	1		3	0				Struck Parked Vehicle			HANCOX AVENUE	No	MORRIS PLACE	25	East	No	40.807420	-74.148140
50	50	16-44265	2016	ESSEX	NUTLEY TWP	9/17/2016	Injury	Incapacitated	1		2	0				Struck Parked Vehicle	07000645__	2.77	ESSEX COUNTY 645	Yes	WILLIAM ST			No	40.816117	-74.161758
51	51	B060-2016-01970A	2016	ESSEX	ORANGE CITY	6/26/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000280__	11.20	I-280	No				Yes	40.766418	-74.222871
52	52	B060-2016-03690A	2016	ESSEX	ROSELAND BORO	11/11/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000280__	5.30	I-280	No				No	40.810771	-74.303155
53	53	B060-2016-04090A	2016	ESSEX	ROSELAND BORO	12/10/2016	Injury	Incapacitated	2		2	0				Fixed Object	00000280__	5.70	I-280	No				No	40.810226	-74.295615
54	54	B060-2016-04295A	2016	ESSEX	ROSELAND BORO	12/21/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000280__	5.40	I-280	No				No	40.810498	-74.301302
55	55	I-2016-003721	2016	ESSEX	SOUTH ORANGE VILLAGE TWP	3/16/2016	Injury	Incapacitated	1		1	0				Fixed Object	07000665__	0.59	ESSEX COUNTY 665	No	EDER TER	75	West	No	40.738102	-74.251778
56	56	I-2016-016531	2016	ESSEX	SOUTH ORANGE VILLAGE TWP	10/10/2016	Injury	Incapacitated	1		1	0				Overturned	07000638__	2.65	ESSEX COUNTY 638	No	TURRELL AVE	20	North	No	40.750995	-74.254088
57	57	16037743	2016	ESSEX	WEST ORANGE TWP	9/23/2016	Injury	Incapacitated	1		1	0				Fixed Object	07221445__	0.22	VALLEY WAY	No	ALAN ST	10	North	No	40.797082	-74.234782
58	58	B060-2016-03609A	2016	ESSEX	WEST ORANGE TWP	11/5/2016	Injury	Incapacitated	2		2	0				Same Direction - Rear End	00000280__	8.20	I-280	No				Yes	40.797678	-74.253263
59	1	16-00931	2016	ESSEX	EAST ORANGE CITY	1/21/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000508__	7.95	ROUTE 508	No	S HARRISON ST	5	North	No	40.761991	-74.225305
60	2	16-017377	2016	ESSEX	EAST ORANGE CITY	11/19/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000509__	12.27	ROUTE 509	No	ROUTE 508 / CENTRAL AVE	700	North	No	40.753430	-74.204981
61	3	16-08339	2016	ESSEX	GLEN RIDGE BORO	3/21/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			HILLSIDE AVE	No	BLOOMFIELD AVENUE	8	North	No	40.799260	-74.201970
62	4	16-34412	2016	ESSEX	GLEN RIDGE BORO	11/15/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			HIGHLAND AVENUE	No	BAY STREET		North	No	0.000000	0.000000
63	5	CC16-1595	2016	ESSEX	IRVINGTON TWP	2/21/2016	Injury	Incapacitated		1	2	1	2			Pedestrian	07000619__	1.62	ESSEX COUNTY 619	Yes	CR 665 / CLINTON AVE		South	Yes	40.728927	-74.236062
65	6	I-2016-001182	2016	ESSEX	MILLBURN TWP	1/21/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000527__	71.24	ROUTE 527	Yes	ROUTE 527 / ROUTE 577 / ESSEX ST			No	40.724703	-74.307503
64	7	I-2016-018254	2016	ESSEX	MILLBURN TWP	9/30/2016	Injury	Incapacitated		1	1	1	2			Pedestrian	00000577__	1.03	ROUTE 577	Yes	LACKAWANNA PL			No	40.724409	-74.305115
66	8	16RED555	2016	ESSEX	MONTCLAIR TWP	5/24/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07000621__	1.68	ESSEX COUNTY 621	Yes	WILDWOOD AVE			No	40.836851	-74.206664
67	9	C16-8465	2016	ESSEX	NEWARK CITY	2/21/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141905__	0.52	WILSON AVE	Yes	ROME ST.			No	40.721808	-74.149617
68	10	P16071851	2016	ESSEX	NEWARK CITY	3/18/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141844__	1.92	FERRY ST	Yes	LOCKWOOD ST			No	40.733257	-74.131929
78	11	P16073743	2016	ESSEX	NEWARK CITY	3/20/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000510__		ROUTE 510	No	VERMONT AVENUE		East	No	40.745070	-74.220660
73	12	P16108361	2016	ESSEX	NEWARK CITY	4/25/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141865__		BROAD ST	No			South	No		
76	13	P16108361 6119975	2016	ESSEX	NEWARK CITY	4/25/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141865__		BROAD ST	No	MARKET ST		South	No	40.735580	-74.172130
77	14	P161083611619975	2016	ESSEX	NEWARK CITY	4/25/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141865__		BROAD ST	No			South	No		
80	15	P1614299226725	2016	ESSEX	NEWARK CITY	5/28/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07141930__	0.60	HELLER PARKWAY	Yes	MOUNT PROSPECT AVE.			No	40.775491	-74.165809
71	16	P1615721916-29248	2016	ESSEX	NEWARK CITY	6/10/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000021__	1.00	NJ 21	Yes	EMMET ST		West	No	40.720108	-74.179523
70	17	P1615785916-29326	2016	ESSEX	NEWARK CITY	6/11/2016	Injury	Incapacitated		1	1	1	2		1	Pedestrian			LINCOLN AVE	No	CHESTER AVENUE	100	North	Yes	40.768420	-74.164540
79	18	P16234383	2016	ESSEX	NEWARK CITY	8/20/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07141891__	0.75	ELIZABETH AVE	Yes	ELIZABETH AVE.			No	40.707792	-74.202115
74	19	P1626255316-47238	2016	ESSEX	NEWARK CITY	9/16/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			CLAY ST	No	NJ 21/MC CARTER HIGHWAY		East	No	40.750440	-74.167770
69	20	P16320661	2016	ESSEX	NEWARK CITY	11/11/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07141865__	2.22	BROAD ST	Yes	GRANT ST		South	No	40.747857	-74.170637
75	21	P16342648	2016	ESSEX	NEWARK CITY	12/2/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07000667__	2.05	ESSEX COUNTY 667	No	E SYLVAN AVE		West	No	40.780210	-74.155246
72	22	P16359549	2016	ESSEX	NEWARK CITY	12/27/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			FABYAN PL	No	LYONS AVE			No	40.714640	-74.223180
82	23	I-2016-002126	2016	ESSEX	ORANGE CITY	1/20/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			NORTH DAY ST	No	GIST PL	250		No	40.779590	-74.224370
81	24	I-2016-016421	2016	ESSEX	ORANGE CITY	5/23/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			BERWICK ST	No	BERKELEY AVE	300	West	No	40.759190	-74.241880
83	1	I2016-021667	2016	ESSEX	LIVINGSTON TWP	8/6/2016	Injury	Incapacitated		1	1			1		Pedalcyclist	00000510__	20.69	ROUTE 510	Yes	CR 608 / E HOBART GAP RD / WHITE OA			No	40.759806	-74.322237
84	2	16-3899	2016	ESSEX	EAST ORANGE CITY	3/23/2016	Injury	Incapacitated		1	1			1		Opposite Direction (Head On	00000509__	12.14	ROUTE 509	Yes	ROUTE 508 / CENTRAL AVE		North	No	40.751628	-74.205739

2 Less 2 Fatal Crashes

82 Total Serious Injury Crashes

TOTAL **67** **26** **124** **24** **27** **2** **10**

Hit and Run Crashes **12%**

# of crashes Not Mapped and cannot locate **12**

# of crashes Not Mapped and can be approximately located by cross street information **4**

Total # of crashes not mapped **16**

Alchohol Involved Crashes **13**

15%

Summary	
Occupant Physical Condition: Incapacitated Injuries	67
Pedestrians Involved + Incapacitated	24
Pedcyclist Involved + Incapacitated	2
Total	**93**
Total Serious Injury Crashes	**82**

Comparison NJDOT CRU Statistics	
Serious Injuries (Occupant)	67
Serious Injuries (Pedestrians)	24
Serious Injuries (Pedcyclist)	2
Total	**93**
Total Serious Injury Crashes	**82**

TABLE 4 - SAFETY VOYAGER EXPORT DATA: NEWARK - 2016 - INCAPACITATED INJURIES (COMBINED QUERIES)

		Case Number	Year	County	Municipality	Occurrence Date	Severity	Severity Rating Code	Occupant Physical Condition: Incapacitated (Count)	Pedestrian Physical Condition: Incapacitated (Count)	Total Injured	Pedestrians Injured	Pedestrian Involved	Cyclist Involved	Hit and Run Accident	Crash Type	Standard Route Identifier	Milepost Number	Location Text	Cross Street Intersection	Cross Street Name	Distance to Cross Street	Cross Street Direction	Alcohol Involved	Latitude	Longitude
1	1	C-2016-000014	2016	ESSEX	NEWARK CITY	1/2/2016	Injury	Incapacitated	1		1	0			1	Fixed Object			BRANCH BROOK DRIVE EAST	No	ELWOOD AVE	40		No		
2	2	P16006660	2016	ESSEX	NEWARK CITY	1/7/2016	Injury	Incapacitated	2		4	0			2	Same Direction - Rear End	07141891__		ELIZABETH AVE	No				No		
3	3	P16009867/CC#16-17?	2016	ESSEX	NEWARK CITY	1/11/2016	Injury	Incapacitated	2		3	0				Right Angle	07000605__	1.18	ESSEX COUNTY 605	Yes	18TH AVE			No	40.740641	-74.234267
4	4	P16009867	2016	ESSEX	NEWARK CITY	1/11/2016	Injury	Incapacitated	2		4	0				Right Angle	07000605__	1.18	ESSEX COUNTY 605	Yes	18TH AVE			No	40.740641	-74.234267
5	5	D030-2016-00154A	2016	ESSEX	NEWARK CITY	1/20/2016	Fatality	Killed	1		1	0				Fixed Object	00000095__	59.55	I-95, N.J. TURNPIKE	No				No	40.707195	-74.150761
6	6	P16032519	2016	ESSEX	NEWARK CITY	2/1/2016	Injury	Incapacitated	2		3	0				Same Direction - Rear End	00000001__	49.53	US 1	No	DELANCEY ST	100	South	No	40.716561	-74.151800
7	7	16-6246	2016	ESSEX	NEWARK CITY	2/6/2016	Injury	Incapacitated	2		3	0				Same Direction - Rear End	07141865__	1.98	BROAD ST	Yes	BRIDGE ST			Yes	40.744500	-74.169809
8	8	37845-16	2016	ESSEX	NEWARK CITY	2/9/2016	Injury	Incapacitated	1		1	0				Right Angle	07141885__	2.62	18TH AVE	Yes	BROOME ST			No	40.728355	-74.187766
9	9	P16044092	2016	ESSEX	NEWARK CITY	2/20/2016	Injury	Incapacitated	1		1	0				Struck Parked Vehicle			DELAVAN AVE	No				No		
10	10	16-8343	2016	ESSEX	NEWARK CITY	2/20/2016	Injury	Incapacitated	1		1	0			1	Struck Parked Vehicle	07141920__		N 6TH ST	No	DELAVAN ST		South	No		
11	11	P16051188	2016	ESSEX	NEWARK CITY	2/28/2016	Injury	Incapacitated	1		2	0				Right Angle			LENOX ST	No	MEAD STREET		West	No	40.738780	-74.233150
12	12	D030-2016-00519A	2016	ESSEX	NEWARK CITY	3/3/2016	Injury	Incapacitated	1		2	0				Opposite Direction (Head On	00000095__	60.75	I-95, N.J. TURNPIKE	No				Yes	40.718637	-74.134382
13	13	P16077807	2016	ESSEX	NEWARK CITY	3/24/2016	Injury	Incapacitated	1		1	0				Fixed Object			SEYMOUR AVE	No				No		
14	14	P1609183716974	2016	ESSEX	NEWARK CITY	4/9/2016	Injury	Incapacitated	1		2	0				Same Direction - Rear End			VALLEY ST	No	SUNSET AVE			No	40.737670	-74.229230
15	15	P1611567421387	2016	ESSEX	NEWARK CITY	5/2/2016	Injury	Incapacitated	1		2	0				Struck Parked Vehicle	07141926__		MOUNT PROSPECT AVE	No	HELLER PARK WAY			No	40.775500	-74.165830
16	16	P1612265922804	2016	ESSEX	NEWARK CITY	5/9/2016	Injury	Incapacitated	2		2	0				Same Direction - Sideswipe	00000001__		US 1	No			South	No		
17	17	P16136751	2016	ESSEX	NEWARK CITY	5/22/2016	Injury	Incapacitated	1		4	0				Same Direction - Sideswipe	07141891__		ELIZABETH AVE	No	CONCORD STREET		North	No	40.714390	-74.192590
18	18	P1614916027791	2016	ESSEX	NEWARK CITY	6/3/2016	Injury	Incapacitated	1		2	0				Fixed Object	00000021__	5.32	NJ 21	No				No	40.775527	-74.152712
19	19	C-2016-003081	2016	ESSEX	NEWARK CITY	6/20/2016	Injury	Incapacitated	1		1	0				Struck Parked Vehicle			N 5 TH ST	No	2ND AVE WEST	450	South	No		
20	20	P1617175816-31794	2016	ESSEX	NEWARK CITY	6/23/2016	Injury	Incapacitated	1		2	0				Same Direction - Rear End			MAYBAUM AVE	Yes	TREMONT AVENUE			Yes	40.747300	-74.214120
21	21	P1622339916-40777	2016	ESSEX	NEWARK CITY	8/10/2016	Injury	Incapacitated	1		1	0				Fixed Object	00000001__		US 1	No				No		
22	22	P16227728	2016	ESSEX	NEWARK CITY	8/14/2016	Injury	Incapacitated	1		4	0				Left Turn/U Turn	07171203__	2.59	MAIN ST	Yes	GOULD AVE			No	40.752677	-74.194213
23	23	P1623045716-41970	2016	ESSEX	NEWARK CITY	8/16/2016	Injury	Incapacitated	1		1	0				Right Angle	07091883__	0.65	15TH AVE	Yes	S. 12TH STREET			No	40.737872	-74.203542
24	24	P1624595816-44520	2016	ESSEX	NEWARK CITY	9/1/2016	Injury	Incapacitated	1		3	0				Fixed Object	07000603__	3.49	ESSEX COUNTY 603	Yes	BROOME ST		West	No	40.735360	-74.184740
25	25	P1625353216-45672	2016	ESSEX	NEWARK CITY	9/8/2016	Injury	Incapacitated	1		1	0				Right Angle	07141885__	0.31	18TH AVE	Yes	SUNSET AVENUE			No	40.739059	-74.228681
26	26	P1626560016-47689	2016	ESSEX	NEWARK CITY	9/19/2016	Injury	Incapacitated	1		1	0				Fixed Object	07091882__	0.38	AVON AVE	Yes	SOUTH 14TH STREET			No	40.727475	-74.209503
27	27	P1632714816-58016	2016	ESSEX	NEWARK CITY	11/18/2016	Injury	Incapacitated	1		1	0				Overturned	00000001__		US 1	No			South	No		
28	28	P1633024216-58437	2016	ESSEX	NEWARK CITY	11/21/2016	Injury	Incapacitated	1		2	0				Same Direction - Rear End			CHADWICK AVE	No	WEST RUNYON ST	50	South	No	40.717600	-74.202880
29	29	P1633936216-59901	2016	ESSEX	NEWARK CITY	11/30/2016	Injury	Incapacitated	2		2	0				Fixed Object	00000021__		NJ 21	No	CHESTER AVE E		North	No		
30	30	P1635049416-61681	2016	ESSEX	NEWARK CITY	12/10/2016	Injury	Incapacitated	1		2	0				Left Turn/U Turn	07000605__	0.78	ESSEX COUNTY 605	Yes	MT VERNON PL			No	40.735338	-74.237166
31	31	P1636134816-63318	2016	ESSEX	NEWARK CITY	12/19/2016	Injury	Incapacitated	1		2	0				Right Angle	07000603__	1.87	ESSEX COUNTY 603	Yes	S 20TH ST			No	40.729584	-74.214530
32	1	C16-8465	2016	ESSEX	NEWARK CITY	2/21/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141905__	0.52	WILSON AVE	Yes	ROME ST.			No	40.721808	-74.149617
33	2	P16071851	2016	ESSEX	NEWARK CITY	3/18/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141844__	1.92	FERRY ST	Yes	LOCKWOOD ST			No	40.733257	-74.131929
34	3	P16073743	2016	ESSEX	NEWARK CITY	3/20/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000510__		ROUTE 510	No	VERMONT AVENUE		East	No	40.745070	-74.220660
35	4	P16108361	2016	ESSEX	NEWARK CITY	4/25/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141865__		BROAD ST	No			South	No		
36	5	P1610836119975	2016	ESSEX	NEWARK CITY	4/25/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141865__		BROAD ST	No	MARKET ST		South	No	40.735580	-74.172130
37	6	P161083611619975	2016	ESSEX	NEWARK CITY	4/25/2016	Injury	Incapacitated		1	1	1	1		1	Pedestrian	07141865__		BROAD ST	No			South	No		
38	7	P1614299226725	2016	ESSEX	NEWARK CITY	5/28/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07141930__	0.60	HELLER PARKWAY	Yes	MOUNT PROSPECT AVE.			No	40.775491	-74.165809
39	8	P1615721916-29248	2016	ESSEX	NEWARK CITY	6/10/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	00000021__	1.00	NJ 21	Yes	EMMET ST		West	No	40.720108	-74.179523
40	9	P1615785916-29326	2016	ESSEX	NEWARK CITY	6/11/2016	Injury	Incapacitated		1	1	1	2		1	Pedestrian			LINCOLN AVE	No	CHESTER AVENUE	100	North	Yes	40.768420	-74.164540
41	10	P16234383	2016	ESSEX	NEWARK CITY	8/20/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07141891__	0.75	ELIZABETH AVE	Yes	ELIZABETH AVE.			No	40.707792	-74.202115
42	11	P1626255316-47238	2016	ESSEX	NEWARK CITY	9/16/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			CLAY ST	No	NJ 21/MC CARTER HIGHWAY		East	No	40.750440	-74.167770
43	12	P16320661	2016	ESSEX	NEWARK CITY	11/11/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07141865__	2.22	BROAD ST	Yes	GRANT ST		South	No	40.747857	-74.170637
44	13	P16342648	2016	ESSEX	NEWARK CITY	12/2/2016	Injury	Incapacitated		1	1	1	1			Pedestrian	07000667__	2.05	ESSEX COUNTY 667	No	E SYLVAN AVE		West	No	40.780210	-74.155246
45	14	P16359549	2016	ESSEX	NEWARK CITY	12/27/2016	Injury	Incapacitated		1	1	1	1			Pedestrian			FABYAN PL	No	LYONS AVE			No	40.714640	-74.223180
								TOTAL	**38**	**14**	**76**	**14**	**15**	**0**	**10**										
													Hit and Run Crashes		**22%**										

21 Total Occupant Condition: Incapacitated Injuries mapped
10 Total Occupant Condition: Incapacitated Injuries unmapped
12 Total Pedestrian with Incapacitated Injury mapped
2 Total Pedestrian with Incapacitated Injury unmapped
0 Total Cyclist with Incapacitated Injury mapped
0 Total Cyclist with Incapacitated Injury unmapped
45 Total Incapacitated Injury Crashes
33 Total Incapacitated Injury Crashes mapped

Summary	
Occupant Physical Condition: Incapacitated Injuries	38
Pedestrians Involved + Incapacitated	14
Pedcyclist Involved + Incapacitated	0
Total Incapactitated Injuries	**52**

Total # of crashes not mapped	**12**	**27%**
# of crashes Not Mapped and cannot locate	**8**	
# of crashes not Mapped but can be approximately located by cross street information	**4**	
Alchohol Involved Crashes	**4**	
	9%	

New Jersey Department of Transportation
Bureau of Transportation Data and Safety
Crash Records Unit
Fatal and Serious Injury Crashes Statistics (2007-2018)

Year	Severity	County	Bergen (02)	Essex (07)	Hudson (09)	Hunterdon (10)	Middlesex (12)	Monmouth (13)	Morris (14)	Ocean (15)	Passaic (16)	Somerset (18)	Sussex (19)	Union (20)	Warren (21)	Total
2016	Fatal	Fatal Crash	32	42	22	10	43	47	20	39	22	18	12	24	13	**344**
		Fatalities (Total)	35	46	24	11	47	50	21	41	22	19	12	25	15	**368**
		Fatalities (Occupant)	21	23	11	10	38	40	17	31	16	12	12	16	12	**259**
		Fatalities (Pedestrian)	14	22	12	1	9	10	4	8	6	6	0	7	1	**100**
		Fatalities (Pedcyclist)	0	1	1	0	0	0	0	1	0	1	0	1	2	**7**
		Other	0	0	0	0	0	0	0	1	0	0	0	1	0	**2**
	Serious Injury	Serious Injury Crash	68	82	42	15	62	56	29	90	63	24	24	47	21	**623**
		Serious Injuries (Total)	76	93	45	15	67	60	32	100	71	26	34	48	22	**689**
		Serious Injuries (Occupant)	56	67	23	13	56	49	26	85	57	24	29	38	20	**543**
		Serious Injuries (Pedestrian)	17	24	19	2	8	11	5	12	13	1	3	7	1	**123**
		Serious Injuries (Pedcyclist)	3	2	3	0	3	0	1	3	1	1	2	3	1	**23**
2017	Fatal	Fatal Crash	25	39	23	8	44	40	26	52	18	22	7	33	11	**348**
		Fatalities (Total)	27	40	26	8	48	43	29	53	18	23	7	34	11	**367**
		Fatalities (Occupant)	18	17	9	7	33	31	21	36	13	15	6	20	9	**235**
		Fatalities (Pedestrian)	8	22	15	1	13	11	7	13	5	7	1	14	2	**119**
		Fatalities (Pedcyclist)	1	1	2	0	2	1	1	4	0	1	0	0	0	**13**
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Serious Injury	Serious Injury Crash	97	94	35	20	66	62	33	69	57	26	14	51	23	**647**
		Serious Injuries (Total)	103	104	39	22	69	65	37	81	58	28	16	59	26	**707**
		Serious Injuries (Occupant)	74	72	26	19	55	51	35	71	47	23	16	45	24	**558**
		Serious Injuries (Pedestrian)	25	31	13	3	12	12	2	7	10	3	0	10	1	**129**
		Serious Injuries (Pedcyclist)	4	1	0	0	2	2	0	3	1	2	0	4	1	**20**
2018	Fatal	Fatal Crash	32	43	22	3	47	28	25	30	20	23	12	27	7	**319**
		Fatalities (Total)	32	45	23	3	50	29	28	38	21	23	12	27	7	**338**
		Fatalities (Occupant)	12	18	8	2	36	19	22	29	12	13	11	12	7	**201**
		Fatalities (Pedestrian)	19	25	14	1	14	9	5	8	9	9	1	14	0	**128**
		Fatalities (Pedcyclist)	1	2	1	0	0	1	1	1	0	1	0	1	0	**9**
		Other	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	Serious Injury	Serious Injury Crash	90	90	61	15	51	34	33	90	41	44	19	56	19	**643**
		Serious Injuries (Total)	102	110	70	16	57	36	52	102	42	53	28	63	20	**751**
		Serious Injuries (Occupant)	78	88	52	12	48	33	47	84	27	45	27	51	16	**608**
		Serious Injuries (Pedestrian)	16	18	13	4	8	2	3	12	12	8	1	9	4	**110**
		Serious Injuries (Pedcyclist)	8	4	5	0	1	1	2	6	3	0	0	3	0	**33**

Notes:
- FARS is the source of all Fatal numbers except 2017 2018 from the NJ State Police website
- DOT DB is the source of all Serious Injury numbers
- No Private Properties crashes included
- 2018 updated as of 3/6/2018 at 9:00 am