

## **2017 INTRODUCTION**

The purpose of the North Carolina Highway Safety Improvement Program (HSIP) is to provide a continuous and systematic procedure that identifies and reviews specific traffic safety concerns throughout the state. Within these areas are determined the potentially hazardous (PH) locations that are possibly deficient. The ultimate goal of the HSIP process is to reduce the number of traffic crashes, injuries, and fatalities by reducing the potential for these incidents on public roadways. The Traffic Safety Unit continuously strives to improve the identification of relevant traffic safety issues, minimum warranting criteria, and the location selection process.

The 2017 HSIP is a preliminary list of PH locations intended to be primarily utilized by engineers within the Transportation Mobility and Safety Division as well as NCDOT Division Operations personnel. However, other interested parties may find information presented here useful. These locations are divided into three categories: intersections, sections, and bicycle/pedestrian intersections. We encourage anyone using this information to contact us with any questions about the safety program.

It is important to understand what this preliminary list of statewide locations signifies. The following are a few key points regarding the 2017 HSIP that may help non-primary users:

- Each location listed has been flagged as potentially exceeding at least one safety warrant. This list is not based on frequency alone and this program is not an effort to list locations around the state that experience the highest number of crashes. Basically, each location listed has a targeted pattern of crashes that can be identified, analyzed, investigated, and recommended for appropriate countermeasures where applicable.
- Locations are weighted and prioritized using many factors. These factors are used to rank locations for analysis and investigation in a particular category.
- This list does not represent a “Most Dangerous Locations in the State” type of list. Any effort to measure “danger” is subjective and the HSIP is a data-driven approach which is an effort to remove subjectivity from the selection of locations that may need to be analyzed and investigated.

## **2017 HSIP OVERVIEW**

A few changes have been made to the intersection and the section safety warrants for the 2017 cycle of the HSIP.

### ***Intersection Warrants:***

- I-1, the Frontal Impact Warrant, has been modified to use a minimum number of frontal impact crashes instead of a minimum number of total crashes. For I-1(a), the minimum number of frontal impact crashes is now 12. For I-1(b), the minimum number of frontal impact crashes is now nine.
- I-5, the Chronic Crossing Pattern Warrant, has been modified to use a minimum number of crossing pattern crashes instead of a minimum number of total crashes. The minimum number of crossing pattern crashes is now 15 in ten years.

### ***Section Warrants:***

- The freeway frequency and density thresholds have both been modified. The minimum frequency has been raised to 48 crashes (from 30 in 2016 HSIP). The minimum density has been lowered to 48 crashes per mile (from 60 in 2016 HSIP).
- Warrant F-1, the Run Off Road during Wet Road Conditions (Freeway) Warrant, has been modified to lower the minimum percentage of ran off road crashes during wet conditions to 40% (from 50% in 2016 HSIP)
- Warrant F-2, the Run Off Road (Freeway) Warrant, has been modified to lower the minimum percentage of ran off road wet to 70% (from 75% in 2016 HSIP)
- Warrant F-3, the Wet Condition (Freeway) Warrant, has been modified to lower the minimum percentage of ran off road wet to 50% (from 60% in 2016 HSIP)

### ***Total potentially hazardous locations identified:***

- 3,110 potentially hazardous intersection locations were identified.
- 479 potentially hazardous section locations were identified.
- 148 potentially hazardous bicycle/pedestrian intersection locations were identified.

## **SAFETY ANALYSES**

Detailed crash analyses based on the most recent crash data are completed for locations prior to field investigation by the Regional Traffic Engineer's office. The analyses will be conducted using the following guidelines below. If a Regional Traffic Engineering office decides to initiate an investigation of a listed PH location before receiving an HSIP package, they should notify the HSIP Engineer of this activity and the results of the investigation.

### ***All Analyses***

- The analyst should contact the appropriate Regional Traffic Engineering Office prior to conducting a crash analysis to determine if there is any recent or current project near the PH location.
- The analysis period will be the most recent five or ten years of available data based on the warrant criteria.
- Collision diagrams, response form and available signal plans will be sent electronically.
- A crash listing will be sent electronically with each analysis.
- Regional staff will be notified electronically of locations that do not have a significant, correctable crash pattern.
- Analysis of locations maintained by municipalities will be sent directly to the municipality and the package will only include the crash analysis and a code index.

### ***Intersection Analyses***

- The Y-line will be 150 feet.
- All loop situations will be separated and analyzed on an individual basis.
- Interchanges will be broken out with each intersection of the interchange being analyzed separately. However, if the situation necessitates that the location be treated as one spot (i.e. - night crashes spread throughout the interchange) then it will be analyzed as a whole.

### ***Section Analyses***

- The Y-line will be 0 feet.
- The endpoints of the locations will be adjusted to the most precise section possible. However, separate locations within close proximity to each other may be incorporated into a single location.
- Animal crashes will be deleted from the analysis. In most cases, there are no effective and feasible countermeasures to reduce this crash type.

### ***Bicycle/Pedestrian Analyses***

- The Y-line will be 50 feet for all non-motorist locations
  - Only bicycle and pedestrian crashes will be analyzed and included in the final analysis statistics (unless otherwise requested).
  - Collision diagrams will only be completed for locations that have a definitive non-motorist pattern.
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## **FIELD RECOMMENDATIONS**

The TSSS is required to regularly evaluate the HSIP with regards to the development and evaluation of warrant criteria, the PH location selection process, and the development and effectiveness of treatments. This evaluation will provide a gauge for overall program effectiveness and also provide insight to any necessary modifications. The Safety Evaluation Group will evaluate the effectiveness of treatments in order to develop crash modification factors. In order to accomplish this, the Regional Traffic Engineer should return the following information to the HSIPG for every PH location that is investigated (even if a project is not developed for spot safety or hazard elimination funding). A response form will be supplied to assist with this process:

- Location information (county, city and description) including precise endpoints for section locations.
- PH number and HSIP analysis work order number. Include TEB File Number on all correspondence.
- Overview narrative of the location (i.e. – traffic control, configuration, immediate land use, etc.). A condition diagram can be substituted in lieu of a narrative.
- Historical narrative and other pertinent information related to the location (i.e. – recent improvements, zoning changes, crash patterns, collision diagram, complaints, etc.). We need the dates the project was started and completed, what was involved, and the type of project (i.e., spot safety, maintenance, etc.).
- Signal phasing (protected only, protected-permitted, etc.).
- Photographs (if possible).
- Description of any recommended treatment(s). Keep in mind that recommendations for bicycle and pedestrian locations or for older and teen driver-involved locations may not necessarily conform to traditional traffic engineering improvements and that a wider perspective of treatments may be necessary.
- Date construction began (or let date) and end date of construction.
- Completed field investigation worksheets (if a bicycle and/or pedestrian location).
- Documentation for no recommendations.

## **SAFETY WARRANTS**

The updated safety warrant criteria for the 2017 HSIP is based on non-PVA reportable crashes occurring between 2012 and 2016 (2007 through 2016 for warrants requiring 10 years of data). The following warrants are intended to identify a specific crash type, pattern, or condition and the warrant name is typically used as the identifying moniker. All safety warrants are based on five years of crash data (unless specifically noted otherwise).

### ***Intersection Warrants***

#### Warrant I-1: Frontal Impact

Locations with 25% of the total crashes having occurred in the last 2 years AND at least one of the following conditions:

(a) A minimum of 12 frontal impacts crashes AND a minimum of 50% of all crashes were frontal impact crashes.

-OR-

(b) A minimum of 9 frontal impacts crashes AND a minimum of 35% of all crashes were frontal impact crashes AND a minimum severity index of 6.0 for the frontal impact crashes.

For the purposes of this warrant, a frontal impact crash is considered to be one of the following crash types:

- Angle
- Left Turn (same or different roads)
- Right Turn (same or different roads)
- Head On

#### Warrant I-2: Last Year Increase

Locations with a minimum of 25 total crashes AND a minimum of 35% of the total crashes occurred in the last year.

#### Warrant I-3: Frequency with a Severity Index Minimum

Locations with a minimum of 25 total crashes AND a minimum severity index of 6.0 AND a minimum of 40% of the total crashes occurred in the last 2 years.

#### Warrant I-4: Night Location

Locations with a minimum of 25% of the total crashes occurring in the last 2 years AND a minimum of 12 crashes occurring at night AND a minimum of 38% of the total crashes occurred at night.

#### Warrant I-5: Chronic Crossing Pattern

(NOTE – this warrant is only used if none of warrants I-1 through I-4 are met)  
(NOTE – this warrant is based on ten years of data)

Locations with a minimum of 15 crossing pattern crashes, 15% of the total crashes occurring in the last 3 years AND a minimum of 75% of the total crashes were crossing pattern crashes. For the purposes of this warrant, a crossing pattern crash is considered to be one of the following crash types:

- All Left Turn
- Angle
- Head On

### ***Section Warrants***

For each valid warrant location, it is required that for the analysis period of 5 years, a minimum number of crashes and crashes/per mile rates are met. These minimum required values were defined by facility type as follows:

Facility Type	Minimum Total Crashes	Minimum Crashes/Mile Rate
All Freeway Sections	48	48
US Non-Freeway Route	20	40
NC Non-Freeway Route	15	30
SR Non-Freeway Route	15	30
City Non-Freeway Street	20	40

For the purposes of warrants F-1, F-2, N-1 and N-2, a run off road (ROR) type crash is considered to be one of the following crash types:

- Run Off Road (right, left or straight)
- Fixed Object
- Overturn/Rollover

In addition, the following crash types are reviewed and may be considered as run off road crashes during the analysis.

- Sideswipe Opposite Direction
- Parked Motor Vehicle
- Head On

Currently, the animal crash type has been removed from the section warrant analysis to assist in identifying target crash locations. This is done because animal crashes, predominately deer crashes on rural routes, are not applicable to the current warrants. Eliminating these crashes helps to focus the attention on to crash locations that counter measures can be applied based upon the current warrants.

Warrant F-1: Run Off Road during Wet Road Conditions (Freeway)

Freeway locations that met the minimum total crash and crash rate for freeways AND a minimum of 40% of the total crashes were run off road crashes occurring during wet road conditions.

Warrant F-2: Run Off Road (Freeway)

Freeway locations that met the minimum total crash and crash rate for freeways AND a minimum of 70% of the total crashes were run off road crashes.

Warrant F-3: Wet Road Condition (Freeway)

Freeway locations that met the minimum total crash and crash rate for freeways AND a minimum of 50% of the total crashes occurred during wet road conditions.

Warrant F-4: Night Location (Freeway)

Freeway locations that met the minimum total crash and crash rate for freeways AND a minimum of 50% of the total crashes occurred during dark lighting conditions.

Warrant N-1: Run Off Road during Wet Road Conditions (Non-Freeway)

Non-freeway locations that met the minimum total crash and crash rate for the respective facility type AND a minimum of 35% of the total crashes were run off road crashes occurring during wet road conditions.

Warrant N-2: Run Off Road (Non-Freeway)

Non-freeway locations that met the minimum total crash and crash rate for the respective facility type AND a minimum of 68% of the total crashes were run off road crashes.

Warrant N-3: Wet Road Condition (Non-Freeway)

Non-freeway locations that met the minimum total crash and crash rate for the respective facility type AND a minimum of 48% of the total crashes occurred during wet road conditions.

Warrant N-4: Non-Intersection Night Location (Non-Freeway)

Non-freeway locations that met the minimum total crash and crash rate for the respective facility type AND a minimum of 38% of the total non-intersection crashes were run off road crashes occurring during dark lighting conditions.

***Bicycle / Pedestrian Intersection Warrant***

Warrant BP-1: Chronic Location

Locations with a minimum of 5 crashes involving pedestrians or bicyclists reported in the last 10 years AND a minimum of 50% of all crashes involving pedestrians or bicyclists must have occurred in the last 5 years.