

## 2021 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 2021 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 four categories: intersections, sections, bicycle/pedestrian intersections, and bridges. 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 2021 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.

## **2021 HSIP OVERVIEW**

There were no changes made to the HSIP cycle this year

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

- 3,096 potentially hazardous intersection locations were identified.
- 881 potentially hazardous section locations were identified.
- 156 potentially hazardous bicycle/pedestrian intersection locations were identified.
- 76 potentially hazardous bridge locations

## **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 HSIP group will 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.
- Crash analyses, collision diagrams, and other crash analysis files will be placed on the HSIP Tracker SharePoint site.
- A crash listing, location map, and area map will be provided for each analysis.
- Regional staff will be notified 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 300 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 be completed using the updated 2021 HSIP bicycle/pedestrian methodology which includes additional bicycle/pedestrian symbology and specifics.
- Location map with the pattern description should be included

### ***Bridge Analyses***

- A standard distance of 500 feet from each end of the structure will be used for the limits
- Due to the nature of the referencing system, crash reports of crashes mileposted much further away than 500 feet will likely need to be reviewed in order to determine their true proximity to the bridge. In addition to the location information, the diagram, and narrative on the crash report form, the road feature (69) can also be helpful in making this determination. A road feature value of one (1) is a bridge and a value of two (2) is a bridge approach.
- If a curve is within 500 feet of an end of the structure, extend the limits to include the whole curve.
- Bridges within 500 feet of each other should be analyzed together

## **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 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 following information for every PH location that is investigated should be entered in the HSIP Tracker (even if a project is not developed for spot safety or hazard elimination funding).

- 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 if appropriate.
- Completed field investigation notes.

## SAFETY WARRANTS

The safety warrant criteria for the 2021 HSIP is based on non-PVA reportable crashes occurring between 2016 and 2020 for 5-year warrants and 2011 through 2020 for 10-year warrants. 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 either five or ten years of crash data.

### *Intersection Warrants*

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-1u: Frontal Impact Urban – 5 Years

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 impact crashes AND a minimum of 55% of all crashes were frontal impact crashes.

-OR-

(b) A minimum of 35 total 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.

#### Warrant I-1r: Frontal Impact Rural – 10 Years

Locations with a minimum of 9 frontal impact crashes, AND 20% of all crashes having occurred in the last 3 years AND a minimum of 60% of all crashes were frontal impact crashes.

#### Warrant I-2u: Last Year Increase Urban – 5 Years

Locations with a minimum of 25 total crashes AND a minimum of 38% of the total crashes occurred in the last year.

#### Warrant I-2r: Last Year Increase Rural – 10 Years

Locations with a minimum of 20 total crashes AND a minimum of 32% of the total crashes occurred in the last year.

Warrant I-3u: Frequency with a Severity Index Minimum Urban – 5 Years

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-3r: Frequency with a Severity Index Minimum Rural – 10 Years

Locations with a minimum of 20 total crashes AND a minimum severity index of 9.0 AND a minimum of 30% of the total crashes occurred in the last 3 years.

Warrant I-4u: Night Location Urban – 5 Years

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 40% of the total crashes occurred at night.

Warrant I-4r: Night Location Rural – 10 Years

Locations with a minimum of 20% of the total crashes occurring in the last 3 years AND a minimum of 10 crashes occurring at night AND a minimum of 46% of the total crashes occurred at night.

## ***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	30	30
US Non-Freeway Route	20	40
NC Non-Freeway Route	15	30
SR Non-Freeway Route	12	24
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
- 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 48% 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 80% 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 55% 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 52% 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.

## ***Bridge Warrant***

### Warrant B-1: Chronic Location

Locations with a minimum of 5 run off road crashes (ROR) type crashes in the last 10 years AND a minimum of 50% of all crashes were run off road.

Only applies to 2-lane roadways.

Animal crashes should be excluded from the study.

For the purposes of this warrant, a ROR crash is one of the following crash types:

- Run Off Road (right, left or straight)
- Fixed Object
- Overturn/Rollover
- Sideswipe Opposite Direction
- Parked Motor Vehicle
- Head On