HIN Development Memorandum

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To: Valerie Brookens, Forward Pinellas

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Subject: HIN Development Methodology

Introduction

This memo summarizes the proposed approach to developing the High-Injury Network (HIN) for Pinellas County. The development of the HIN will inform the strategies and projects developed as part of the Comprehensive Safety Action Plan (further referred to as Safe Streets Pinellas) with the objective of substantially reducing (and eventually eliminating) traffic-related fatal and serious injury crashes in Pinellas County. The HIN will consist of streets where a disproportionate number of crashes result in someone being killed or severely injured (KSI). Together, these crashes are referred to as KSI crashes or KA crashes throughout this memo (see KABCO injury scale in Table 1).

Data Inputs

Roadway Network

The centerline roadway network which serves as the basis for this analysis will be obtained through Open Streets Map (OSM) to link contextual location-based data (i.e., roadway data) with transportation-related data such as commuter patterns, bike and pedestrian traffic, network link volumes etc. The location-based data contains information regarding several important roadway contextual factors, including number of lanes, posted speed, and whether a roadway is one-way or two-way. Built upon this network, additional contextual factors obtained from FDOT open data and Forward Pinellas will be conflated to the network, including median presence and width, context, and functional classification, AADT, presence of sidewalks and other multimodal facilities, and shoulder types and widths. Other factors such as land-use and demographic factors may also be included in the analysis.

Consistent with best practices, limited access facilities and their corresponding on/off ramps will be removed from the network prior to development of the High Injury Network.

As part of the initial analysis, a summary will be provided detailing the proportion of the severe crashes that occurred on Limited Access facilities versus those that occurred on surface streets. Limited access facilities are typically removed to avoid roadways where project implementation is jurisdictionally infeasible and also to avoid skewing the data towards locations with higher vehicular exposure where pedestrians and bicyclists are prohibited. Ramp terminal intersections will be included in the analysis, including the ramp influence area of 100 feet.

Crash Dataset

The crash data used for the HIN will be reflective crashes that occurred in Pinellas County from January 1, 2020, to December 31, 2024, downloaded from Signal 4 Analytics in October 2025. Data will also be downloaded from the Crash Data Management System (CDMS) and compared to the data downloaded from Signal 4 to identify any inconsistencies which will also inform the preferred dataset to use in the preparation of the HIN.

Using GIS, crashes will be mapped and cleaned prior to the analysis. Data cleaning includes:

1) Removing any crash not actually occurring within Pinellas County: crash databases have a known issue of including a small number of incorrectly labeled crashes in the data downloads, in this case crashes labeled as Pinellas County that actually occur in a different county or different part of the state. These crashes will be checked to ensure that the geolocation is correct, irrespective of the “Pinellas County” label.
2) Flagging and removing crashes on limited access facilities: Identifying which crashes occur on limited access facilities will be done in the following way:
    a) Flagging all crashes where the data field ROAD_SYSTEM_IDENTIFIER is equal to Interstate or Turnpike/Toll.
    b) Manually flagging (using spatial observation) remaining crashes on limited access facilities where the ROAD_SYSTEM_IDENTIFIER field is not Interstate or Turnpike/Toll. In most cases, these crashes will be labeled as ROAD_SYSTEM_IDENTIFIER = US or State (since some limited access facilities have US or State road designations). Since not all US or State roads can be flagged as limited access, the ones geolocated along limited access facilities with information within the crash record which supports that the crash occurred on a limited access facility (e.g. ON_STREET_ROAD_HIGHWAY (field for facility name) equal to “Interstate 275”) will be flagged.
    c) Any crash meeting the 2 criteria above will be labeled as a limited access crash.
3) Flagging crashes on private roads and/or parking lots: Any crashes with ROAD_SYSTEM_IDENTIFIER equal to Private/Parking lot will be flagged and not included in the HIN.

4) Determining the mode for each crash: This is determined using several fields within the dataset. Understanding that a crash could involve several different modes, the crashes are labeled according to the most vulnerable user in the crash, i.e.:
    a) Any crash where PEDESTRIAN_COUNT > 0 is labeled as Pedestrian.
    b) Any remaining unlabeled crash where BICYCLIST_COUNT > 0 is labeled as Bicyclist.
    c) Any remaining unlabeled crash where MOTORCYCLIST_COUNT > 0 is labeled as Motorcyclist.
    d) All remaining crashes will be labeled as “Motor Vehicle”

Prior to the development of the HIN, a crash trend summary for the entire dataset will be provided. This will include summaries of crashes by severity, crash type, mode, year, and time of day along with a summary detailing the proportion of severe crashes that occurred on Limited Access facilities versus those that occurred on surface streets.

High Injury Network

Crash Severity Weighting

To prioritize locations where crashes result in a fatality or severe injury, KSI crashes will be assigned a weight factor. As presented in **Table 1,** crash weights are derived from comprehensive crash costs from the 2025 FDOT Design Manual, with the Highway Safety Manual (HSM) Equivalent Property Damage Only (EPDO) weighting applied. The EPDO method follows the KABCO injury scale which classifies crashes based on the greatest level of severity of injury occurring in the crash. For example: if someone is killed in a crash, the crash is labeled as a “K” crash; similarly, a crash where someone sustained incapacitating injuries would be labeled as an “A” crash. As previously mentioned, this analysis will focus on crashes where someone was killed or suffered incapacitating injuries, referred to as KA crashes or KSI crashes. Consequently, crashes involving Property Damage Only (PDO crashes) are not included in the weighting criteria for developing the HIN; these crashes may be included as a differentiating factor during the development of the prioritization criteria further along in the development of the Plan.

Comprehensive crash costs include both economic costs and monetized pain and suffering costs. Economic costs are monetary costs associated with emergency services deployment, medical services, productivity loss due to victim injury, insurance, legal costs, cost associated congestion impacts as a result of the crash, and property damage costs. Monetized pain and suffering costs are an assumption of the costs associated with lost quality-of-life (or Quality-Adjusted Life Years), accounting for reductions in life expectancy and quality of life changes as a result of a crash.

Crash severity weights were developed using a weighted average approach that reflects crash history specific to Pinellas County. First, fatal (K) and incapacitating injury (A) crashes were combined into a single KSI category, and non-incapacitating injury (B) and possible injury (C) crashes were combined into an injury category. This was done to account for fatal crashes receiving significantly higher weight which could skew the HIN. In addition, the severity outcome of a crash is sometimes dependent on factors that might not be readily apparent, e.g., a crash that results in a fatality could have been severe injury had the victim not had underlying health issues. Conversely, a fatal crash involving someone not wearing a seatbelt could have been injury only if the victim was wearing a seatbelt. Secondly, County-specific crash frequencies from 2020 to 2024 were used to calculate average annual crash costs for each combined severity group. These costs were then divided by the cost of a Property Damage Only crash to determine modified EPDO weighting factors.

For example, Pinellas County experienced 573 Fatal (K) crashes and 3,057 Serious Injury (A) crashes between 2020 and 2024; this resulted in an average of approximately 115 K crashes and 611 A Crashes per year. Based on the KABCO crash costs, the average annual cost of Fatal crashes in Pinellas County was $1,247,994,000 (i.e.,115* $10,890,000). The process was repeated for combined B and C crashes. By dividing each combined cost per crash category by the cost of a Property Damage Only (O) crash, the primary weighting factors were determined and are presented in **Table 1** below.

Table 1: EPDO Weighting

Severity	Cost per Crash[1]	EPDO Weight	Pinellas County Crashes (2020-2024)	Pinellas County Average Annual Crashes	Annual Average Crash Cost	Combined Weighted Average Cost Per Crash	Modified EPDO Weight[2]
Fatal (K)	$10,890,000	1,414	573	115	$1,247,994,000	$2,466,853.36	320
Incapacitating Injury (A)	$888,030	115	3,057	611	$542,941,542		
Non-Incapacitating Injury (B)	$180,180	23	11,289	2,258	$406,810,404	$134,756.92	18
Possibly Injury (C)	$103,950	14	16,645	3,329	$346,049,550		
No Injury (O)	$7,700	1	90,081	18,016	$138,724,740	$7,700	1

1. *Source: FDOT Design Manual (2025), Table 122.6.2 FDOT KABCO Crash Costs*
2. *Based on an average weighted KA crash cost in Pinellas County of $$2,466,853.36 for 2020 – 2024 and an average weighted BC crash cost in Pinellas County of $134,756.92.*

Supplemental weighting criteria were also incorporated to provide additional weighting to crashes based on the most vulnerable user involved in the crash. This is done to account for over-representation of injury crashes for certain modes as compared to others. Supplemental mode weights were developed by comparing each mode's share of injury crashes to its share of total crashes. This comparison produces a severity ratio that reflects the degree to which injury crashes are over-represented for each mode relative to total crashes. For example, Pedestrian-related crashes represent 7.53% of all injury crashes but account for 2.23% of total crashes; similarly, motor vehicle crashes represent 79.91% of all injury crashes but account for 93.69% of all crashes. This translates into a severity ratio (Injury crashes-to-Total crashes) of 3.38 (7.53 ÷ 2.23) for pedestrian crashes and 0.85 (79.91 ÷ 93.69) for motor vehicle crashes i.e., pedestrian crashes are approximately 4 times more over-represented than motor vehicle crashes (3.38 ÷ 0.85). These calculations are repeated for bicycle-related crashes and motorcycle crashes to determine the additional weighting criteria assigned by mode. These supplemental weights were applied in conjunction with the crash severity weights to emphasize locations where vulnerable roadway users experience a disproportionate risk of injury crashes. The supplemental weighting by mode is presented in **Table 2** below.

Table 2: Supplemental Weighting Criteria by Mode

Mode	% Total Crashes	% of Injury Crashes	Severity Ratio	Representative Ratio
Pedestrian	2.23%	7.53%	3.38	4
Bicycle	2.24%	6.94%	3.10	4
Motorcycle	1.84%	5.63%	3.06	4
Motor Vehicle	93.69%	79.91%	0.85	1

HIN Development

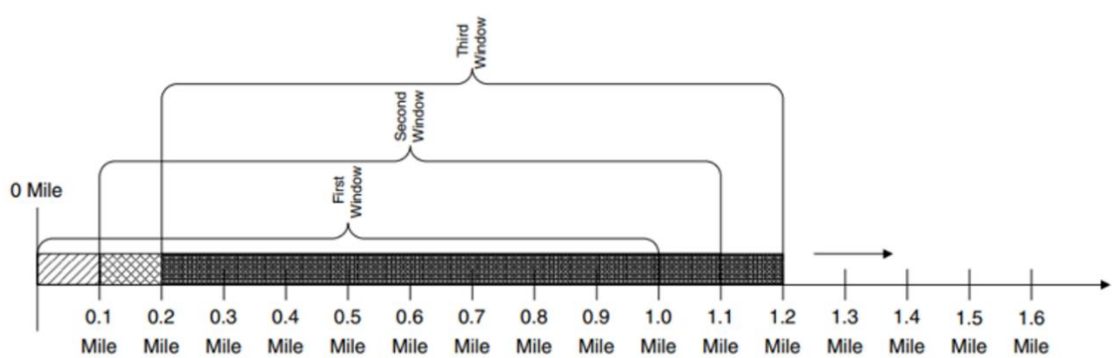
Sliding Window Approach

The HIN will be identified using the sliding window approach, which summarizes collisions on a specific corridor (and throughout the entire network) using discrete, overlapping “windows” of uniform length. Each window receives a collision score, consisting of the sum of weighted collisions (using the weights described in the previous section) for all collisions associated with that window. Using this approach, a single collision could be accounted for in several adjacent windows, so any inaccuracies inherent within crash location reporting can be accounted for. Windows with the highest collisions scores are used to create HIN corridors throughout the network. Compared to other network screening approaches for HIN development, the sliding window excels at uncovering corridor-wide trends (since the windows can overlap) while also providing a uniform unit of analysis (so different locations can be compared directly). The graphic below shows a visual representation of the sliding window approach.

Sliding Window Parameters

A 1/2-mile window length with a 1/8-mile offset distance is proposed for the analysis. Previous analyses on different Vision Zero projects have shown that this window size and offset distance is appropriate for a county-wide analysis. Any segment less than 1/2-mile in length will be treated as a single segment without any offset shifting.

Figure 1: Sliding window visual representation



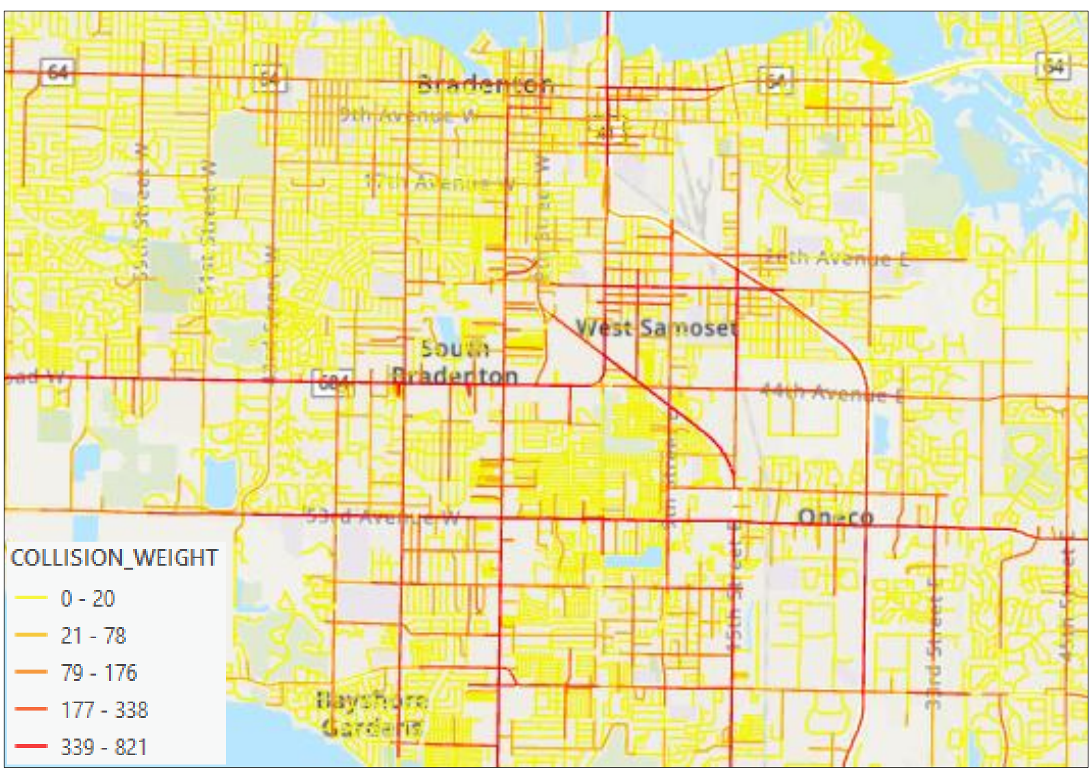
Crash Summary for Each Window

Crashes will be summarized for each window using a 100-ft search radius from the centerline. This radius was chosen by inspecting crash locations relative to the centerline at various locations throughout the network. The crash summary for each window will consist of summing the weighted crash values (using the weights discussed in the previous section) within the search radius. For example, a window with 10 minor injury crashes and 5 KSI crashes would receive an initial weighted score of 1,780 i.e., (10*18+ 5*320). If the 10 minor injury crashes were all vehicle related and the 5 KSI crashes included 3 pedestrian crashes and 2 motor vehicle crashes, applying the supplemental weighing would produce a final weighted score of 4,660 i.e., [1*(10*18) +4*(320*3) +1*(320*2)] for that window.

Preliminary HIN Development

After summarizing crashes for all windows throughout the network, the preliminary HIN will be built using the weighted score of each window. Visualizing the weighted score throughout the network, potential HIN corridors can begin to be identified, as shown on **Figure 2** below (using an example from a previous analysis).

Figure 2: Initial Visualization of Crash Weight Summaries Throughout Network



Source: FDOT District 1 High Injury Network for Manatee County

The preliminary HIN crashes will be formally constructed using the following steps:

1. Select/flag window segments throughout the network with crash weight values above a certain threshold (to be determined after creating windows). This is an iterative process, with the appropriate threshold resulting in roughly 40% to 60% of the KSI crashes within the network being accounted for.
2. Adjacent/overlapping high-scoring windows (flagged in the previous step) are aggregated into longer corridor segments when appropriate.
3. Cleaning/reasonableness check:
    a. Some high scoring windows on local roads which intersect with major roads will be removed from consideration if it is discovered that the crash score was being skewed by the number of crashes on the major leg of the intersection. This is done to account for crashes geocoded to the approach on the minor road but the crashes were within the influence area of the intersection with the major.
4. Any small gaps (<1/2 mile) in between the aggregated corridor segments in step 2 are joined together to create continuous HIN segments.

When the draft HIN is complete, a summary of crashes and roadway length accounted for on the HIN will be created (e.g. X% of KSI crashes occur on Y% of the roadway network). A web map will also be created for internal viewing and feedback. For the final HIN, other summaries will be prepared, like the jurisdictional breakdown and other characteristics, like average speed limit.

Top HIN Corridors

After the preliminary HIN has been created, individual HIN corridors (i.e. segments representing areas for potential safety improvement projects) will be defined. In the event that a single roadway on the HIN extends for a relatively long distance (e.g. several miles), the roadway may be split into several smaller HIN corridors according to contextual factors (e.g. changes in number of lanes, speed limit, etc.). With the understanding that the purpose of developing the HIN is to identify potential roadway locations for improvement; this is done so that the selected roadway segments have relatively uniform contextual characteristics and are manageable in length (i.e. feasible for potential projects). For each of the individual corridors, a new crash summary will be performed (using the total weight of crashes described previously). The total weighted score for each corridor will be normalized by mileage (since not all corridors will be the same length). This process will allow us to rank each HIN corridor according to concentration of crashes i.e., crashes per mile.

Top Intersection Analysis

Using GIS, every intersection in the centerline network will be analyzed using 300' non-overlapping buffers (representing the influence area of each intersection); this will be completed to identify the most dangerous intersections throughout the network. Crashes will be summarized within these buffers using the previously established crash weights. The result of the analysis will be a ranking of the intersections with the highest crash concentrations in Pinellas County.

Limitations of the Analysis

There are known limitations in crash datasets used for safety analyses and the extent to which these limitations affect the overall dataset may not be fully quantifiable. Some limitations include:

- Only reported crashes are included in the dataset. Some crash types may be underreported due to a variety of reasons, such as fear of law enforcement, lack of knowledge about the reporting process, lack of insurance or desire not to go through the insurance process, legal status of people involved in crash, or no apparent injuries.
- Potential for incomplete or inaccurate data within crash reports. While there are many layers of review that occur for crash reports, some information may not be correct. For example, in some instances, the reporting officer may use the GPS coordinates of where they completed the crash report, which could be a parking lot near the crash site, instead of the location of the first harmful event. Additionally, crashes involving a person in a wheelchair, or micro-mobility device, like an e-scooter, may be classified as pedestrian or bicyclist related, and a golf cart crash may be characterized as a vehicle crash as there are no fields within the crash report to denote the wide range of roadway users. While the details are often available in the crash report, the re-coding of crash data is not applicable at this scale of analysis.
- Only crashes involving a vehicle are reported in the dataset. A crash between a bicyclist and a pedestrian or a bicyclist and a train would not be reflected in the dataset.
- Results are based on crash data and current attribute data from 2020-2024 and do not account for roadway improvements made during the study period. It is recommended that before-and-after analysis be completed at any location with major safety improvements to determine if the roadway improvements had any effect on crash severity, crash frequency, crash causes, and/or crash types. This type of analysis would also inform the effectiveness of roadway safety improvements within the study area.
- Some crash analyses are based on exposure by using the average annual daily traffic (AADT) volumes for motor vehicles, where available. However, pedestrian and

bicyclist volumes are not readily available to adjust for exposure. The analyses reported here do not adjust for exposure rates based on volumes by mode or by time of day. Therefore, results show crash density but not frequency of crashes based on how many people are walking, i.e., exposure. For example, in many communities, pedestrian crashes are more common during daylight conditions than dark conditions. This does not mean that daylight conditions are more dangerous than dark conditions. Rather, it reflects the fact that people are more likely to travel, and especially more likely to walk, during daylight than when it is dark. Having the volumes by mode would provide some insight into exposure and frequency for non-motorized modes.

This completes the HIN Methodology Memo for Safe Streets Pinellas. If you have questions, please contact Kristof Devastey at (954) 657-1984 or k.devastey@fehrandpeers.com.