



Statewide Bike & Pedestrian High Injury Networks

Sonja Piper | Minnesota Department of Transportation

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mndot.gov/

Presentation Content

- Introduction to the Vulnerable Road User Safety Assessment
- Analysis contained in VRUSA
- Statewide High Injury Network
- Analysis Trends



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Vulnerable Road User Safety Assessment

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VRUSA Requirements

- Requirement of Bipartisan Infrastructure Law (BIL)
- Completed November 15, 2023
- Incorporated into Strategic Highway Safety Plan
 - Amended into 2020-2024 SHSP
 - Updated with SHSP every 5 years
- Align with Safe System Approach



VRU Crash Analysis



Engagement High-Risk Populations



Implementation Strategies

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VRU Crash Analysis Requirements



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- Predictive Safety Analysis
 - 2016 District Safety Plans Intersection Risk Assessment
- Systemic Safety Analysis
 - 2021 Statewide Pedestrian Safety Analysis
 - New bicycle safety analysis
- High Injury Network
 - New statewide analysis

Where are You on the Safe System Journey?

Traditional approach

Prevent crashes



Safe System approach

Prevent death and serious injuries

Improve human behavior



Design for human mistakes/limitations

Control speeding



Reduce system kinetic energy

Individuals are responsible



Share responsibility amongst all stakeholders

React based on crash history





Proactively identify and address risks

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Complete Streets Supports a Safe System Approach



Eliminate fatal and serious injuries for all road users by:

-  Accommodating human mistakes
-  Keeping impacts on the human body at tolerable levels

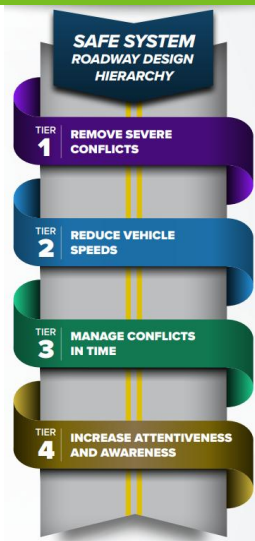
Complete Streets is an implementation strategy:

-  Safer Roads
-  Safer Speeds

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Image Credit: <https://www.transportation.gov/NRSS/SafeSystem>

VRUSA Alignment with Safe System Approach

- Focus on eliminating fatal & serious injury crashes
- SSA Design Hierarchy
- Goal: Self-enforcing roadway



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Self-Enforcing Roadway

- Self-enforcing roadways focus on managing driving speeds through design.
- Drivers use clues from roadway design and environment to choose their driving speed.
 - “Friction” from narrow lanes or curb extensions
 - Horizontal deflection
 - Vertical deflection
 - Reduced turning radii
- Use the design to achieve “Safe Speeds”



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“You cannot have a safe system if you do not provide safe mobility for pedestrians, bicyclists, and motorcyclists.”

Wes Kumfer, Collaborative Sciences Center for Road Safety, Nov 4, 2020

VRUSA Online!

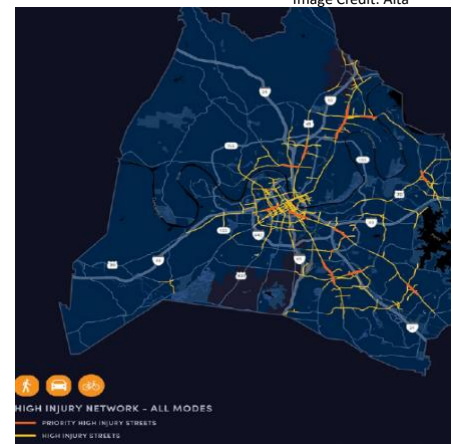
- <https://www.dot.state.mn.us/trafficeng/safety/shsp/>
- <https://www.dot.state.mn.us/trafficeng/safety/vrusa.html>



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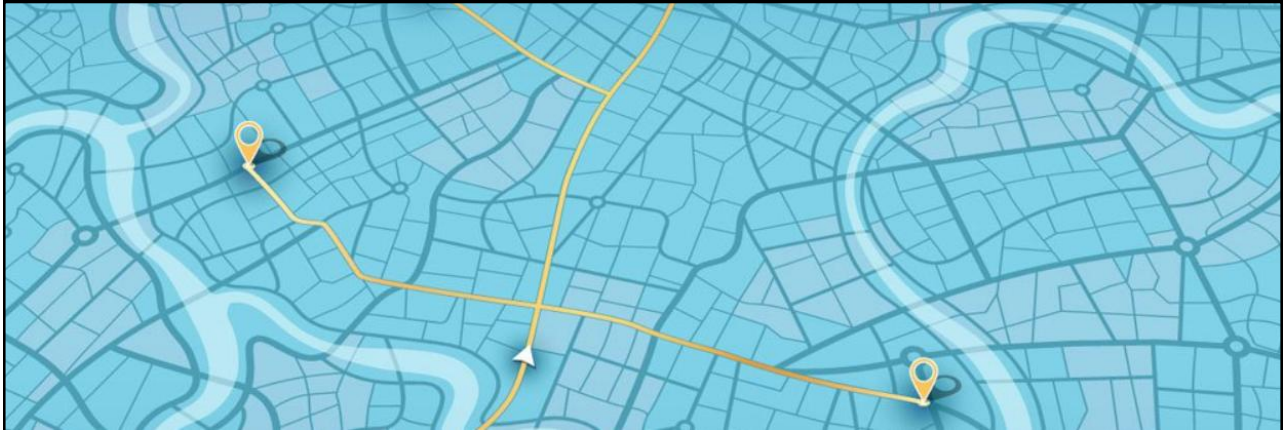
VRUSA Analysis

- Systemic Safety Analysis
 - 2016 District Safety Plans - Intersection Risk Rating Assessment
- Predictive Safety Analysis
 - Statewide Pedestrian* Safety Analysis, completed 2021
*included other non-bicyclist VRUs as well
 - Completed on roads with facility data – primarily trunk highways
 - Data from 2016–2019
 - Expand to include a bicycle safety analysis, in order to capture all VRU
- High-Injury Network Analysis
 - Geospatial, sliding window analysis
 - Completed for ALL roads in MN
 - Data from 2017–2021 (plus internal testing of pre/post pandemic data)



Sample High-Injury Network Analysis

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High Injury Network

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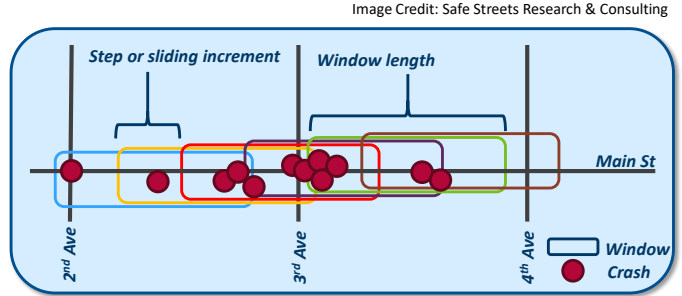
High Injury Networks

- Purpose: Identify the ***highest densities of fatal and injury VRU crashes.***
 - Primarily reactive (crash history) but with some proactive features (spatial patterns).
 - Pair with systemic analysis to help address risk proactively.
- Challenge: Diverse geography patterns and large statewide scale.
 - Methodology originally developed for cities.
 - Made methodological adaptations to fit the statewide scale.

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Methodology (Sliding Windows)

- Crash Modes: Bicyclist and Pedestrian + Other Human Powered
- Crash Severity
 - Primary focus on Fatal and Suspected Serious Injury (F+SI)
 - Secondary focus on Minor Injury (weighted less)
 - Excludes possible injury and property damage only
- Geography
 - Metro areas: shorter corridors; analyze modes separately; higher thresholds
 - Smaller communities and rural areas: longer corridors; combine modes; lower thresholds



Example Sliding Window Process

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HIN Results – 34% of Severe VRU Crashes on 2% of the Network

Geography Group	Minimum Densities	HIN Size	Severe (F+SI) Crashes
Twin Cities Metro – Mpls & St. Paul	<ul style="list-style-type: none"> • Ped + Other: 12+ per mile • Bike: 7+ per mile 	113 miles 6%	241 56%
Twin Cities Metro – Suburbs	<ul style="list-style-type: none"> • Ped + Other: 7+ per mile • Bike Score: 5+ per mile 	100 miles 1%	101 23%
Greater MN metro areas (e.g., Duluth, Rochester)	<ul style="list-style-type: none"> • Ped + Other: 7+ per mile • Bike: 5+ per mile 	24 miles 1%	30 30%
Small urban communities (e.g., Bemidji, Alexandria)	<ul style="list-style-type: none"> • Combined / All VRU: 5+ per 2 miles 	95 miles 1%	64 32%
Rural areas	<ul style="list-style-type: none"> • Combined / All VRU: 5+ per 2 miles 	20 miles 0%	7 5%
Statewide Total		352 Miles 2%	443 34%

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Welcome
Why?
Equity
HIN
Who?
Crash Severity
Moving Forward

High Injury Network

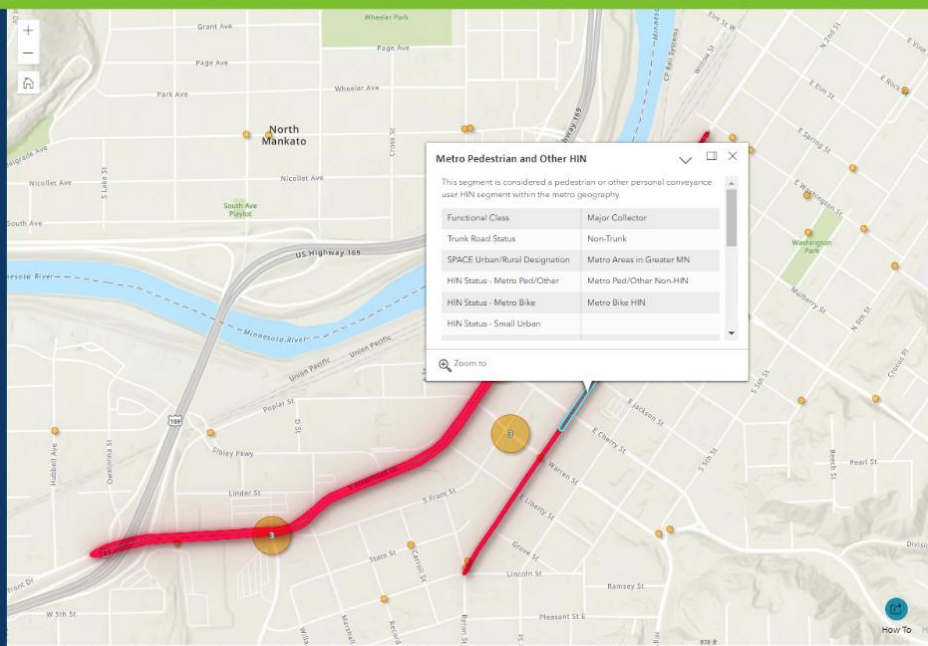
MnDOT's High Injury Network (HIN) consists of roadways with the highest numbers of people who have died or been seriously injured in a traffic crash while walking or biking.

The High Injury Network covers 283 miles across the state of Minnesota, accounting for 30% of the state's total walking and biking crashes. Seventy-five percent of the HIN is in the Minneapolis – St. Paul metropolitan area, but there are important trends in communities across the state.

The HIN identifies areas where investment can be impactful in reducing serious crashes across all roadways in Minnesota. MnDOT has created several HIN networks, which are shown on the map to the right. Click on the HIN Filter button in the lower righthand corner to switch between the 3 networks.



The High Injury Network covers **283 miles of road** across the state of Minnesota, accounting for **30%** of all walking and biking crashes.



Metro Pedestrian and Other HIN

This segment is considered a pedestrian or other personal conveyance user HIN segment within the metro geography.

Functional Class	Major Collector
Trunk Road Status	Non-Trunk
SPACE Urban/Rural Designation	Metro Areas in Greater MN
HIN Status - Metro Ped/Other	Metro Ped/Other Non-HIN
HIN Status - Metro Bike	Metro Bike HIN
HIN Status - Small Urban	

Zoom to



How to use HIN

Data Dashboard Overview

- Share results of High-Injury Network Analysis
- Intended for use by safety partners
- Map forward, story second
- Highlights important trends from HIN and predictive safety analyses
- Provides additional context layers

Image Credit: Alta



Sample High-Injury Network Analysis

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Welcome Why Who Where Strategies to Move Forward

MnDOT Vulnerable Road User Safety Assessment (VRUSA) Data Dashboard


According to the Federal Highway Administration (FHWA) [report on vulnerable users](#), Fatalities of the most vulnerable road users in the United States are increasing at a greater rate overall fatalities among all road users in the United States.


There is an urgent need to take action in response to the current crisis in traffic fatalities by “taking substantial, comprehensive action to significantly reduce fatal and serious injuries on the Nation’s roadways,” in pursuit of the goal of achieving zero highway deaths.

Vulnerable road users (VRU) are defined as any pedestrian, bicyclist, or other non-motorist involved in a motor vehicle crash. This [VRUSA](#) provides a holistic, data-driven approach to non-motorist safety. Proactive/systemic risk factors as well as reactive, network screening are provided to identify locations where further safety considerations



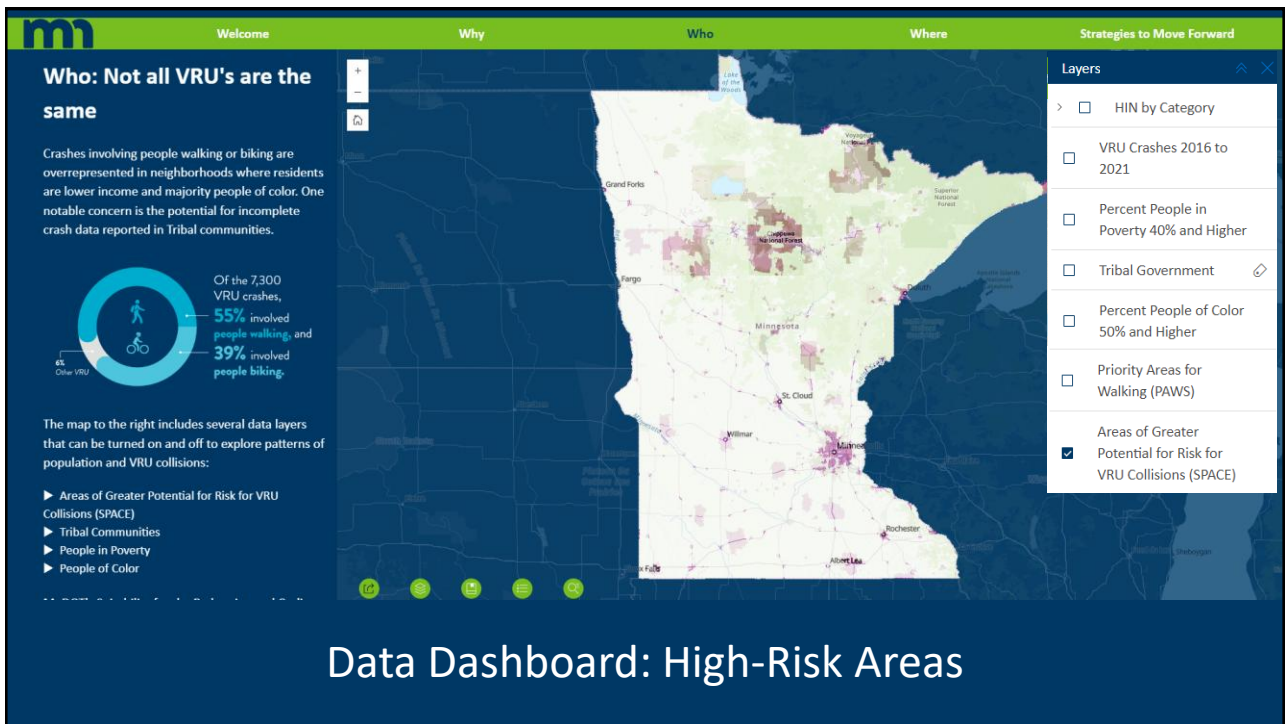
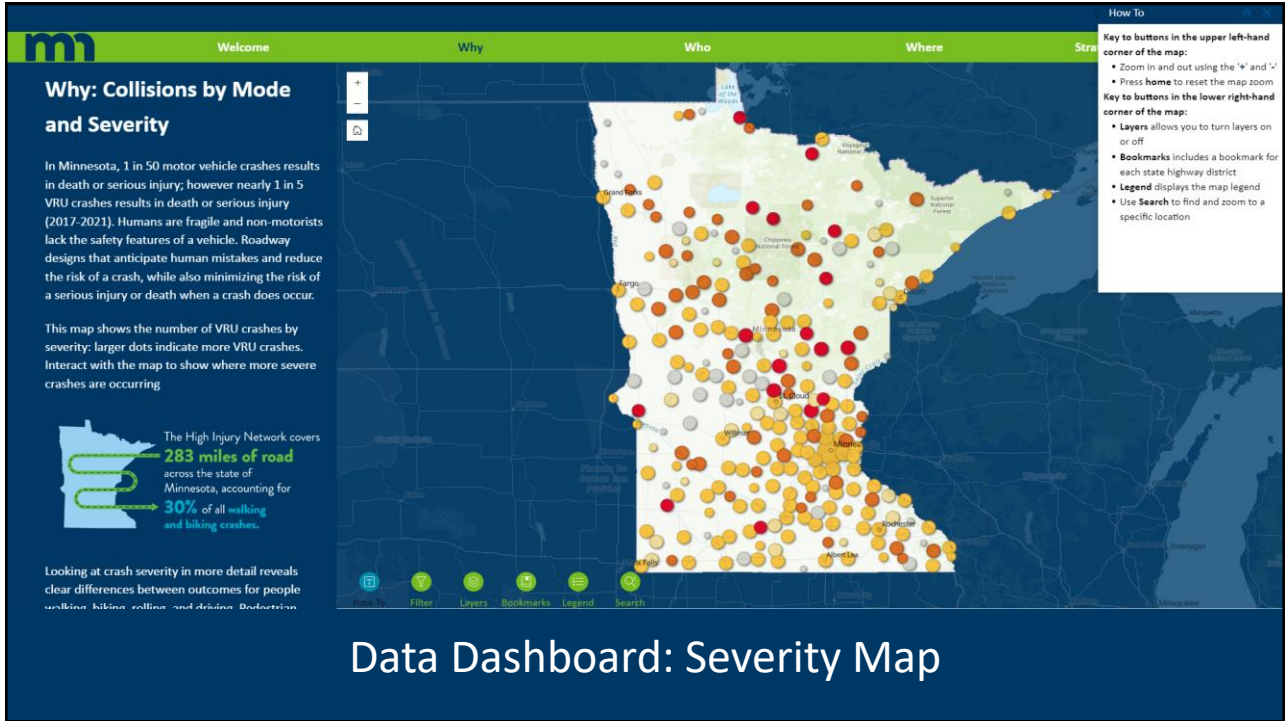
Bicyclists and pedestrians are vulnerable road users that are disproportionately likely to be killed or seriously injured on the transportation system.

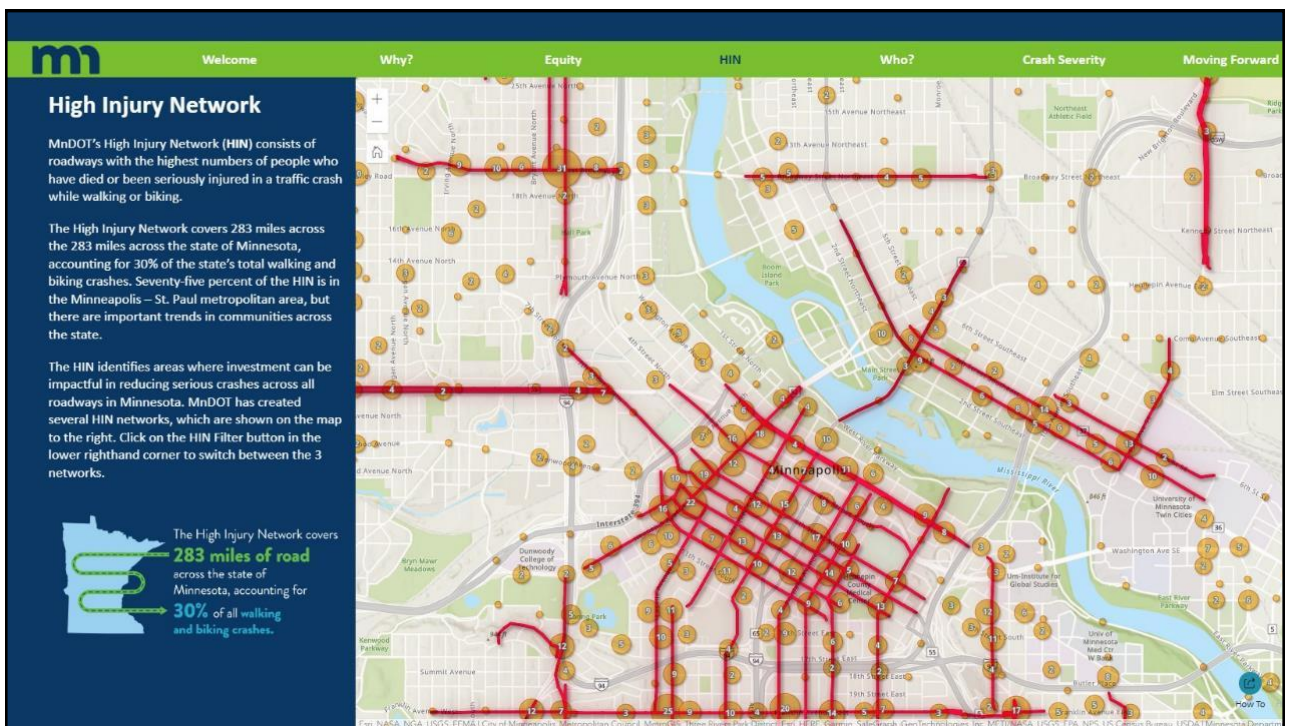
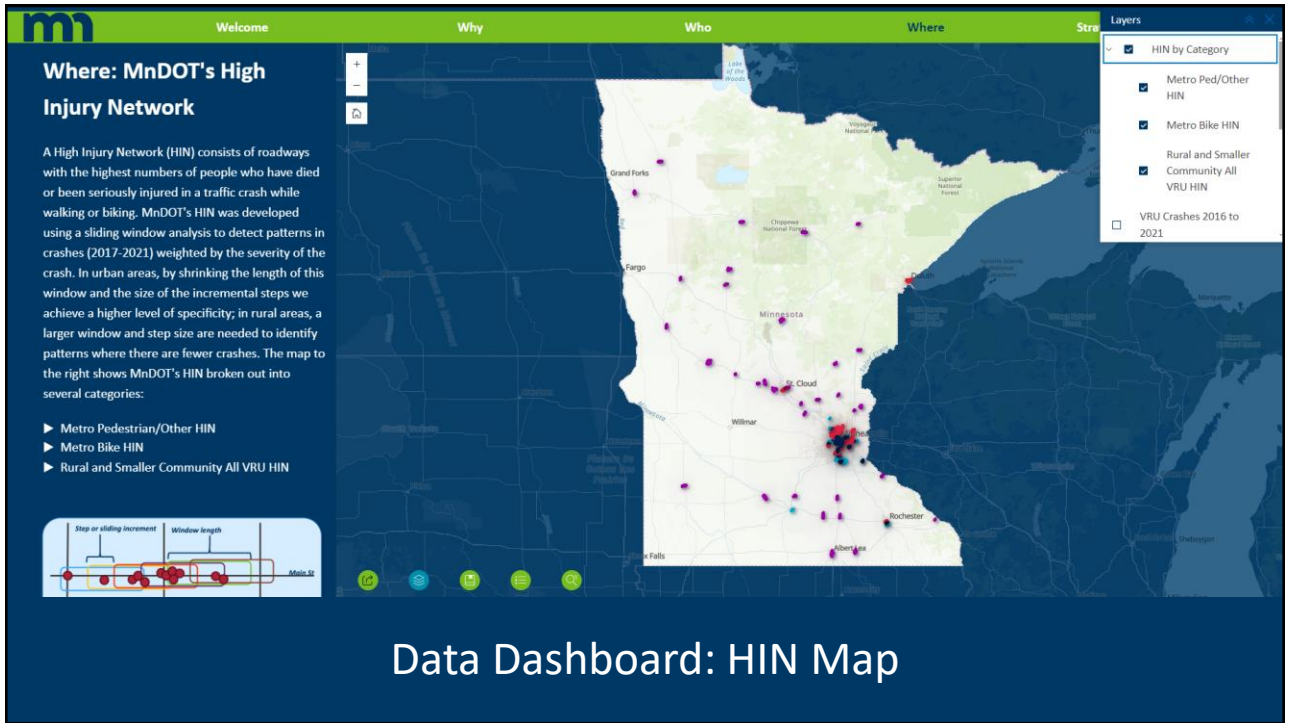






Data Dashboard: Welcome Page





High Injury Network

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HIN Status - Small Urban	

Data Dashboard Online!

VULNERABLE ROAD USER SAFETY ASSESSMENT

- <https://experience.arcgis.com/experience/5d9ae0a5b2e04c298a391ac718ccac92>
- <https://www.dot.state.mn.us/trafficeng/safety/vrua.html>

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Notable Crash Trends



HIN Data Analysis Findings

Modal Differences

- Large metro areas have data to support both pedestrian HIN and bicycle HIN
- Other areas have combined VRU HIN

Demand

- HIN segments are concentrated in areas with medium to high walking and biking demand

Equity

- More VRU crashes in areas with majority low income and POC
- HIN may underestimate risk on Tribal lands due to lack of crash data

Intersection Types

- HIN segments are more likely to include corridors with traffic signals

Pedestrian Safety Analysis Findings



Signalized Intersections

Over **1/3** of pedestrian fatal or serious injury intersection crashes occurred at signalized intersections, despite these comprising a much smaller share of all intersections.



Transit

Over **40%** of fatal and injury pedestrian crashes statewide occurred within 500 feet of a transit stop.²



Equity

Areas with high poverty rates have **3.9x** as many fatal and injury pedestrian crashes per square mile as high income/low poverty areas.



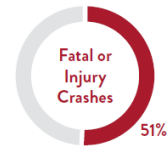
Areas where a majority of residents are Black, Indigenous, and People of Color have almost **9x** as many fatal and injury pedestrian crashes per square mile as majority white areas.



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Minor Arterials

51% of pedestrian fatal and injury crashes and 53% of pedestrian crashes overall, occurred on Minor Arterials², while only 7% of Minnesota roads are estimated to be of this type.



Minor arterials had over **28x** as many pedestrian injury and fatal crashes per mile as local roads.



Descriptive Bike Crash Analysis Findings



Severity	Age	Location	State Highways	Sidewalks
<ul style="list-style-type: none"> Statewide bike crashes: 10% result in fatality or serious injury Rural bike crashes: 35% result in fatal or serious injury 	<ul style="list-style-type: none"> Largest share of bicycle victims: 10-14 year olds Largest share of bicycle fatal and serious injury victims: 15-19 year olds 	<ul style="list-style-type: none"> 75% crashes occur at intersection 77% of crashes occur during daylight hours Crashes occurring in dark, unlit conditions are disproportionately severe 	<ul style="list-style-type: none"> 15% of all bicycle crashes <ul style="list-style-type: none"> Only 8% of MN Roads More common in small urban and rural areas Disproportionately severe outcomes in Greater MN 	<ul style="list-style-type: none"> Bicycle crashes most frequently occurred using sidewalk along State Highway Bicycle crashes are less severe where sidewalks present

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Summary

- MnDOT has developed many safety tools
- Use HIN and other safety data:
 - Funding applications
 - Project development
 - Application of safe system approach & design hierarchy
- Currently updating VRUSA, Strategic Highway Safety Plan, District Safety Plans, and more



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Thank you!



DREAMS.
I dream of a world. A better world where chickens can cross the road without having their motives questioned.

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TRANSPORTATION