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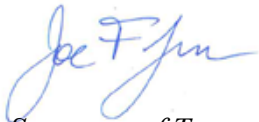
Agency of Transportation

A message from VTrans Secretary Flynn:

Our Vermont Agency of Transportation (VTrans) mission is to provide the safe and efficient movement of people and goods and the Strategic Highway Safety Plan (SHSP) provides guidance and action items associated with improving safety on Vermont’s roadways. The attached Vulnerable Road User (VRU) Safety Assessment, to be appended to the 2022 – 2026 SHSP, further underscores the focus VTrans puts on improving safety for our vulnerable road users in Vermont.

VTrans promotes the “Toward Zero Deaths” philosophy, as we believe that one death on Vermont roads is too many. The 2022 – 2026 SHSP highlighted vulnerable road users as an emphasis area and the VRU Safety Assessment focused additional attention on safety data analysis, outreach to higher risk populations, and the different challenges facing vulnerable road user safety throughout the state. As a part of the Assessment, VTrans has developed strategies to continue to move the needle in the future to reduce crashes for these vulnerable road users.

Joe Flynn



Secretary of Transportation
Vermont Agency of Transportation



Vermont

Vulnerable Road User Safety Assessment 2023



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Introduction

“Vulnerable Road User” (VRU) is a term for people traveling public roads on foot, bicycle, or personal conveyance device. A VRU Safety Assessment analyzes the safety record of a State with respect to these vulnerable users, with an emphasis on fatalities and serious injuries, and the State’s plan to improve VRU safety.

Vermont’s most recent Strategic Highway Safety Plan (SHSP), published in March 2022, featured a Vulnerable Users Focus Area, and includes Pedestrians and Bicyclists as a Critical Emphasis Area. The Vermont Agency of Transportation’s (VTrans) comprehensive strategies are formalized in the Bicycle and Pedestrian Strategic Plan¹ issued March 2021. VRU safety and mobility are of high importance in Vermont, making up key factors in VTrans’ network planning and infrastructure investment decisions. VTrans promotes the use of innovative practices to improve the experience for VRUs. A key element of the SHSP was to incorporate the elements and principles of the [Safe System Approach](#), as outlined by USDOT’s [National Roadway Safety Strategy](#) (NRSS). The VRU Safety Assessment uses the Safe System framework to understand safety issues in Vermont and propose programs, projects, and strategies to reduce fatalities and serious injuries.

¹ https://vtrans.vermont.gov/sites/aot/files/planning/bikeplan/VTrans_BPSP_Report_FINAL_20210310-ExecutiveSummary.pdf

Overview of Vulnerable Road User Safety Performance

In 2022, Vermont experienced 76 roadway fatalities with 8 being VRUs. Over the past 6 years, there have been less than 10 VRU deaths per year (see Table 1 and Figure 1).

Table 1. VRU Fatalities from 2017 to 2022.

	2017	2018	2019	2020	2021	2022	Total
Pedestrian	9	6	2	7	8	7	39
Bicyclist	-	-	-	1	-	1	2
Road Worker	-	-	1	-	-	-	1
Total	9	6	3	8	8	8	42

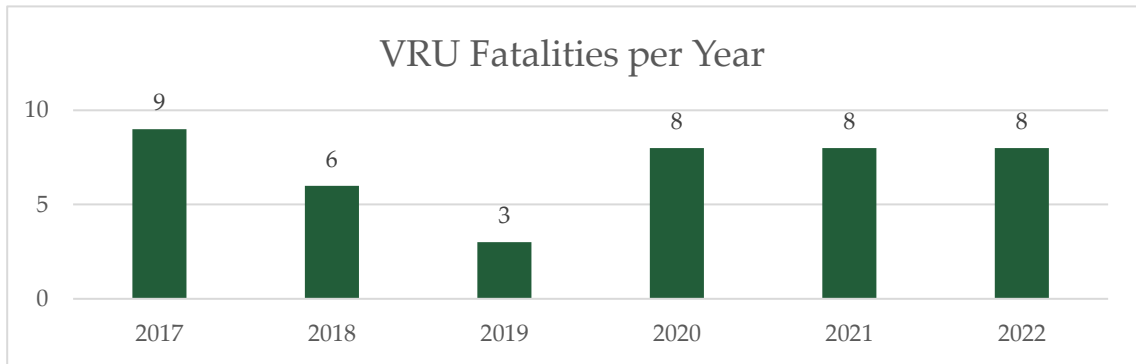


Figure 1. VRU Fatalities from 2017 to 2022.

Figure 2 shows the number VRU fatal and serious injuries by VRU type.

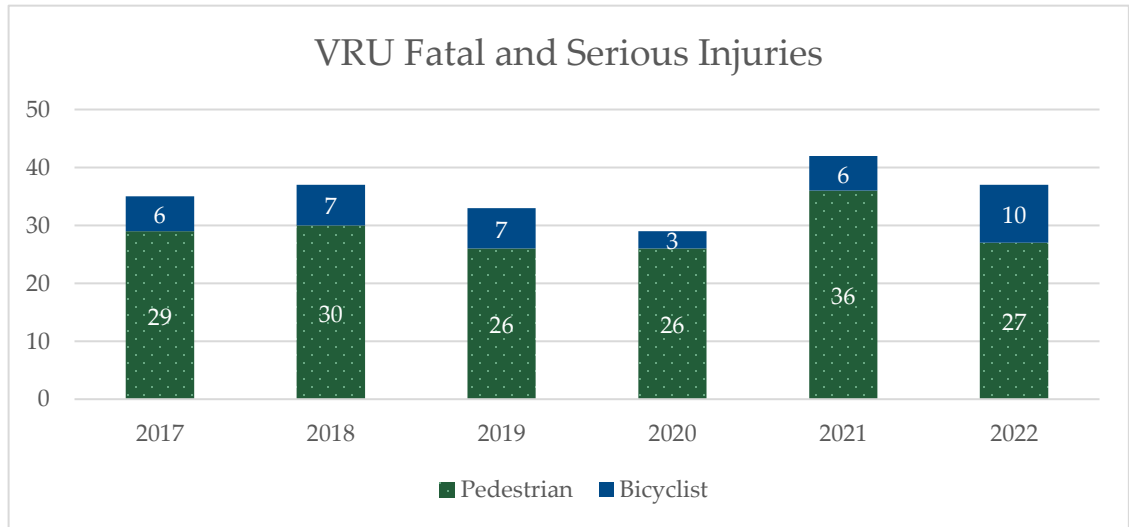


Figure 2. VRU Fatalities and Serious Injuries from 2017 to 2022.

VRU fatalities and serious injuries (denoted by K and A, respectively, on the KABCO injury severity scale) have made up 9 to 12 percent of total fatalities and serious injuries in Vermont (see Table 2). Data for 2022 was found in Vermont’s Highway Safety Plan 2022 Annual Report.²

Table 2. VRU Safety Performance to Overall Safety Performance.

	2017	2018	2019	2020	2021	2022
Total KA	324	325	307	296	355	320
Non-Motorized KA	37	37	36	28	40	37
Percent	11%	11%	12%	9%	11%	12%

Performance Targets

VTrans sets targets for non-motorized fatalities and serious injuries on an annual basis. This is listed in the Highway Safety Improvement Plan (HSIP) Annual Report³. For 2018-2022, the target was set at 35.0 fatalities and serious injuries per year. The actual performance for 2018-2022 (35.6) narrowly missed this target. Vermont continues to work towards reducing this number, and the 2019-2023 target was lowered to 34.4.

Area Type

In Vermont, 89 percent of public road mileage is in rural areas.⁴ Of the 42 VRU fatalities in Vermont from 2017 to 2022, 22 occurred in a rural area, which amounts to 52 percent (see Table 3). Relative to mileage, pedestrian and bicyclist fatalities are overrepresented in urban areas. Urban areas tend to have more pedestrian and bicycle facilities and therefore more activity and exposure. Denser towns and cities also have higher rates of commuting by non-auto modes and greater recreational walking and cycling.

Table 3. VRU Fatalities by Area Type (2017-2022).

	Rural	Urban	Total
Pedestrian	21	18	39
Bicyclist	0	2	2
Road Worker	1	0	1
Total	22	20	42

² https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-06/VT_FY2022HSPAR-v2%20tag.pdf

³ [Highway Safety Improvement Program 2021 Annual Report: Vermont \(dot.gov\)](https://www.fhwa.dot.gov/policyinformation/statistics/2020/hm20.cfm)

⁴ <https://www.fhwa.dot.gov/policyinformation/statistics/2020/hm20.cfm>

Age

Vermont's aging population is a factor in VRU fatalities. Vermont residents aged 65 and over account for 22 percent of the State population⁵, which is higher than the national average of 17 percent.⁶ This population is overrepresented in fatal crashes at 35 percent of VRU deaths. From 2010 to 2020, Vermont's population of 65 years and older has increased by 45 percent, which is a faster rate than the national average of 39 percent.⁷

Table 4. VRU Fatalities by Age Group (2017-2022).

	< 10	30-39	40-49	50-59	60-69	70-79	≥ 80	Total
Pedestrian	1	3	8	7	9	5	6	39
Bicyclist	1				1			2
Road Worker		1						1
Total	2	4	8	7	10	5	6	42

Impairment

In Vermont, a driver or struck non-motorist was impaired (alcohol and/or drugs) in only three percent of VRU crashes. However, impairment was more frequently a factor in severe crashes, with impairment involved in 6 percent of serious injury crashes and 16 percent of fatal crashes (see Table 5). When drivers and/or VRUs are impaired, there is a higher likelihood of a death or serious injury.

Table 5. VRU Fatalities by Area Type (2017-2022).

	Impairment	None	Total	
Death	11	55	66	17%
Serious Injury	17	287	304	6%

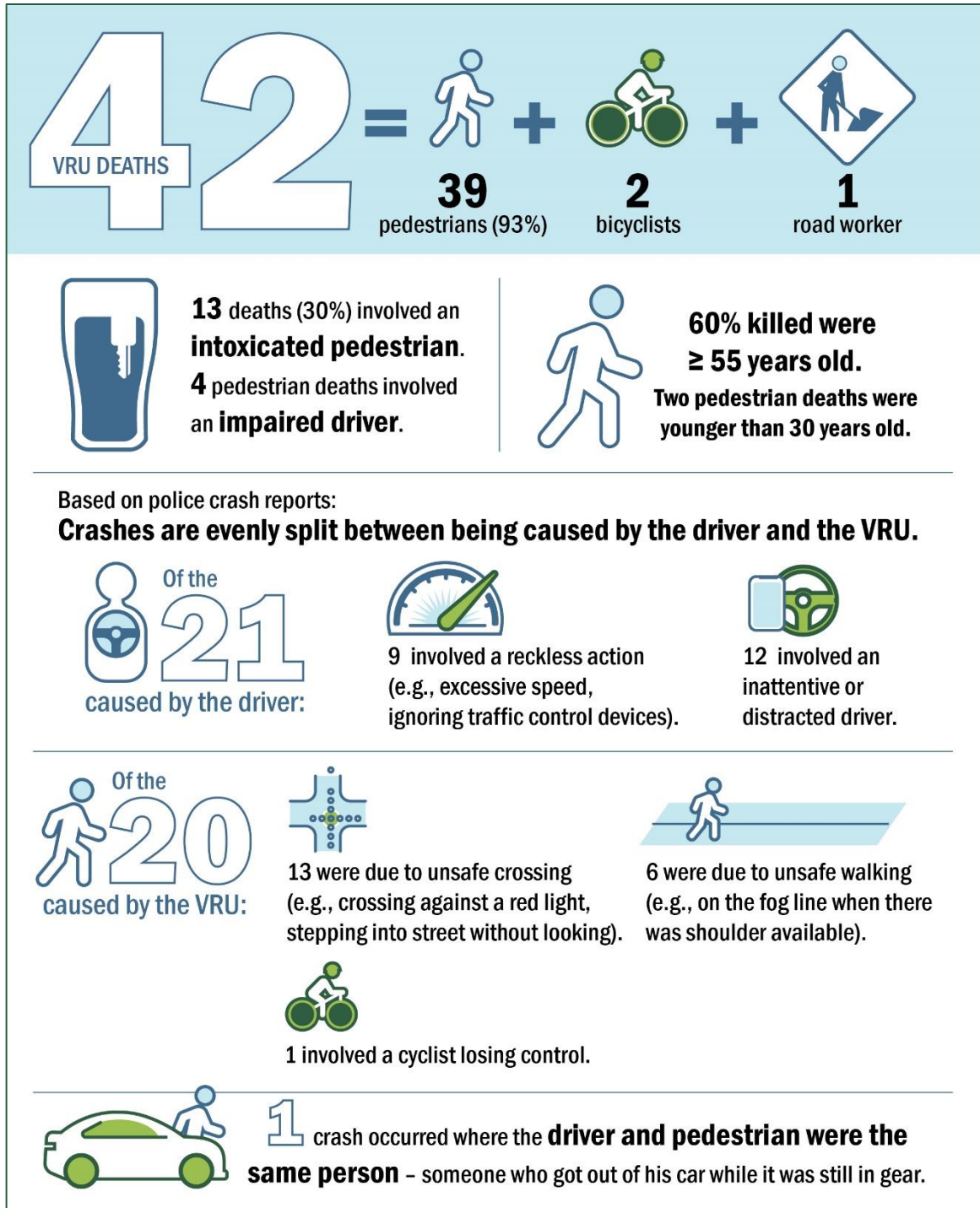
⁵ <https://www.census.gov/quickfacts/fact/table/VT/AGE775222>

⁶ <https://www.census.gov/quickfacts/fact/table/>

⁷ <https://www2.census.gov/library/publications/decennial/2020/census-briefs/c2020br-07.pdf>

Key Findings

Because Vermont has a relatively small number of roadway fatalities compared to larger States, crash narratives could be reviewed in detail to discern trends and patterns. The following summarizes key findings from the 42 VRU deaths from 2017 to 2022:



These findings support the need for a Safe System Approach addressing both infrastructure and behavior, so that when humans make mistakes it does not lead to a fatality or serious injury.

Summary of Quantitative Analysis

To identify high risk areas for VRU fatalities and serious injuries, VTrans calculated a composite score for each census tract. The composite score included five criteria, outlined below:

1. Number of VRU KA crashes (2013-2022).
2. Rate of VRU KA crashes per 100,000 bicycle and pedestrian commuter trips (2017-2022).⁸
3. Rate of VRU KA crashes per 100,000 population (2017-2022).⁹
4. Percent difference between observed and predicted VRU KA crashes.
5. Vermont Social Vulnerability Index (SVI) (2016-2020).¹⁰

Higher-risk areas were identified at the census tract level, with additional outreach to any town containing a high-scoring tract.

Due to the low number and random nature of VRU fatalities and serious injuries in Vermont, it is not appropriate to rely solely on crash history for this analysis as it would overlook other risk factors besides exposure. This methodology combines crash frequency, crash rates adjusted for exposure, a statistical analysis comparing predicted and observed crashes, and a risk-based measure regarding equity considerations.

Vermont Social Vulnerability Index (SVI)

The Vermont Department of Health developed the SVI using U.S. Census Bureau 2016-2020 American Community Survey (ACS) data using 5-year estimates at the census tract level. A census tract is a small, relatively permanent statistical subdivisions of a county or statistically equivalent entity. Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people.¹¹ This risk-based measure accounts for concentrations of sub-populations that may travel as VRUs out of necessity and are at heightened risk. The SVI includes the following 16 criteria:

1. Population below federal poverty level.
2. Population unemployed.
3. Income per capita.
4. Population without a high school degree.
5. Population without health insurance.
6. Population between ages 0 and 17.
7. Population age 65 and over.
8. Population with disability.
9. Households with children headed by single parent.

⁸https://services.arcgis.com/P3ePLMYs2RVChkJx/ArcGIS/rest/services/ACS_Means_of_Transportation_to_Work_Boundaries/FeatureServer/2

⁹https://services.arcgis.com/P3ePLMYs2RVChkJx/ArcGIS/rest/services/ACS_Population_by_Race_and_Hispanic_Origin_Boundaries/FeatureServer/2

¹⁰<https://geodata.vermont.gov/maps/8515b14b8da249d9900a005bde87e921/about>

¹¹[https://www.census.gov/programs-surveys/geography/about/glossary.html#:~:text=Census%20Tracts%20are%20small%2C%20relatively,Statistical%20Areas%20Program%20\(PSAP\)](https://www.census.gov/programs-surveys/geography/about/glossary.html#:~:text=Census%20Tracts%20are%20small%2C%20relatively,Statistical%20Areas%20Program%20(PSAP))

10. Population persons of color.
11. Population with limited English.
12. Housing units in large apartment buildings of 10+ units.
13. Housing units mobile homes.
14. Housing units with crowding (>1 person per bedroom).
15. Population without vehicle access.
16. Population living in group quarters.

High Risk Areas

The analysis developed composite scores for each census tract and the high-risk areas were determined to be the 10 towns and cities with the highest score. If one census tract scored high, then the entire city or town was included as a high-risk area. The high risk areas include cities and towns across the State, accounting for both the areas with high crash frequencies and rates and high risk for a VRU death or serious injury.

The following 10 cities and towns (see Figure 3) represent the areas of greatest risk for VRU fatalities and serious injuries and need to be the primary focus for improvements:

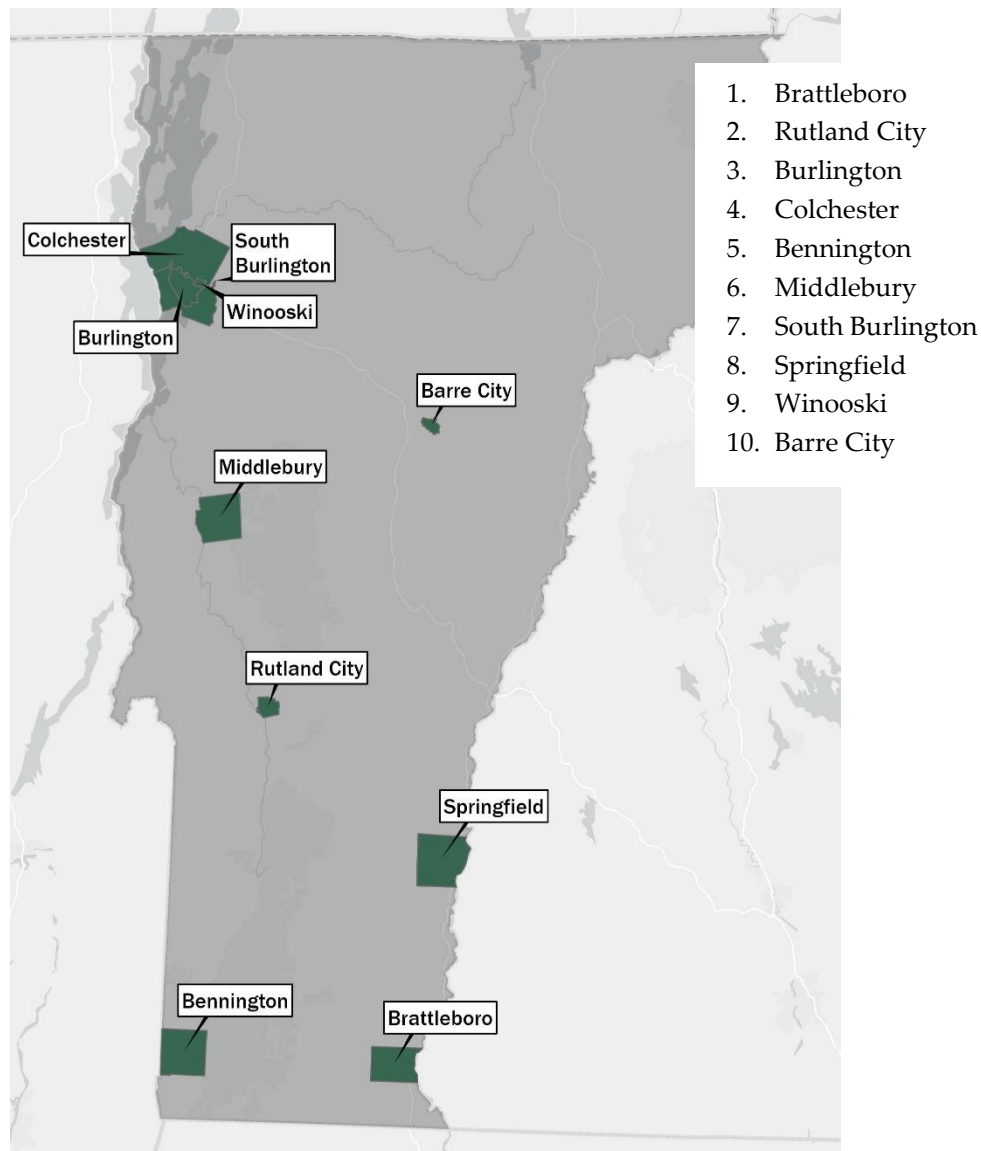


Figure 3. Top High Risk Towns and Cities.

Summary of Consultation

VTrans conducted 1-hour virtual meetings with the identified cities and towns, with MPOs in attendance as able.¹² Each conversation followed a similar format of discussing KA VRU crash data in the jurisdiction, existing infrastructure for pedestrian and bicyclist facilities, commuting verses recreational walking and bicycling, user behaviors and interactions with other modes, safety culture, needs/complaints from residents, and potential countermeasures or projects planned or desired in the future. While data were used to identify the communities for consultations, the discussions were mostly anecdotal and/or qualitative. The following discusses the common themes from the consultation meetings:

Infrastructure & Context

- Certain municipalities described major State Routes bisecting their towns as barriers to VRUs, especially outside village center or downtown areas. This was usually either due to inadequate pedestrian crossings or a lack of VRU facilities/alternate routes. These routes usually contain larger volumes of trucks, higher speeds, and through traffic (e.g., commuters or non-residents) driving to another city/town.
- Sidewalks generally exist in downtown areas and activity centers but are more sparse further from the city/town center. Sidewalk networks are incomplete or missing for pedestrians — regardless of whether they own a car and want to walk or those without cars that must walk.
- Some dedicated bicycle lanes exist in larger cities but are not as frequent in smaller cities and towns. Bicycle lanes are usually incomplete within a city/town and regionally.
- Vermont has cities/towns hundreds of years old and have unique intersection and roadway geometries as a result. For example, some intersections have harsh skew angles (reducing sightlines and can promote higher turning speeds on certain approaches) and are very wide (increasing exposure for pedestrians and bicyclists traversing). Many roads do not have adequate public right-of-way (ROW) to add/enhance/expand pedestrian and bicycle facilities.
- Road crossings usually have overhead lighting, but some segments farther from downtown areas are not as well lit. However, residents tend to not want lighting near their house.
- Smaller cities and towns do not have adequate maintenance forces and/or budget to maintain sidewalks and pavement markings.

User Behavior & Safety Culture

- Municipalities cited mixed experiences with yielding compliance for pedestrians in mid-block crosswalk and at intersections. However, cities/towns using rectangular rapid flashing beacons (RRFBs) at mid-block crossings experienced high rates of drivers yielding.
- Municipalities with marked mid-block crossings tend to see pedestrians crossing at the marked crosswalk. However, if no marked crossings are provided, pedestrians still make mid-block crossings along desire lines.
- Some cities/towns mentioned driver aggression toward bicyclists.

¹² Note that consultations could not be scheduled with Rutland City or Barre City. However, the cities' crash data were reviewed in conjunction with other municipalities to develop the program of projects/strategies.

Countermeasures

- Some cities/towns have plans and/or prioritization methods for sidewalk projects (e.g., bike/walk master plans).
- RRFBs are effective where implemented; there is a perception of more compliance yielding to pedestrians crossing than at other crossings without RRFBs.

Transit

- Outside Chittenden County, public transportation is generally oriented toward intercity travel along commuting routes. Intracity transit is more limited and riders sometimes face inadequate pedestrian facilities between their stop and their destination. Intracity/town transit is needed, especially to accommodate older adults (Vermont has a higher percentage of older adults compared to the national average).

Program of Strategies

The Safe System Approach was considered to address the crash trends and issues noted through the consultations. VTrans, and in most cases, cities and towns, have been planning and implementing proven countermeasures that align with Safe System elements (i.e., Safer Roads, Safer Speeds, Safer Users, Safer Vehicles, and Post Crash Care). The State understands that redundancy is crucial and is created by layering various types of strategies.



The Safe System Approach is a framework for road safety that represents a significant shift from traditional approaches. The principles of the Safe System Approach anticipate human mistakes by designing and managing road infrastructure to keep the risk of a mistake low; and when a mistake leads to a crash, to mitigate the impact on the human body to help reduce fatalities and serious injuries. Managing the forces surrounding a crash is especially important for VRUs since they do not have the same protection offered inside a vehicle. Road design and management should encourage safer speeds. The responsibility to create such a Safe System is shared among all transportation stakeholders, from transportation system users to roadway managers, designers, law enforcement, educators/advocates, engineers, and planners. The VRU Assessment’s program of projects/strategies aligns with the Safe System Approach by creating safer road and speeds at high-crash locations and locations with higher risk of crashes occurring, even if no crash history exists. It is imperative that redundancy is built into the transportation system so that safety is never fully dependent on one facet of the system.

The following strategies were developed based on crash data analysis, consultations, and the Safe System principles and elements.

Strategy 1. Increase Visibility of VRUs

This strategy recommends measures that increase conspicuity where pedestrians are more exposed and vulnerable—nighttime and at crossing locations. The following countermeasures can be considered for installation in applicable contexts:

- Lighting at intersections, mid-block crossings, and along the roadway.
- Trim vegetation for sight distance.
- High visibility crosswalk markings.
- New marked mid-block crossings where needed, considering RRFBs and pedestrian refuge islands on roads with higher speed and more than two lanes.
- No Turn on Red and/or Leading Pedestrian Intervals at signalized intersections.

Strategy 2. Separate VRUs in Space

Providing pedestrians and bicyclists with dedicated facilities decreases opportunities for conflicts with motor vehicles. The following countermeasures can be considered for installation in applicable contexts:

- Expand and connect sidewalk and/or shared use path networks to extend outside city/town centers, where pedestrians may not have access to vehicles, or who do own a vehicle but choose to walk.
- Consider pedestrian refuge islands on multilane roads to facilitate a safer crossing.
- Consider bicycle lanes, with buffered bicycle lanes and separated bicycle lanes with vertical elements from the travel lane being the safest.
- Allocate roadway width to accommodate wider shoulders and/or bicycle lanes (can be done in conjunction with repaving projects).
- Install Americans with Disabilities Act (ADA) compliant curb ramps and pedestrian crossing signals based on VTrans' ADA Transition Plan, which will be especially accommodating for Vermont's aging population and pedestrians with disabilities.

Strategy 3. Safer Speeds

To decrease injury severities when a crash occurs, vehicle speeds and crash forces should be managed so that the kinetic energy transferred does not exceed the tolerances of the human body. The following countermeasures can be considered for installation in applicable contexts:

- Towns with major State routes experience high traffic volumes and often have transitions from 50 mph to 25 mph speed limits. Gateway treatments, such as roundabouts, will require vehicles to decrease speeds to navigate the intersection. Crosswalk enhancements (e.g., signs and RRFBs) may also be used to alert drivers to reduce speeds and be aware of VRUs.
- In addition to gateway treatments, circular intersections, such as roundabouts for larger intersections and mini roundabouts in residential areas, can be used as a safer alternative to traditional stop-controlled intersections because the potential for more severe crash types (e.g., head-on, angle, and turning crashes) is eliminated.
- Consider traffic calming measures in residential areas, such as bulb outs and chicanes.

- Convert two-way minor stop-controlled intersections to all-way stop controlled intersections, where warranted. This countermeasure could be applied in both urban contexts (e.g., neighborhood streets) and in rural areas.

Strategy 4. Establish VRU Safety Culture

The strategies in the Pedestrian and Bicyclist Critical Emphasis Areas in Vermont’s SHSP align with the results of the data analysis and consultation feedback regarding education and established safety culture between modes.

- Implement and promote educational programs for VRUs regarding proper equipment and safe riding in traffic (specifically for bicyclists) including commuter programs and Safe Routes to School.
- Improve and promote understanding and education for pedestrians, bicyclists, and motorists on rules of the road and how to properly share the road; include law enforcement in education and outreach efforts.

Strategy 5. Increase Transit Options

Increase intracity transit for people without access to vehicles, such as the elderly population, people with disabilities, low-income individuals, and school-aged children and teens. Increased transit options may also decrease vehicle usage, reducing opportunities for collisions between vehicles and VRUs.

Strategy 6. Conduct VRU-Related Planning Activities

Developing specific safety action plans will put cities/towns in a better position to apply and receive grant funding for implementation. The planning process has the benefit of bringing together transportation safety stakeholders, community, and advocacy groups to identify and address safety issues.

- Develop sidewalk inventory and prioritization plan (for cities/towns without an existing plan). A sidewalk inventory may be included as part of a larger asset management program in a town/city.
- Develop pedestrian and bicyclist plans (e.g., master plans, safety plans, action plans).
- Develop ADA Transition Plans for high-risk towns without ADA Transition Plans (i.e., Burlington, South Burlington, Rutland, Bennington, Barre, Winooski, and Middlebury).

Implementation



As indicated above, VTrans has already focused on Vulnerable Road Users in the SHSP by identifying Pedestrians and Bicyclists as a Critical Emphasis Area. As a part of that identification, the SHSP identified seven strategies in the Pedestrians and Bicyclists Action Plan. The recommendations in this Assessment are consistent with those strategies which include a focus on continuing to accommodate pedestrian and cyclists in the roadway network through roadway design, implementing educational programs, and supporting pedestrian planning.

VTrans' Strategic Highway Safety Office (SHSO) currently leads safety education efforts including those around bicycles and pedestrians (**Strategy 4**). SHSO uses grant funding to support the Vermont Department of Health's (DOH) "Watch for Me VT" campaign,¹³ which uses public service messages and community engagement to increase visibility of VRUs. The program also provides educational material and expert consulting to leaders and community members (e.g., government staff, VRU advocates, city planners, law enforcement agencies, engineers, public health professionals, the media, influencers, elected officials, parents, educators, and concerned citizens). Another SHO Program, Drive Well Vermont,¹⁴ calls attention to some of the items noted in the data breakdown of this assessment: distracted driving, impaired driving, and speeding and aggressive driving. Although not specifically to address bicycle and pedestrian crashes, improvements in these areas should also work to reduce VRU fatalities and serious injuries. The Safe Routes to School program, coordinated by Local Motion,¹⁵ is part of the VTrans' Bicycle and Pedestrian Program. It is a comprehensive program that strives to make it safe and easy for students to get to school on foot and on wheels through education and community outreach in Vermont Schools.

VTrans is also already addressing VRU safety (**Strategies 1 to 3** of this Assessment) through project development and the Complete Streets policy that seeks to include infrastructure improvements for bicyclists and pedestrians in projects, including during construction. Items such as designing properly for the desired speeds, accommodation of bicycles and pedestrians and evaluation of sight lines and lighting are considered in each project. At the time of this Assessment, VTrans is developing a new version of the Complete Streets policy.

Moving into the future, VTrans is working to better align its HSIP spending with the crash profiles. As such, a focus will be on spending on rural improvements to a higher percentage. In addition, there will be greater investment on the local roadway system which has historically had lower investment.

VTrans currently provides bicycle and pedestrian grants to municipalities to improve the accommodation of these users, which specifically addresses **Strategy 2** of this Assessment, but can also include pieces of **Strategies 1 and 3** as well as projects are developed. These grants have been used to plan, design, and build sidewalks and shared use paths throughout the State, as well as crossing improvements. Municipalities are responsible for maintaining sidewalks through their towns, including on State highways.

Recently VTrans has initiated a safety grant for projects on local roadways. In the initial year, 40 communities applied for funding for a variety of signage, striping, and removing sight distance projects, totaling \$1,000,000. In the future, the countermeasure focus of this grant program is anticipated to change. A program specifically to improve bicycle and pedestrian infrastructure could be incorporated and support the communities included in the outreach who indicated that

¹³ <https://safestreets.vermont.gov/WatchForMe>

¹⁴ <https://drivewell.vermont.gov/>

¹⁵ https://www.localmotion.org/about_srts

the ability to invest in this infrastructure is significantly limited. Specifically, items such as lighting and sight distance improvements at crossing locations, speed reduction treatments of transition areas, and bicycle and pedestrian infrastructure could all be considered as countermeasures in the grant program moving forward.

Strategy 5 will need to move forward in a collaborative way with transit providers and administration; however, in areas that currently have transit, VTTrans can continue to evaluate the proper locations for transit stops that are separated from the traveled way through the delivery of projects as well as the municipal grant program. In addition, in areas with existing transit service, consideration of the connections between the transit stops and key destinations should be considered on all projects.

Strategy 6, VRU-related planning activities, is currently occurring to varying levels in the State, but most specifically supported by Chittenden County Regional Planning Commission. This is another potential area for additional investment in the local grant program to enable municipalities outside of that metropolitan area to conduct planning.