Chittenden County
I-89 2050 Study

FINAL REPORT

PREPARED FOR
Chittenden County Regional
Planning Commission

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Contents

The Chittenden County I-89 2050 Study is a collaborative effort of the Chittenden County Regional Planning Commission (CCRPC) and the Vermont Agency of Transportation (VTrans) to develop a comprehensive investment program for the 37 mile I-89 corridor in Chittenden County, Vermont through 2050. The project involves the development of a Vision, Goals, and Objectives which will guide the identification and prioritization of enhancements for the I-89 corridor over the next 30 years.

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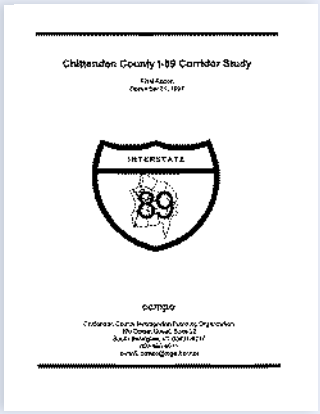
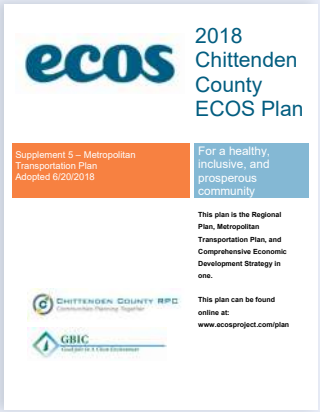
SECTION 1

1 Project Overview

Chittenden County is home to a little over 37 miles of Interstate 89 which is the only primary interstate highway within Chittenden County. An additional 1.5-mile spur of an auxiliary route, Interstate 189, which is accessed via Exit 13 in South Burlington. Seven interchanges are within Chittenden County spanning the numbered designations 11 in Richmond at the south through 17 in Colchester at the north.

The broad intent of this study is to assess the safety and capacity of Interstate 89, identify existing and future multimodal needs, develop and evaluate improvements, examine transportation and land use impacts of new or expanded interchanges, determine asset management/maintenance needs, and develop an implementation plan for making recommended investments.





TOP: Cover page of the 1997 Chittenden County I-89 Corridor Study.

BOTTOM: Cover of the Chittenden County Metropolitan Transportation Plan

1.1 Project Background

Capacity and safety issues on Interstate 89 in Chittenden County have been evaluated numerous times over the years and were last systematically examined in the 1997 Chittenden County I-89 Corridor Study (see Overview of Previous Studies Appendix for previous studies of the I-89 corridor in Chittenden County). Since the completion of the 1997 study, several enhancements have been made to the I-89 corridor through Chittenden County, including expanded interchange ramps at Exits 11, 12, 14 and 15, and plans for significant interchange reconstruction projects are currently programmed at Exits 12, 16, and 17.

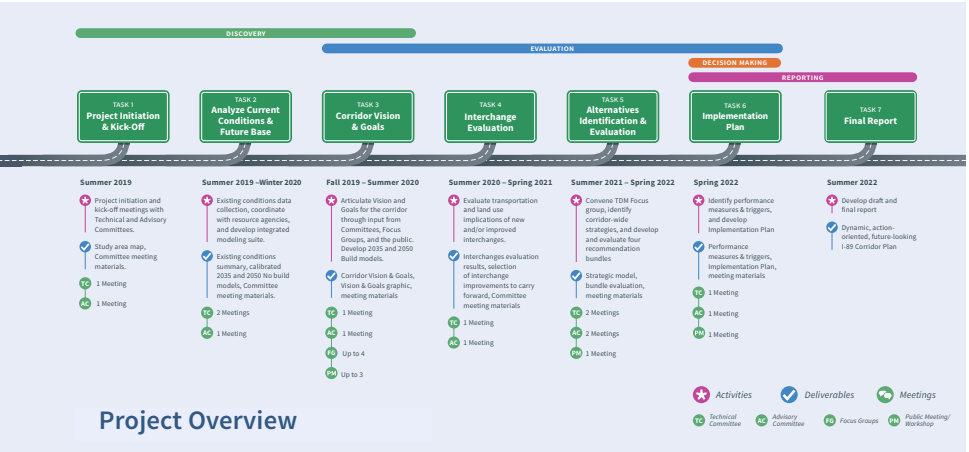
During the development of the current Chittenden County Metropolitan Transportation Plan (MTP) in 2018, the CCRPC evaluated numerous future transportation system and growth scenarios to develop a plan that best achieves the defined goals of providing accessible, safe, efficient, interconnected, secure, equitable and sustainable mobility choices for the region's businesses, residents and visitors. To strike a balance between promoting livable communities and addressing capacity constraints, the resulting 2050 MTP program includes the addition of Exit 12B (as a placeholder for future interchange improvements between Exit 12 and Exit 16) and the addition of a third lane on I-89 between Exits 14 and 15.

As the development of the 2050 MTP concluded, the CCRPC committed to studying the I-89 corridor more holistically through this I-89 2050 study to identify a comprehensive package of improvements for the I-89 corridor in Chittenden County through 2050 and to re-evaluate the needs for both Exit 12B and mainline widening through 2050.

1.2 Vision, Goals, and Objectives for the I-89 Corridor

The Vision, Goals, and Objectives for the I-89 Corridor were developed through an extensive and iterative process with both the Advisory Committee and members of the public to arrive at an overarching vision and goals for the I-89 corridor that best aligns with local, regional, and statewide priorities. The Vision, Goals, and Objectives outlined below are intended to help guide corridor investment and policy decisions over the next thirty years.

As the Vision and Goals statement was being developed, the project Advisory Committee recognized that, due to the significant uncertainty about long-lasting changes on where people will live and how they will travel in the future due to the COVID-19 pandemic, technology, demographics, and other dynamics, the I-89 Vision, Goals, Objectives and implementation actions will need to be reassessed periodically to ensure that they address the evolving situation. The Implementation Plan chapter outlines specific corridor monitoring recommendations to help ensure future decisions are aligned with changing travel and demographic trends.



Project Overview

Vision Statement

The 2050 Vision for the I-89 Corridor through Chittenden County is an interstate system (mainline and interchanges) that is safe, resilient, and provides for reliable and efficient movement of people and goods in support of state, regional, and municipal plans and goals.

Project Goals

Safety

Enhance safety along the I-89 Study Corridor and areas surrounding adjacent interchanges for all users

- Reduce the frequency and severity of crashes along the I-89 Study Corridor and at adjacent interchanges
- Enhance safety of bicyclists and pedestrians at areas surrounding interchanges
- Improve incident response with operational improvements (e.g. information and interstate access)

Livable, Sustainable and Healthy Communities

Promote compact, smart growth that supports livable, affordable, vibrant, and healthy communities

- Invest in transportation infrastructure that encourages transportation choice, transportation affordability, and smart growth in the urban core of the county and is consistent with state, regional and municipal plans and goals
- Ensure that transportation improvements do not disproportionately impact low income and minority populations negatively and prioritize improvements with positive impacts

Mobility & Efficiency

Improve the efficiency and reliability of the I-89 Corridor and Adjacent Interchanges for all users

- Accommodate current and anticipated future traffic demand, with a particular focus on the urban core (Exits 12-16). Continually monitor traffic volumes and develop triggers for specific improvements
- Maintain reliable travel times for people and goods along the corridor
- Address the mobility needs of all users, including those without access to automobiles
- Improve connectivity to support walking & bicycling through the study area interchanges
- Increase current and future public transportation access and/or services

Environmental Stewardship & Resilience

Establish a resilient I-89 Corridor that minimizes environmental impacts associated with the transportation system

- Improve water quality and stormwater treatment
- Reduce greenhouse gas emissions associated with fossil fuels used in transportation
- Improve wildlife and habitat connectivity
- Improve the ability of I-89 to withstand and recover from extreme weather events

Economic Access & Vitality

Improve economic access and vitality in Chittenden County

- Support anticipated economic growth in the region
- Accommodate freight and goods movement served by the I-89 Corridor, considering possible diversion of freight to other forms of transportation

System Preservation

Preserve and improve the condition and performance of the I-89 Corridor

- Provide for sound and effective maintenance and preservation activities to achieve a "State of Good Repair" of the I-89 Corridor

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SECTION 2

Summary of Public Outreach

2.1 Summary of Public Outreach

The approach to Public Participation and Stakeholder Engagement focused on being open, inclusive, and interactive—providing multiple opportunities throughout the process to engage with the project's development and multiple platforms for providing input.

This multiyear study solicited input and feedback from a broad and diverse group of stakeholders and the public. The Public Participation Plan for the Chittenden County I-89 2050 Study was designed in the spirit of the CCRPC's Public Participation Plan guidelines. The plan was predicated on an effective public outreach campaign that involved transportation stakeholders and the broader public early in the process, checked in with them frequently, and supported a broad and inclusive outreach effort to present the final plan. Input, comments, and feedback were continuously solicited and incorporated into the technical work. The intent of the public involvement effort was to foster a spirit of inclusiveness, transparency, and collective ownership of the study and its recommendations—providing multiple opportunities throughout the process to engage with the project's development and multiple platforms for providing input. A full list of all outreach meetings is included in the Appendix of this document.

Public involvement was integrated into all aspects of the work plan. Participation elements included Advisory Committee and Technical Committees, Focus Groups, Public Meetings/Workshops, Outreach to Underrepresented Groups, and public outreach tools.

2.1.1 Advisory Committee

A project Advisory Committee, comprised of a broad cross-section of municipal leaders, transportation providers, regional planners, environmental advocacy groups, and business leaders, provided input and guidance on a wide range of topics from study goals and stakeholder engagement strategies to scenario planning and alternatives evaluation and ultimately served as the decision-making body.

Advisory Committee Role:

The Advisory Committee will **provide input and guidance** on a wide range of topics from study goals and stakeholder engagement strategies to scenario planning and alternatives evaluation and decision-making. This group will function as a body with wide knowledge who can speak on behalf of many communities impacted by this project and will **help in the decision-making process** throughout the project.

The Advisory Committee (AC) was a relatively large and diverse group (24 organizations represented), composed of representatives from State agencies, adjacent Regional Planning Commissions, municipal staff, transportation providers, and nonprofits. Charlie Baker, Executive Director of the CCRPC served as Chair. The AC met seven times between June 1, 2019 and May 18, 2022. The AC was ultimately responsible for accepting the Implementation Plan for the entire study.

2.1.2 Technical Committee

A project Technical Committee, comprised of members from VTrans, FHWA, the Cities of Burlington and South Burlington, and the CCRPC, focused on the key technical issues and decisions that arose during the course of the study—including goals and criteria, confirmation of data collection, technical design criteria, inputs to scenarios, and the technical review of the alternatives and final plan recommendations.

The Technical Committee (TC), including representatives from the CCRPC, VTrans, FHWA, and CCRPC Technical Advisory Committee members, met ten times between June 6, 2019 and April 5, 2022. These meetings preceded AC meetings with the discussions focused on the key decisions that need to be advanced—including the definition of the study goals, the refinement of the stakeholder outreach plan, the scenario planning and alternatives evaluation, and the refinement of the final implementation plan.

2.1.3 Focus Groups

Focus groups provided an opportunity to connect with targeted groups of interested parties to solicit meaningful input on a particular topic or topics during the study.

The following Focus Groups were engaged during the study:

- **Freight and Logistics Providers:** Vermont Truck and Bus Association online survey to the membership in March 2020
- **Emergency Management Officials:** Vermont State Police, Vermont Emergency Management, VTrans Operations and Safety, Williston Fire Department, Milton Fire Department, Richmond Rescue
- **Environmental & Natural Resources:** Vermont Department of Conservation, Vermont Fish and Wildlife, Army Corps of Engineers, Environmental Protection Agency, Vermont Division for Historic Preservation

Technical Committee Role:

The Technical Committee will focus on the key **technical issues and decisions** that need to be advanced during the course of the study—including study goals, technical design criteria, outcomes from modeling and other evaluations, and review of the alternatives and final plan recommendations. This group will function as the body that will ensure **quality from a technical standpoint** throughout the life of the project and assist the project team with **disseminating complex concepts** and technical information to the Project's Advisory Committee.

- **Transportation Systems Management & Operations (TSMO) and Intelligent Transportation Systems (ITS)**: VTrans representatives from across the agency
- **Asset Management:** VTrans Asset Management Bureau staff and representatives from across the agency
- **Major Employers:** University of Vermont (UVM), UVM Medical Center, Champlain College
- **Delphi Panel:** A panel of experts on commercial and residential development and community planning to inform the land use changes and induced demand from various transportation infrastructure investments
- **Transportation Demand Management (TDM) Focus Group:** This Focus Group of 12 participants provided input on strategies for Interstate interchanges and corridor investment bundles (that included all modes of transportation). It assisted the Project Team to prioritize TDM strategies for further evaluation

2.1.4 Public Meetings and Workshops

Seven public meetings were held over the course of the study. The first three public meetings were held in-person between January and March of 2020 and the final four meetings were held virtually due to the COVID-19 pandemic.

Outreach for meetings (when allowable during the pandemic) included County-wide and City-wide Front Porch Forum posts, Envision89 postings, municipal calendar listings, event posting on social media (Facebook and Twitter, Envision89 and municipal channels), CCRPC ENewsletter, email blasts to CCRPC's mailing list, online calendars/ notifications in local media, flyers, and Town Meeting Television. All virtual meetings were live streamed and available on demand from Town Meeting Television.

Figure 1: Summary of Public Comments by Source

2.2 First Round of Public Outreach

The first round of public outreach was held from January through March 2020 and focused on introducing the project and soliciting feedback on current issues and opportunities along the corridor as well as requesting input on the draft project Vision and Goals.

The following three public meetings were held as part of the first round of public outreach:

- **South Burlington:** South Burlington City Hall, January 30, 2020
- **Williston:** Williston Town Hall, February 13, 2020
- **Winooski:** Winooski City Hall, March 11, 2020

Each of the public meetings was also live streamed online so interested citizens could participate in the meetings even if they could not attend in person. The format was the same at each meeting. Sixty-two members of the public signed-in and six municipal staff attended.

In addition to the public meetings noted above, public input was also collected through emails, website comment forms and an online survey posted to the project website during the January to March 2020 outreach period. A total of 309 comments were received from the public during the first round of outreach. These comments are summarized by source in Figure 1.

To assist with compiling and summarizing the public input, each of the individual comments was associated with a more general issue, concern, or opportunity. As shown in the table below, these comments were sorted into three main comment groups: 1) promoting alternative transportation modes and livable communities 2) interchange improvements, and 3) interstate widening. Based on this grouping of comments, approximately 45% of the comments related to increased support for alternative transportation modes, 32% of the comments supported some level of interchange upgrades, while almost an equal number of commenters supported the widening of I-89 as those who did not support widening the interstate.

Table 1. Public Comment Summary by General Category

Comment Group	# of Comments	% of Comments
Increase Bicycle & Pedestrian Infrastructure Investment	49	16%
Increase Public Transit Investment, Reduce Auto Dependency	67	22%
Promote Livability, Climate Change Concerns	23	7%
Interchange Upgrades—**Support**	99	32%
Interchange Upgrades—**Don't Support**	3	1%
Widen I-89—**Support**	14	5%
Widen I-89—**Don't Support**	12	4%
Other	41	13%

The table below summarizes a more detailed tabulation of the issues and opportunities identified by the public. As shown in the table, increased investment in public transportation (which included individual comments such as increasing bus frequency and service area, expanding park-and-ride lots, and providing commuter rail service) received the most comments. Comments related to expanding bicycle and pedestrian infrastructure and support for a new Exit 12B at Hinesburg Road/VT 116 both received the second most comments.

Table 2. Summary of Public Comments by Issue/Opportunity Category

# of Comments	Issue/Opportunity
38	Increased Investment in Public Transportation
34	Additional Bike/Ped Infrastructure
34	Exit 12B—**Support**
22	Reduce Auto Dependency
17	Exit 13 Full Interchange—**Support**
15	Exit 14 Bike/Ped Bridge—**Support**
14	Exit 14 Improvements—**Support**
14	Widen I-89—**Support**
13	US 2 Traffic Improvements at Exit 14
12	Widen I-89—**Don't Support**
12	Circ Highway—**Support**
10	Noise Walls—**Support**
8	Climate Change
8	Exit 10B Bolton Interchange—**Support**
7	HOV/Transit Lanes
5	Promote Livable Communities
4	Exit 11 - Geometric Improvements
4	Exit 15 Full Interchange—**Support**
4	ITS/Technology
3	Vision
2	Exit 12B—**Don't Support**
2	Exit 16—**Support**
2	Exit 17N—**Support**
1	Exit 10B Bolton Interchange—**Don't Support**
1	Exit 17—**Support**

In addition to soliciting input on issues and opportunities, the online survey also asked participants to identify their top priority for the corridor. 36% of survey participants identified "Reduce Congestion" as their top priority, 30% identified "Improve Resilience/Minimize Environmental Impacts" as their top priority, 29% identified "Improve Safety" as their top priority, and 5% identified "Promote Economic Development" as their top priority.

Public comment information, meeting presentation and notes, and links to recorded meeting videos are detailed in the Appendix.

Figure 2. Word Cloud Generated by First Round Public Comments

2.3 Second Round of Public Outreach

The second round of public outreach was held between February and May 2021. The aim of the second round of outreach was primarily to solicit feedback on the interchange concepts and evaluation. The possible interchange options were narrowed in a first round, high-level screening. The second round of evaluation developed conceptual alternatives for three possible interchanges at Exit 14, Exit 13, and Exit 12B. Altogether, five different concepts were developed and evaluated, two at each of the existing interchanges and one at a new interchange.

With the aim of progressing interchange concepts forward into broader project and program bundles for the corridor, two additional areas of outreach were imperative. The first was targeted outreach to the community most affected by the interchange concepts as the interchange alternatives would all connect directly to South Burlington. The second was outreach to populations that are often underrepresented in transportation planning and decision-making to understand the transportation challenges and priorities for their communities.

2.3.1 Targeted Stakeholder Outreach

Stakeholder engagement at this phase of the project was expanded to target communities most directly impacted by the interchange concepts (i.e. South Burlington). The project team presented at a South Burlington City Council meeting on February 16, 2021, met with an assembly of the South Burlington Committees on March 10, 2021, held a special South Burlington-focused virtual public workshop on March 18, 2021 which included 49 participants, held a workshop with the South Burlington City Council on March 29, 2021, and followed up with a presentation at the South Burlington City Council Meeting on April 19, 2021. In addition, meetings were held with the South Burlington Business Owners and South Burlington Rotary to provide a short presentation on the concepts and garner input from these communities.

2.3.2 Outreach to Underrepresented Populations

Stakeholder engagement for this phase of the study was specifically aimed at garnering input from underrepresented or marginalized communities on the study, process, and interchange concepts.

Community Focus Groups: Three Focus Groups were designed to solicit information about transportation issues faced by those traditionally left out of the planning process and strategies to help them improve their mobility. A third Focus Group included representatives from the Association of Africans Living in Vermont (AALV) and other community members. These meetings were held virtually in early March of 2021. Meeting notes from each of these meetings can be found in the appendix.

Transportation Equity Coalition Focus Group: The Study Project Manager met with 6 members of the Old Spokes Home's Transportation Equity Coalition on March 24, 2021 and April 4, 2021.

2.3.3 Planning Commissions and Public Meeting

During this round of outreach, the project team additionally presented updates on the study to the CCRPC Board, Transportation Advisory Committee, CCRPC Planning Advisory Committee, and Northwest Regional Planning Commission. This round of outreach culminated with the fifth public meeting of the project, which was attended by 132 participants, focused on analysis of interchanges, and held virtually on April 29, 2021. The focus of the meeting was to review the evaluation of the interchange alternatives and gather input on additional projects and programming for the corridor bundles to progress forward through evaluation.

2.4 Third Round of Public Outreach

The third round of public outreach was focused on the development of the project and program bundles, bundle evaluation, and ultimately the advancement of projects and programs in the Implementation Plan for the I-89 corridor going forward. The steps taken towards developing the Implementation Plan and recommended actions were brought to stakeholders and the public for their input and feedback throughout this third round of engagement. This engagement spanned two periods, the first focused on the demand management scenario development process and the second on the corridor bundle evaluation and Implementation Plan culminating in May 2022.

2.4.1 Transportation Demand Management Engagement

Following the second round of outreach and engagement, feedback was gathered and brought back to the Technical and Advisory Committees with the aim of progressing forward a set of bundles that included programs and projects for the full I-89 corridor. As part of the feedback process, it became clear that at least one of the project bundles would require a more in-depth evaluation of transportation demand management and telework opportunities to gain an understanding of how impactful such strategies may be in future scenarios.

A Transportation Demand Management Focus Group was assembled and met once a month for three months through the process of developing a strategic model to evaluate scenarios which leverage a wide variety of demand management strategies, policies, and investments. The focus group helped to guide the mix of policy and investment levels appropriate for Chittenden County to include increasing telework, mixed use walkable neighborhoods, frequency of transit, bike mode share, paid parking, carbon tax, mileage-based fees, fuel costs, and electric vehicles in the fleet. The strategic modeling outcomes and their integration with the travel model for evaluation of project and program bundles are summarized in a technical memorandum in the Appendix and in a public meeting held on January 26, 2022. This sixth public meeting was held virtually with 51 participants attending. The Advisory Committee convened on February 8, 2022 to review the strategic modeling outcomes and unanimously supported the integration of the TDM and telework bundle as part of the bundle evaluation in the study's next steps.

2.4.2 Bundle Evaluation and Implementation Plan

Equipped with feedback on the interchange concepts and demand management and telework scenarios, the corridor bundles were developed and evaluated. These bundles are described in more detail below in the Corridor and I-89 Mainline Recommendations section. Vetted initially by the Technical Committee, the bundle evaluation was used to craft the draft Implementation Plan, spelling out the action plan for the corridor into the future. The evaluation and draft Implementation Plan were brought before the public in a final public meeting for the study. The meeting was held virtually on May 10, 2022 with 40 participants. An open comment period solicited comments from six members of the public. Input from the meeting participation and open comment period helped to clarify and refine the short, medium, and long term actions, including the triggers for various actions into the future.

The bundle evaluation and refined implementation plan were brought to the Advisory Committee for review on May 18, 2022. Through discussion, further refinements to the Implementation Plan actions were adopted and the Advisory Committee motioned to approve the Implementation Plan unanimously.

2.5 Public Outreach Tools

In order to ensure that members of the public and committee members were kept well-informed throughout the study process and have ample opportunity to provide feedback, a number of information sharing tools were made available.

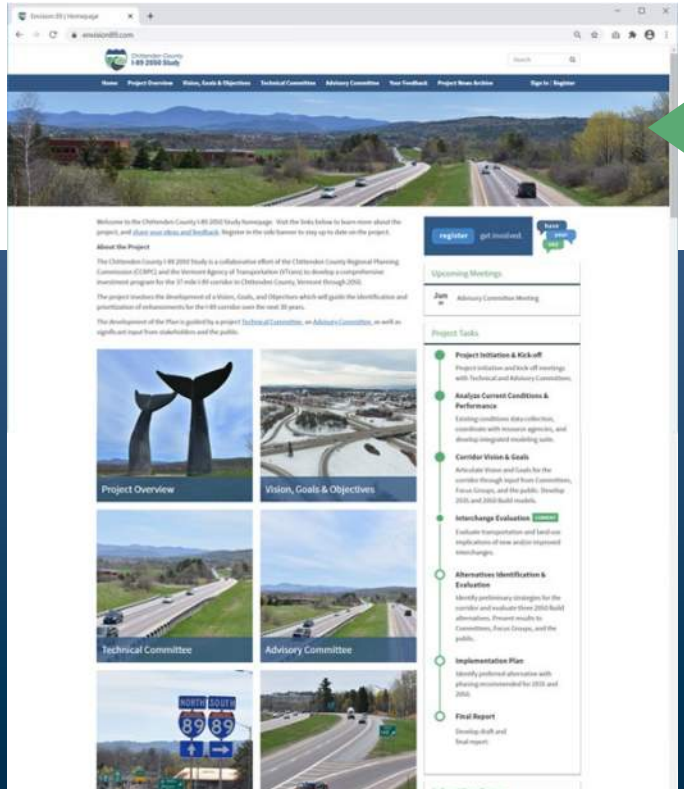
Project Website: The Envision 89 website (http://www.envision89.com/) provided up-to-date information on the project, including an overview of the project schedule, key milestones, committee membership, meetings and events, as well as project team contact information and a public comment form. All committee meeting agendas, presentations, meeting notes, and recordings (where available) were included with presentation materials. In total, there were over 10,300 visits to the website through the course of the study with the peak website activity coming in April 2021. Many visitors to the website visited multiple pages and

over 1,800 participants downloaded relevant project materials from the website. For instance, the conceptual alternatives for the I-89 interchange improvements were downloaded the most of any of the documents on the site with 360 individual visitors downloading the concepts. Furthermore, 259 individuals registered with the website so they would receive more direct communications regarding the study and stay informed of project meetings and progress.

Virtual Public Meetings: Meetings during the pandemic were held virtually, recorded, and live streamed by Town Meeting Television. This allowed for greater participation, since travel was unnecessary.

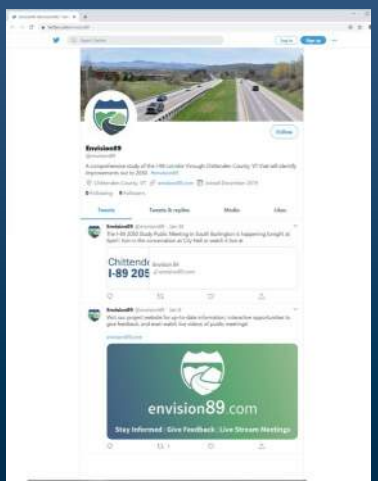
Social Media Outreach: Social media outreach included Facebook, Twitter, and Instagram posts to continually publicize outreach effort. In addition, the Cities of Winooski and Burlington posted events through their social media outlets.

Email List: A mailing list of interested parties was maintained throughout the study. Those registering on the project website were added to the mailing list. By the end of the study, over 200 people were receiving direct emails regarding meetings and outreach events.



Envision89.com Visitation Statistics

10,293	247	88
SITE VISITS	SITE REGISTRATIONS	ACTIVATED PARTICIPANTS




OPPORTUNITIES
INCREMENTAL IMPROVEMENTS
INCENTIVIZE TRANSIT
PARK + RIDE
REDUCE S.O.V. USE
WIDEN FOR H.O.V.s BUSES
USE BREAKDOWN LANES?
RECRUIT
ATTRACT
RICHMOND
Village
Park + Ride
BUILD
MINDS HAVE CHANGED
GO OVER
SUPERFUND
THINK CREATIVELY
- LESS COST
- FLEXIBILITY
SAFETY!
12(B)
COULD GROW

3

SECTION 3

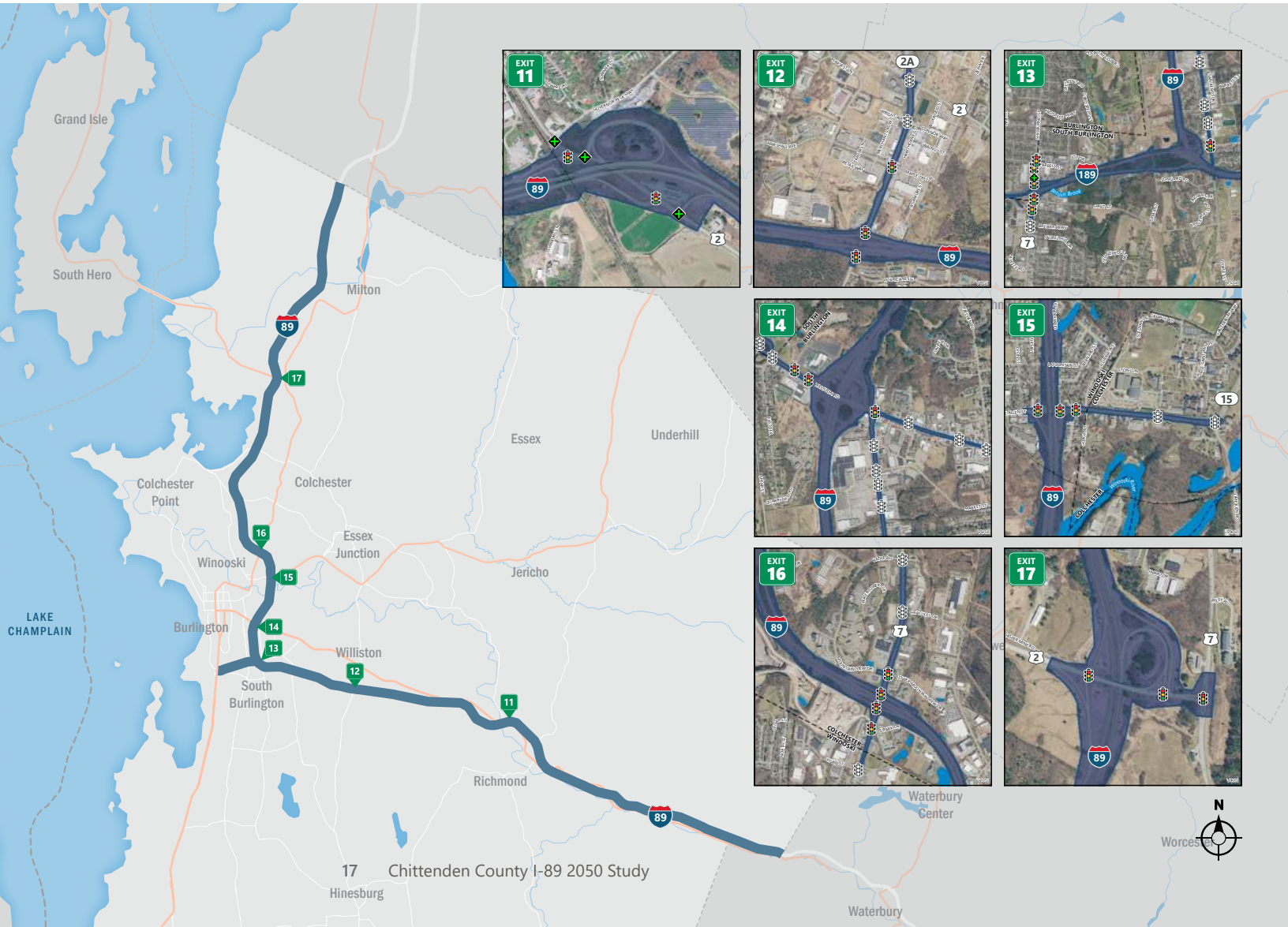
Existing Conditions Assessment

3.1 Existing Conditions Assessment

The I-89 corridor spans approximately 37 miles from the southeast corner of Chittenden County in Bolton to the northwest corner of Chittenden County in Milton. Traveling north on the interstate, I-89 passes through the towns of Bolton, Richmond, Williston, South Burlington, Winooski, Colchester, and Milton. Interchanges along the limited access facility include the numbered exit designations 11 through 17. In addition, I-189 is a 1.5-mile spur accessed via Exit 13 and connects to US Route 7 in South Burlington and eventually to the Champlain Parkway once it is constructed.

As a population, employment, and retail hub in Northwest Vermont, I-89 serves as the primary travel corridor for commuters, visitors, shoppers, and freight providers to access the Burlington metropolitan area, as well as serving longer distance through trips. The annual average daily traffic (AADT) between Exit 14 and 15 ranks this corridor the busiest in the state of Vermont at approximately 55,000 vehicles per day. I-89 has a southern terminus at I-93 in Bow, New Hampshire and a northern terminus at the Canadian border crossing in Highgate, Vermont.

Figure 3: I-89 2050 Study Area Map



3.2 Corridor Land Use Context

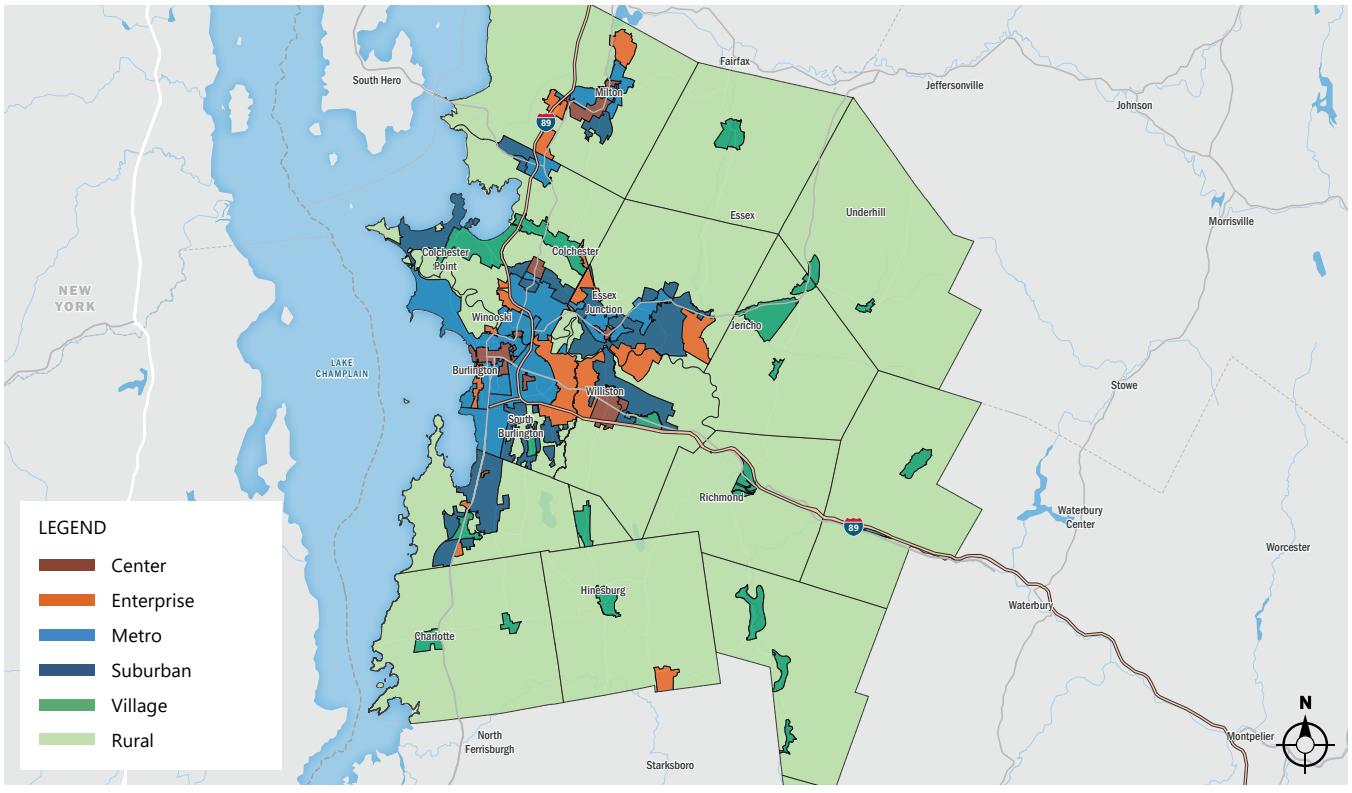
The I-89 corridor in Chittenden County runs northwest along the Winooski River from Bolton through Richmond, continues towards Burlington then travels north to Milton. The corridor serves the largest population and employment centers in the state of Vermont concentrated around the Burlington area and extending outward. Chittenden County is home to over 168,000 people[1] across approximately 74,000 housing units[2].

The region is home to the state's only Level 1 Trauma Center at the University of Vermont Medical Center, the state's land-grant University of Vermont along with other colleges, and Burlington International Airport which accommodates both commercial and military flights. As a hub of healthcare, education, and technology, the project corridor is host to some of the state's largest employers including the University of Vermont Medical Center, the University of Vermont, St. Michael's College, Champlain College, Howard Center, Global Foundries, Dealer.com, BETA Technologies, and OnLogic.

Commercial, industrial, and residential development is concentrated predominantly in the Burlington area and the areas immediately adjacent in South Burlington, Essex, Colchester, Williston, and Shelburne, as well as pockets of concentrated development in other village and town centers throughout the county. Growth has largely been locating in areas designated for growth, with 86% of homes built in Chittenden County locating in those designated growth areas in the period 2015-2019. As a means to align with smart growth patterns and regional energy goals, these designated growth areas account for 15% of the County's land area and were developed to reflect municipal land use regulations, zoning, and anticipated growth.

This study is intended to evaluate land use and transportation conditions along the I-89 out to the horizon year 2050. Based on economic analyses and historical trends, the growth assessments conducted for the ECOS Plan development were adopted to include 14% population growth, 20% household growth, and 35% employment growth from 2015 to 2050.

Figure 4: CCRPC ECOS Regions Map



1 Estimate for 2021 based on US Census Population Estimates Program
2 Estimate for 2021 based on US Census Population Estimates Program

Figure 5: Future 2050 Household (HH) Densities Map

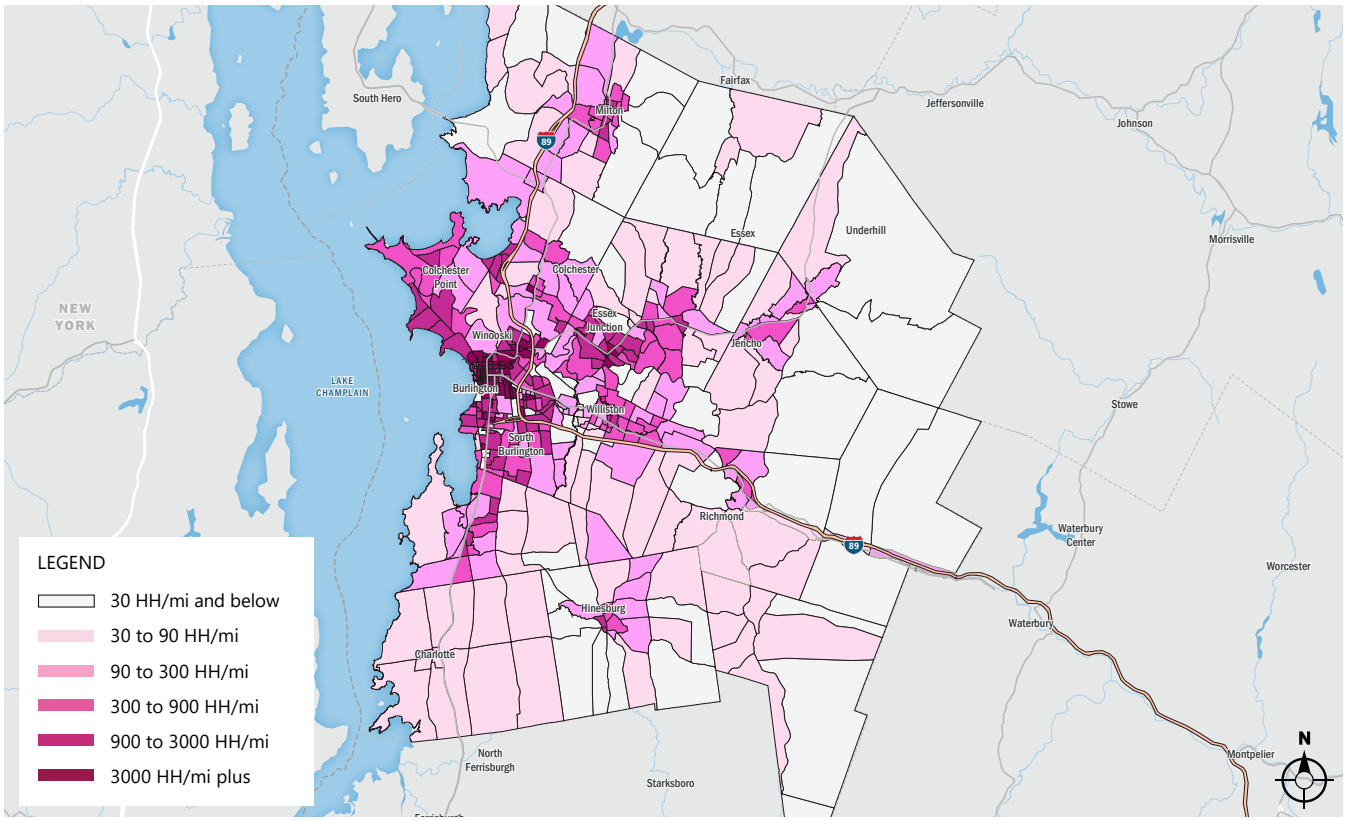
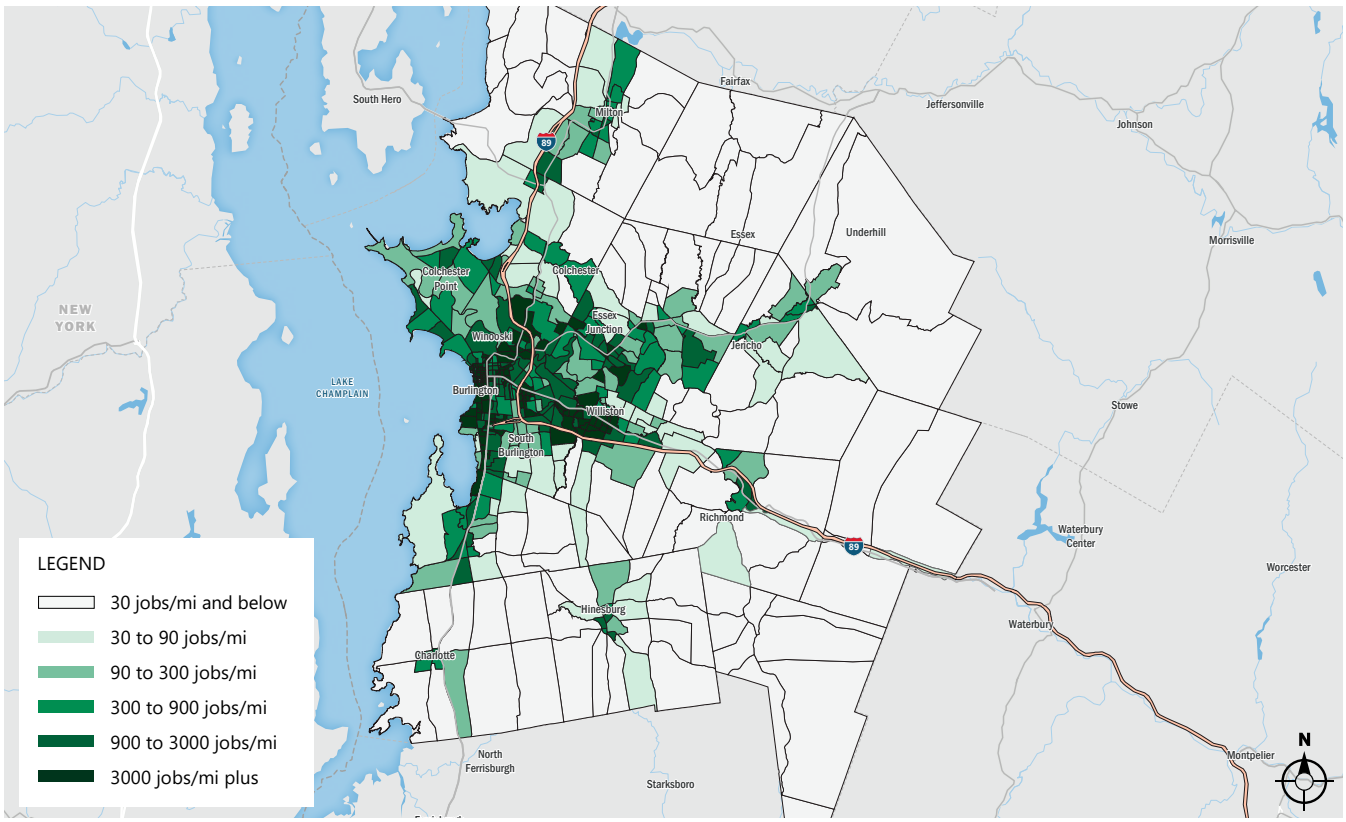


Figure 6: Future 2050 Employment Densities Map



3.3 Transportation Systems Overview

3.3.1 Metropolitan Transportation Plan Context

The Chittenden County Metropolitan Transportation Plan (MTP), adopted as part of the CCRPC's ECOS Plan in 2018, is the long-term transportation planning document for the Chittenden County region. The fiscally-constrained plan identifies the projects and strategies throughout the region that will be advanced with Federal funding through 2050. Although system preservation projects represent 70% of the funding identified for the transportation system in Chittenden County, there are still $420M in new improvements identified for the region through 2050. These new investments are comprehensive, including multimodal roadway improvements, major roadway upgrades, new transportation facilities, safety improvements, traffic operations enhancements, ITS deployments, transit expansion, bike and pedestrian enhancements, and intermodal and park and ride projects, to help improve safety, increase livability, reduce congestion, and enhance transportation alternatives to driving. Even with the investments in other strategies and projects, modeling and projections for the region conducted as part of the MTP development identified capacity issues for the interstate corridor and interchanges in the planning forecast years. This Chittenden County I-89 2050 Study was initiated to help evaluate the projected I-89 mainline capacity constraints and to develop a plan for investments along the full I-89 corridor in Chittenden County through 2050.

3.3.2 Mainline Overview

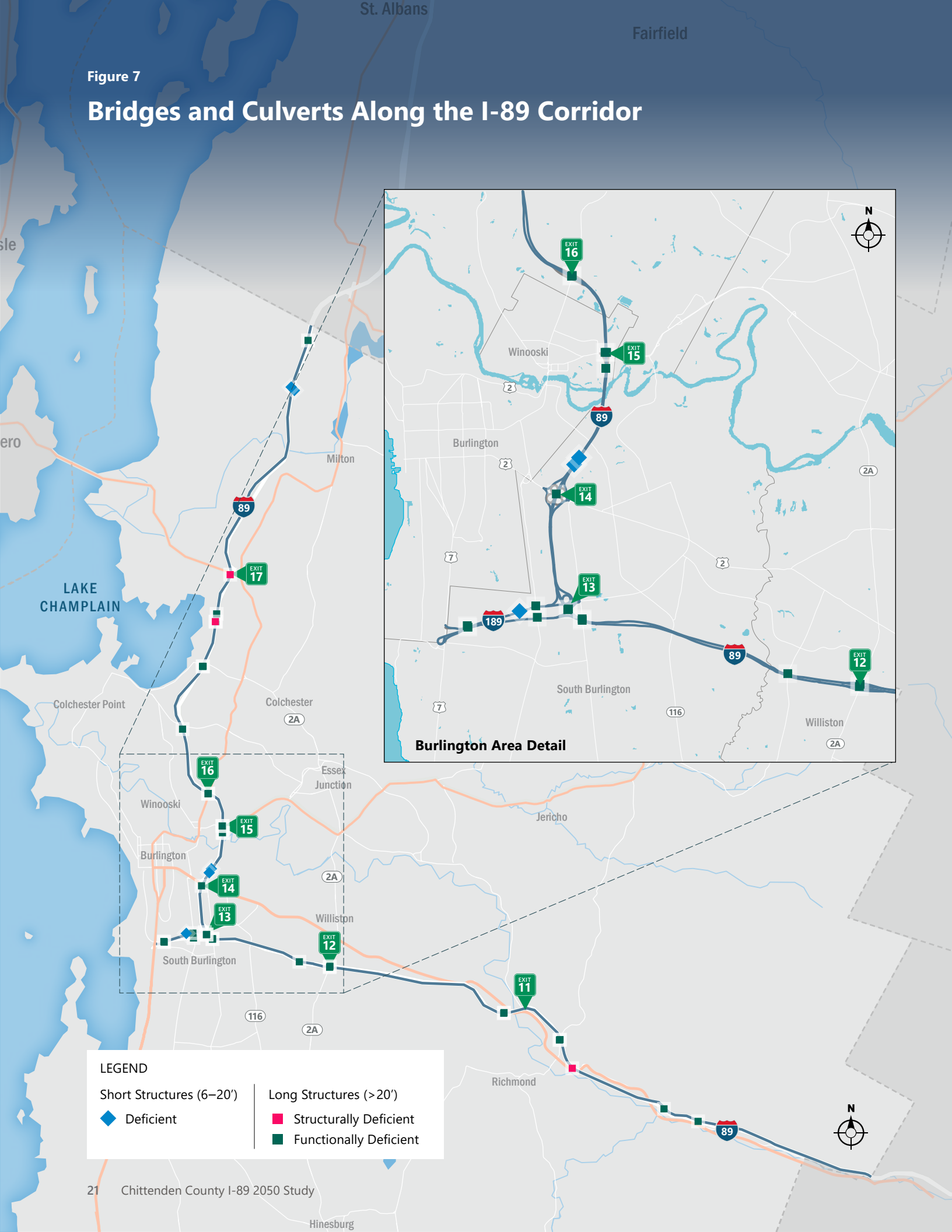
Infrastructure

The mainline of the interstate along the corridor generally provides two 12' travel lanes in each direction with 4' left shoulders and 10' right shoulders. The lane and shoulder geometry detail, presence of guardrail and rumble strips, pavement condition, bridge and culvert location details and ratings, and high crash location designations and crash data are detailed on the Route Logs for each segment of the mainline. The current VTrans Route Logs for I-89 can be found here.

There are 59 long structures (i.e. bridges with over a twenty-foot span) along the I-89 corridor in Chittenden County, including 11 bridges that cross over the I-89 mainline and nine bridges that cross waterbodies. There are 34 short structures (i.e. bridges with less than a twenty-foot span) along the corridor, predominantly serving to cross waterbodies. Most of the short structures were installed over 60 years when the interstate was first constructed and rely on regular inspection and maintenance to keep them in service. Along the I-89 corridor in Chittenden County, five short structures have been replaced with precast concrete box culverts. Information regarding the sufficiency of the long and short structures along the corridor was reviewed to identify those structures that are either functionally and/or structurally deficient and likely to require major rehabilitation or replacement within the study timeframe.

Figure 7

Bridges and Culverts Along the I-89 Corridor



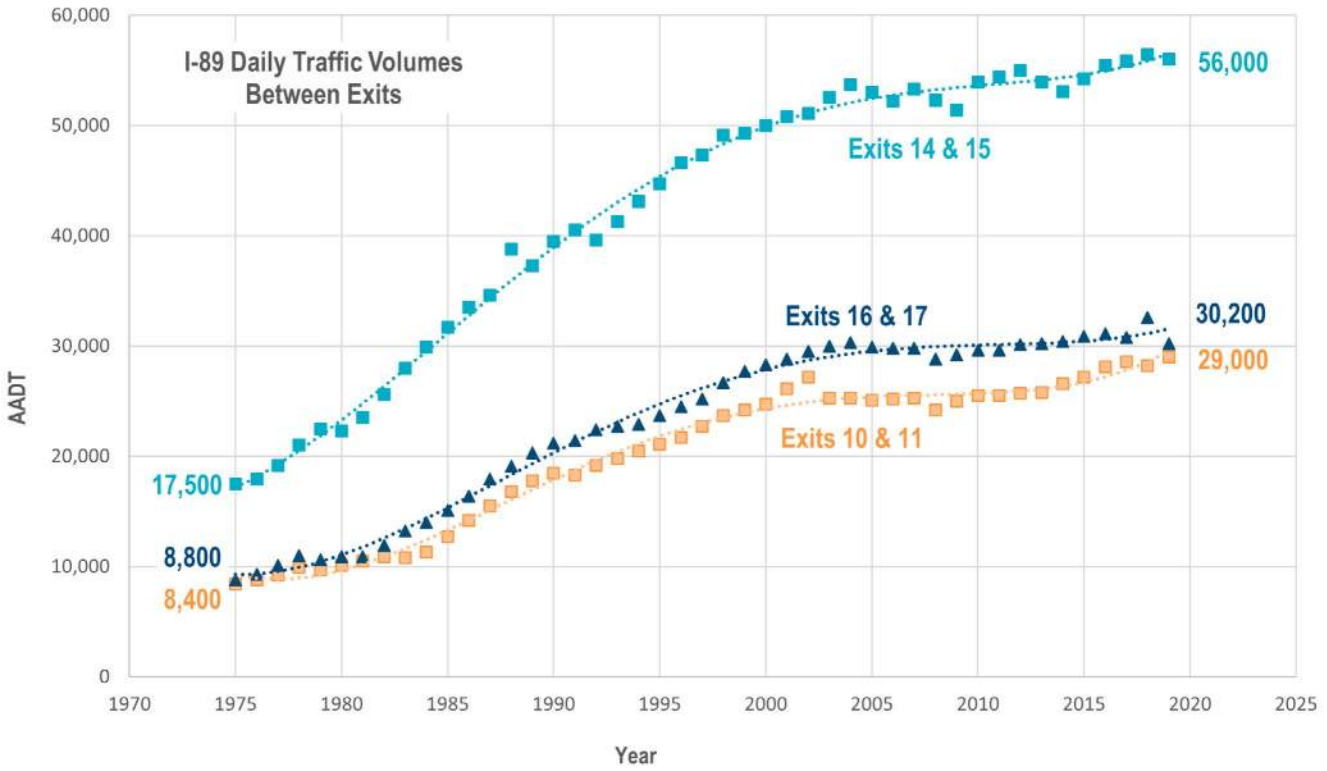
There are a number of segments of the mainline that have been identified as potentially vulnerable to flood hazards. The segments south of Exit 11 are designated as the highest flood risk according to the Vermont Statewide Flood Vulnerability and Risk Map based on the segments' combined network criticality and flood vulnerability. The segments that contain bridge structures over the Winooski River and Mallet's Creek similarly have high flood risk, based on the greatest network criticality ratings, meaning those structures are critically important to the function of the transportation network overall. In addition, there are known voids in the median of the mainline in the Bolton Flats area and multiple stretches with rock fall hazards mostly south of Exit 12.

Travel Patterns

Since 1975, traffic volumes along the I-89 corridor in Chittenden County have grown an average of 2–2.5% per year, with certain periods experiencing more rapid growth (1980–2000) and certain periods experiencing slower growth rates (2000–2020). The historical trend in Average Annual Daily Traffic (AADT) volumes between 1975 and 2020 at three I-89 continuous traffic count stations is shown in Figure 8. As the data in the figure shows, AADT has more than tripled on these segments of I-89 since 1975.

The I-89 mainline through Chittenden County experiences the heaviest traffic volumes of any facility throughout the state.

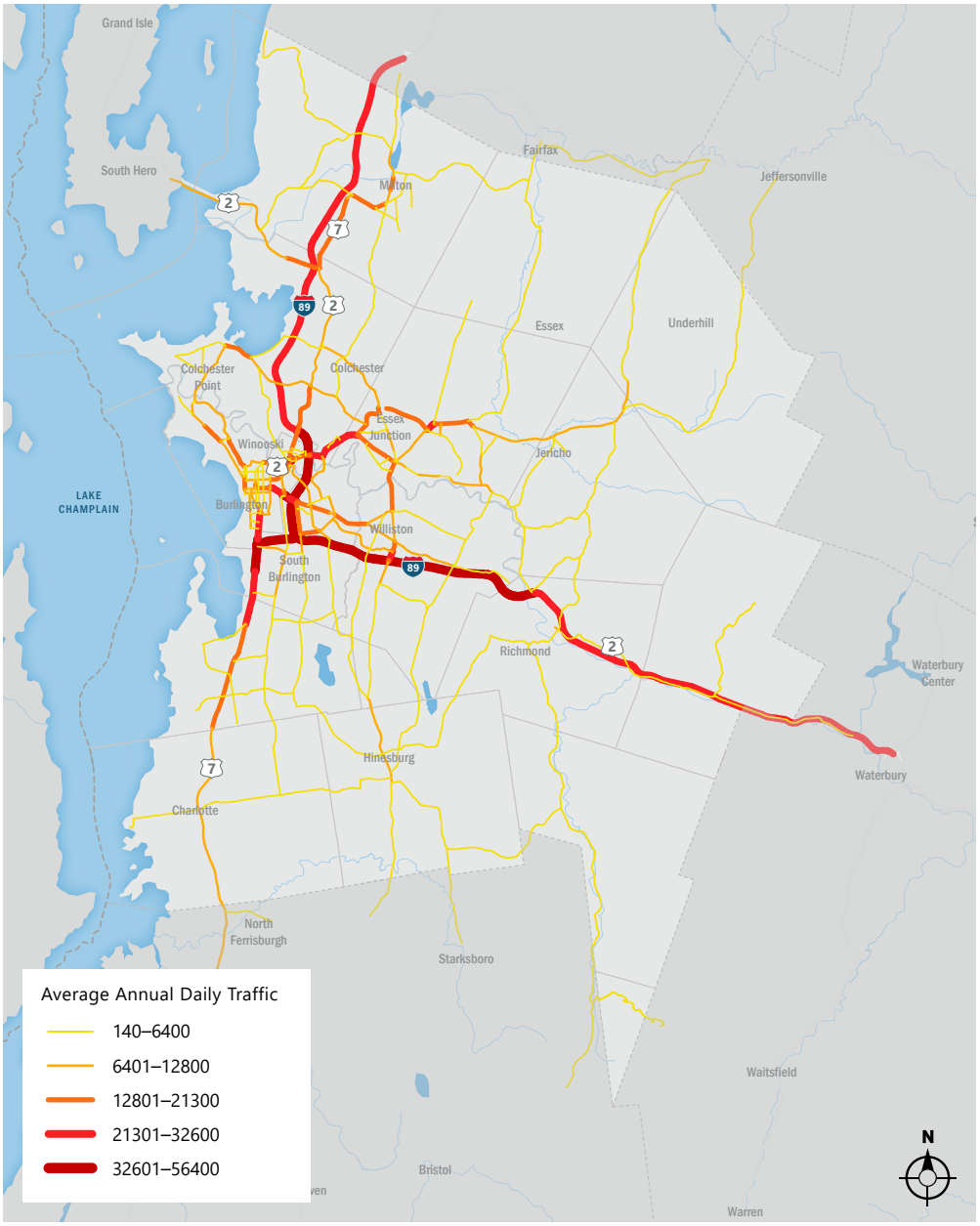
Figure 8: Historical AADT growth on mainline segments along I-89 through Chittenden County



As shown in the previous figure, traffic volumes along I-89 are the highest between Exit 14 and Exit 15 with an Average Annual Daily Traffic (AADT) volume of over 56,000 vehicles per day. In general, the traffic volumes are highest in the "urban" section of I-89 (Exits 12–16), with volumes decreasing south of Exit 12 and north of Exit 16 (see Figure 9).

Based on the latest American Community Survey 5-Year Estimates, the average Chittenden County resident's commute time is 21.6 minutes (compared with 23.3 minutes statewide), with approximately 2.7% of commute trips made by public transportation (compared with 1.2% statewide), and approximately 9.2% of all employees working from home (compared with 9.0% statewide).

Figure 9: AADT from 2017 for state-owned facilities



Safety Assessment

The safety assessment for the I-89 corridor in Chittenden County included reviewing the most recently published High Crash Location (HCL) report (2012–2016) and historic crash data for the corridor. The High Crash Location intersections and segments within the study area were highlighted as potential areas of concern. The crash data was queried to draw insights on common issues and any safety related deficiencies that were notable for the corridor and interchanges within the study area. There are 16 different segments along I-89 and I-189 in Chittenden County that are identified as High Crash Locations (HCLs) by VTrans using crash data collected for a 5-year period from 2012 to 2016. These locations are displayed in Figure 10 and summarized in Table 3. The I-89 segment with the most crashes (64) within this 5-year period was a 0.3-mile segment from mile marker 90.0 to 90.3, immediately south of Exit 15 in Winooski.

Table 3: High Crash Location Segments

Route	Town	Mileage	AADT	Years	Crashes	Fatalities	Injuries	PDO Crashes	Critical Rate	Severity Index ($/Crash)
I-89	Bolton	72.000-72.300	25700	5	23	0	0	23	1.56	11300
I-89	Bolton	72.800-73.100	25700	5	28	0	1	27	1.56	14057
I-89	Richmond	73.800-74.100	25700	5	30	0	4	27	1.56	21970
I-89	Richmond	78.000-78.300	25700	5	43	0	3	41	1.56	16949
I-89	Williston	79.800-80.100	29900	5	25	1	2	22	1.26	77024
I-89	Williston	83.800-84.100	34147	5	39	0	0	39	1.23	11300
I-89	South Burlington	86.800-87.100	39000	5	41	0	6	36	1.20	22873
I-89	South Burlington	87.800-88.100	39400	5	53	0	2	51	1.20	14213
I-89	Winooski City	90.00-90.300	55000	5	64	0	17	54	1.13	33042
I-89	Colchester	91.800-92.100	30100	5	21	0	6	18	1.26	34971
I-89	Colchester	95.000-95.300	30100	5	21	0	3	18	1.26	22329
I-89	Colchester	96.000-96.300	30100	5	34	0	5	30	1.26	22985
I-89	Colchester	97.000-97.300	30100	5	24	0	1	23	1.26	14517
I-89	Colchester	97.800-98.100	23275	5	24	0	2	22	1.33	17733
I-89	Burlington-South Burlington	0.000-0.240	40400	5	43	0	14	33	1.19	37486
I-89	South Burlington	0.040-0.340	40400	5	31	0	10	23	1.19	36932

An assessment of historic crash data along the I-89 corridor in Chittenden County between 2010 and 2020 generated the following observations:

» Across Vermont's full Interstate system, the average crash rate is 0.688 crashes per million vehicle miles traveled. The I-89 corridor in Chittenden County had a crash rate slightly lower than the Statewide rate at 0.640 crashes per million vehicle miles traveled. The following two segments in the I-89 corridor in Chittenden County exceeded the statewide interstate crash rate:

  - Between Exits 10–11: 0.837 crashes per million vehicle miles traveled
  - Between Exits 14–15: 0.790 crashes per million vehicle miles traveled

» There were 21 fatalities along I-89 in Chittenden County from 2010 through 2020. The highest rate of fatalities and serious injuries was 0.030 per million vehicle miles traveled between Exits 10 and 11. This stretch saw 9 fatalities and 27 serious injuries over those eleven years. Other segments were close to or below the statewide interstate fatality average of 0.020.

» Rear-end crashes are overrepresented in the I-89 corridor (16% of total crashes) compared to interstates overall (10% of crashes).

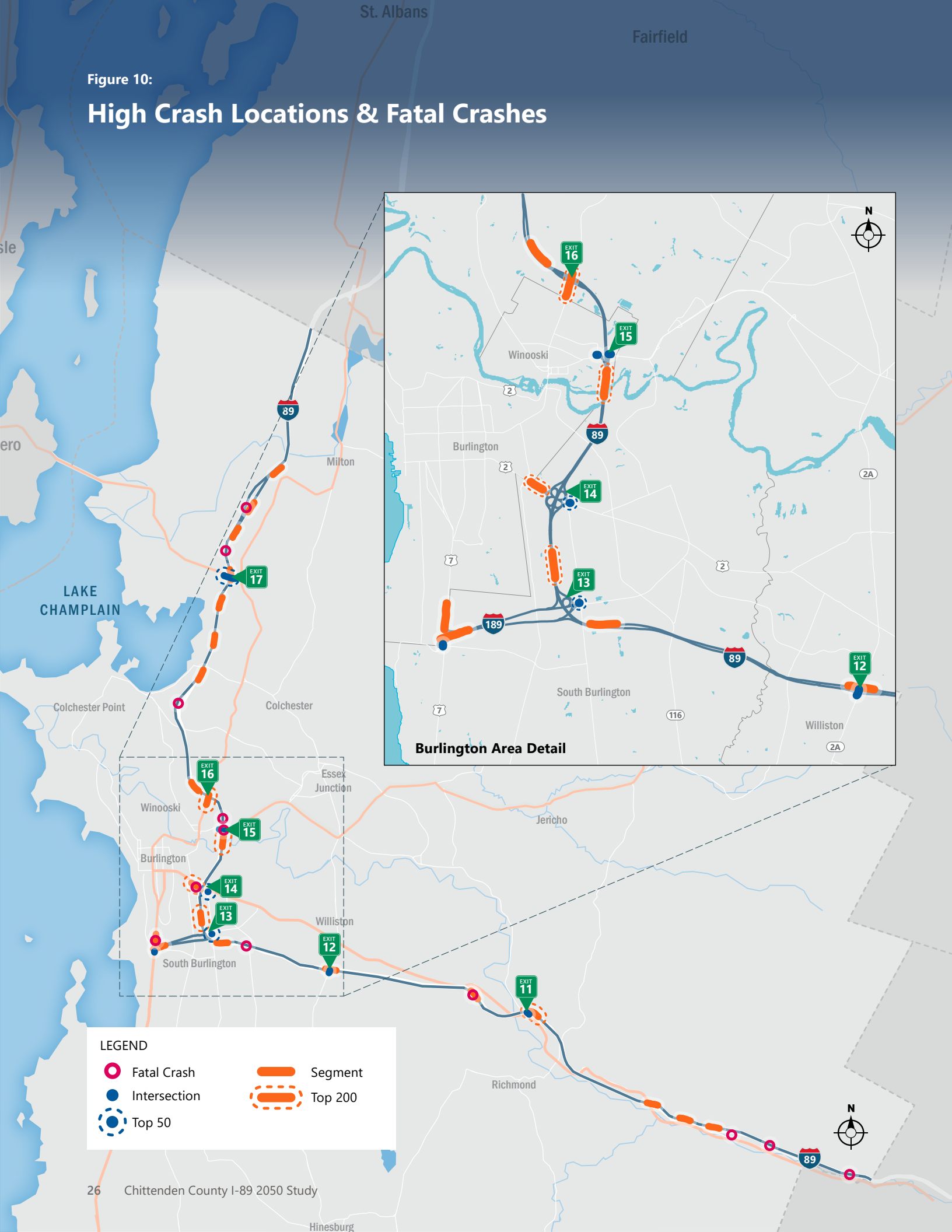
» Lane departure crashes are most frequent between Exits 10–12 and 17–18. Over 19% of the reported crashes on those segments are lane departure crashes, compared to about 10% elsewhere on Vermont's interstate system.

» Speed-related crashes are overrepresented between Exits 14 and 15 at 32% of crashes compared with 13-20% elsewhere on the interstate system in Vermont. As the highest volume segment of I-89, it is not surprising to also see the highest rate of speed-related crashes (as a proxy for potential aggressive driving).

» The segment of I-89 between Exits 10–11 has significantly higher rates of crashes attributed to rain, sleet, and snow than the rest of I-89 in Chittenden County.

Figure 10:

High Crash Locations & Fatal Crashes



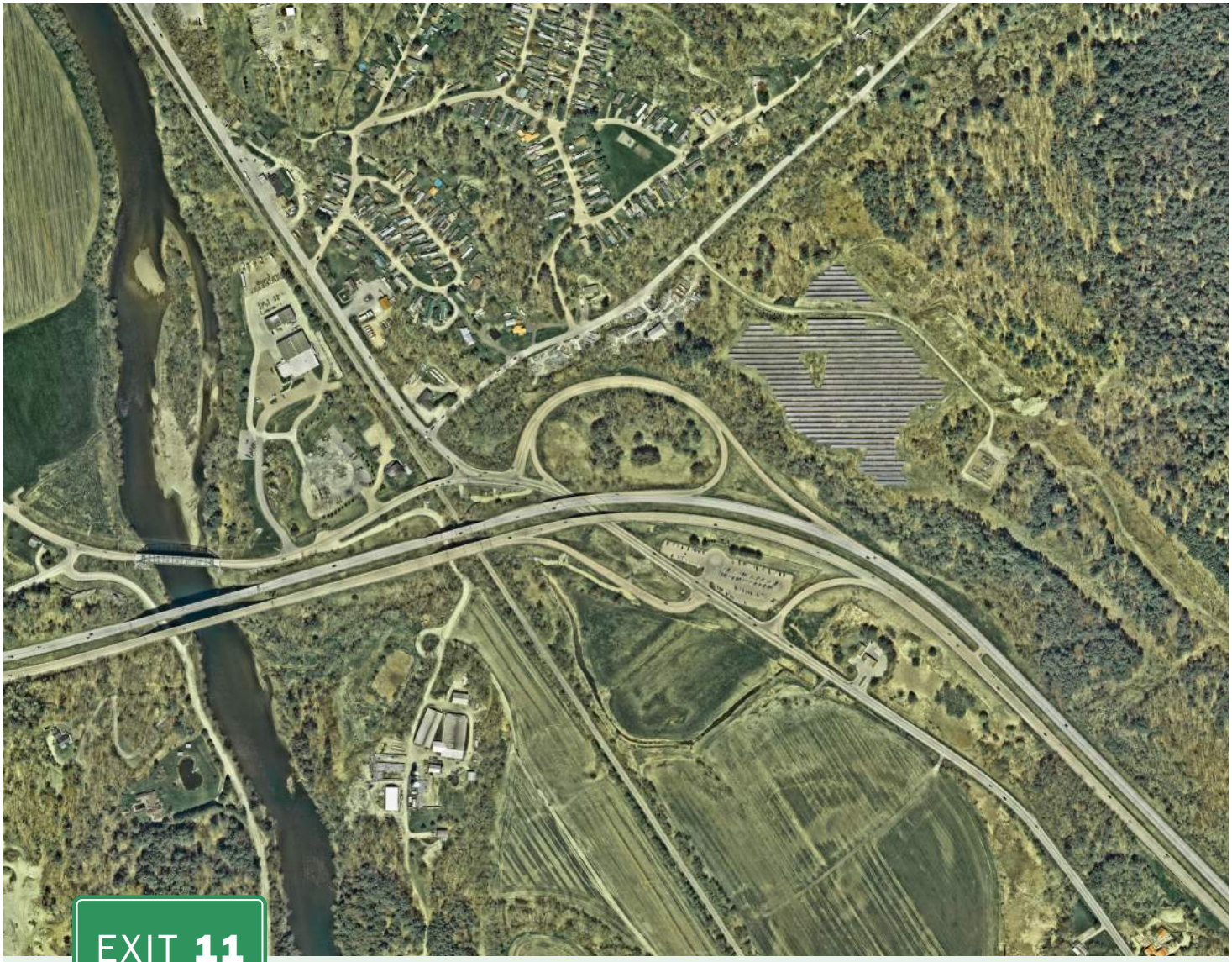
3.4 Interchange Overview

Each of the interchanges along the corridor were assessed, evaluating the existing geometry compared to the standards set forth in the latest edition of *A Policy on Geometric Design of Highways and Streets*[3]. The existing interchange geometry was determined primarily from as-built record drawings, including referencing original design drawings for the interstate. The evaluation examined the following on-ramp, off-ramp, and ramp spacing features at each interchange:

- Number of lanes
- Controlling curve radius
- Tapered or parallel entrance/exit ramp type
- Acceleration/deceleration length
- Minimum acceleration/deceleration length
- Assumed speed at controlling feature
- Profile grade along length
- Profile grade along ramp
- Merging taper
- Maximum grade
- Year of latest geometric changes
- Required entrance/exit spacing

Given that much of the existing interchange geometry is original to the interstate, it was expected that existing geometry deficiencies would be identified compared to current design standards. In recognizing these deficiencies, opportunities for modernizing the infrastructure through improvements that better align with today's design standards were identified.

3 "A Policy on Geometric Design of Highways and Streets, 7th Edition", American Association of State Highway and Transportation Officials (AASHTO), 2018



EXIT **11**

Overview

Exit 11 is located in Richmond approximately 1,000 feet east of the Winooski River. This interchange connects the interstate with US Route 2. The interchange ramps are geometrically configured as a Trumpet. US Route 2 is part of the National Highway System and has an AADT of approximately 8,400 vehicles per day proximate to the interchange.

Interchange Geometric Assessment

Ramp B is the southbound on-ramp at this interchange and has a controlling radius of 330 feet and has an acceleration length that is 500 feet deficient when compared to the minimum AASHTO requirement of 1,000 feet for this ramp. Ramp C is the on-ramp in the northbound direction and has an acceleration length of approximately 630 feet which is 600 feet less than the minimum AASHTO requirement. The merging taper length for ramp BC is also shorter than the minimum requirement of 300 feet. A summary of the Exit 11 on-ramp features can be found in Table 4.

Ramp A is the northbound off-ramp and has a tapered merge. This ramp has a posted advisory speed of 35 mph, and the deceleration length falls approximately 330 feet short of the minimum requirement set by AASHTO for these conditions. The southbound off-ramp is also deficient in its deceleration length by about 50 feet. A summary of the Exit 11 off-ramp features can be found in Table 5.

Table 4. Exit 11 On-Ramp Features

			On-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
11-B	I-89 SB On-Ramp, "Ramp BA"	1	330	Parallel	**600**	1000	35	**-1%**	5%	**250**	4-6	1964
11-C	I-89 NB On-Ramp (from Rte 2 WB), "Ramp BC"	1	170	Parallel	**630**	1220	25	**1%**	2%	**220**	5-7	1964

Table 5. Exit 11 Off-Ramp Features

			Off-Ramp Features								
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
11-A	I-89 NB Off-Ramp, "Ramp AD"	1	955	Tapered - Curvilinear	35	**310**	440	4-6	**1%**	-2%	1964
11-D (1)	I-89 SB Off-Ramp	1	385	Parallel	35	**450**	440	5-7	**-1%**	-6%	2001

Interchange Operational Assessment

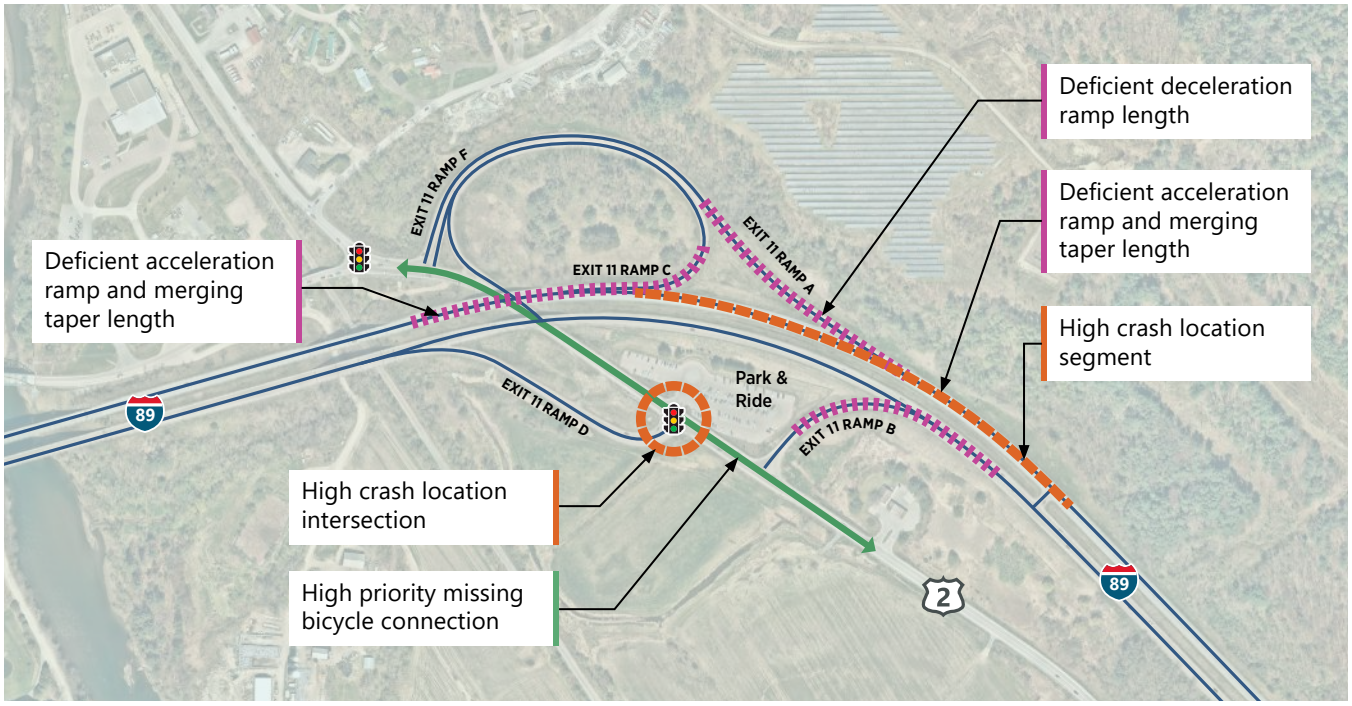
The southbound off-ramp comes to a four-way signalized intersection with US-2 and the Richmond park and ride. Both the off-ramp and park and ride have a left and right turn lane. South of this intersection, on US-2, there is a left turn lane onto the I-89 southbound on-ramp. The northbound on- and off-ramps meet at an intersection to the north with US-2. The I-89 northbound off-ramp intersection with US-2 is stop-controlled. North of this intersection is a signalized three-way intersection of US-2 and VT-117 which has a westbound right turn lane onto VT-117.

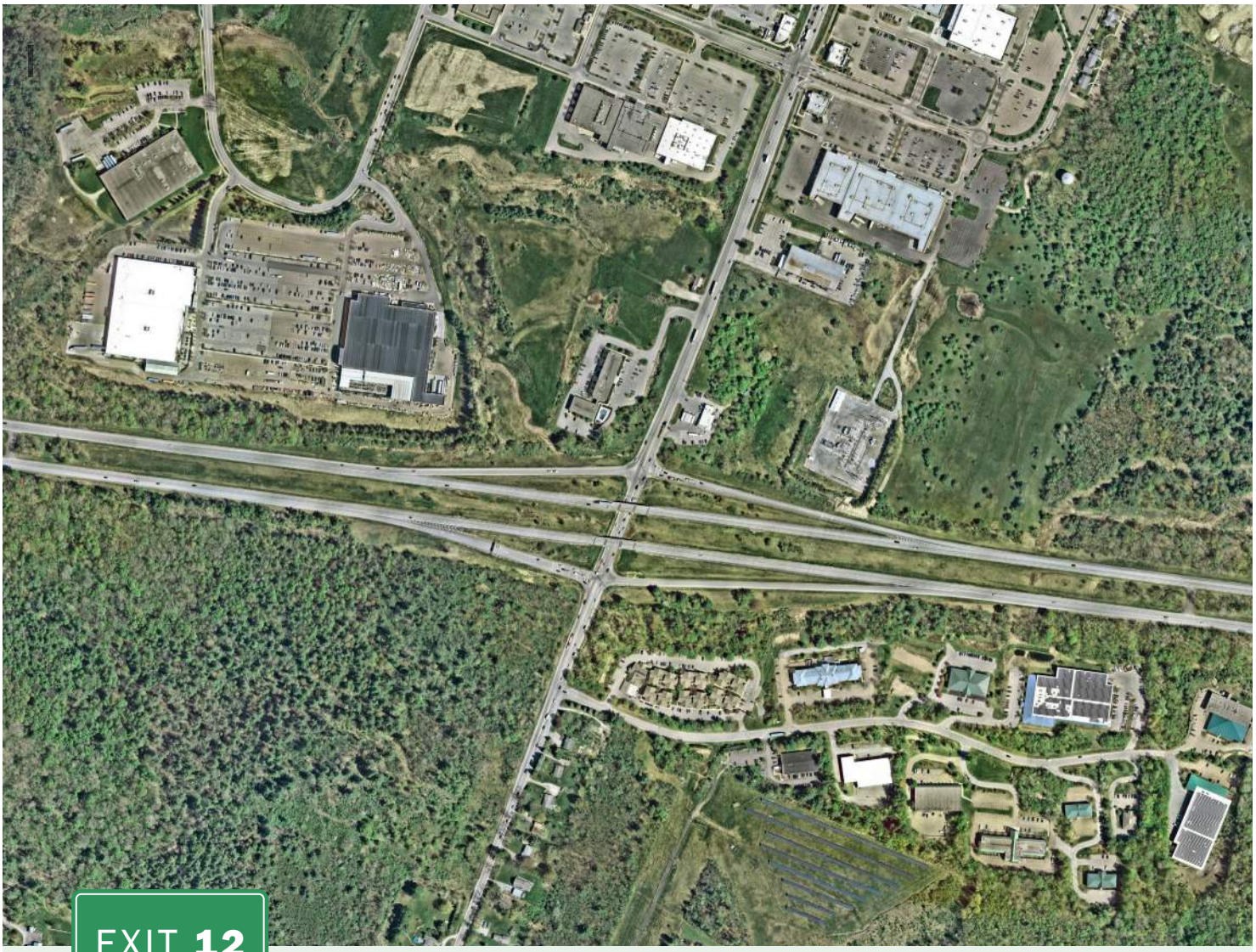
There are no bicycle or pedestrian facilities through the Exit 11 interchange and no bicycle or pedestrian facility enhancements are currently planned in this area.

Interchange Safety Assessment

Between 2014 and 2018, there were 38 total crashes reported at the Exit 11 interchange on I-89. 26% of these crashes occurred with wet surface conditions and 32% involved property damage only. Of the predominant crash types, 39% of these crashes were rear ends and 29% were single vehicle collisions. It is also important to note that 29% of the crashes at this interchange occurred at the US 2/Southbound Off-Ramp signalized intersection.

Figure 11: Exit 11 Summary of Findings





EXIT **12**

Overview

I-89 Exit 12 is located in Williston, approximately a mile east of the town's western border with South Burlington. This interchange provides connection to Vermont Route 2A which links north-south travel from VT-116 in St. George to US-2 in Colchester. The interchange is a conventional diamond interchange with four ramps all extending from two signalized intersections located on VT-2A. Each ramp is a parallel design with one lane designated for merging and diverging movements. None of the ramps have a radius smaller than 1,000 feet and the intersection of the ramps and VT-2A is the controlling feature.

Interchange Geometric Assessment

Both of the on-ramps of this interchange are deficient in the length of their acceleration lane partly because of the steeper upgrades on these segments. The speed at the controlling point of the ramp was assumed to be 15 mph because vehicles are leaving a signalized intersection. The southbound on-ramp has an approximate acceleration length of 1,870 feet and AASHTO requires a minimum length of approximately 2,500 feet. The northbound on-ramp has an approximate acceleration length of 1,460 feet and AASHTO requires a minimum length of 1,950 feet. It is also important to note that the merging taper length of the northbound on-ramp is also deficient as it falls below the minimum length of 300 feet. A summary of the Exit 12 on-ramp features can be found in Table 6.

The off-ramps have a STOP condition along the deceleration length and their geometry meets AASHTO Standards despite steep downgrades. A summary of the Exit 12 off-ramp features can be found in Table 7.

Interchange Operational Assessment

The southbound on- and off-ramps come to a four-way signalized intersection with VT-2A. The I-89 off-ramp approach has a right turn lane, an exclusive left turn lane, and a shared left/through lane. The VT-2A northbound approach has an exclusive through lane and a shared through/right-turn lane while the VT-2A southbound approach has two through lanes and a dedicated right turn lane.

Table 6. Exit 11 On-Ramp Features

			On-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
16-B	I-89 NB On-Ramp	1	2050	Parallel	**1600**	1440	15	7%	7%	**240**	6-8	1964
16-C	I-89 SB On-Ramp	1	1000	Parallel	**1320**	900	15	**2%**	1%	**250**	6-8	1962

Table 7. Exit 11 Off-Ramp Feature

			Off-Ramp Features								
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
16-A	I-89 SB Off-Ramp	1	1940	Tapered - Tangent	STOP	**1270**	576	6-8	**-4%**	-4%	1962
16-D	I-89 NB Off-Ramp	1	2400	Tapered - Curvilinear	STOP	**810**	480	6-8	**-2%**	-2%	1962

The northbound on- and off-ramps also come to a four-way signalized intersection with VT-2A. The I-89 off-ramp approach has a right turn lane and a shared left/through lane. The VT-2A northbound approach has a through lane and a shared through/left-turn lane while the VT-2A southbound approach has one through lane and a shared through/right turn lane. There are plans to expand the southbound VT-2A approach to include two through lanes and an exclusive right-turn lane in 2022.

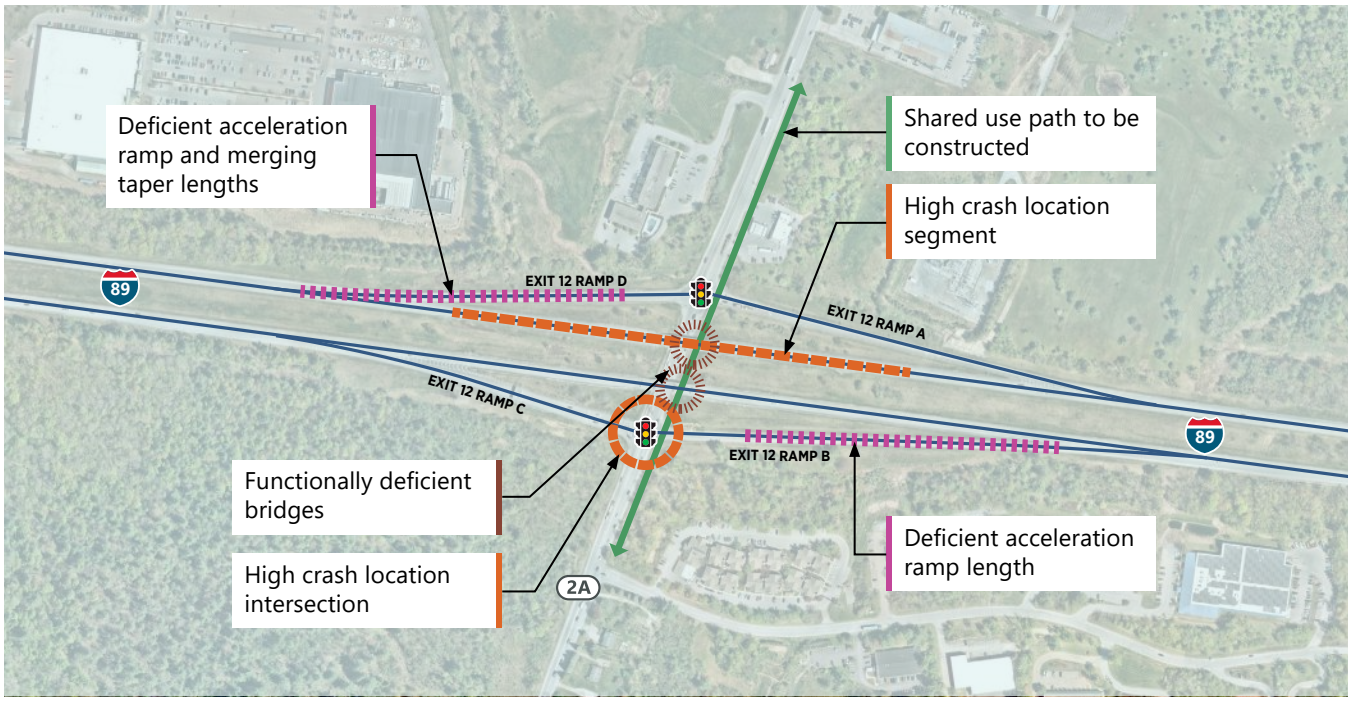
There are currently no bicycle or pedestrian facilities through the Exit 12 interchange, however, a multi-use path is proposed to be constructed in 2022 from the State Police barracks to Hurricane Lane.

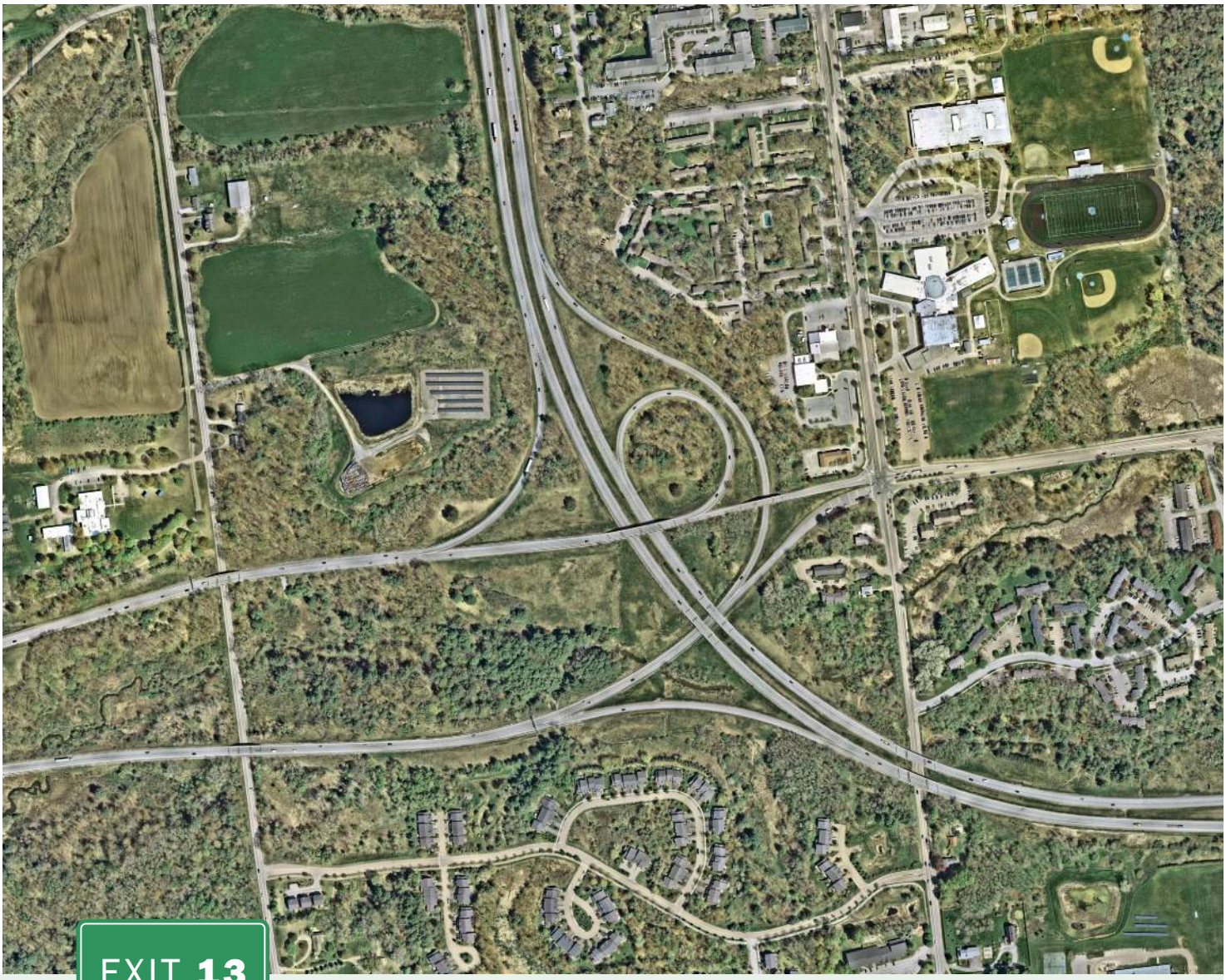
Interchange Safety Assessment

Exit 12 had 159 recorded crashes between 2014 and 2018. Of the crash types, 27% of these crashers were rear-end collisions and 20% were sideswipes. 66% of the crashes involved property damage only. Most of the crashes occurred during the daytime (81%), with very few occurring in wet surface conditions (11%).

There is a high crash location at Exit 12 in Williston, where the interstate connects to VT-2A. Twenty-one crashes were reported with a severity index of $26,543 per crash from 2012 to 2016.

Figure 12: Exit 12 Summary of Findings





Overview

I-89 Exit 13 is located in South Burlington about 2.5 miles west of the border with Williston. This exit connects I-89 with I-189 and I-189 with Dorset Street. I-189 extends 1.5 miles west from Exit 13 and provides access to Burlington via Shelburne Road. Dorset Street runs north-south for about 10 miles and connects Hinesburg Road in Charlotte to Williston Road (US-2) in South Burlington.

Interchange Geometric Assessment

The geometry of the on-ramps at this interchange meets AASHTO standards. A summary of the Exit 13 on-ramp features can be found in Table 8.

Ramp A is the I-89 southbound on-ramp that stems off I-189 N. This ramp has a deficient merging taper length of 190 feet which is under the AASHTO requirement of 300 feet. Ramp B is the I-89 southbound off-ramp that connects to I-189 westbound. This ramp has a posted advisory speed of 40 mph and the controlling radius is approximately 570 feet with a 1% downgrade. The deceleration length of this ramp is approximately 270 feet long and this is deficient for AASHTO's minimum requirement of 285 feet for these conditions. Ramp C is the northbound off-ramp that connects to I-189 westbound. This ramp has a controlling radius of 330 feet and a posted advisory speed of 30 mph. AASHTO requires a minimum deceleration length of 380 feet and the actual length is only 230 feet. A summary of the Exit 13 off-ramp features can be found in Table 9.

Table 8. Exit 13 On-Ramp Features

			On-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
13-A	I-189 EB to I-89 SB	1	1270	Parallel	**1055**	464	40	**3%**	4%	190	4-6	1962
13-D	I-189 EB to I-89 NB	1	590	Parallel	**680**	320	40	**1%**	4%	160	4-6	1962

Table 9. Exit 13 Off-Ramp Features

			Off-Ramp Features								
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
13-B	I-89 SB to I-189 W	1	570	Tapered-Curvilinear	40	**270**	285	4-6	**-1.00%**	-3%	1962
13-C	I-89 NB to I-189 W	1	330	Parallel	30	**230**	380	5-7	**1.00%**	3%	1962
13-F	I-189 NB Off-Ramp	1	550	No merge	15	**480**	409.5	6-8	**4%**	4%	1962

Interchange Operational Assessment

Kennedy Drive has two lanes in both the westbound and eastbound directions approaching the intersection with Dorset Street and Exit 13. At the four-way signalized intersection, Kennedy Drive westbound has a left and right turn lane onto Dorset Street and a thru lane onto I-189. On the northbound approach, Dorset Street has one shared through/left turn lane and an exclusive right-turn lane. On the southbound approach, Dorset Street has an exclusive left- and right-turn lane and a through lane. Exiting I-189 there are two left turn lanes, a through lane, and a shared through/right-turn lane.

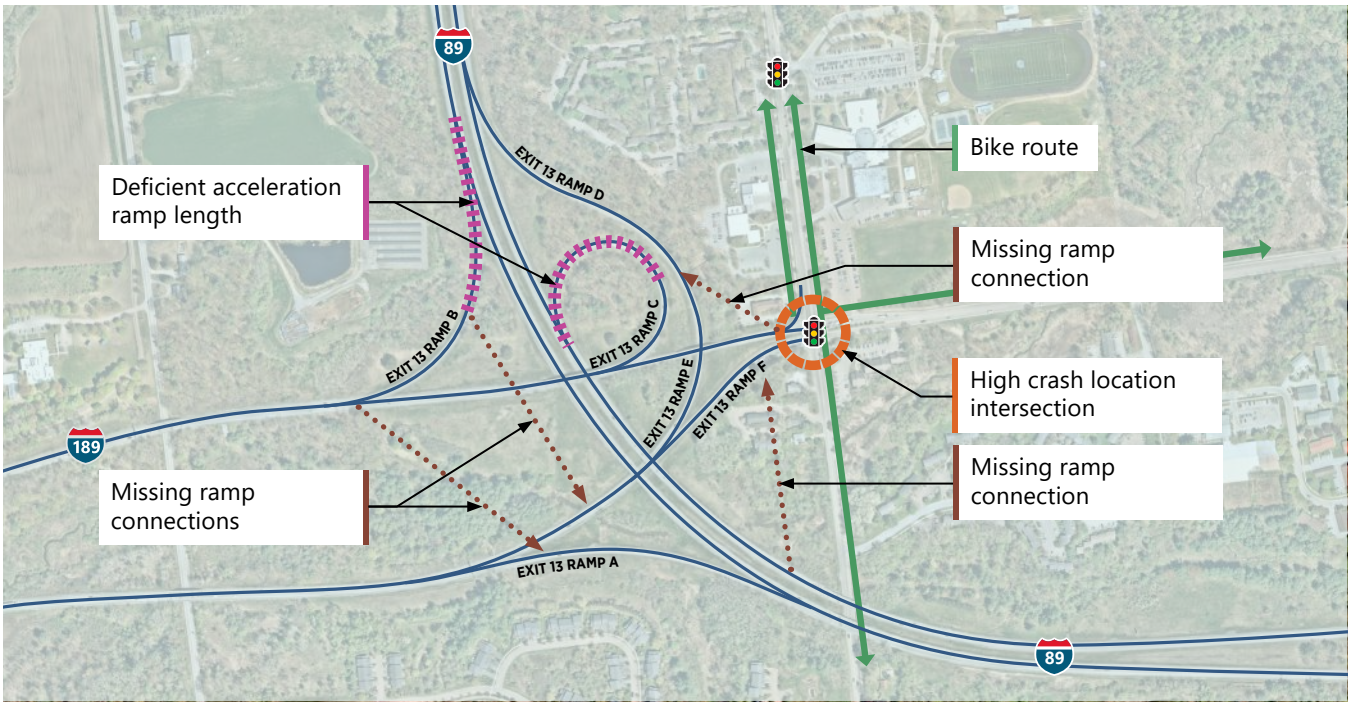
There is a multi-use path along the north side of Kennedy Drive and along the east side of Dorset Street and there are sidewalks along the western side of Dorset Street. The Kennedy Drive/Dorset Street intersection has an exclusive pedestrian phase with marked crosswalks across each intersection approach.

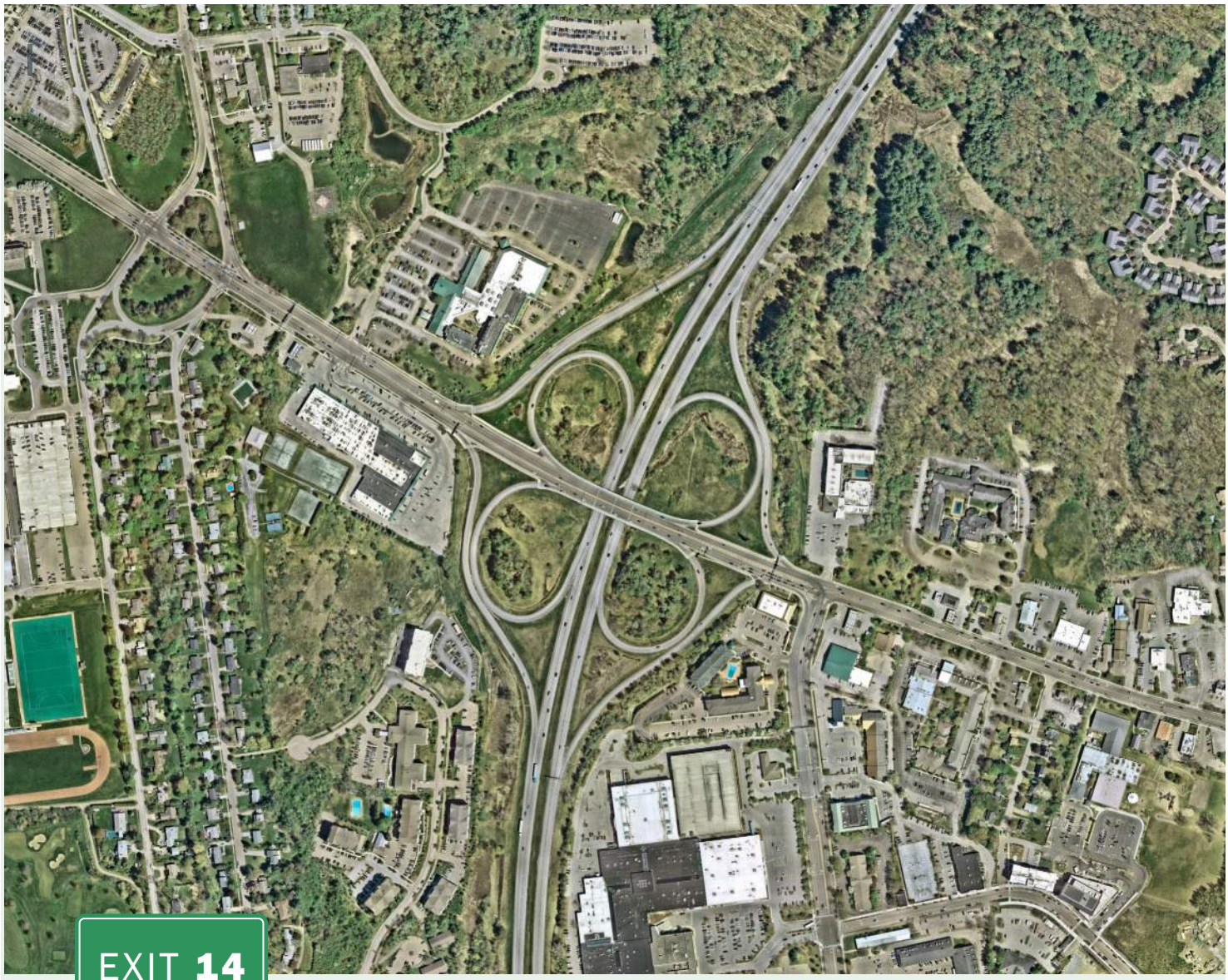
Interchange Safety Assessment

Exit 13 a total of 106 recorded crashes from 2014 to 2018. Of those crashes, 87% crashes resulted in property damage and 11% resulted in injuries. The crash types at this location included rear-end crashes (37%), single vehicle crashes (23%), and sideswipes (18%). The highest concentration of crashes occurred at the intersection of I-189, Dorset Street, and Kennedy Drive.

There is a designed HCL intersection at the Kennedy Drive/Dorset Street intersection which had a total of 40 crashes reported from 2012 to 2016, with only one crash resulting in injury and no fatalities. The severity index at this location was $13,230 per crash.

Figure 13: Exit 13 Summary of Findings





EXIT **14**

Overview

Exit 14 is located in South Burlington. This interchange connects the interstate to US Route 2, and is the primary interchange used to access downtown Burlington, the University of Vermont and the University of Vermont Medical Center. The interchange is in the form of a cloverleaf and contains four on-ramps and four off-ramps.

Interchange Geometric Assessment

Ramp D is the I-89 southbound on-ramp from US-2 westbound and has a controlling radius of 220 feet with a posted advisory speed of 20 mph. The acceleration length is approximately 590 feet with a 3% upgrade. This length is less than the required AASHTO length of approximately 1,100 feet for these conditions. Ramp E is the northbound on-ramp from US-2 East with a tight radius of 220 feet and a controlling speed of 20 mph. This ramp's acceleration length is about 100 feet deficient of the AASHTO required length of 810 feet. Ramps A and H are the other two on-ramps in this interchange that are on the outer sections of the cloverleaf. These two ramps had geometrically efficient acceleration lengths, but their merging taper lengths fall below the threshold of 300 feet. A summary of the Exit 14 on-ramp features can be found in Table 10.

All of the Exit 14 off-ramps met the minimum AASHTO geometric requirements as shown in Table 11.

Table 10. Exit 14 On-Ramp Features

		On-Ramp Features										
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
14-A	I-89 SB On-Ramp from US-2 EB "Ramp A"	1	500	Parallel	**590**	550	35	**1%**	-2%	**240**	4-6	1962
14-D	I-89 SB On-Ramp from US-2 WB (Cloverleaf)	1	220	Weave	**490**	1093.5	20	**3%**	-5%	NA	6-8	2006
14-E	I-89 NB On-Ramp from US-2 EB (Cloverleaf)	1	300	Weave	**680**	810	20	**-1%**	-4%	NA	6-8	1962
14-H	I-89 NB On-Ramp from US-2 WB "Ramp H"	1	500	Parallel	**680**	550	35	**-1%**	-4%	**230**	4-6	1962

Table 11. Exit 14 Off-Ramp Features

		Off-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
14-B	I-89 SB Off-Ramp to US-2 EB (Cloverleaf)	1	300	Weave	20	**530**	440	6-8	**2.16%**	2.16%	1962
14-C	I-89 SB Off-Ramp to US-2 WB	1	820	Parallel	35	**740**	350	4-6	**2.00%**	5%	2006
14-F	I-89 NB Off-Ramp to US-2 EB	1	720	Parallel	45	**280**	235	4-6	**-1.50%**	1%	1962
14-G	I-89 NB Off-Ramp to US-2 WB (Cloverleaf)	1	300	Weave	20	**700**	396	6-8	**3.14%**	5%	1962

Interchange Operational Assessment

As a cloverleaf interchange, the northbound-to-eastbound and southbound-to-westbound off-ramps intersect US-2 at a signalized intersection while the other two off-ramps intersect US-2 under a merge condition. The southbound-to-westbound off-ramp signalized intersection has two right turn lanes and three through lanes on US-2. The northbound-to-eastbound signalized intersection has a single approach lane on the off-ramp and two through lanes and an exclusive right-turn lane for movements on to Dorset Street east of the intersection. The proximity of the I-89 northbound off-ramp signal with the traffic signal at the Dorset Street/Williston Road intersection (approximately 200 feet) causes confusion for drivers and often results in queues spilling back through the off-ramp signal.

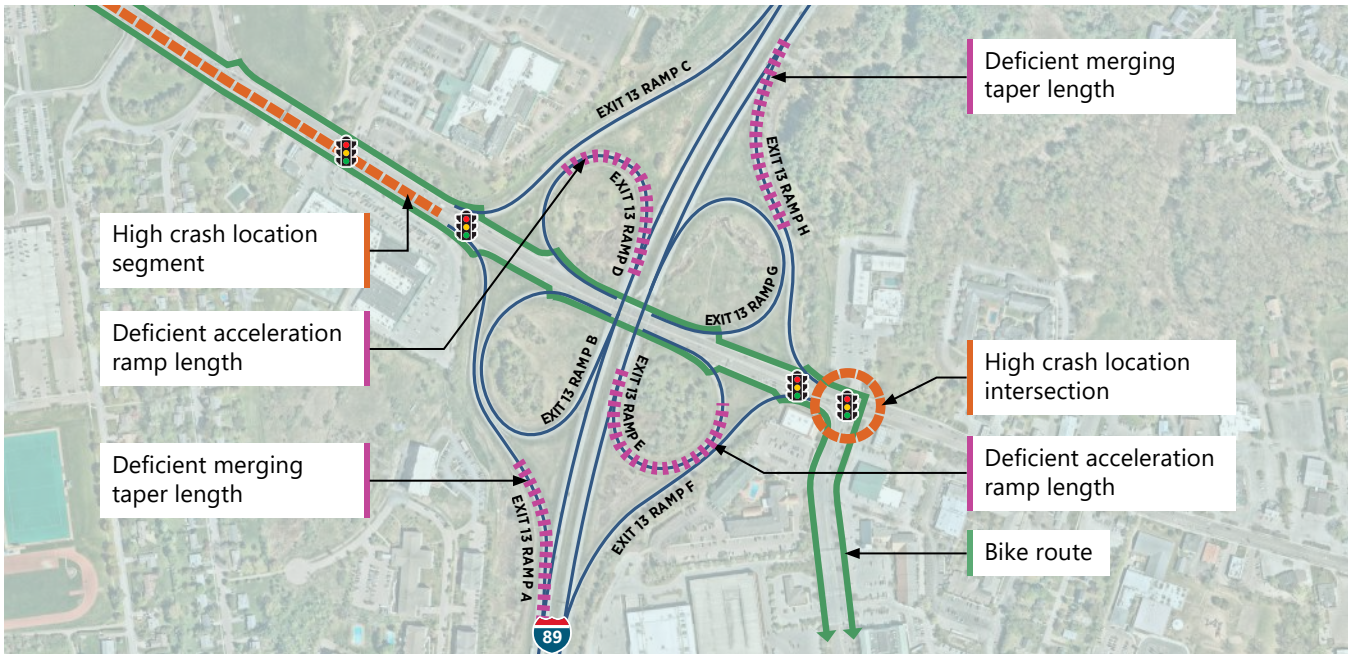
There are sidewalks along the east and west side of Dorset Street and along the north and south sides of US-2 through the interchange. There are crosswalks at all intersections and at unsignalized intersections there are signs to yield to bicycles and pedestrians. A multi-use path traverses a portion of the interchange on both sides of US 2, with the path converting to an on-road bicycle lane on the segment of US 2 that travels over I-89.

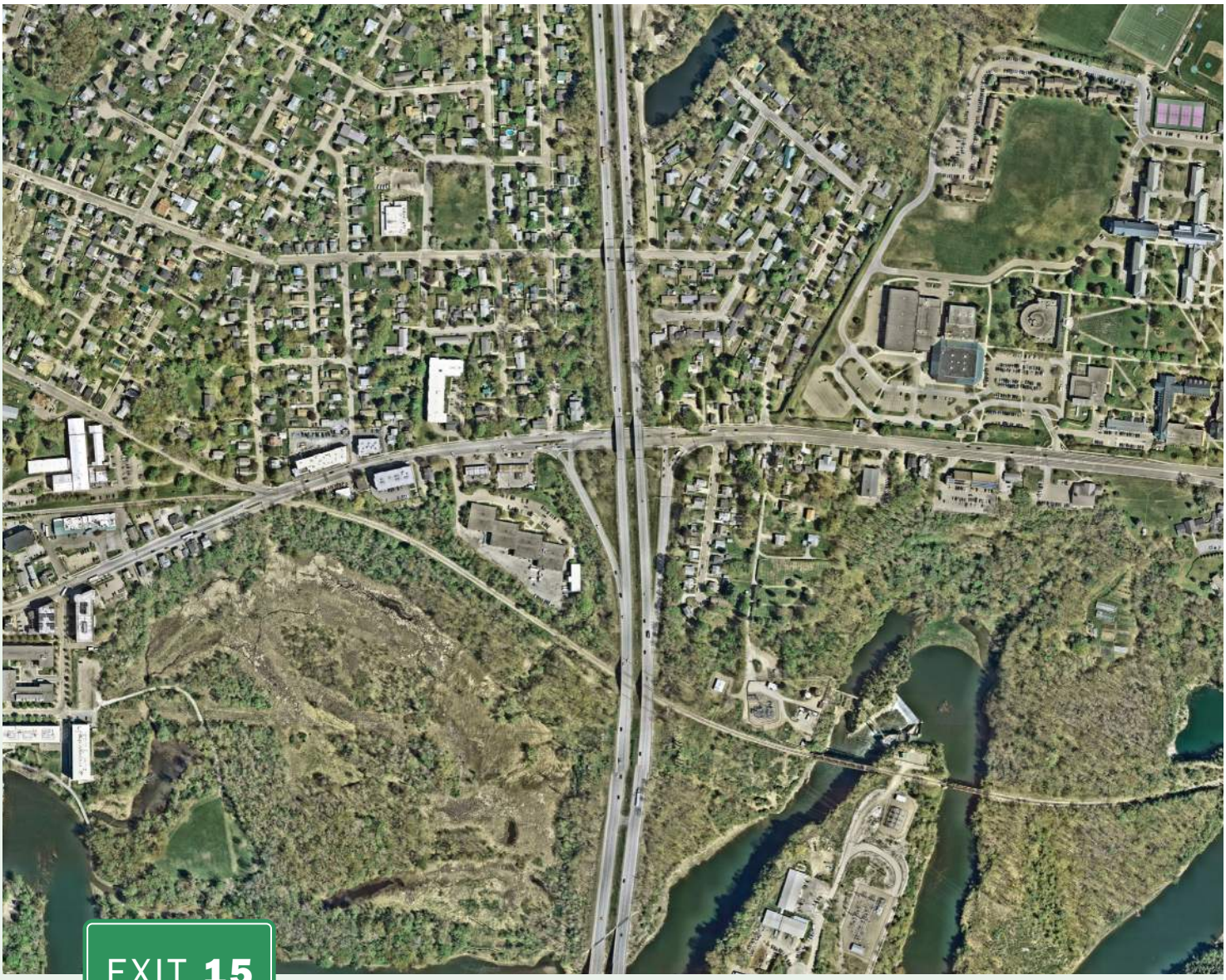
Interchange Safety Assessment

Exit 14 had 320 reported crashes from 2014 to 2018. Of the crash types that occurred at this location, 42% were reported as rear-end crashes and 23% were reported as sideswipe crashes. Crashes occurred predominantly in the daytime (84%) and most resulted in property damage only (84%). The greatest concentration of crashes at this interchange occurred adjacent to the Dorset Street/Williston Road intersection.

There are no identified High Crash Locations within the immediate interchange area. However, there is a HCL intersection at the Dorset Street/Williston Road intersection and an HCL segment along US-2 west of the interchange.

Figure 14: Exit 14 Summary of Findings





EXIT **15**

Overview

Exit 15 is located in Winooski approximately half a mile north of the Winooski River bridge. The interchange connects I-89 to VT-15 which runs east-west through northern Vermont from Winooski to Danville. This interchange has only two ramps which include a northbound off-ramp and a southbound on-ramp in the form of half of a conventional diamond interchange. Both ramps at this interchange are geometrically compliant with respect to AASHTO standards.

Interchange Geometric Assessment

Ramp A is the southbound on-ramp and Ramp B the northbound off-ramp. There is no northbound on-ramp or southbound off-ramp at this interchange. Both the on-ramp and off-ramp meet all the AASHTO standards. A summary of the Exit 15 on-ramp features can be found in Table 12. A summary of the Exit 15 off-ramps features can be found in Table 13.

Table 12. Exit 15 On-Ramp Features

			On-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
15-A	I-89 SB On-Ramp	1	820	Parallel	**2800**	NONE	50	-4%	-4%	**300**	3-5	1962

Table 13. Exit 15 Off-Ramp Features

			Off-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
15-B	I-89 NB Off-Ramp	1	2370	Parallel	35	**2370**	315	4-6	**3%**	3%	2011

Interchange Operational Assessment

Exit 15 has two signalized intersections with VT-15. The VT-15/I-89 Northbound on-ramp intersection has two eastbound through lanes and an exclusive right-turn lane, two westbound through lanes and an exclusive left-turn lane, and a single receiving lane on the southbound on-ramp. The VT-15/I-89 Southbound off-ramp intersection has two eastbound and westbound through lanes on VT-15 and a left-turn lane and two right-turn lanes on the northbound off-ramp approach.

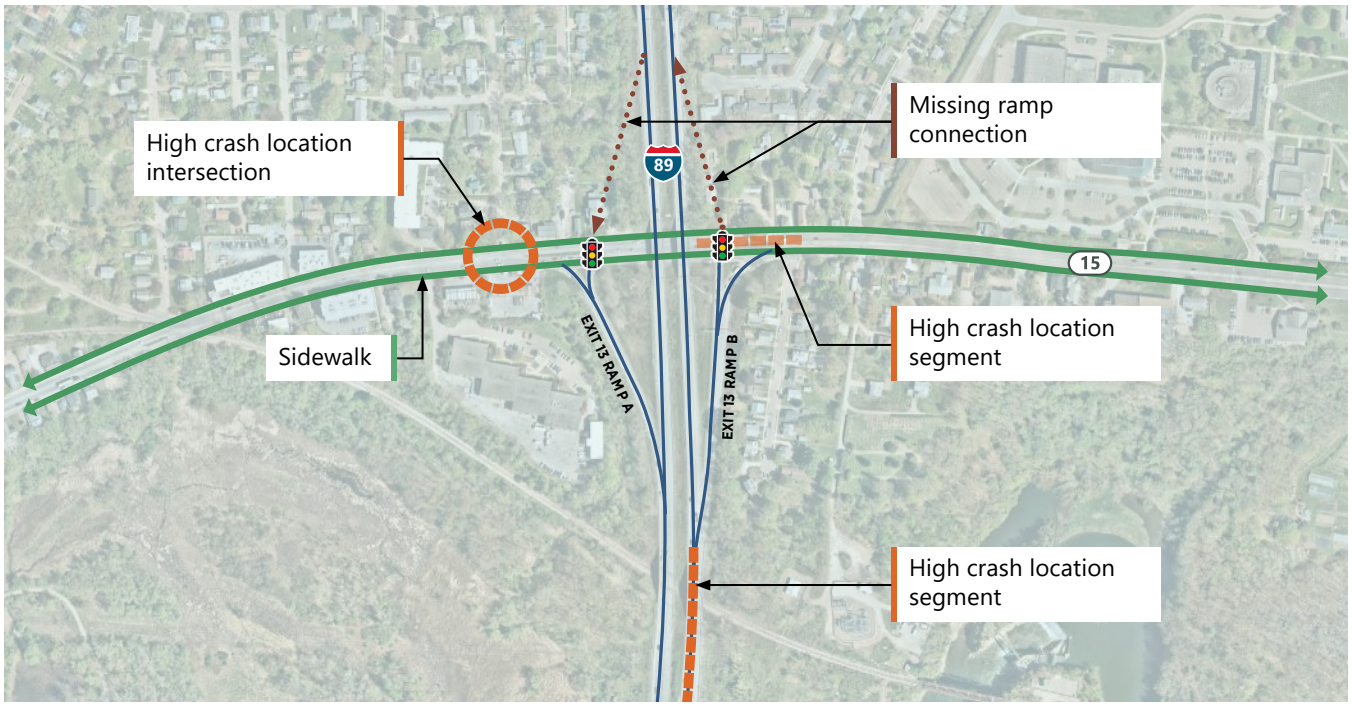
There is a sidewalk located along the north side of VT-15 and a multi-use path along the south side of VT-15 through the interchange. The multi-use path on the south side of VT-15 transition back to a sidewalk just east of Roland Court. Sidewalks on both sides of VT-15 with crosswalks at each intersection across side roads or on- and off-ramps. There are pedestrian signals and marked crosswalks at both ramp intersections with VT-15.

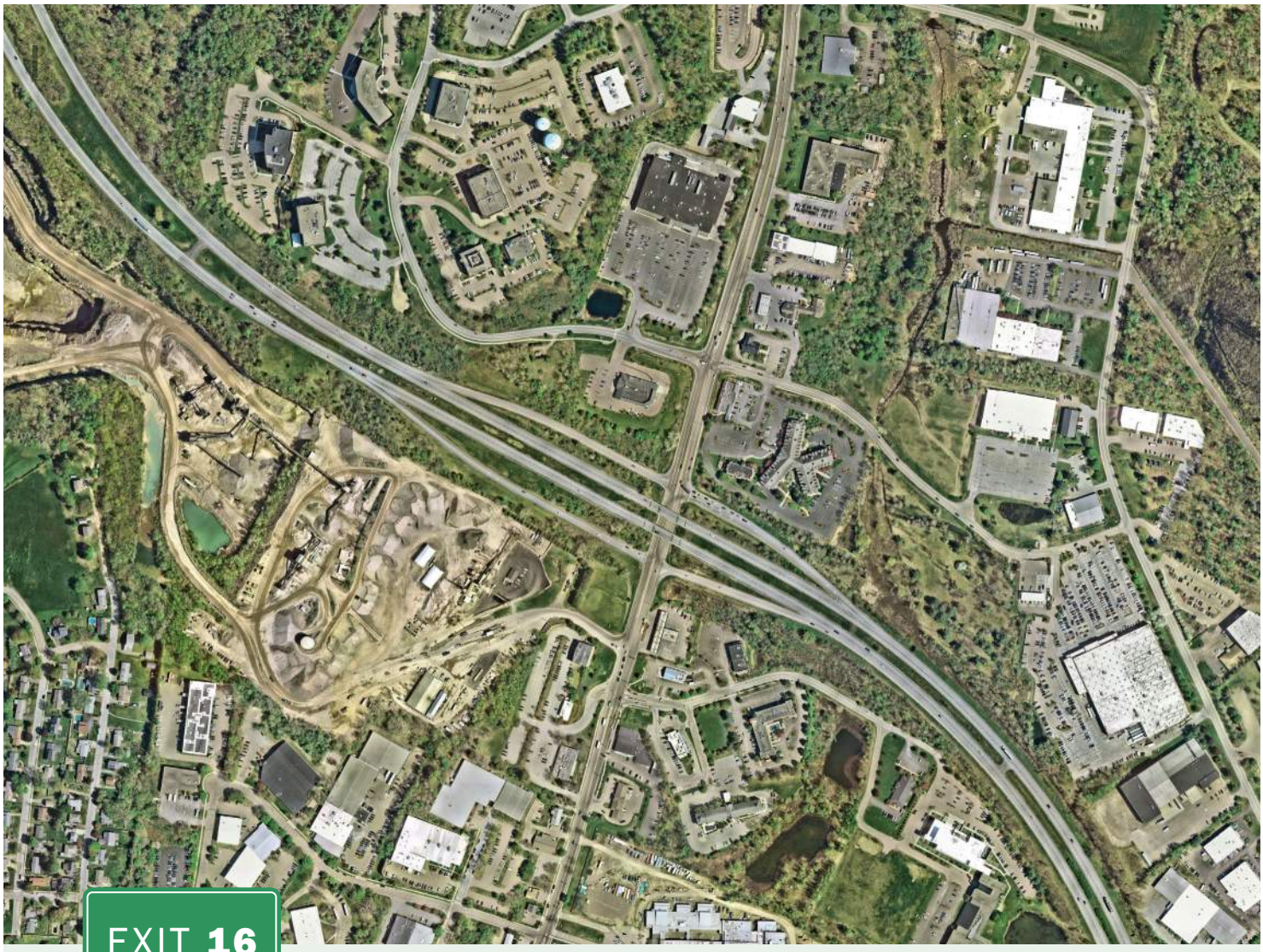
Interchange Safety Assessment

Exit 15 had a total of 124 crashes reported from 2014 to 2018. 47% of these crashes were rear-end crashes and 19% were sideswipes. 77% of the crashes at this interchange resulted in only property damages and 19% resulted in injuries. Crashes at this interchange are concentrated at the ramp termini, particularly at the northbound off-ramp.

Both the northbound off-ramp intersection with VT 15 and the intersection of VT-15 and Dion Street are identified as HCL intersections.

Figure 15: Exit 15 Summary of Findings





EXIT 16

Overview

Exit 16 is located in Colchester, approximately 1,000 feet north of the Winooski city line and is a conventional diamond interchange. Exit 16 connects Interstate 89 with US Route 2/7 that runs through Chittenden County. The curvature on these ramps is very minimal and the intersection between the ramps and US-2 is considered the controlling feature. Both off-ramps have downgrades, and both on-ramps have upgrades. A Diverging Diamond Interchange is proposed for Exit 16 that would improve overall operations and create dedicated bicycle and pedestrian facilities through the interchange. The project is expected to begin construction in 2023.

Interchange Geometric Assessment

Ramps B and C are the two on-ramps at this interchange. Both have uphill grades, and both have merging tapers that are approximately 250 feet in length. These lengths are under the minimum AASHTO requirement. A summary of the Exit 15 on-ramps features can be found in Table 14.

The off-ramps at this interchange meet the AASHTO geometric standards. A summary of the Exit 16 off-ramps features can be found in Table 15.

Table 14. Exit 16 On-Ramp Features

			On-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
16-B	I-89 NB On-Ramp	1	2050	Parallel	**1600**	1440	15	7%	7%	**240**	6-8	1962
16-C	I-89 SB On-Ramp	1	1000	Parallel	**1320**	900	15	**2%**	1%	**250**	6-8	1962

Table 15. Exit 16 Off-Ramp Features

			Off-Ramp Features								
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
16-A	I-89 SB Off-Ramp	1	1940	Tapered-Tangent	STOP	**1270**	576	6-8	**-4%**	-4%	1962
16-D	I-89 NB Off-Ramp	1	2400	Tapered-Curvilinear	STOP	**810**	480	6-8	**-2%**	-2%	1962

Interchange Operational Assessment

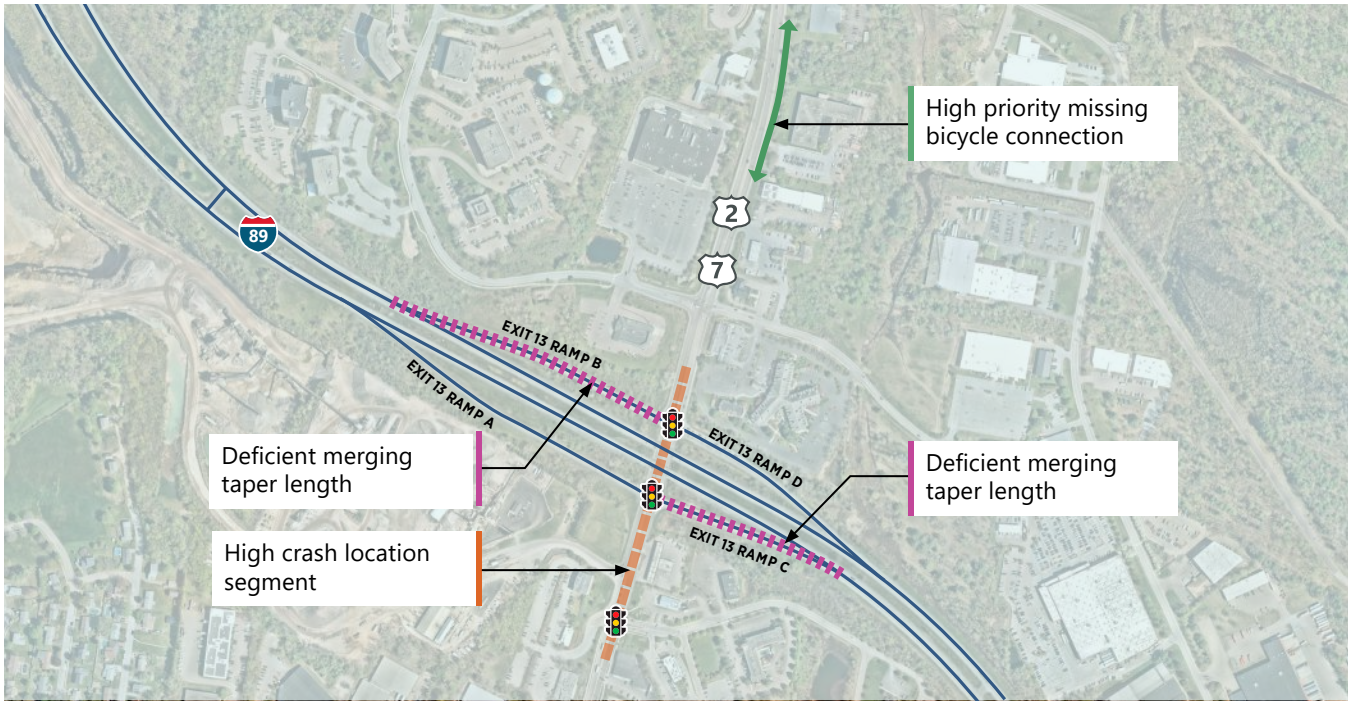
I-89 Exit 16 intersects with US-2/7 at two signalized intersections. At the I-89 Northbound Ramps/US-2 intersection, the I-89 off-ramp approach has one left-turn lane and two exclusive right-turn lanes, the northbound US 2 approach has two through lanes and an exclusive left-turn lane, while the southbound US-2 approach has two through lanes and an exclusive right-turn lane. At the I-89 Southbound Ramps/US-2/7 intersection, the I-89 off-ramp approach has and exclusive right-turn lane and a shared left/right turn lane, the northbound US 2 approach has two through lanes and an exclusive right-turn lane, while the southbound US-2 approach has two through lanes and an exclusive left-turn lane.

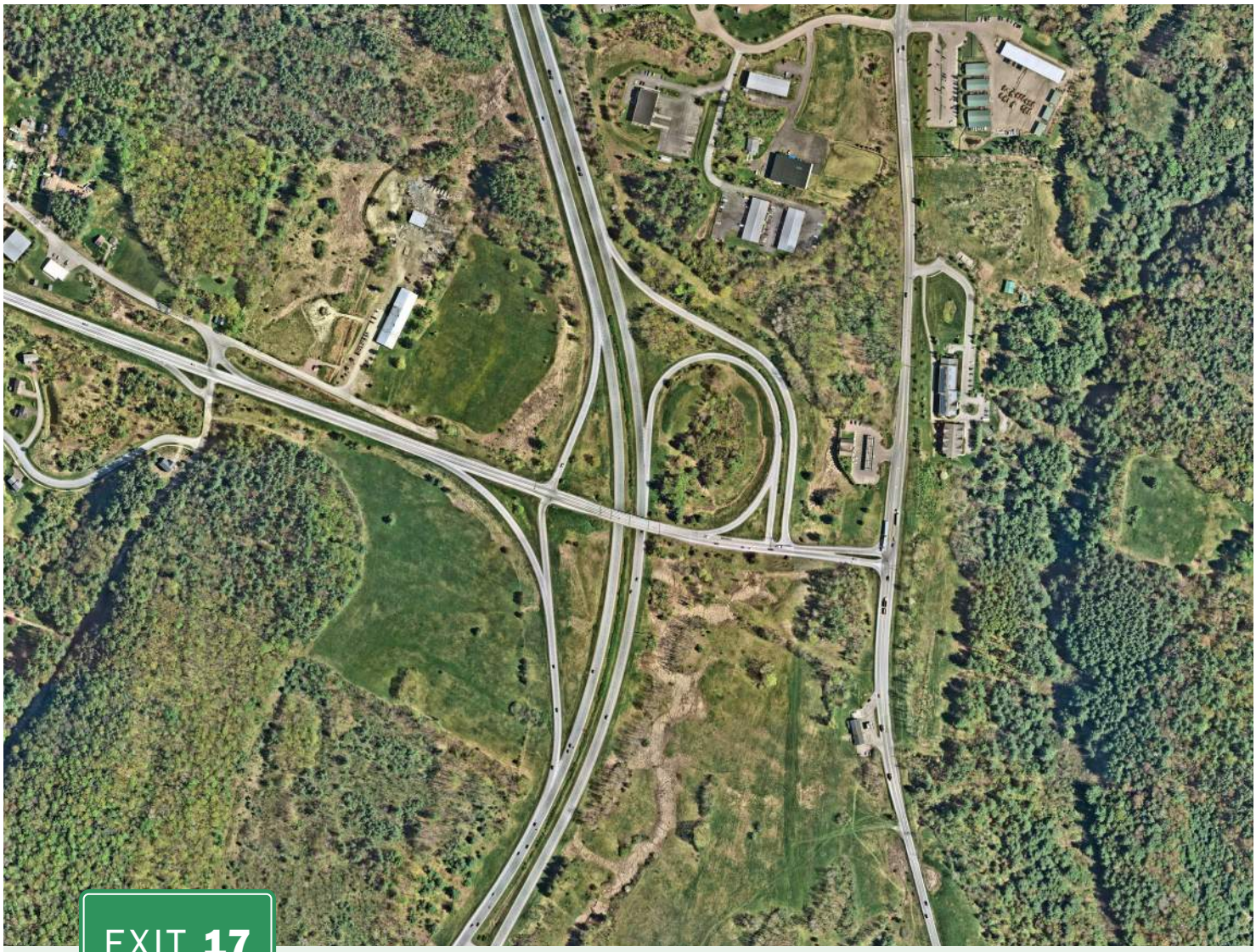
There are currently no bicycle or pedestrian facilities provided through the interchange.

Interchange Safety Assessment

The Exit 16 interchange is a conventional diamond interchange and had 80 reported crashes from 2014 to 2018. Crash types reported at this location include rear-ends (43%), sideswipes (16%), and through movement crashes (13%). Of these crashes, 86% occurred in the daytime and 64% occurred in dry road conditions. The crashes at this interchange concentrated at the ramp termini, particularly at the northbound on- and off-ramps.

Figure 16: Exit 16 Summary of Findings





EXIT **17**

Overview

Exit 17 is located in Colchester, approximately 3,000 feet south of the Milton town line and connects I-89 to US Route 2. US-2 runs through Vermont and crosses over Lake Champlain before passing through Chittenden County, Essex County, and then through Montpelier. This interchange also provides access to US-7 which runs north-south through Vermont. Exit 17 is proposed to be reconstructed, beginning in 2024, to provide additional capacity at the off-ramp intersection, additional through lanes on US-2, improvements to the US 2/US 7 intersection, and pedestrian accommodations.

Interchange Geometric Assessment

Ramp A is the southbound on-ramp and has a controlling curve radius of approximately 700 feet. The acceleration length along this ramp is approximately 560 feet. This length is deficient when compared to the minimum AASHTO requirement of 600 feet for these ramp conditions. It should also be noted that the merging taper length is also less than the minimum requirement of 300 feet. A summary of the Exit 17 on-ramps features can be found in Table 16.

Ramp D is the tapered northbound off-ramp at this interchange and has a posted advisory speed of 30 mph and a controlling radius of 230 feet. The deceleration length of the ramp is measured to be approximately 330 feet which is under the minimum requirement according to AASHTO standards. A summary of the Exit 17 off-ramps features can be found in Table 17.

Table 16. Exit 17 On-Ramp Features

			On-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Entrance Ramp Type (Tapered, Parallel)	Acceleration Length, La (ft)	AASHTO Minimum Acceleration Length (ft)	Assumed Speed at Controlling Feature, V' (mph)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Merging Taper (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Year of Latest Geometric Charges
17-AF	I-89 SB On-Ramp	1	716	Parallel	**560**	600	45	**0%**	-5%	**210**	3-5	1964
17-C	I-89 NB On-Ramp	1	572	Parallel	**640**	600	45	**1%**	1%	**430**	3-5	1964

Table 17. Exit 17 Off-Ramp Features

			Off-Ramp Features									
Ramp No.	Ramp Description	Number of Lanes	Controlling Curve Radius (ft)	Exit Ramp Type (Tapered, Parallel)	Assumed Speed at Controlling Feature, V' (mph)	Deceleration Length, La	AASHTO Minimum Deceleration Length (ft)	AASHTO Maximum Grade (%) (Table 10-2)	Profile Grade along La (%)	Profile Grade along Ramp (%)	Year of Latest Geometric Charges
17-B	I-89 SB Off-Ramp	1	720	Parallel	45	**370**	235	3-5	**-1.00%**	4.00%	1964
17-DE	I-89 NB Off-Ramp	1	230	Tapered-Curvilinear	30	**280**	470	5-7	**0.80%**	4.00%	1964

Interchange Operational Assessment

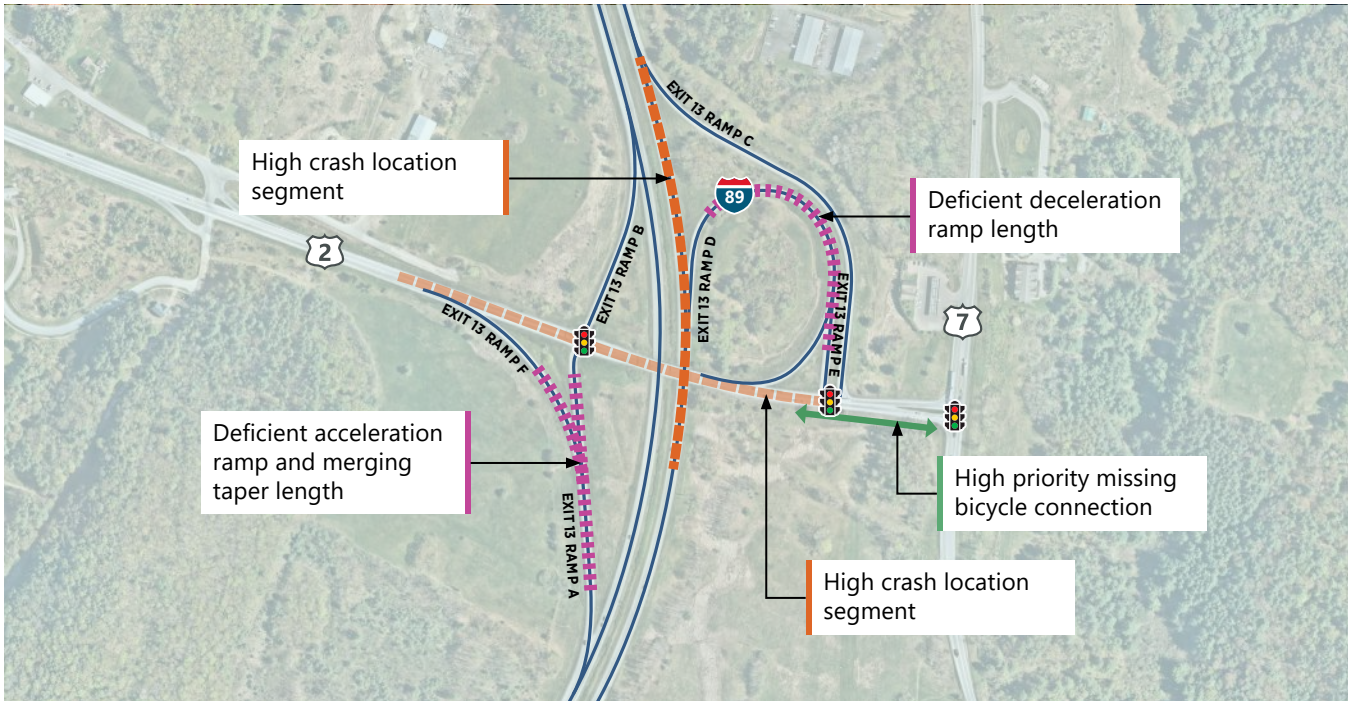
The I-89 northbound on- and off-ramps intersect US-2 at two signalized intersections. At the northbound on/off ramps signalized intersection, there is a single left- and right-turn lane on the northbound off-ramp approach, a single westbound through lane, and a single eastbound through lane. At the southbound on/off ramps signalized intersection, there is a single lane on the southbound off-ramp approach, a through and exclusive left-turn lane on the westbound US-2 approach and a through lane and exclusive right-turn lane on the eastbound US-2 approach.

Interchange Safety Assessment

Exit 17 in Colchester had a total of 92 recorded crashes between 2014 and 2018. In this area, 22% of the reported crashes occurred with wet road conditions 47% resulted in property damages, 24% resulted in injuries, and 42% involved rear-end collisions.

There are two High Crash Location segments located proximate to Exit 17. One of the HCL segments runs along US-2 from US-7 to approximately Jasper Mine Road while the second runs along I-89 northbound adjacent to the interchange.

Figure 17: Exit 17 Summary of Findings



3.5 Public Transportation

Green Mountain Transit (GMT) serves Chittenden County with fixed route service, local commuter routes, LINK Express routes, and ADA paratransit services. GMT also provides shuttles from senior housing complexes to local supermarkets and student transportation to Burlington schools. Significant investment in the regional transit system is forecast in the MTP with an anticipated $40M in system expansion through 2050 to reduce headways to 15 minutes on all trunk routes, reduce headways to 20-30 minutes on all routes in the system, add new routes, and add additional weekend service. Routes that utilize the I-89 corridor include the Montpelier LINK and St. Albans LINK services. Total annual GMT ridership has fluctuated in recent years due to the COVID-19 pandemic, with 2019 ridership at 2.7M passengers, 2020 ridership at 2.2M passengers, and 2021 ridership at 1.4M passengers. Prior to the COVID-19 pandemic annual GMT ridership averaged approximately 2.6M passenger rides per year.

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GMT Downtown Transit Center

Transit riders coming to and from Addison, Northern Windsor, and Orange Counties can transfer between GMT and Tri-Valley Transit routes in either downtown Burlington or at the University Mall in South Burlington.

Regional transportation options in the area also include Megabus and Greyhound intercity bus service with stops in Burlington, and Amtrak service that originates in St. Albans (Vermonter) and Burlington (Ethan Allen).

3.6 Park & Ride Lots

There are currently three state Park and Ride lots located along I-89 in Chittenden County at Exit 11, Exit 16, and along US 7 in the vicinity of Exit 17. In addition, there are Park and Ride lots located just outside of the project study area at Exit 10 and Exit 18 and a new state Park and Ride facility is currently under construction at Exit 12. The Exit 11 Park and Ride lot has 158 parking spaces and no electric vehicle charging stations. The Exit 16 Park and Ride lot has 114 parking spaces and eleven Level 1 electric vehicle charging stations. The Exit 17 Park and Ride lot has 106 parking spaces and no electrical vehicle charging stations. All three Park and Ride lots are served by GMT transit service.

3.7 Intelligent Transportation Systems

Early coordination with VTrans' Transportation Systems Management and Operations (TSMO) group representatives helped to identify existing Intelligent Transportation System (ITS) assets along the I-89 corridor in Chittenden County, identify issues and concerns with existing ITS equipment, and summarize future plans for expanding ITS infrastructure along the I-89 corridor.

The primary ITS infrastructure in place along the I-89 corridor includes the following assets:

» **Road Weather Information Systems** (RWIS) have sensors to detect atmospheric and on-road weather conditions including temperature, wind speed, wind direction, precipitation, and visibility. Cameras provide visual verification of on-road conditions. Along the I-89 corridor in Chittenden County, there are currently five RWIS stations: 1) between Exits 10 and 11 in Bolton, 2) between Exits 11 and 12 in Williston, 3) between Exits 16 and 17 in Colchester, and 4) two units located between Exits 17 and 18 in Milton. The RWIS station in Colchester also includes weigh-in-motion sensors to capture axle weights and gross vehicle weights.

» **Continuous Traffic Counters** (CTC) collect continuous traffic information including traffic volume and vehicle classification data. Along the I-89 corridor in Chittenden County, there are three CTC stations: 1) I-189 between I-89 and Shelburne Road (D099), 2) I-89 between Exits 14 and 15 (D091), and 3) I-89 between Exits 16 and 17 (D092). CTC unit D092 also includes weigh-in-motion sensors to capture axle weights and gross vehicle weights.

» **Bluetooth** (BT) monitoring devices have been deployed on five arterial corridors in Chittenden County by the CCRPC as part of their Advanced Traffic Monitoring System to measure travel times and speeds, and origin/destination information. The BT sensors have been deployed along the following five corridors:

- US 2/Williston Road/Main Street from University Heights to Industrial Avenue—Burlington and South Burlington
- VT 15 from Exit 15 to Susie Wilson Road and VT 289—Colchester and Essex
- US 2/VT 2A from Exit 12 to Five Corners—Williston and Essex Junction
- US 2 at Exit 17—Colchester
- US 2/Main Street from Barrett Street/Riverside Avenue to Severance Road—Winooski and Colchester

» **Variable Message Signs** (VMS) have been deployed at various locations along the I-89 corridor to provide timely notifications, weather alerts, and emergency response information to the traveling public. Along the I-89 corridor in Chittenden County, there are several temporary and permanent VMS installations:

- Between Exits 10 & 11
  Northbound & Southbound: Temporary VMS

- Between Exits 11 & 12
  <u>Northbound:</u> Permanent VMS (co-located with RWIS)
  <u>Southbound:</u> Permanent VMS
- Between Exits 12 & 13
  <u>Northbound & Southbound:</u> Temporary VMS
- Between Exits 16 & 17
  <u>Northbound:</u> Temporary VMS
  <u>Southbound:</u> Permanent VMS (co-located with RWIS)

VTrans manages a Transportation Operations Center (TOC) that is operated 24-hours a day and monitors system performance and weather conditions, provides information to the traveling public through public service announcements, press releases, and variable message boards, and assists with emergency response through collaboration with emergency first responders.

Figure 18: Variable Message Sign (VMS) Locations

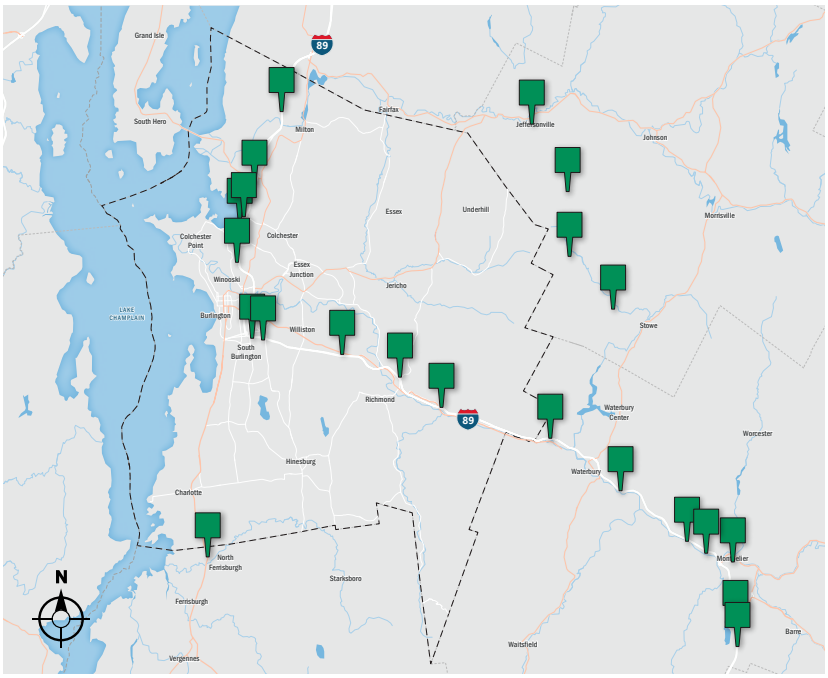
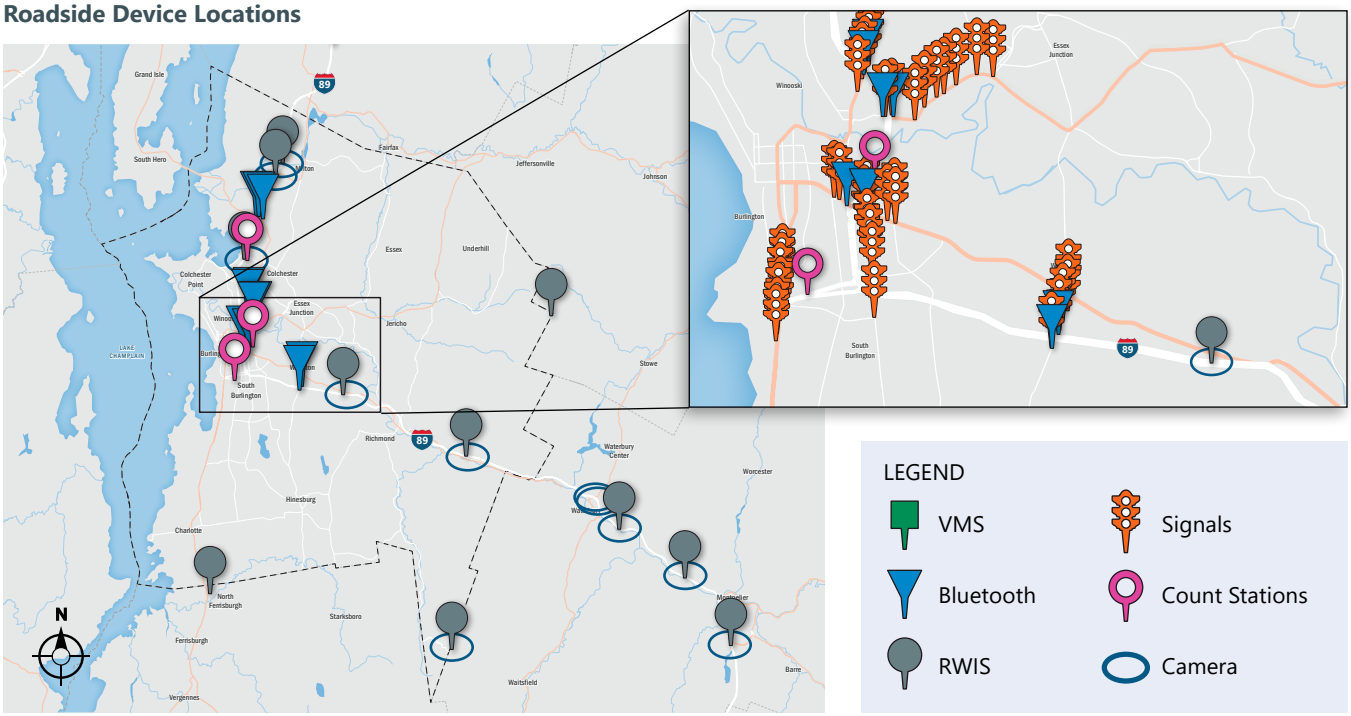


Figure 19: Intelligent Transportation System Roadside Device Locations



3.8 Natural Resources

While the Interstate 89 corridor in Chittenden County runs through and provides access to the most developed lands in the State, it also abuts a wide variety of significant natural resources, including streams, floodplains, marshes, swamps, forested wetlands and uplands, habitat for rare, threatened and endangered species, conserved lands, and other resources vital to the ecological health and biodiversity of the area.

The I-89 corridor occupies two Vermont biophysical regions: the Northern Green Mountains and the Champlain Valley. The I-89 corridor in the Towns of Bolton and Richmond occupies the Northern Green Mountains biophysical region, though the Interstate was purposefully constructed in the relatively gentle relief of the Winooski River valley, with the river to the south and the steep slopes of the Green Mountains to the north. In many places, the 100-year floodplain abuts the south side of the highway embankment and occasionally abuts both sides, such as between Jonesville and Richmond where it traverses agricultural lands. Lands adjoining the I-89 corridor in Bolton and Richmond have large and intact interior forest blocks that are well connected to other habitat blocks (i.e., experiencing minimal fragmentation) and have a high degree of physical landscape diversity.

The transition to the Champlain Valley biophysical region generally occurs where I-89 diverges from the Winooski River at Exit 11 (Bolton/Richmond) and continues westerly, though some prominent foothills attenuate this landscape change, notably the climb up the northern flank of French Hill out of the Winooski River valley and the forested stretch to and just beyond Exit 12 (Vermont Route 2A, Williston/Essex Junction). It is at the top of this climb, about 0.8 mile west of the Allen Brook crossing, that I-89 reaches its highest elevation in Chittenden County (approximately 596 feet). From there, the Interstate corridor has comparatively less relief and gradually becomes more developed. Intact habitat blocks and connectivity are predictably more sporadic, occurring primarily along stream corridors and crossings.

In the Champlain Valley, I-89 bisects stream features as opposed to running parallel to them. Proceeding west and north into Williston and South Burlington, prominent examples include Allen Brook, Muddy Brook, Potash Brook (crossed twice), and Centennial Brook. The latter two stream features are on the 303(d) list of impaired waters due to elevated chloride levels from road salt. A second crossing of the Winooski River occurs at the South Burlington / Winooski town line at the Winooski Gorge. A large natural area—the 105-acre Casavant Nature Area (a City of Winooski park)—incorporates the forested island and lands between the river and the New England Central Railroad track to the north, just upstream of the Winooski Falls. Much of the Casavant Nature Area is classified by the State of Vermont as a significant natural community, specifically a Silver Maple-Ostrich Fern Floodplain Forest.

North of Exit 16 and the Whitcomb quarry that abuts its southern flank, the I-89 corridor gradually returns to a more natural setting. The Sunderland Brook and Indian Brook valleys provide

important habitat diversity. The Interstate then makes its closest approach to Lake Champlain and reaches its lowest elevation (in Chittenden County) just south of the Malletts Creek crossing (103 feet). The large Malletts Creek Marsh lies between I-89 and US Route 2 at this location, where Indian Brook, Pond Brook, and Allen Brook all make confluence with Malletts Creek. A variety of state-listed rare and threatened plant and animal species are present in this marsh.

The last major river crossing before the Franklin County line is over the Lamoille River just downstream of Milton. Continuing north and just past the Lake Road overpass, I-89 bisects five east to west-flowing streams that are relatively closely spaced, draining the western flank of Arrowhead Mountain. These streams coalesce just west of I-89 in a very large swamp feature called Towne Swamp, consisting of two significant natural communities: a Red Maple-Black Ash Seepage Swamp, and a Red Maple-Northern White Cedar Swamp. Towne Swamp is 600-acre wetland and one of the Champlain Valley's largest forested wetlands that is not associated with a river.

Mapping of the natural resources along the I-89 corridor is available in detail in Appendix G.

3.9 Cultural Resources

Above-ground historic properties in close proximity to the I-89 corridor in Chittenden County are limited. Rather, the majority are present along the preceding major transportation corridors: US Routes 2 and 7, with only occasional properties outside of these highways being those that ended up being positioned close to and sometimes bisected by the Interstate upon its construction.

This discussion does not include components of Interstate 89, which at greater than 50 years old could be considered historic properties.

3.9.1 State Register of Historic Places

The State Register of Historic Places (State Register) lists a number of residential and farm complexes along US Route 2 and near the Interstate in Bolton, Jonesville, and Richmond. In South Burlington, State Register-listed properties include the Stuart/Emmons House, built c.1855 and located close to the Interstate right-of-way just southeast of the Dorset Street underpass and the University of Vermont Horticultural Farm, which abuts the west side of I-89 between Exits 13 and 14. In Colchester, the c. 1850 Curtis House at 389 Bay Road (Vermont Route 127) is located just east of the I-89 overpass. No State Register-listed properties are present in close proximity to the I-89 corridor in Winooski and Milton.

3.9.2 National Register of Historic Places

Properties listed in the National Register of Historic Places (National Register) located in close proximity to I-89 include the following:

- **Preston-Lafreniere Farm:** An historic homestead and agricultural barn complex on the south side of the Winooski River at the confluence with Preston Brook in Bolton, near the intersection of Duxbury Road and Honey Hollow Road.
- **M. S. Whitcomb Farm:** Located on US Route 2 in Richmond, about 1.5 miles east of Richmond Village. The farmhouse dates to 1875, but it is the

four level 1901 bank barn that is a recognizable landmark, being visible from the Interstate.

» **Gray Rocks:** Includes approximately 380 acres with c. 1813 farmhouse, barns and other outbuildings at 1147-1148 US Route 2 and abutting the north side of the I-89 right-of-way in Richmond.

» **Checkered House Bridge:** A single span, steel through truss bridge, measuring 356 feet long and built in 1929 (after the 1927 flood) to carry US Route 2 over the Winooski River. It is located just north of the I-89 bridge crossing in Richmond.

» **Dan Johnson Farmstead:** A 210-acre property bisected by I-89 near Johnson Lane (to the north) and South Road (to the south) in Williston, including farmhouses dating to c. 1840 and c. 1893, a tenant's house (c. 1890), a barn (c. 1840), and various other buildings.

It should be noted that other properties within the corridor may be eligible for listing in the State or National Registers and have not yet been formally determined as such.

3.10 Environmental Justice

In a 1992 report on Environmental Equity, the US Environmental Protection Agency (EPA) documented health and exposure disparities associated with race/ethnicity and income.[4] Subsequently, through Executive Order 12898, it was mandated that each "…federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, any disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority, low-income, tribal and indigenous populations."[5]

The State of Vermont has recently passed Act 154, which "…establishes an environmental justice policy for the [State] and requires the State agencies to incorporate environmental justice into their work, rules, and procedures."[6]

The EPA's online EJScreen tool can be used to perform environmental justice screening. Those data indicate that the I-89 corridor passes through or abuts communities that have relatively high percentiles for various socioeconomic indicators and environmental justice indices relative to the rest of the state. Most notable is census block group 50007002501 in the City of Winooski, which is bisected by I-89 between East Allen Street (VT 15) and the Colchester town line. Within this block group, people of color represent 32 percent of the population and 54 percent of the population is classified as low income. These values correspond with state percentiles of 99 and 93, respectively (meaning few areas have a higher percentage of people of color and people with lower incomes). This population is also estimated to be 3 percent linguistically isolated. In this block group, high percentiles are also

The US Environmental Protection Agency (EPA) has defined "environmental justice" as follows:

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies."*

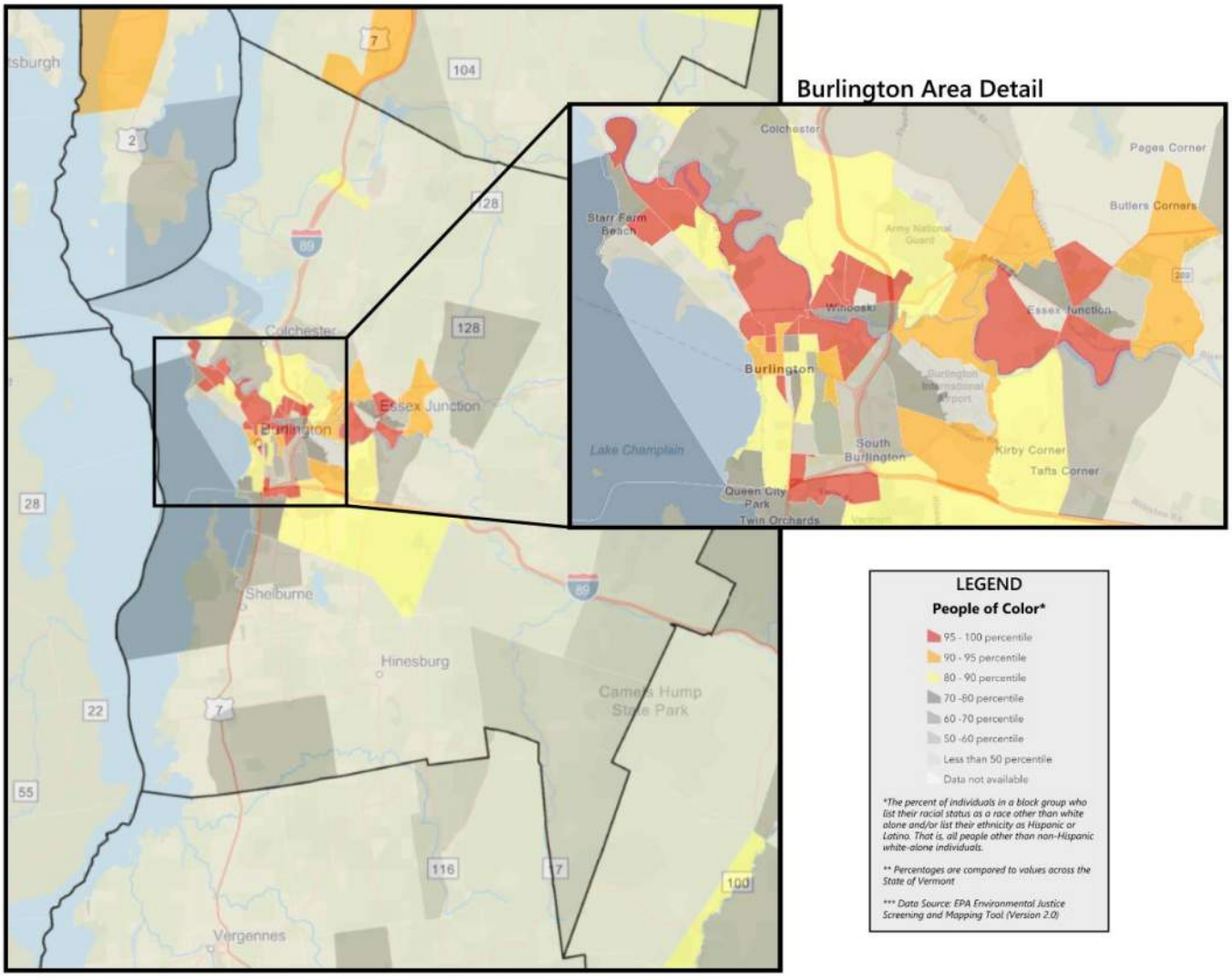
* https://www.epa.gov/environmentaljustice/learn-about-environmental-justice

4 US EPA. (1992). Environmental Equity: Reducing the Risk for All Communities. Washington, DC: Retrieved from http://nepis.epa.gov/Exe/ZyNET.exe/40000JLA.TXT
5 https://www.epa.gov/sites/default/files/2021-04/documents/ejscreen_technical_document.pdf
6 https://legislature.vermont.gov/bill/status/2022/S.148

associated with all of the environmental indices, including those corresponding to proximity to traffic such as particulate matter, ozone, air toxics cancer risk, and air toxics respiratory hazard index.

Generally speaking, the percentiles for environmental indices are considerably lower to the north and south of this block group, though the demographic index (average of people of color and those with a low income) remains high for the two block groups to the south; bisected by I-89 and including south Winooski and portions of South Burlington north of I-189 and generally between Hinesburg Road and Spear Street. The block group abutting the south side of I-189 and including the neighborhoods abutting Shelburne Road (US Route 7) from Brewer Parkway to Flynn Avenue also has a high demographic index (20 percent people of color and 34 percent low income).

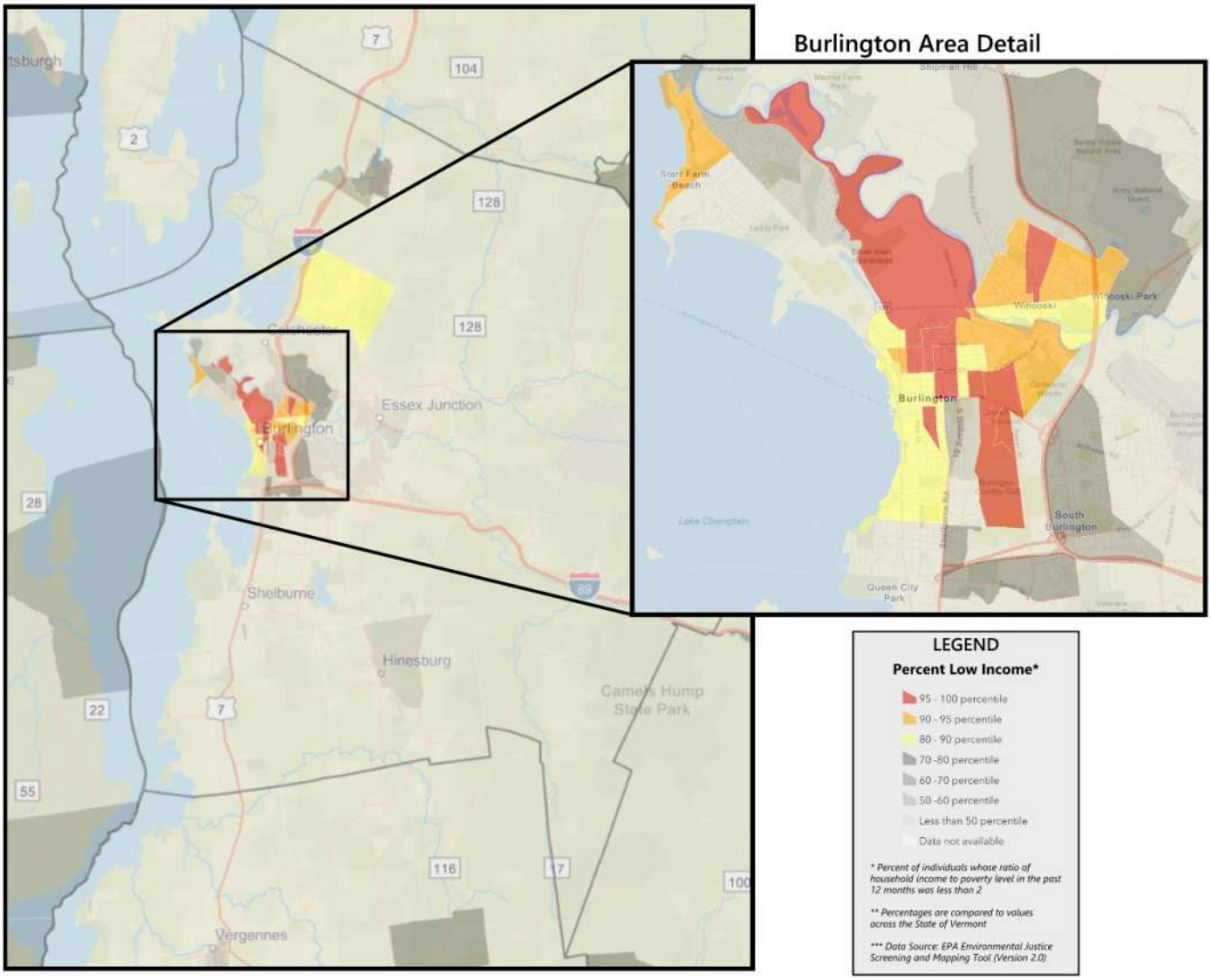
Figure 20: EJScreen Mapping—People of Color (Percentiles Based on Comparison with Statewide Figures)



To the north, the block group that abuts the east side of I-89 from Bay Road to Chimney Corners in Colchester has a high demographic index, attributable primarily to a low-income population of 42 percent, as people of color represent just 5 percent of the population in this block group. Lastly, the block group bisected by I-89 in Milton between Checkerberry Village and the Lamoille River has a population that is 13 percent people of color and 32 percent low income.

It should be noted that these data are for screening purposes only and substantial uncertainty remains for environmental indicators based on proximity to transportation corridors. Local data should be leveraged to the extent feasible to supplement these data for site- or project-specific EJ assessments.

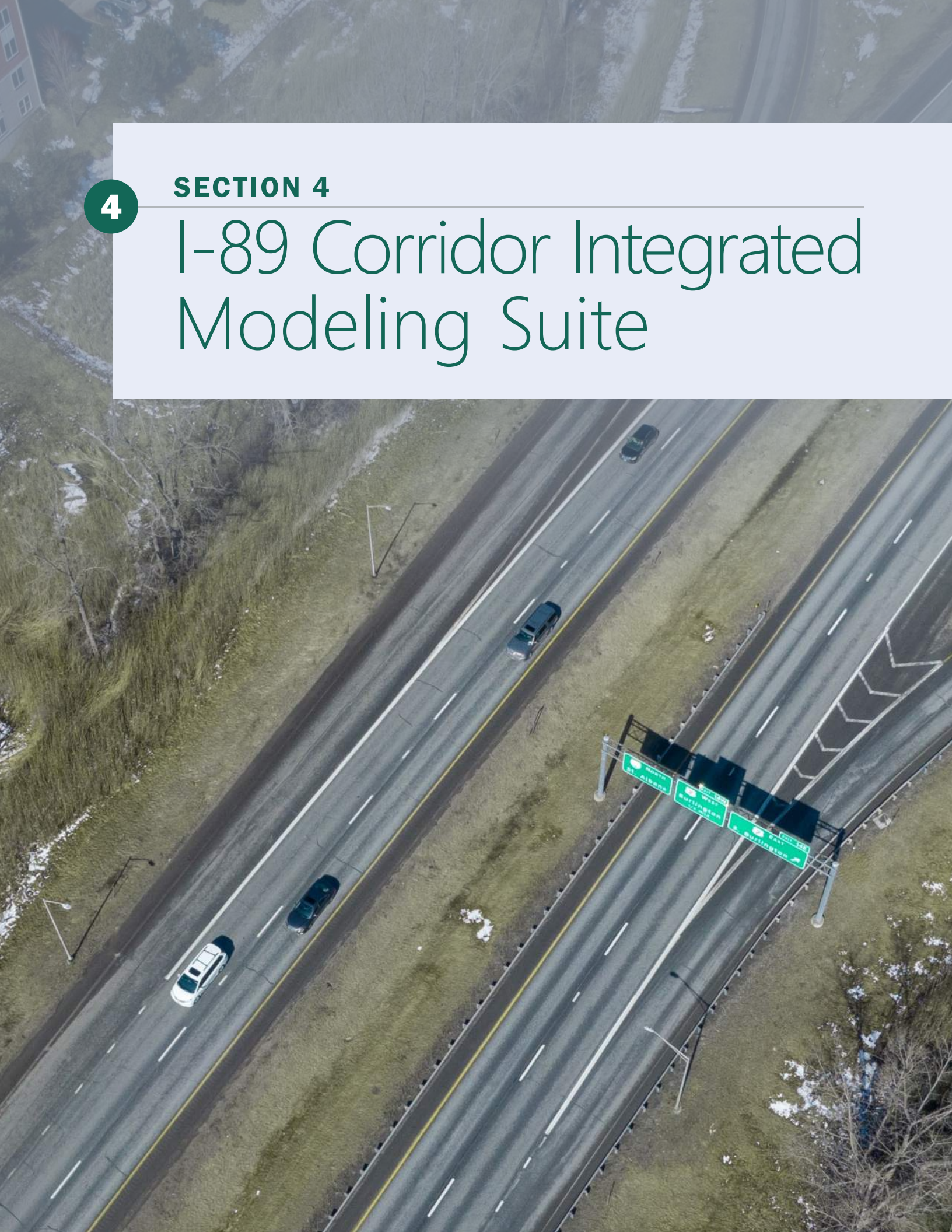
Figure 21: EJScreen Mapping—Percent Low Income (Percentiles Based on Comparison with Statewide Figures)



4

SECTION 4

I-89 Corridor Integrated Modeling Suite

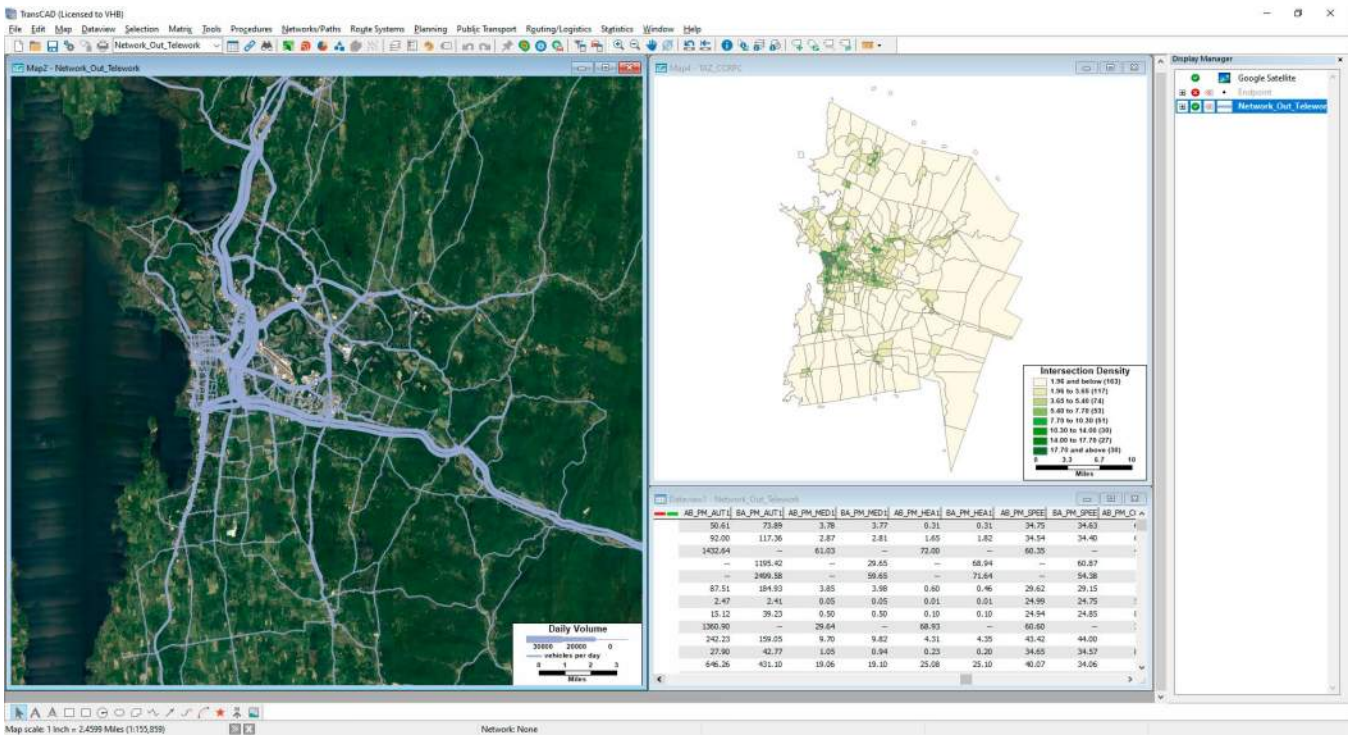


4.1 I-89 Corridor Integrated Modeling Suite

A modeling suite was developed for this study capable of evaluating existing conditions and forecasting future scenarios in order to assess various projects and programs using relevant transportation metrics. Through the recent regional planning and Metropolitan Transportation Plan (MTP) update process, the CCRPC has updated the Chittenden County Regional Travel Demand Model to evaluate future projects and transportation investments to include in the future MTP scenario. The model, developed and implemented in Caliper's TransCAD environment, is a four-step travel demand model representing the travel patterns on the transportation network in the Chittenden County region on a typical fall day.

The forecasting scenarios from the MTP effort provided the foundation for the scenarios developed for this study. For the base model scenarios, an update to the land use allocation was completed to better represent the growth patterns and distribution over the last five years. Projects included in the future scenarios generally fell into two categories, based on either 1) projects with committed funds from the Transportation Improvement Program (TIP) and VTrans Capital Program, or 2) projects from the regional planning and MTP process. The list of projects from the MTP scenario was adjusted to remove projects with direct impacts on the I-89 corridor that were intended to be part of this study's assessment, including the widening of the I-89 mainline and the construction of Exit 12B. These projects were included in the MTP evaluations as placeholder projects for the improvements considered in this study.

Figure 22: Screenshot of CCRPC Regional Travel Demand Model



Microsimulation Model

A microsimulation model ("I-89 Corridor Model") for the project area was developed in Caliper's TransModeler to evaluate existing conditions, forecast future conditions, and assess potential projects at higher spatial and temporal resolutions than the regional model allows. Whereas the regional modeling environment represents the larger and coarser scale transportation network, travel demand, and modal split, the microsimulation environment represents finer scale traffic operations, vehicle interactions, and operator behaviors. The microsimulation environment provides a platform for evaluating macro- and micro-scale traffic operation metrics like delays, queues, travel times, and trip statistics, while also providing a visual representation of the infrastructure and traffic operation through simulation.

Corridor Model Network Development

The network for the I-89 Corridor Model simulation was seeded with a subarea of the regional model geographic network and refined with local network links, lane configurations, intersection geometries, traffic signal phasing and timing, and other operation considerations. These details were gathered from VTrans data resources, local municipality data resources, aerial imagery, Google Streetview, and local knowledge. The geographic extents of the model were determined early in the project with input from the Technical and Advisory Committees.

The demand for the base model network was developed through an origin-destination matrix estimation (ODME) process, with inputs of an origin-destination (OD) seed matrix and a network of traffic and turning movement counts. The demand was seeded with an hourly OD matrix from a subarea analysis of the regional model, which represents the demand from origins and destinations within the geographic extents of the project area by maintaining the Traffic Analysis Zone centroids within the project area and converting the links at the subarea boundary to external zones. Traffic and turning movement counts were used across the network to develop a reliable volume network that served as a target for the ODME process and model volume calibration. The most recent available weekday screenline and turning movement counts from the VTrans Transportation Data Management System were gathered. The peak hours according to the continuous counter between Exits 14 and 15 were identified as the peak hours for the system, with the simulation scenarios spanning the pre- and post-hour in the AM and PM peak. Therefore, each scenario spans a 3-hour period, 6 AM to 9 AM in the morning and 3 PM to 6 PM in the evening. The mainline, interchange ramp, and turning movement volume network was balanced to the mainline segment counts. The peak hour volume network is depicted in the Appendices.

Strategic Model

In recognition of the need to evaluate various projects and programs for the I-89 corridor in a range of possible future land use and transportation environments, the integration of a scenario planning tool into the modeling suite was pursued. The VisionEval Regional Strategic Planning Model (VE-RSPM) is a platform that enables evaluation of host of different conditions and constraints as they relate to a particular outcome. Provided a variety of ways in which the desired outcome might be achieved, the model can be used

to identify those conditions or constraints that may collectively lead to the objective. In this case, the VE-RSPM was integrated to help identify the transportation and land use strategies as well as other policy shifts that achieve desired regional reductions in vehicle miles traveled. In other words, what transportation demand management policies other programs and policies can be leveraged to achieve the goal of reduced VMT.

To integrate this policy level evaluation with the regional model, sensitivity of the regional model to adjustments in non-motorized, transit, policy, and telework was explored. Operationalizing the strategies within the modeling environment was imperative to further evaluation of corridor projects and programs in the context of a TDM policy future scenario. In the modeling environment, non-motorized mode share is related to a traffic analysis zone's walkability, residential density, employment density, and intersection density. Transit mode share is related to routes, fares, speed, transfer times, and headways. Changes in policy and pricing would be reflected at the household level in relation to household trip making characteristics and vehicle ownership. The propensity for telework is related to a traffic analysis zone's mix of remote, mixed, and on-site occupations and the home-based work trip patterns. Adjustments to these model inputs were the key to integrating the VE-RSPM to the regional model for evaluation of the projects and programs for the I-89 corridor in a TDM policy future. The model adjustments and sensitivity analyses were detailed further in a technical memorandum included in the Appendix.

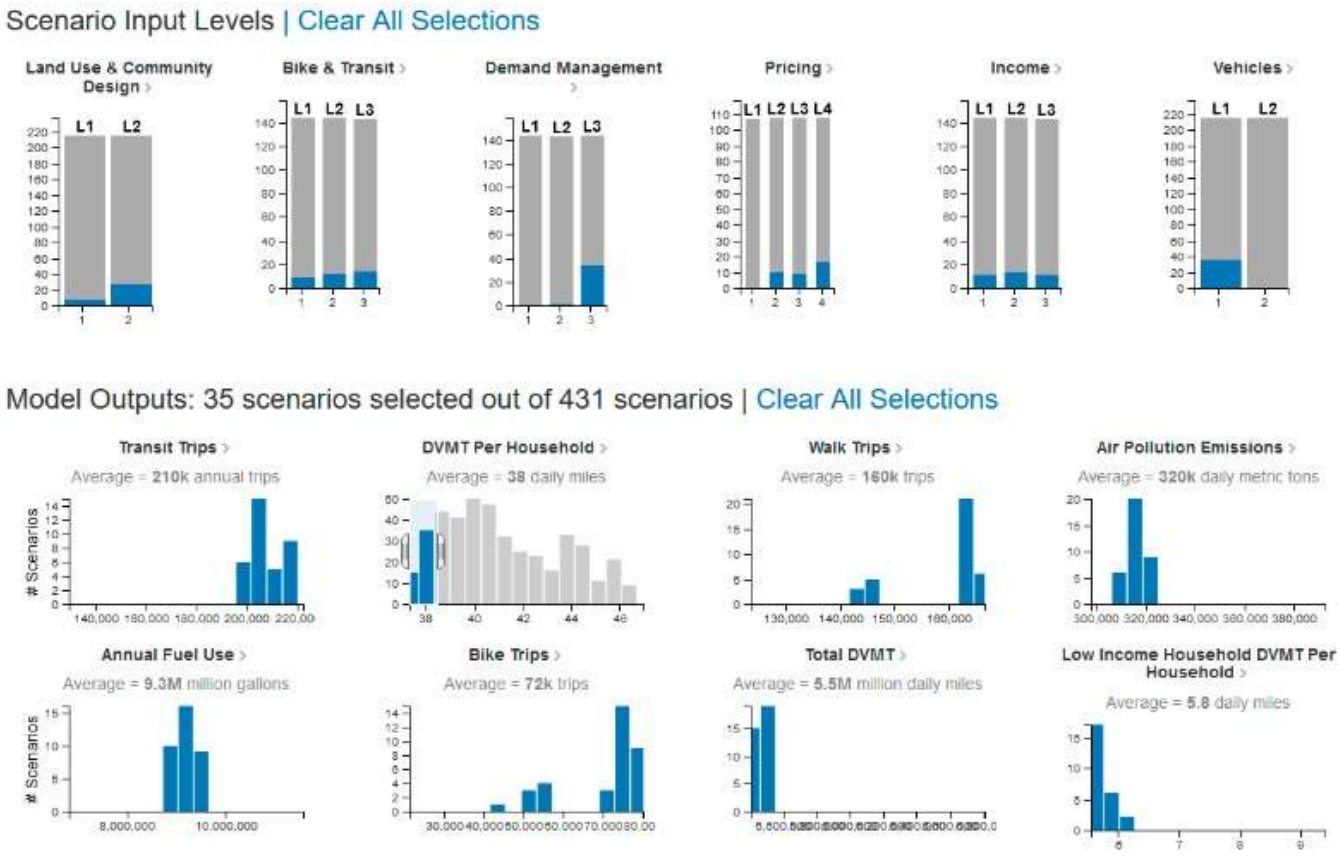


Figure 23: VisionEval Regional Strategic Planning Model Multiscenario Visualizer (Courtesy: RSG)

SECTION 5

5

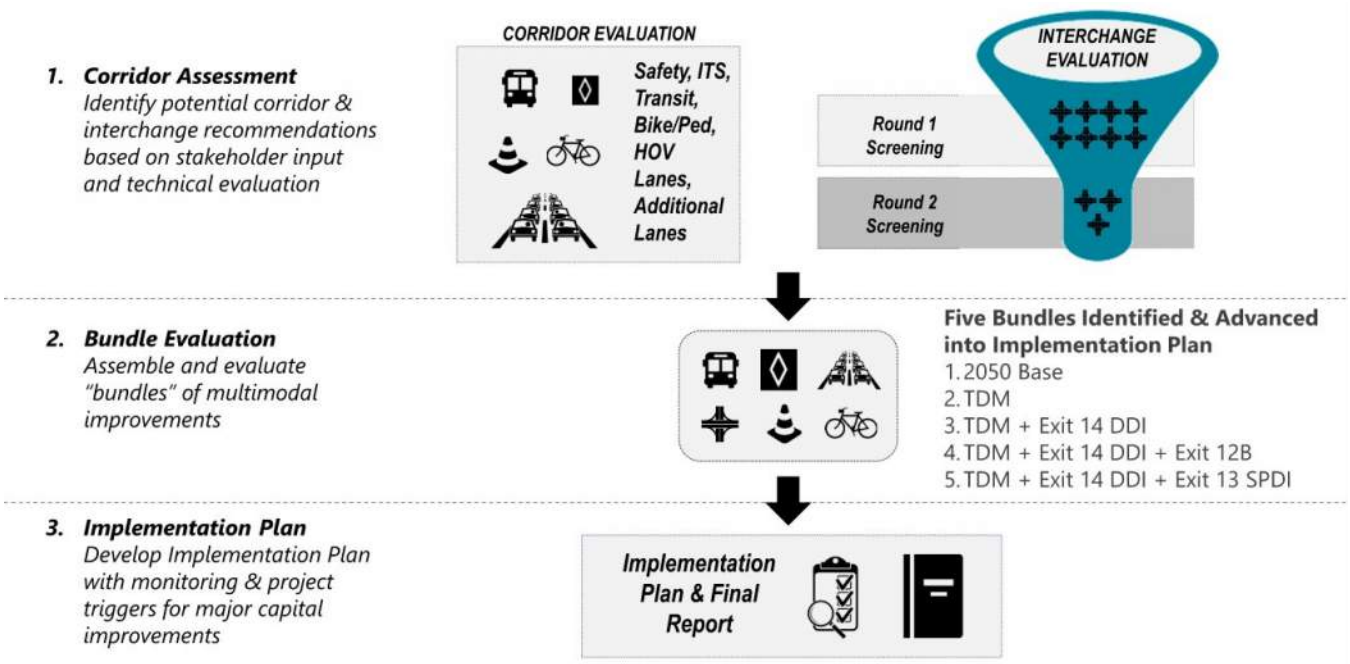
Alternatives Identification and Evaluation

Alternatives Identification and Evaluation

Building upon initial stakeholder input, an understanding of existing conditions, issues, and opportunities, and a documented Vision and Goals for the corridor, the next step in the process is to identify, evaluate, screen, and prioritize a package of improvement alternatives for the I-89 corridor through 2050. This process involved extensive public outreach, data modeling and analysis, committee and stakeholder input and a detailed project screening process to arrive at the identified package of improvements for the I-89 corridor.

A general overview of the alternatives identification and evaluation process used for this study is shown in Figure 24 and is expanded upon in more detail in following sections.

Figure 24: Developing and Evaluating I-89 Corridor "Bundles"



5.1 Interchange Screening & Evaluation Process

Improvements to access along the I-89 corridor within Chittenden County has long been a point of discussion, with numerous planning, feasibility, scoping, and design efforts completed over the years exploring various alternatives to expanding access at existing interchanges or constructing new interchanges. Given the scope and complexity of the interchange evaluation, a two-step screening and evaluation process was used to identify interchange improvements to advance into the prioritization and implementation phase. The first-round interchange screening involved a high-level assessment of previously evaluated interchange concepts which identified three candidate interchanges to advance into a more detailed second round interchange evaluation process. The two-step interchange evaluation process is described further below.

5.1.1 First Round Interchange Screening

A systematic evaluation of previously proposed interchange improvements along the I-89 corridor was conducted. This initial round of evaluation was aimed at determining the interchange projects that would have optimal benefits for the system relative to one another as assessed against the various project goals established by the public input process and project committees. Metrics under each of the study goals were developed and used to evaluate the interchange concepts.

Interchange Alternatives—Previously Proposed Concepts

There are several active interchange projects in Chittenden County that are already in some phase of the project development progress, including Exit 12, which is planned to be reconstructed as a Diverging Diamond Interchange (DDI), Exit 16, which will begin construction in 2022 to reconstruct as a DDI, and Exit 17, which is currently in the design phase of a bridge replacement and roadway geometry upgrades and currently programmed for construction in 2024.

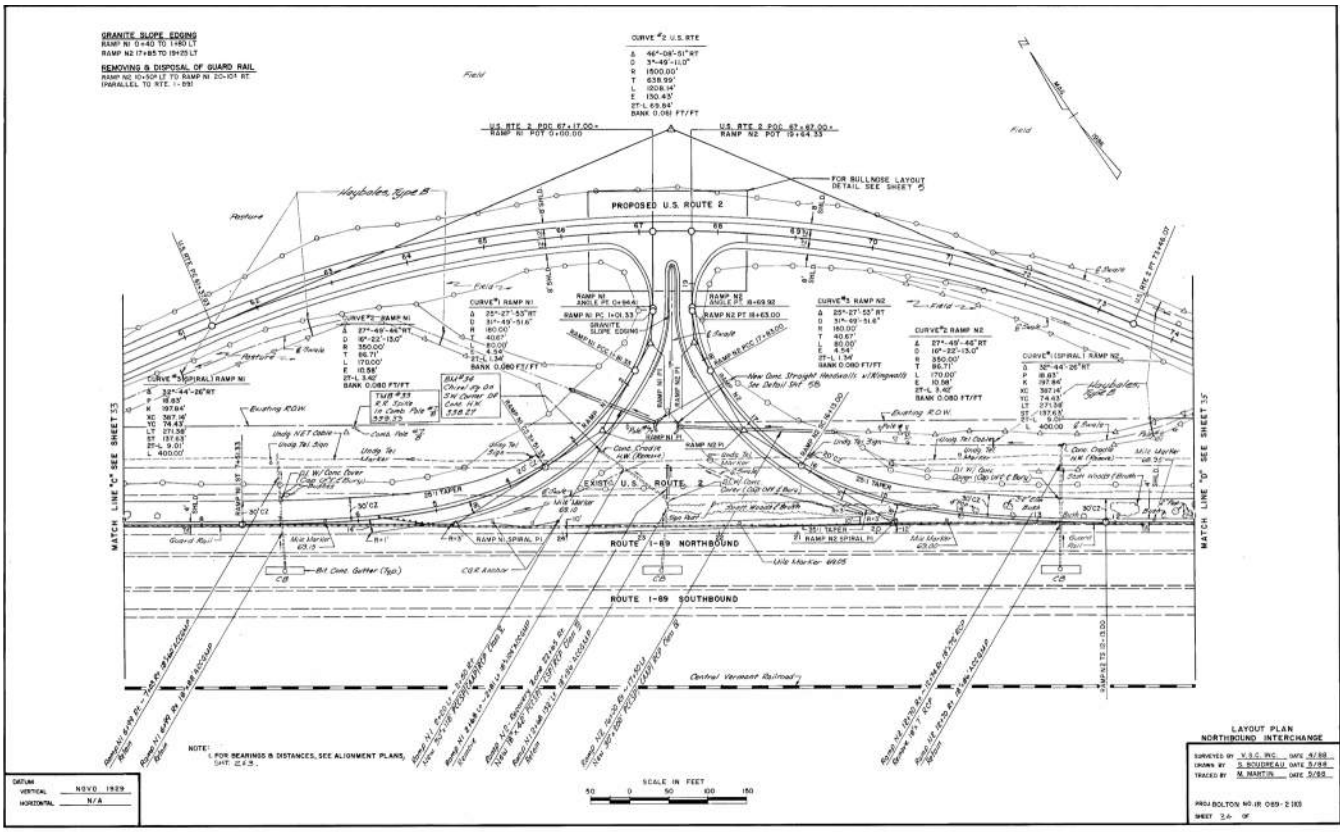
In addition to these interchange improvements included in the VTrans Transportation Program, there are seven additional new or improved interchange projects that have been evaluated along the I-89 corridor in the past that were explored as part of this initial screening. These interchange projects include:

- Exit 10A New Interchange in Bolton
- Exit 12B New Interchange in South Burlington
- Exit 13/I-189 U-Turn in South Burlington
- Exit 13 Full Interchange in South Burlington
- Exit 14N New Interchange in South Burlington
- Exit 15 Full Interchange in Winooski
- Exit 17N New Interchange in Milton

Exit 10A—Bolton

A planning and conceptual design effort was completed in 1990 that examined a new interchange in Bolton. The proposed interchange ramps were split on either side of the US 2 overpass near the Bolton Valley Access Road. The northbound ramps, located just south of the overpass, would require a realignment of US 2 in order to accommodate the ramp geometries to a stop condition. The southbound ramps, located just north of the overpass, would accommodate a similar ramp geometry to a stop condition without a realignment of US 2.

Figure 25: Exit 10A Concept Plans
(Source: Exit 10A Draft Environmental Impact Statement, 1990)



Exit 12B—South Burlington

Exit 12B would create a new grade-separated interchange at the existing VT 116/ Hinesburg Road overpass in South Burlington. This interchange has been the subject of considerable evaluation over the years, with a Scoping Study completed in 2008 identifying a modified diamond interchange as the preferred configuration. In the preferred configuration, the northbound on-ramp connects directly to Tilley Drive, while the other three ramps would remain in a typical diamond configuration connecting directly to VT 116. The project would require a new bridge on VT 116 to accommodate additional lanes for ramp turning movements.

Figure 26: Exit 12B Concept Plans-Western Extent

(Source: Exit 12B Scoping Study, RSG, 2008)

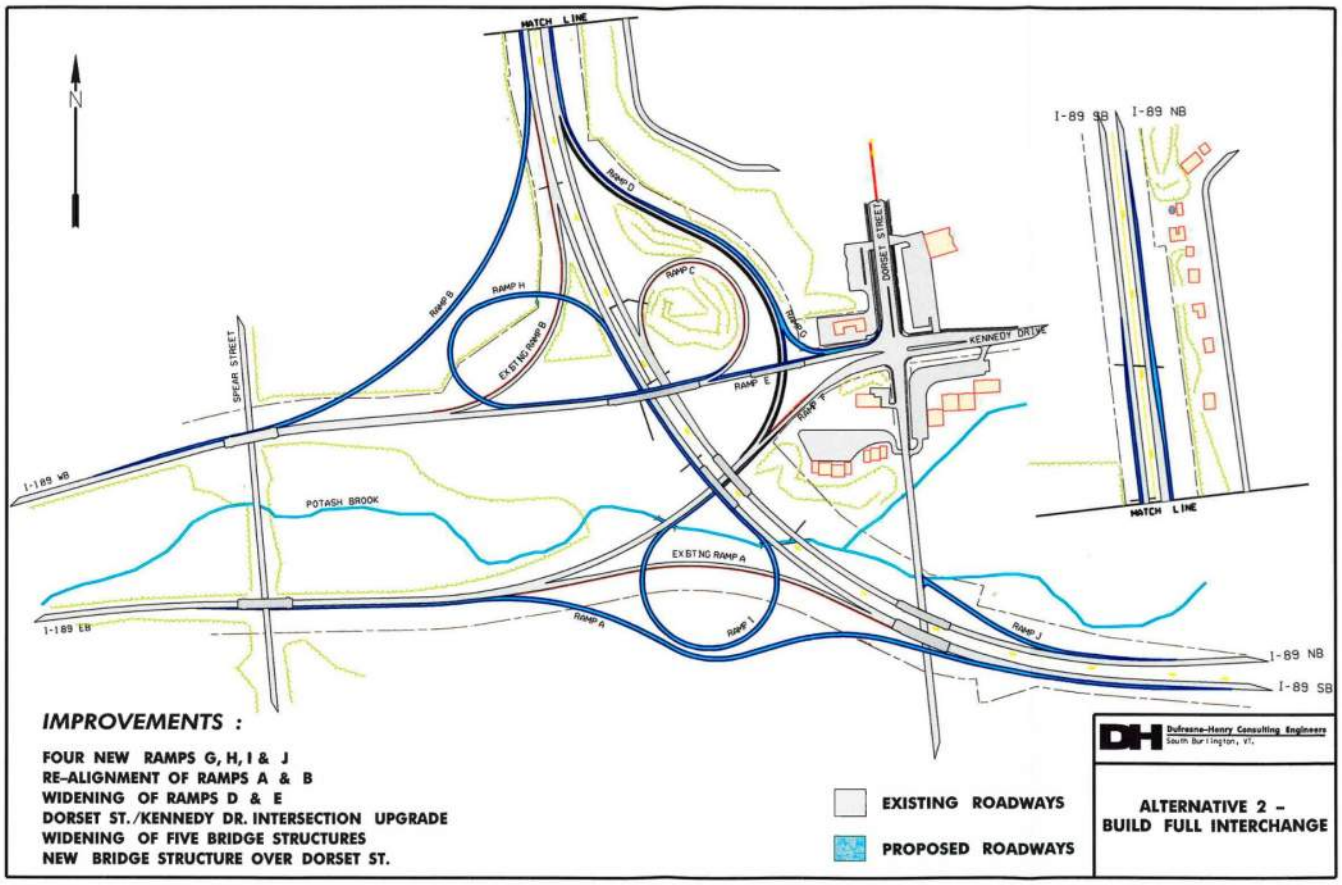
Figure 27: Exit 12B Concept Plans-Eastern Extent

(Source: Exit 12B Scoping Study, RSG, 2008)

Exit 13—South Burlington

The Exit 13 Access Improvements Scoping Report, completed in 1999, identified a full-service interchange at Exit 13 as the preferred alternative. Currently, Exit 13 provides full connectivity between I-89 and I-189, however there are no direct connections from I-89 to Dorset Street/Kennedy Drive. The full interchange concept would add new ramps G, H, I and J and reconfigure ramps A and B to provide a full-service interchange, as shown below in Figure 28.

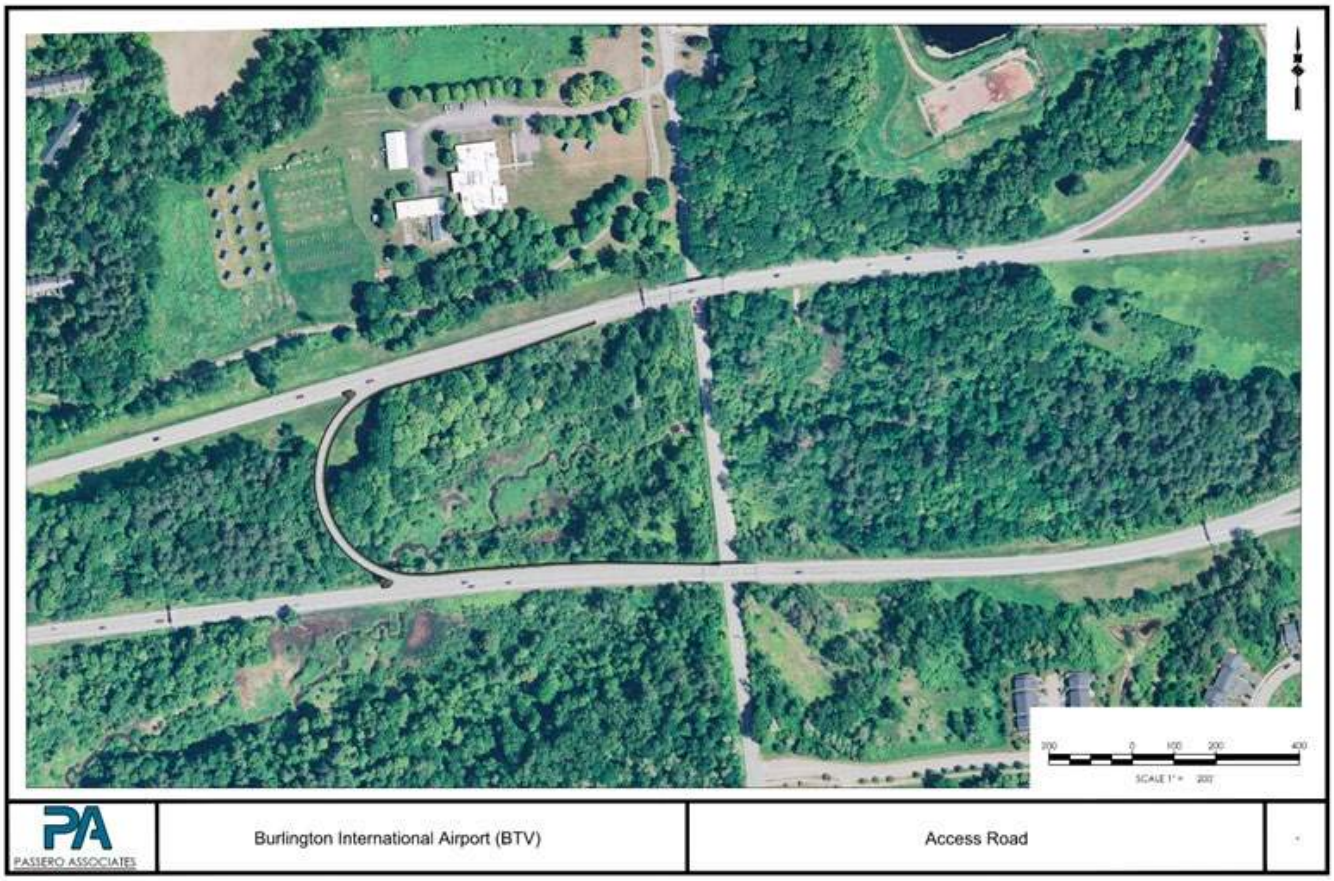
Figure 28: Exit 13 Concept Plan
(Source: Exit 13 Access Improvements Scopint Report, Dufresne-Henry, 1999)



Exit 13/I-189 U-Turn—South Burlington

The Exit 13 U-Turn concept was originally identified in the 1999 Exit 13 Access Improvements Scoping Report and was integrated into the Burlington International Airport's recent master planning efforts. The concept, borrowed from the Burlington International Airport Ground Access Alternative Memorandum (2019), provides a U-turn ramp just west of the Spear Street overpasses on I-189. The addition of the U-turn ramp would functionally provide access to all movements at the Exit 13 interchange.

Figure 29: I-189 U-Turn Concept Layout
(Source: Burlington International Airport Draft Master Plan, Passero, 2021)

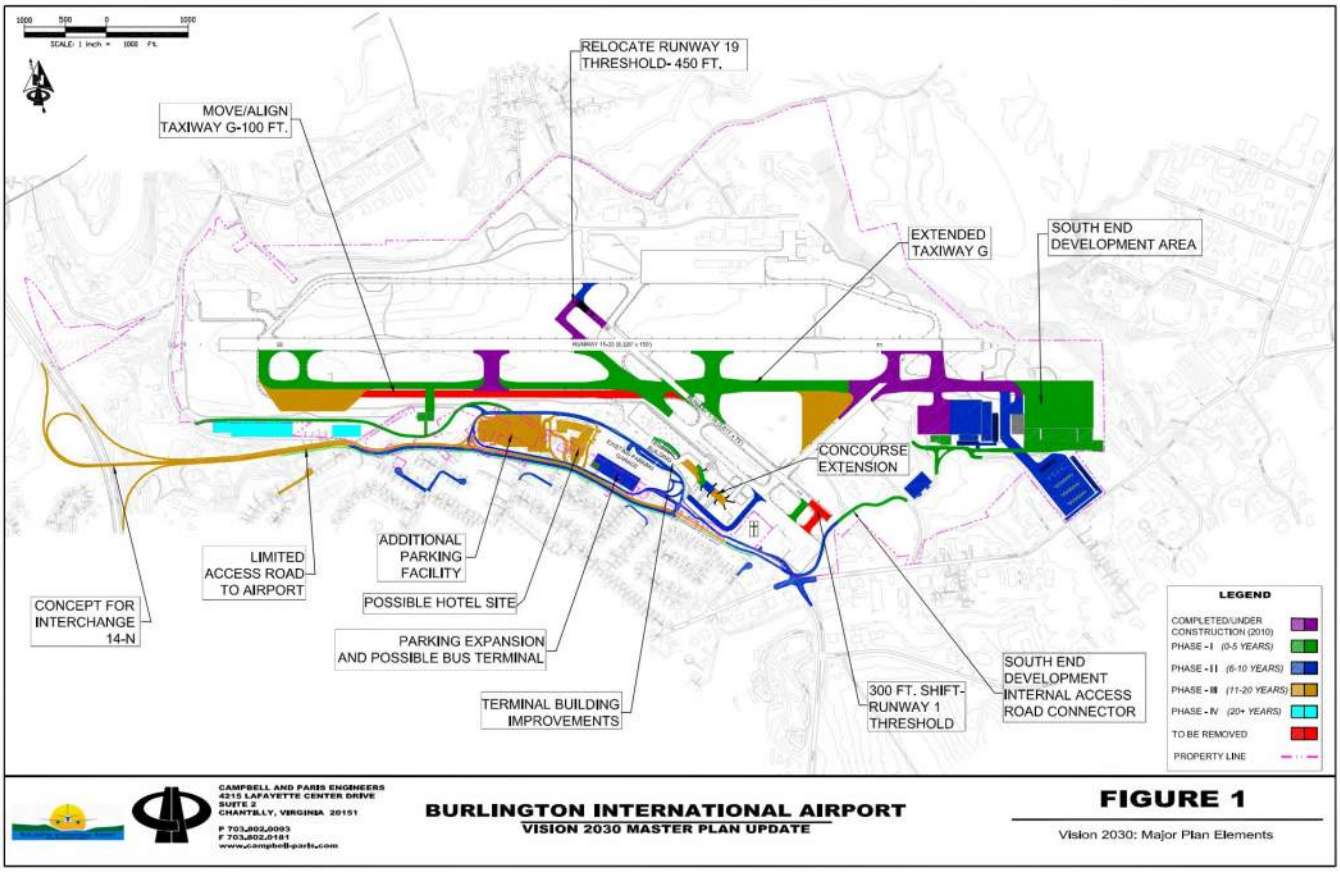


Exit 14N—South Burlington

The concept for Exit 14N, which would create a direct connection to Airport Parkway and provide more direct interstate access to the Burlington International Airport, was developed as part of the Burlington International Airport's Vision 2030 Master Plan in 2011. This new interchange would require a new bridge over the I-89 corridor and a new connector road from the interchange to Airport Parkway. Improvements and realignment of the existing Airport Parkway to improve this connection were also explored as part of the previous master planning effort.

Figure 30: Exit 14N Concept Plan

(Source: Burlington International Airport Vision 2030 Master Plan Update, 2011)



Exit 15—Winooski

Currently, Exit 15 has a northbound off-ramp and southbound on-ramp connecting VT 15 with the I-89 corridor. Providing full access at Exit 15 would require two additional ramps: a northbound on-ramp and southbound off-ramp. These concepts were examined in the 2004 I-89/VT 15 Interchange Reconfiguration Analysis study. The preferred alternative from the feasibility study was a tight or compressed diamond interchange, which would limit the impacts on the neighborhoods surrounding the interchange.

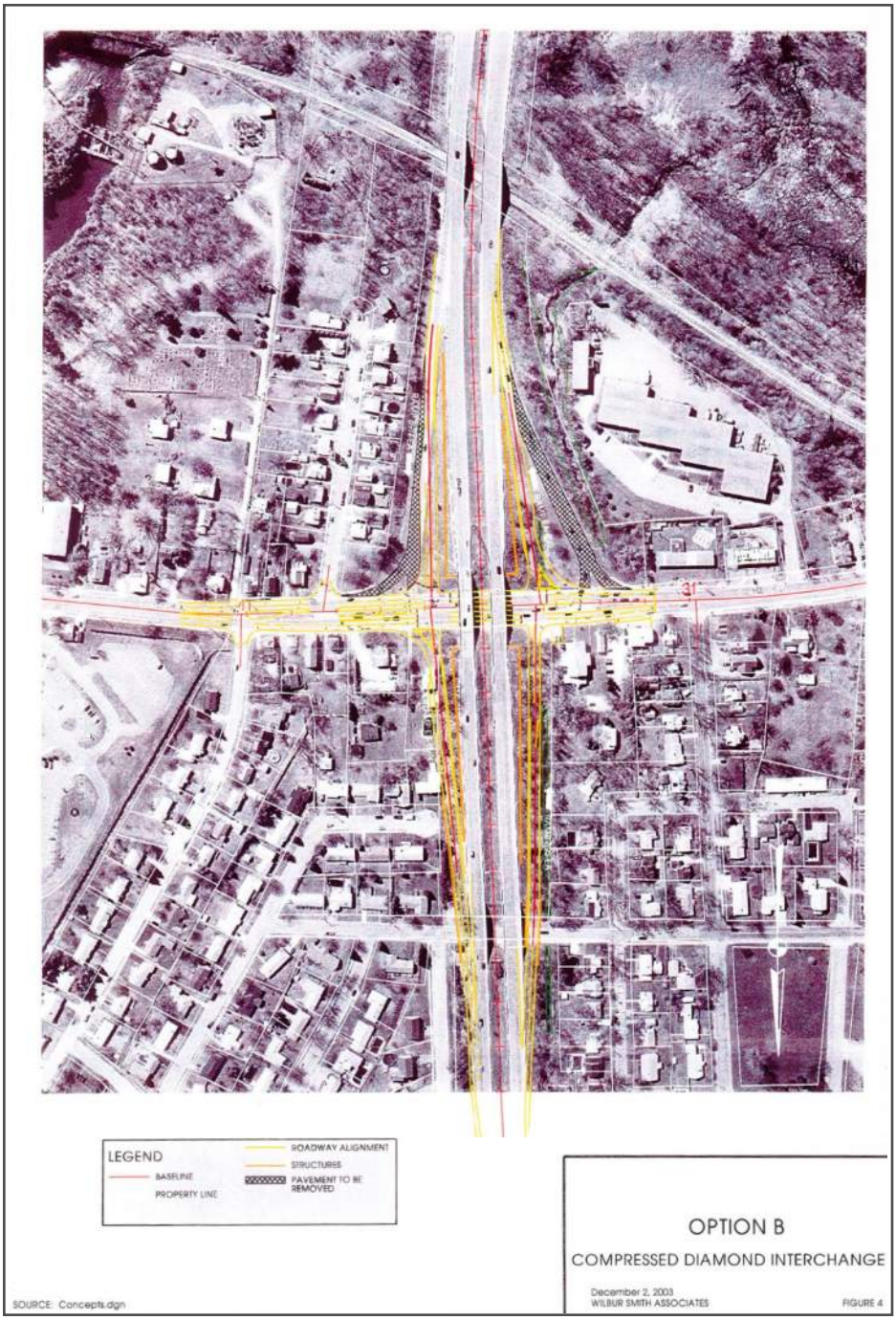


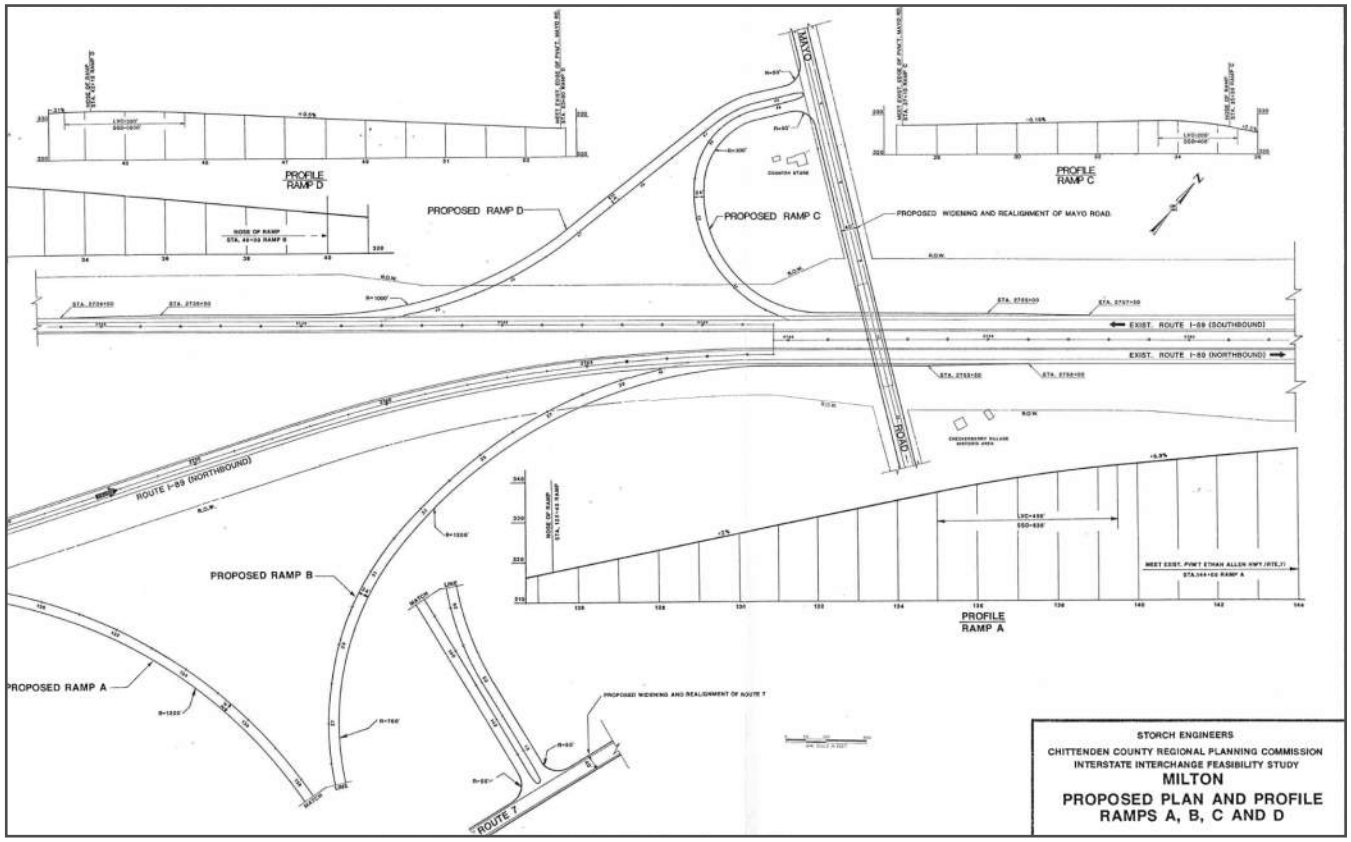
Figure 31: Exit 15 Concept Plan *(Source: I-89/VT 15 Interchange reconfiguration Analysis, Wilbur Smith, 2004)*

Exit 17N—Milton

A concept for Exit 17N was explored as part of the 1987 Interchange Feasibility Studies at Four Locations in the Chittenden County MPO Area study. The preferred geometry for Exit 17N was to connect the northbound on- and off-ramps to US 7 just south of West Milton Road and connect the southbound on- and off-ramps to West Milton Road just west of the overpass. The center of Milton lies just to the east of the existing overpass.

Figure 32: Exit 17N Concept Plan

(Source: Interchange Feasibility Studies at Four Locations in the Chittenden County MPO Area, Storch Engineers, 1987)



5.1.2 First Round Interchange Screening Metrics

The eight previously studied interchange improvements outlined above were evaluated using objective metrics tied to the identified project goals. The individual evaluation metrics are described below, followed by the completed first round screening matrix.

Safety: From a safety standpoint, screening metrics for each of the interchange concepts included interchange spacing distances and change in traffic volumes through identified High Crash Locations. Based on FHWA guidance, interstate interchanges should be spaced at least one mile apart in an urban context and at least three miles apart in a rural context. This spacing allows adequate distance between interchanges for ramp geometries, acceleration/deceleration lanes, merge/diverge movements, and lane changing behaviors at interstate operating speeds. In addition, new or changed access with each interchange concept would likely result in either shifting vehicle traffic to arterials to access the interchange or from arterials onto the interstate. Two metrics were developed to assess the impact of each new or changed access on High Crash Locations by evaluating the likely change in traffic through those segments or intersections. The links from the regional travel demand model that are part of the latest (2012-2016) High Crash Location list were identified and the anticipated change in traffic volumes on those links was calculated for each of the interchange scenarios. The number of High Crash Locations that experienced a 10% increase or more in traffic volumes as well as those that experienced a 10% decrease in traffic volumes were tallied and reported in the evaluation matrix.

Livable, Sustainable, and Healthy Communities: In terms of livable, sustainable, and healthy communities, understanding the direct impacts and benefits of the interchange enhancements to the surrounding community was key at this preliminary screening stage. Therefore, the estimated right of way and property impacts, including consideration for existing home and business structures, was quantified for each interchange. Each of the previously proposed interchange concepts were brought into a GIS environment to evaluate the potential impact the interchange would have on adjacent properties.

Mobility & Efficiency: The mobility and efficiency of each potential interchange was evaluated using cost per trip and congestion mitigation metrics. A measure of relative return on investment was enumerated in the cost per trip metric using two data sources. The anticipated volume of traffic that would be directly served by the new or improved interchange access was estimated based on volumes from the regional travel demand model. These data were combined with the estimated construction costs for each interchange project proposed from previous scoping or feasibility studies and adjusted to 2020 dollars. The congestion mitigation metric identified the reductions in weekday evening peak hour traffic at neighboring interchanges, where the new or improved access afforded by the project may reduce congestion pressures on the adjacent interchange access points.

Environmental Stewardship: The level of environmental stewardship or impact resulting from each of the interchange options was evaluated through impacts to wetlands,

river corridors, and natural habitats. The previously proposed interchange concepts and a 75-foot disturbance buffer were brought into a GIS environment and overlaid with mapping from the Vermont Department of Environmental Conservation (DEC) to quantify the potential project impacts. The impact was quantified by the acres overlapping between the estimated areas of disturbance from a given interchange project and Vermont Significant Wetlands Inventory delineations, 50-foot wetland buffers, river corridors, floodways, 100-year flood zones, rare, threatened, and endangered species, and deer wintering areas.

Economic Access: The goal of improving economic access and vitality was used to screen the interchange options through metrics that were indicative of the access generated from each of the interchange alternatives. Job access was measured as the number of jobs within a one-mile radius of the new or improved interchange, where the number of jobs projected for each transportation analysis zone in 2050 according to the regional travel demand model were counted as long as that zone overlapped with the one-mile buffer. The number of daily trips that used the interchange provided by the new or improved access as well as the existing ramps, if any, were enumerated in the interchange trips metric. Vehicle hours of travel for each interchange scenario was also included in the evaluation matrix as it is indicative of the regional impacts of the interchange on the overall system efficiency.

Other Metrics: Given the history of numerous proposed interchange improvements along I-89 in Chittenden County, it was imperative that the interchange options be measured against their consistency with recent regional planning efforts and the ability to help mitigate, or, at least, not exacerbate, current and anticipated issues for the transportation system. As such, metrics measuring the consistency with the ECOS Regional Plan, impacts to Exit 14 traffic, and impacts to the I-89 mainline between Exit 14 and 15 were quantified. Consistency with the regional plan was measured by quantifying the number of acres within a one-mile radius of the interchange that were covered by areas targeted for growth in the ECOS plan. Based on modeling outputs, the percent change in PM peak hour trips at the Exit 14 interchange and along the I-89 mainline between Exits 14 and 15 were quantified compared to the future base model. These metrics were indicative of whether an interchange mitigated or exacerbated anticipated congestion issues at these locations.

5.1.3 First Round Interchange Evaluation Results

Each metric was assigned a score of zero through four based on a linear relationship to the scored metric for all categories except for the Consistency with Regional Plan and Exit 14 Impacts metrics, which were weighted twice the value of the other metrics. These scores were tallied across all metrics for each interchange alternative, normalizing for the number of metrics in each of the categories and thus weighing the goals of the study equitably.

The results of the first-round interchange screening assessment are summarized in Table 18 and shows Exit 12B new interchange, Exit 13 hybrid interchange, and Exit 13 U-turn ramp alternatives with the highest overall scores. The full first round interchange scoring matrix can be found in the Appendices.

The results of the first-round interchange evaluation were presented to the Technical Committee on May 14, 2020, the South Burlington City Council on June 1, 2020, the CCRPC Board on June 17, 2020, and the Advisory Committee on June 30, 2020. Each body reviewed the evaluation matrix and the supporting methodologies with the aim of advancing up to two of the interchange alternatives from the first-round screening to the second round of evaluation. The two interchanges advanced from the first-round evaluation would be in addition to an evaluation of improvements at Exit 14. A motion by the Advisory Committee on June 30, 2020 to advance alternatives at Exit 12B, Exit 13, and Exit 14 was affirmed by a vote, with 12 of 16 votes tallied in the affirmative.

Table 18: Results of First Round Interchange Evaluation

CATEGORIES	EXIT 10A Bolton Interchange	EXIT 12B New Interchange	EXIT 13 Full Service Interchange	EXIT 13 Hybrid	EXIT 13 U-Turn on I-189	Exit 14N Airport Access	Exit 15 Full Service Interchange	EXIT 17N Milton
Safety	28	16	19	19	19	14	19	19
Livable, Sustainable, and Healthy Communities	14	14	4	18	28	11	14	14
Mobility & Efficiency	21	18	7	14	14	7	0	28
Environmental Stewardship	20	23	25	24	24	16	28	22
Economic Access	9	14	14	14	9	9	12	12
Consistency with Regional Plan & Exit 14 Impacts	0	42	56	49	35	42	28	7
TOTAL SCORE	**92**	**127**	**124**	**137**	**129**	**99**	**100**	**101**

5.1.4 Second Round Interchange Evaluation

Based on the results of the first-round interchange screening process, the I-89 Advisory Committee recommended advancing potential interchanges at Exits 12B, 13, and 14 into a second, more detailed evaluation process. Conceptual designs for each of the three interchanges were developed and carried forward through a more in-depth screening process to evaluate concepts for each of the interchanges against the adopted goals for the study. Ultimately, the motivation for the second-round screening is to further narrow the interchange alternatives to carry into the Implementation Plan.

Significant stakeholder outreach was conducted between February and April 2021 to share details about the second-round interchange evaluation process and solicit input to refine the evaluation. As shown below, seventeen meetings were held with a variety of stakeholders including under-represented communities and the South Burlington City Council and City Committees.

Table 19: Stakeholder Outreach Conducted February-April 2021

South Burlington Business Owners	**2/11/2021**
South Burlington City Council	**2/16/2021**
South Burlington Rotary	**2/18/2021**
CCRPC Transportation Advisory Committee	**3/3/2021**
AALV and Interested Residents	**3/5/2021**
Arabic Community Group	**3/6/2021**
French Community Group	**3/7/2021**
South Burlington City Committee	**3/10/2021**
CCRPC Planning Advisory Committee	**3/10/2021**
South Burlington Public Meeting	**3/18/2021**
Transportation Equity Coalition Focus Group	**3/24/2021**
South Burlington City Council Workshop	**3/29/2021**
University of Vermont & Champlain College	**4/1/2021**
Northwest Regional Planning Commission TAC	**4/8/2021**
University of Vermont Medical Center	**4/8/2021**
South Burlington City Council	**4/19/2021**
Burlington TEUC	**4/27/2021**

Interchange Alternatives

Exit 12B—South Burlington

Exit 12B was advanced from the first-round screening to further develop and assess the addition of a new access at the existing VT 116 overpass. A concept for Exit 12B was developed based on the modified diamond configuration preferred alternative proposed as part of the previous scoping effort and evaluated in the first round of interchange screening. Modifications were made to avoid significant impacts to areas developed since the interchange was scoped and to better accommodate the major movements at the interchange. The modifications resulted in the conceptual design depicted in Figure 33, with northbound on- and off-ramps connecting to Tilley Drive and southbound on and off-ramps connecting to the same point on Hinesburg Road (VT 116) via a loop and typical diamond ramp, respectively. Pedestrians are accommodated via a new sidewalk along the new I-89 overpass while bicyclists are accommodated via a new shared use path along VT 116 across the new overpass.

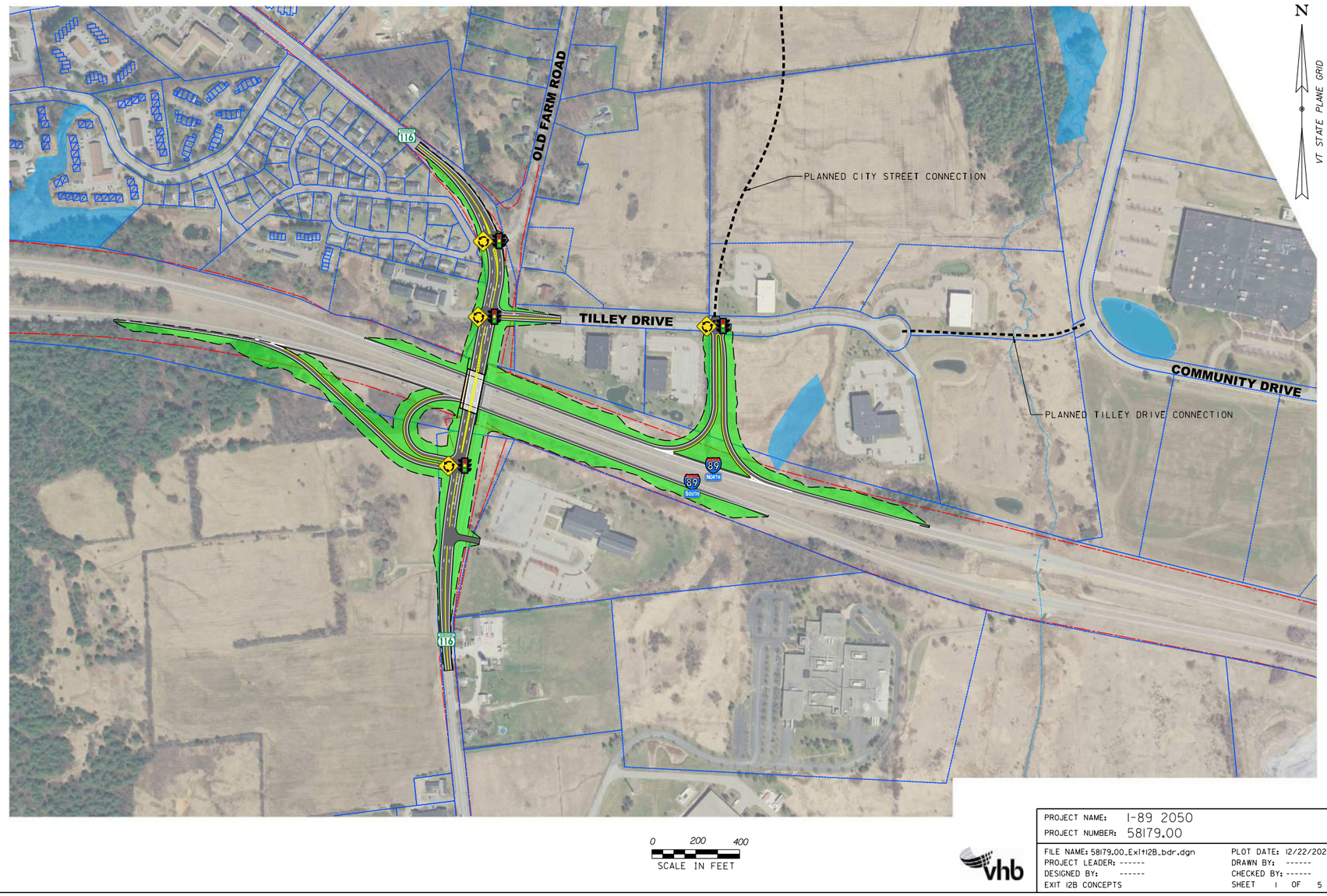


Figure 33: Conceptual Layout from the I-89 Exit 12B Alternative

Exit 13—South Burlington

The existing systems interchange at Exit 13 provides access between I-89 and I-189 and access between I-189 and Kennedy Drive and Dorset Street but lacks connectivity between I-89 and Kennedy Drive and Dorset Street. One concept advanced for the Exit 13 interchange was a hybrid concept that combined elements of previously proposed scoping designs for this interchange. This conceptual design, referred to as the ***Exit 13 Hybrid***, borrows two directional ramps from a full access systems interchange alternative and a U-turn ramp concept that was initially proposed as part of a scoping effort and more recently investigated by the Burlington International Airport as part of their Airport Master Plan update. The directional ramps would provide direct access to and from the I-89 northbound barrel and the Kennedy Drive and Dorset Street area. The U-turn ramp would round out access to and from the I-89 southbound barrel and the Kennedy Drive and Dorset Street area. Pedestrian and bicycle accommodations across the interstate are provided via a new shared use path and overpass to the north of the interchange, connecting with existing shared use paths on Spear Street, Kennedy Drive, and Dorset Street.

Figure 34: Conceptual Layout for the I-89 Exit 13 Hybrid Alternative

Exit 13 (continued)

Another Exit 13 concept that was evaluated in the second-round screening was a reconstruction of the interchange to support a Single Point Diamond Interchange (SPDI) configuration. In this concept, the partial access systems interchange (i.e. limited access highway connections) would be replaced with a full access service interchange. This concept would require the declassification of the I-189 corridor from an interstate designation because the design introduces a signal at the single point connection. The project would require the relocation of the eastbound barrel of I-189 to run adjacent to the I-189 westbound barrel, with a new bridge structure over Spear Street to carry both directions of traffic, and a new bridge structure over I-89 to support the single point connection. The reconfiguration of the interchange ramps would enable the decommissioning of several structures, reducing the asset management and maintenance needs of this interchange compared to the current condition. Pedestrian and bicycle accommodations across the interstate are provided via a new shared use path along the reconfigured I-189, connecting with existing shared use paths on Spear Street, Kennedy Drive, and Dorset Street.

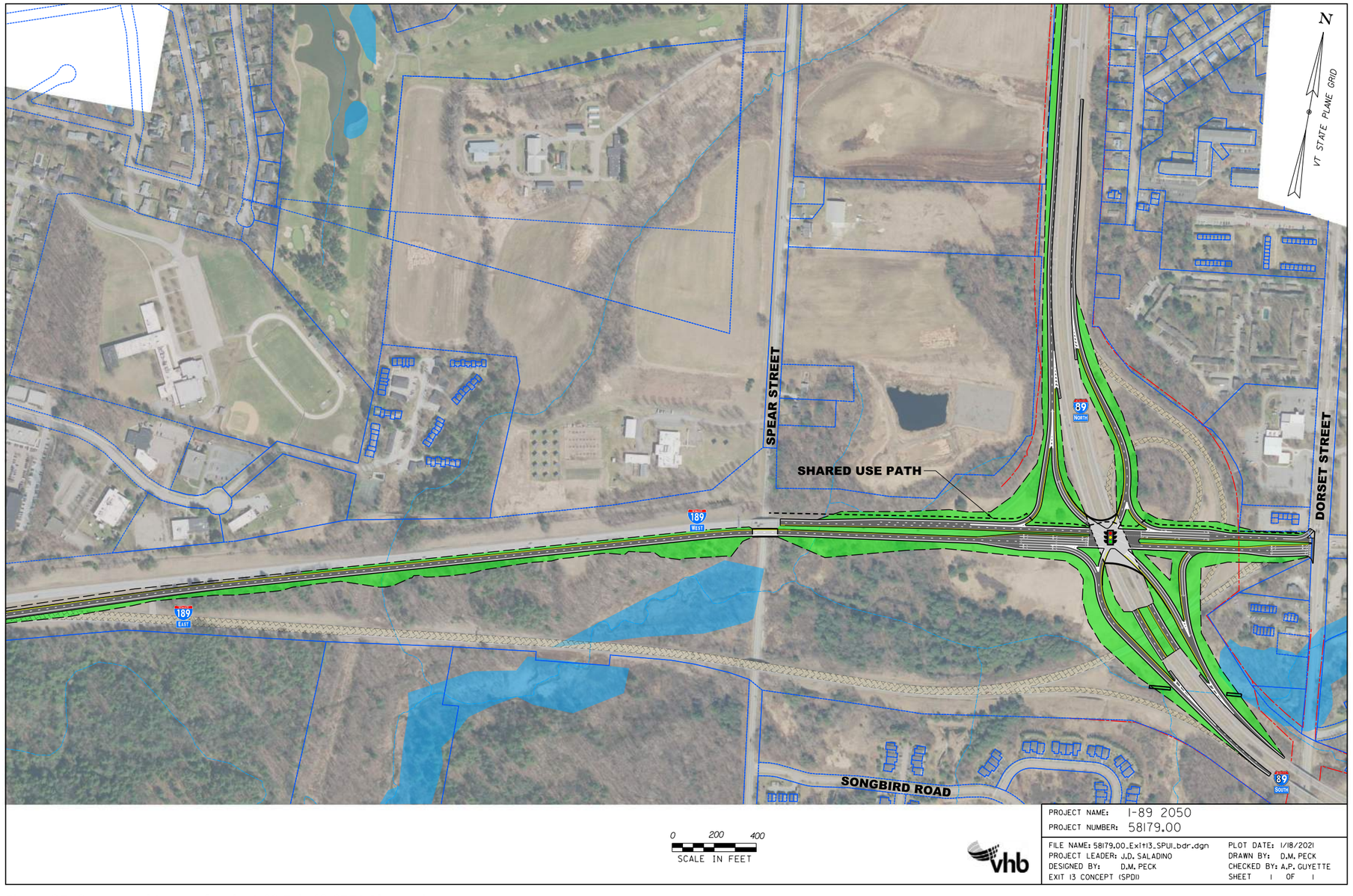


Figure 35: Conceptual Layout for the I-89 Exit 13 SPDI Alternative

Exit 14—South Burlington

Exit 14 was advanced by the Advisory Committee for consideration in the second-round screening. The first of two concepts considered improvements to the existing cloverleaf interchange based on existing and anticipated deficiencies, mainly in regard to safety. Although sidewalks and demarcated bike lanes exist on US Route 2 (Williston Road) in the current Exit 14 configuration, the free-flow condition on all but two loop and directional ramps creates uncontrolled, high speed conflict points between vehicles and bicycle and pedestrian users. The enhanced cloverleaf concept would expand the radii on each of these ramps to create alignments of the ramp termini closer to a 90-degree connection, reducing vehicular speeds at those critical crossing points for bicyclists and pedestrians. Further, in the current condition the loop ramps create a weave section on the interstate mainline. As the sum of the adjoining loop ramp volumes approach 1,000 vehicles per hour, as they are anticipated to do in the future conditions, deterioration of service on the mainline can be expected with the creation of speed differentials and safety implications. This weave conflict is best addressed through the separation of the weaving movements through the use of a collector-distributor road. The enhanced cloverleaf concept includes a collector-distributor road on both the southbound and northbound barrels to mitigate these geometric and operational deficiencies. Additionally, in this concept, a second lane was added to the northbound on-ramp to facilitate improved utilization of existing lanes at the US 2 and Dorset Street intersection as well as address capacity issues anticipated for this heavy-volume movement.

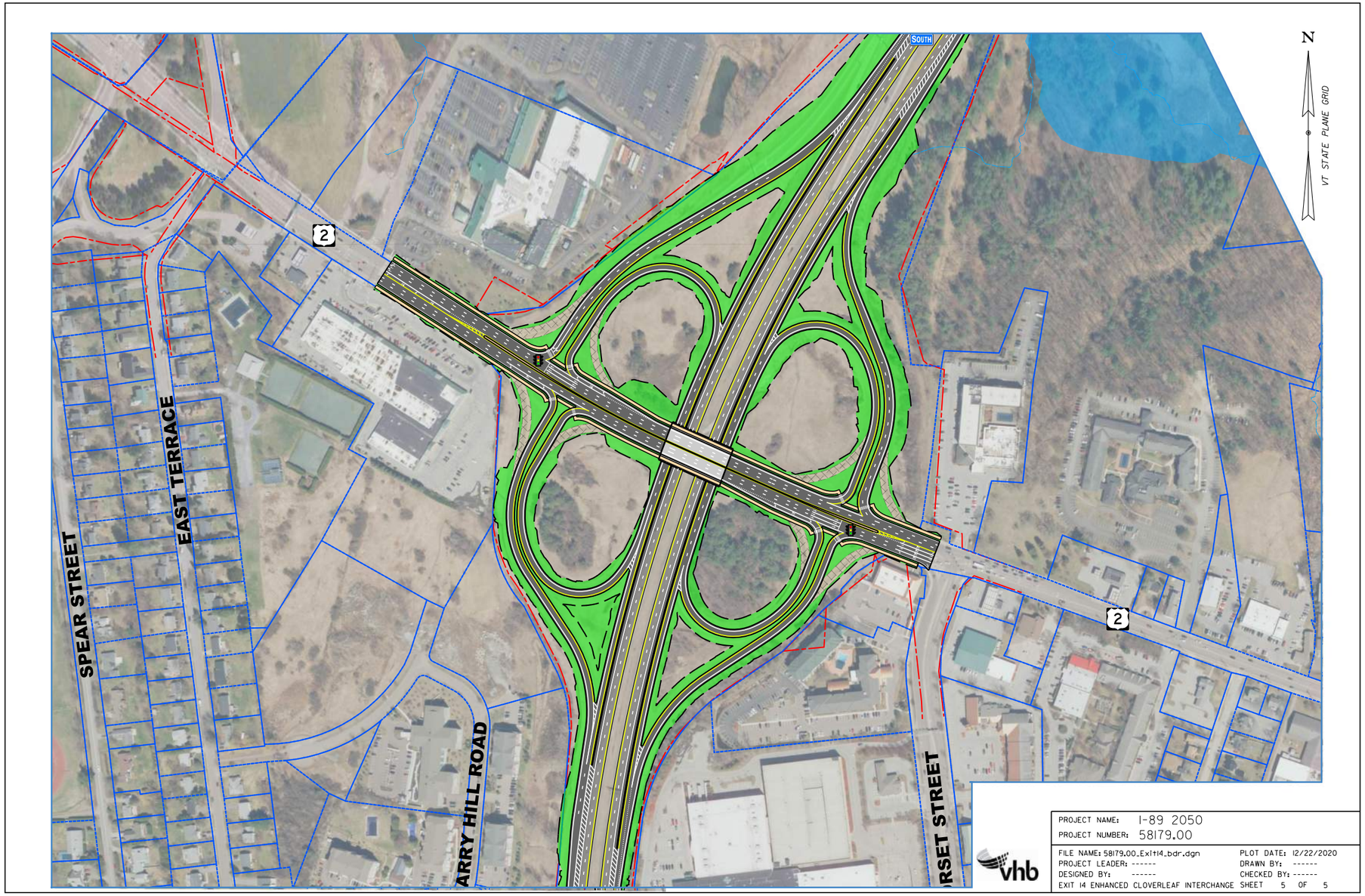


Figure 36: Conceptual Layout for the I-89 Exit 14 Enhanced Cloverleaf Alternative

Exit 14 (continued)

A second concept for the Exit 14 interchange envisioned a reconstruction of the interchange to a Diverging Diamond Interchange (DDI) configuration. The conceptual design would reduce the footprint of the interchange, increase distance between interchange termini and the Dorset Street intersection allowing for more adequate queue storage and intersection operations, and would better accommodate the movements of bicycle and pedestrian users on US Route 2 from an accessibility and safety standpoint. As shown in the conceptual layout, bicycle and pedestrian users would be able to navigate through all quadrants of the interchange via signal protected crossings and a center median path. The DDI would result in a minor overall capacity reduction compared with the existing cloverleaf configuration.

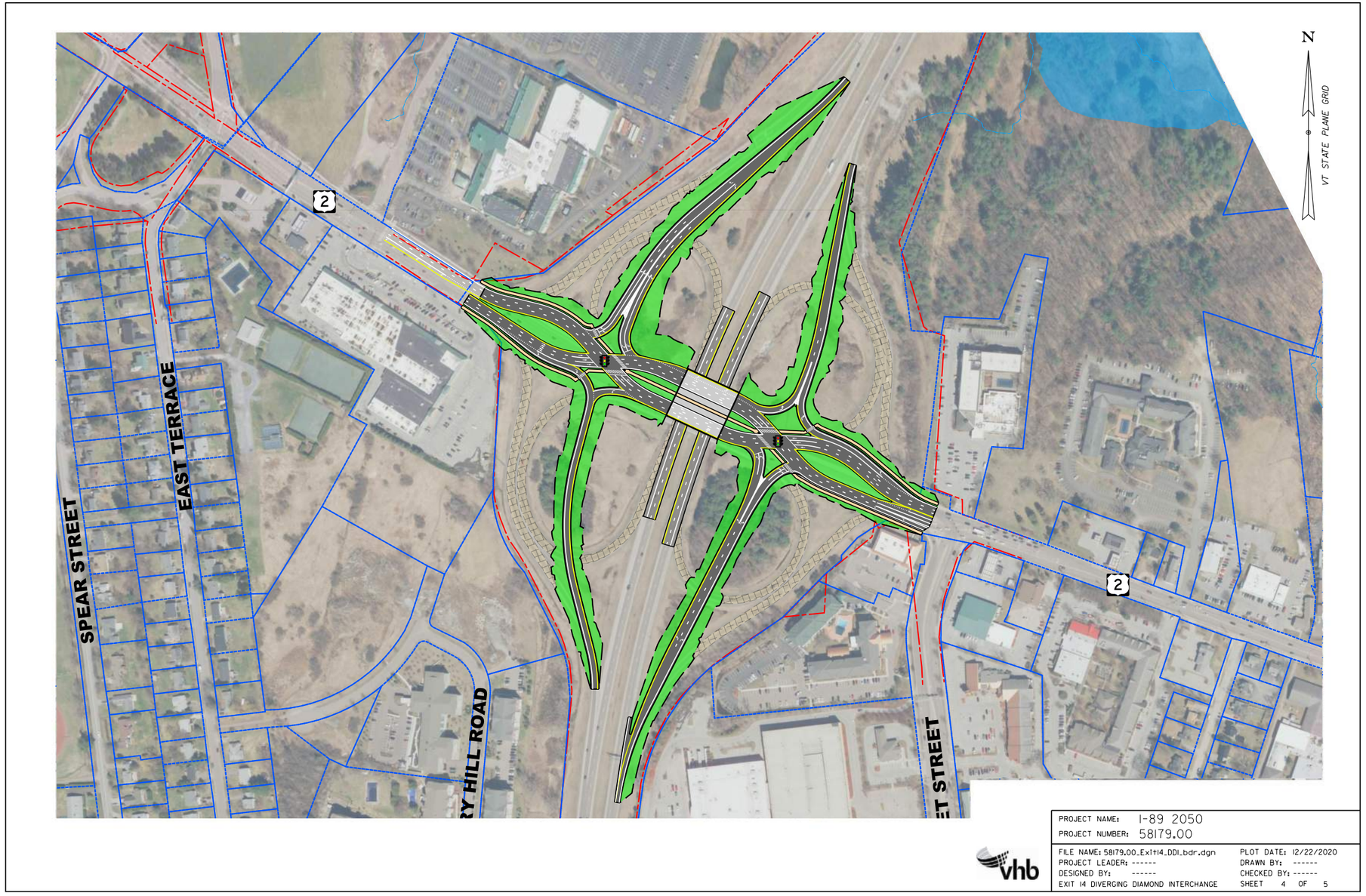


Figure 37: Conceptual Layout for the I-89 Exit 14 Diverging Diamond Interchange Alternative

Second Round Interchange Evaluation Metrics

The alternatives developed for I-89 Exit 12B, Exit 13, and Exit 14 were evaluated using objective metrics tied to the identified project goals. The evaluation metrics in each category acted as a measure of the interchange concept compared against the overarching goals for the corridor.

A number of analytical tools were used to support the evaluation of the interchange concepts across multiple metrics. The conceptual designs were developed with both horizontal and vertical profiles to provide preliminary three-dimensional models to estimate required design elements, geometric features, construction feasibility, major earthwork, limits of disturbance, and conceptual cost estimates for each concept.

Each of the interchange alternatives was also evaluated in the regional travel demand model. A future base scenario was developed with the horizon year 2050 that assumed the same growth and investments as the Metropolitan Transportation Plan (MTP) with the exception of Exit 12B and a third lane on the interstate mainline between Exits 14 and 15. It is important to note that these two projects were incorporated into the MTP as placeholder projects meant to be addressed with this study and were therefore omitted from the future base scenario for this evaluation. It is also important to note that there were significant investments in projects off of the I-89 corridor in the MTP, including other significant roadway projects, transit investments, bike and pedestrian infrastructure enhancements, and transportation demand management strategies that are reflected in the future base scenario.

For evaluation purposes, a scenario was developed for each of the concepts representing the proposed change to the network as well as the anticipated change to land use. The new ramp configurations and intersections resulting from each of the concepts were coded into individual model scenarios with representations of the conceptual design and estimates of capacity. It was anticipated that changes to the land use spurred on by the infrastructure investments were likely to occur not just as direct impacts in the immediate area of the infrastructure due to construction but also as indirect, secondary impacts to the land use and resulting travel patterns in the surrounding areas.

Delphi Panel Helps Estimate Secondary Growth

A Delphi Panel leverages expertise through a facilitated process to build consensus and come to a collective decision. For the I-89 2050 Study, regional experts in commercial and residential development and community planning were convened to inform the anticipated land use changes, secondary growth, and induced demand that may result from various transportation infrastructure investments. The group tackled questions like whether growth resulting from infrastructure investments might focus on residential or commercial development, the anticipated magnitude of growth given the projects and context, whether the growth will be concentrated in the local area or there are implications further from the immediate project area, and whether the growth may be new or relocated from elsewhere in the county or state. The information and consensus building gathered from the Delphi Panel process was used to integrate secondary growth and induced demand scenarios into the modeling and evaluation of future potential infrastructure projects. The Delphi Panel process is further summarized in a technical memorandum available in the Appendix.

A prominent element of these more indirect impacts to consider in the context of the I-89 2050 Study was secondary growth. For each of the interchanges advanced to the second-round screening, growth spurred by infrastructure investments at each interchange was estimated through a Delphi Panel[7] process. The relative growth estimated by the Delphi Panel in anticipation of improvements at each of the three interchanges was translated into number of jobs and households anticipated in the areas surrounding the interchange investments and extrapolated out to the 2050 time horizon for modeling purposes. The job and household growth rates were allocated to the TAZs around the interchange based on both relocation from other areas within Chittenden County and attraction of new jobs or households from outside the County to these areas. The Delphi Panel process, growth estimates, extrapolations, and allocations are detailed in a separate technical memorandum which can be found in the Appendix. The land use projections were updated to reflect the secondary growth anticipated with each interchange concept and used as input for the concept's model scenario. Each of these interchange scenarios were then evaluated in relation to the future base scenario to maintain consistency across the various assumptions to parse the benefits or detriments to each interchange alternative.

The conceptual designs and model scenarios were combined with other data resources to evaluate each of the interchange concepts in terms of the metrics detailed below:

Safety

To align with the goal of enhancing safety along the I-89 corridor for all users, each conceptual design was evaluated based on ramp spacing, predicted safety impact, bicycle and pedestrian safety, and operational features.

The safety implications of each interchange alternative were quantified using the Interactive Highway Safety Design Model (IHSDM). The IHSDM applies the Highway Safety Manual Predictive Method to predict crashes based on high fidelity geometric and safety element inputs. For this study, a model of the project area was developed in the IHSDM environment to include the I-89 corridor between Exit 12 and Exit 15, inclusive of the US Route 2 corridor and other adjacent arterials and connecting streets. Predicted injury and fatal crashes and total crashes were estimated based on the existing and proposed geometric and safety elements as well as the estimated daily volumes from the travel model scenarios. The safety impact metrics were evaluated as the relative change in total crashes and injury/fatal crashes for each of the interchange alternatives compared to the 2050 Base condition.

For the ramp spacing metric, the length between the proposed interchange ramps and the next closest existing interchange ramp was measured and compared against the AASHTO "Green

7 The Delphi method is a structured communication technique or method, originally developed as a systematic, interactive forecasting method which relies on a panel of experts. Retrieved December 12, 2022 from https://en.wikipedia.org/wiki/Delphi_method

Book" standard for ramp spacing (i.e. one mile spacing in urban areas, three mile spacing in rural areas).

Safety for bicycle and pedestrian modes was evaluated by comparing the existing exposure or conflict points against the proposed condition for each scenario. As an advisory to this section of the evaluation matrix, a commentary on the safety and operational design features were added for reference.

Livable, Sustainable, and Healthy Communities

To align with the goal of promoting livable, affordable, vibrant, and healthy communities, metrics evaluating each interchange alternative against its consistency with the regional plan, impacts beyond the highway right-of-way, and environmental justice impacts and equity for underserved or disadvantaged communities were evaluated.

To evaluate the consistency of the conceptual interchange design with the regional plan, the level of household growth within the ECOS Plan designated growth areas was assessed. The projected household growth was assumed to be the number of households added between 2020 and 2050 within areas designated for growth inclusive of secondary growth for each scenario at the Transportation Analysis Zone (TAZ) level. The secondary growth households anticipated in each of the scenarios was added as an advisory row to the matrix for reference. The TAZ boundaries were overlaid with the areas targeted for growth, which include Center, Enterprise, Metro, Village and Suburban land use designations. A TAZ, and therefore its households, were within the area targeted for growth if there was at least 90% coverage of the TAZ. For those TAZs with partial coverage by growth areas, it was assumed that 80% of the households would be concentrated to those areas targeted for growth and 20% would fall in areas designated as rural. Those TAZs that had complete coverage by the rural designation were considered outside of the growth areas.

Right-of-way impacts were enumerated based on the estimated limits of disturbance from the conceptual designs. The limits of disturbance, denoted by bright green areas in each of the interchange concept designs above, were overlaid with the VTrans state right-of-way lines from the Vermont Right-of-Way Spatial Data Hub to quantify the impacted land area outside of the existing highway right-of-way. It is important to note that an effort to minimize impacts to adjacent parcels resulted in the conceptual designs having limited impact beyond the right-of-way and no impact on existing structures.

According to VTrans, one of the fundamental Environmental Justice (EJ) principles in effective transportation decision making is to "avoid, minimize, or mitigate disproportionately high and adverse effects on minority populations and low-income populations." To evaluate the potential impact of the interchange alternatives on underserved and/or disadvantaged populations, the local populations that are considered EJ communities were identified. Using the census block group boundaries, the percent of the population considered to be minority and/or below the poverty level were identified for all the Census block groups in Chittenden County. It is important to note that minority populations are considered those that

identify as Black, African American, American Indian, Alaska Native, Asian, Native Hawaiian, Pacific Islander, some other race (besides white alone), or of Hispanic or Latino descent. Thresholds for identifying the EJ communities were set based on percent minority and percent below the poverty level that were meaningfully greater than the general population. According to this analysis, of the general population of Chittenden County, 11.2% falls below the poverty level and 11.8% is considered minority. Therefore, thresholds meaningfully greater than the general population at 21.2% below the poverty level and 21.8% considered minority were used to identify underserved populations in Chittenden County. These block group thresholds were then used to identify those TAZs that are considered EJ communities based on overlapping geography.

Although there were no anticipated direct impacts to the EJ communities in Chittenden County resulting from the interchange alternatives, an evaluation of disproportionate indirect impacts of any one of the interchange scenarios on the underserved communities was conducted through an analysis of travel time implications. With each of the potential interchange projects, it was expected that there would be some change or benefit to travel times experienced by users of the system. The method employed for this metric evaluated whether that travel time benefit was disproportionately distributed so as to further disadvantage already underserved populations (or disproportionately advantage affluent communities). The average change in travel time between all origins and all destinations in the morning and evening peak hours for each scenario compared to the future base scenario were categorized by location based on whether they were origins or destinations of EJ communities or not at the TAZ level. The limited additional travel time experienced by EJ communities compared to other TAZs as a result of the interchange projects was reported as an advisory row along with the average trip length in minutes as context to the magnitude of the results. The scored metric was the percent additional travel time per average trip as compared to the future base scenario.

Efficiency and Mobility

To align the evaluation of the concepts in the second-round screening with the goal of improving the efficiency and reliability of the I-89 corridor for all users, a number of metrics were derived from the regional travel demand modeling results. These metrics evaluated each interchange concept and associated model scenario to include daily trips using the Exit 14 interchange, average trip length in miles per vehicle trip, network-wide daily vehicle hours of travel, length of mainline corridor exceeding volume to capacity of 0.9 (or severe congestion), and average delay per trip at Exit 14. In addition, a measure of bicycle and pedestrian connectivity was included as a subjective metric and advisory measures of daily trips using the new interchange and network-wide daily vehicle miles of travel were included in this section of the evaluation matrix.

Environmental Stewardship

To align with the goal of establishing a resilient I-89 corridor that minimizes environmental and cultural impacts associated with the transportation system, several metrics were used to

evaluate the concepts for Exits 12B, 13, and 14. The limits of disturbance from the conceptual designs were overlaid with the Vermont Significant Wetlands Inventory (VSWI), 50-ft wetland buffer areas, river corridors, 100-year flood zones, and rare, threatened, or endangered species delineations. The impacts of each concept were quantified as the overlapping land area in acres for each of the given resources.

In addition to the direct impacts on wetland, riverine, and natural habitat resources, a measure of the network resilience and projected daily fuel consumption resulting from each concept were estimated. VTrans has spearheaded the statewide approach to transportation infrastructure resilience planning, which leverages measures of the network criticality and flood vulnerability in combination to assess a transportation infrastructure link-based flood risk score. The underlying principles for the measure of network criticality rely on the Network Robustness Index (NRI) developed by researchers at the University of Vermont Transportation Research Center. This methodology quantifies the overall network implications of some link disruption in the network by measuring relative change in vehicle hours of travel when the capacity on any given link is reduced or eliminated. Effectively, this metric measures the importance of any link in the network to the function of the network. It is anticipated that when new infrastructure is introduced to the network, the criticality of the system's components will change based on redundancy, demand shift, and other network responses to new or different connections and land use patterns. A method to capture the full breadth of influence an infrastructure project might have on the network's criticality is to sum all the NRI scores for the entire network, which is known as the Network Trip Robustness (NTR). When compared to a network without that infrastructure project, like with our future base scenario, this provides a relative measure of the entire network's robustness considering some change. Given the relationship of network criticality to flood resilience, the NTR was chosen as a proxy by which to measure the network resilience resulting from each interchange concept. For each of the scenarios that were evaluated, a capacity reduction of 99% was iterated across each link in the network in the evening peak demand condition and compared to the iterative disruption of the future base scenario. The percent change between the interchange concept and the future base scenarios were reported in the evaluation matrix, with a negative outcome representing a decrease in robustness or less resilient overall network considering the infrastructure change.

The daily fuel consumption metric was estimated based on the vehicle miles traveled in each modeled scenario and the projected fuel economy. A mile per gallon equivalent (mpge) fuel economy was derived from the modeling of the 2050 MTP with CAFÉ Standards and assumed 90% penetration of electric vehicles in the fleet. The mpge value based on the MTP modeling effort was estimated to be 128 mpge. Combined with the vehicle miles traveled, the mpge provided a projected daily fuel consumption that aligns with the 2050 energy goals, the magnitude of which was included as an advisory row in the evaluation matrix and the change relative to the future base which was included as the scored metric.

Calculating Total Interchange Construction and Maintenance Costs

To evaluate the total interchange cost for each alternative, the capital cost to construct the interchange is combined with the total maintenance costs across all three (3) interchange locations.

Capital Costs

+ Maintenance Costs

= Total Interchange Cost

The 'Maintenance Cost' for each interchange alternative is the sum of (a) maintenance costs for assets outside the project footprint, plus (b) the unavoidable maintenance costs of assets within the project footprint (25% of the "saved" maintenance costs).

Economic Access

To align with the goal of improving economic access and vitality in Chittenden County, metrics evaluating the connectivity of interchange improvements to areas planned for growth and job access were included in the evaluation. For each metric, one-mile radii were placed around each interchange. To assess the connectivity of each interchange project with areas planned for growth, the future land uses designated as Center, Enterprise, Metro, Village, or Suburban were overlaid with the one-mile radii. The overlapping coverage area within the one-mile radius for each interchange concept was quantified and reported in the evaluation matrix as a percent coverage area. To evaluate job access, the total number of jobs projected for 2050 in each scenario and total number of new jobs projected to be added between 2020 and 2050 were quantified at the TAZ level. TAZs that were fully or partially within the 1-mile radii were considered within the 1-mile radius of each interchange, and therefore the number of jobs and number of new jobs for those TAZs were totaled as scoring metrics in the evaluation matrix.

System Preservation

To align with the goal of preserving and improving the condition and performance of the I-89 corridor, metrics regarding the construction and engineering capital costs, asset maintenance costs, and the combination of those costs that would result in the implementation of any one of the interchange concepts were included in the evaluation. The approximate costs for designing, permitting, and constructing each of the interchanges include the necessary funds to reconstruct or decommission any existing infrastructure within each respective project footprint. This analysis offers a way to compare the relative costs of each interchange alternative by considering both (a) the capital cost and (b) the cost to maintain the existing infrastructure outside of each project footprint.

Between 2020 and 2050, it is expected that substantial investment will be needed to maintain the existing infrastructure that exists within the study area. The most significant maintenance costs are expected at existing bridges and culverts. For this evaluation, an "analysis area" was defined to be all the bridges and culverts that fall within the footprint of any of the three interchange areas being evaluated. Asset maintenance costs outside this analysis area would be same for all alternatives and were therefore neglected.

In coordination with the VTrans Asset Management Bureau, network-level information, engineering judgment, and historic unit-costs of likely treatments were used to approximate expected maintenance costs assigned to each asset based on its age and condition. From this assessment, a total cost to maintain all assets within the analysis area was found to be approximately $94 million, which is effectively the estimated maintenance cost of a 'No-Build' scenario for the Exits 12B, 13, and 14 areas between 2020 and 2050.

The fundamental principle guiding the system preservation metrics was how spending capital funds at an interchange can reduce future maintenance costs for the broader system. For each project alternative, there are several assets that would be repaired, replaced, or

decommissioned, and the sum of those maintenance costs can be assigned to each interchange alternative as "saved" maintenance costs. When considering the likely time delay between this study and the start of a capital improvement project, it is not realistic to assume that 100% of those maintenance costs could be saved. For simplicity, this analysis assumes that 25% of these "saved" maintenance costs are unavoidable and will be spent regardless of the chosen alternative.

Second Round Interchange Evaluation Results

Each of the second-round interchange evaluation metrics were quantified in the evaluation matrix using the metrics described above. Based on stakeholder and committee feedback, the Exit 12B and 13 interchanges were evaluated separately from the Exit 14 alternatives given the difference in the scale of impacts and benefits resulting from the two sets of interchanges. The Exit 12B and 13 interchange metrics were scored on a 0-2 scale, with the scoring based on the metric's value in relation to the mean and one standard deviation (i.e. a metric value within a half standard deviation of the mean received 1 point, while values below the half standard deviation received 0 points and above the half standard deviation received 2 points). The Exit 14 interchange metrics were scored on a 0-1 scale, with the higher evaluation metric across the two Exit 14 alternatives receiving a one and the lower score receiving a zero.

The results of the second-round interchange screening assessment are summarized on the following pages. The full second round interchange evaluation matrix can be found in the Appendices.

Exit 12B & 13

After developing and reviewing the individual metrics, distinct strengths and weaknesses emerged across all of the interchange alternatives. The table below highlights the key strengths and weaknesses identified for the Exit 12B and Exit 13 interchange concepts. While the new Exit 12B generates the largest percentage reduction in traffic at Exit 12, it also has the largest right-of-way impact and leads to the largest increase in traffic volumes along VT 116 south of I-89. The Exit 13 Hybrid interchange has the lowest construction and maintenance costs but also includes a left exit onto the I-189 U-turn ramp, which is non-standard and could pose safety risks. The Exit 13 SPDI generates the largest percentage reduction in traffic at Exit 14 and along Dorset Street north of Kennedy Drive and provides bicycle and pedestrian accommodations across I-89, this alternative also generates the largest increase in traffic along Dorset Street south of Kennedy Drive.

Table 20: Summary of Strengths and Weaknesses of Exit 12B and Exit 13 Interchange Alternatives

	STRENGTHS	WEAKNESSES
Exit 12B	+ Largest % reduction in traffic at Exit 12 (-14%) + Largest % reduction in traffic on Williston Road east of Exit 14 (-15%) + Potential for more, higher paying jobs resulting from interchange	– Largest ROW impact (4 acres) – Greatest increase in impervious area (3.4 acres) – Largest % increase in traffic on VT 116 south of I-89 (+39%)
Exit 13 Hybrid	+ Lowest overall construction & preservation cost through 2050 ($106M) + Provides new bike/ped connectivity across I-89	– Left exit for I-189 U-turn movement not standard design
Exit 13 Single Point Diamond Interchange	+ Largest % reduction in traffic at Exit 14 (-13%) + Largest % reduction in traffic on Dorset Street at UMall (-17%) + Provides new bike/ped connectivity across I-89	– Largest % increase in traffic on Dorset Street south of I-89 (+ 33%)

The table below shows the total scores for the Exit 12B and Exit 13 interchange alternatives as well as the subtotal of scores by goal, with the highest scoring interchange under each goal shaded in green. As shown in the table, the Exit 13 SPDI scored the highest amongst the three alternatives and also had the highest subtotals across three of the six goals.

Table 21: Summary of Second Round Interchange Evaluation Results: Exits 12B & 13 Alternatives

Goal	Exit 12B New Interchange	Exit 13 Hybrid + Bike Overpass	Exit 13 SPDI
Safety	16	16	20
Livable, Sustainable, and Healthy Communities	13	16	13
Mobility & Efficiency	14	12	16
Environmental Stewardship	5	11	17
Economic Access	21	10	10
System Preservation	4	17	13
TOTAL SCORE	**74**	**83**	**89**

Exit 14

The table below highlights the key strengths and weaknesses identified for the two Exit 14 interchange concepts. While the Enhanced Cloverleaf alternative is estimated to have a higher reduction in crashes and lower construction and maintenance cost than the DDI, it also leads to a higher increase in impervious area and doesn't fully address the potential conflicts between bicycles, pedestrians and vehicles at the uncontrolled ramp termini. The DDI alternative provides a fully signalized path for pedestrian and cyclists to travel through the interchange, but also results in a slight decrease in overall capacity when compared with the cloverleaf configuration which could potentially lead to traffic increases on other routes adjacent to Exit 14.

Table 22: Summary of Strengths and Weaknesses of Exit 14 Interchange Alternatives

	STRENGTHS	WEAKNESSES
Exit 14 Enhanced Cloverleaf	+ Higher % decrease in anticipated crashes (-5%) + Collector/Distributor lanes minimize weave/merge conflicts on I-89 + Lowest overall construction & preservation cost through 2050 ($119M)	– Much higher increase in impervious area (+4.8 acres)
Exit 14 Diverging Diamond Interchange	+ Provides fully signalized path for pedestrians & cyclists to cross I-89 and Williston Road + Results in net reduction in impervious area (-0.5 acres)	– Reduces vehicle capacity at Exit 14 – Results in 3-4% increase in traffic on other routes Winooski Main Street, Limekiln Road)

The table below shows the total scores for the Exit 14 interchange alternatives as well as the subtotal of scores by goal, with the highest scoring interchange under each goal shaded in green. As shown in the table, the Exit 14 DDI scored slightly higher than the Enhanced Cloverleaf alternative, with both alternatives scoring highest in three of the six goals.

Table 23: Summary of Second Round Interchange Evaluation Results: Exits 14 Alternatives

Goal	Exit 14 Enhanced Cloverleaf	Exit 14 DDI
Safety	8	6
Livable, Sustainable, and Healthy Communities	6	11
Mobility & Efficiency	7	4
Environmental Stewardship	2	6
Economic Access	0	2
System Preservation	7	4
TOTAL SCORE	**30**	**33**

The second-round interchange evaluation matrix was presented to the project Technical and Advisory Committee, several South Burlington City Committees and the South Burlington City Council in March and April of 2021. Feedback from each of these groups is summarized below.

South Burlington City Committees: The interchange evaluation process was presented to the South Burlington City Committees on March 10, 2021. The following committees provided direct feedback related to the results of the scoring.

» Planning Commission: Unanimous (7-0) support for two motions:
  - To support the Exit 13 Single Point Diamond Interchange as the top priority of the Planning Commission.
  - To state that the Planning Commission firmly supports continued study and implementation of the pedestrian crossing at Exit 14.

» Energy Committee: The Energy Committee prefers that the money that would otherwise be spent on I-89 (Exit 12B or Exit13) would be better used on enhanced biking, pedestrian mobility and public transportation. If committee members had to choose, they prefer Exit 13 to be re-done to be a more sensible exit, rather than building a new Exit 12B.

» Economic Development Committee: The Economic Development Committee is in support of Exit 12B as the highest potential for economic growth. The EDC is also supportive of the improvements to Exit 13.

» Bicycle and Pedestrian Committee: The Bicycle and Pedestrian Committee recommends upgrading Exit 13 to a Single Point Diamond Interchange (SPDI) & upgrading Exit 14 to a Diverging Diamond Interchange (DDI).

» City Council: The South Burlington City Council reviewed a summary of the preliminary interchange evaluation process during a workshop on March 29, 2021. On April 29, 2021 the City Council reviewed City Committee and public input recommended advancing both Exit 12B and Exit 13 to the next round of evaluation.

I-89 Technical Committee: The I-89 Technical Committee reviewed the evaluation matrix at their April 7, 2021 meeting and unanimously approved the following motion:

» *Joe Segale of VTrans made a motion, duly seconded by Justin Rabidoux of South Burlington, that the I-89 2050 Study Technical Committee has reviewed and endorsed the technical methodology and results of the second-round interchange screening valuation and recommends it to the Advisory Committee for action. Additionally, for the purpose of analysis, the Technical Committee recommends moving forward with the following alternatives: Exit 14 DDI and Exit 13 SPDI with the understanding that other alternatives will be evaluated during the NEPA process. The motion passed unanimously.*

Public Meeting: A public meeting was held virtually on April 29, 2021 to solicit feedback on the second round interchange evaluation and preliminary corridor bundles. At this meeting, numerous attendees requested additional investigation of Transportation Demand Management (TDM) and other non-motorized solutions to address projected capacity limitations on the I-89 corridor. The full set of meeting notes can be found in the appendix.

I-89 Advisory Committee: The I-89 Advisory Committee met on May 19, 2021 to review recent public engagement activities and input and to review and take action on the proposed corridor bundles. The Advisory Committee approved the following motions:

» Justin Rabidoux made a motion, duly seconded by Matt Boulanger, that the *Chittenden County I-89 2050 Study Advisory Committee approve the following Corridor Bundle to advance to the next stage of investment refinement and evaluation: Bundle 1—No Build scenario. With no discussion, the committee approved the motion unanimously.*

» *Dale Azaria made a motion, duly seconded by Karen Yacos, that the Chittenden County I-89 2050 Study Advisory Committee approve the following Corridor Bundle to advance to the next stage of investment refinement and evaluation: Bundle 2—TDM/Bike/Ped/Transit. With no discussion, the committee approved the motion unanimously.*

» *Karen Yacos made a motion, duly seconded by Sandy Thibault, that the Chittenden County I-89 2050 Study Advisory Committee approve the following Corridor Bundle to advance to the next stage of investment refinement and evaluation: Bundle 3—Exit 14 DDI. With no discussion, the committee approved the motion unanimously.*

» *Justin Rabidoux made a motion, duly seconded by Dale Azaria, that the Chittenden County I-89 2050 Study Advisory Committee approve the following Corridor Bundle to advance to the next stage of investment refinement and evaluation: Bundle 4—Exit 13 SPDI. With no discussion, the committee approved the motion unanimously.*

» *Justin Rabidoux made a motion, duly seconded by Sandy Thibault, that the Chittenden County I-89 2050 Study Advisory Committee approve the following Corridor Bun*dle to advance to the next stage of investment ref*inement and evaluation: Bundle 5—Exit 12B. The motion carried with 6 of 14 votes with 6 members voting in the affirmative and 3 abstentions.*

5.2 Corridor and I-89 Mainline Recommendations

In addition to recommendations at the I-89 interchanges, a number of recommendations were developed for the I-89 mainline, areas adjacent to the interstate corridor, and recommendations to reduce overall vehicles miles of travel. These recommendations are detailed further below.

5.2.1 Transportation Demand Management Measures

Through the extensive public engagement process and close coordination with the project committees, an in-depth evaluation of transportation demand management and telework was conducted to understand how impactful such strategies may be in future scenarios. The study pivoted to assemble a Transportation Demand Management Focus Group to shepherd the process of developing a strategic model to evaluate scenarios leveraging a wide variety of demand management strategies, policies, and investments. The VisionEval Regional Strategic Planning Model (VE-RSPM) provided the framework through which 432 unique combinations of variables were modeled to explore the influence of inputs on the targeted regional VMT reduction. Inputs such as mixed-use walkable neighborhoods, frequency of transit, walk/bike mode share, paid parking, mileage-based fees, electric vehicles in the fleet, were adjusted in the model framework and possible scenarios resulting in the most advantageous VMT reductions were selected from the combinations. This selection of 35 scenarios was then further refined based on input from the focus group on a mix of policy and investment levels appropriate for Chittenden County while targeting the more aggressive reductions in vehicle miles of travel. Inputs for the single resulting low VMT scenario became the basis for the TDM recommendations for the I-89 corridor and were integrated with the regional model to develop a scenario through which the other bundled corridor recommendations could be evaluated. The inputs, summarized in the figure below were translated into more specific recommended targets for various TDM measures based on the levels that were reflected in the strategic model scenario.

Table 24: TDM Inputs for Low VMT Scenario

LEVELS	Land Use & Community Design	Bike & Transit	Demand Management	Pricing	Income	Commercial Vehicles
1	Base - No change from CCRPC's Long Range Transportation Plan					
2	Community Design					Increase EVs
3		Double Bike Trips Transit L3	Double TDM Parking L3			
4				Mileage-based Fee		

The inputs at the levels described above translate to the following recommended TDM strategies:

» Increase telework share by 50%
» 90% of new households located in Existing Developed Areas
» Double walking and biking trips
» Triple transit service
» Increase employer sponsored TDM participation
» Reduce supply of residential parking and increase cost of paid parking
» Implement a mileage-based fee

Integration of the scenario inputs with the regional model entailed adjustments to the non-motorized mode share, transit mode share, household trip making, and home-based work trip making. These adjustments, further detailed in the technical memorandum in the Appendix, operationalized the VE-RSPM and TDM Focus Group developed scenario in the regional model environment so that the TDM bundle could be evaluated in comparison with the other bundle scenarios. Ultimately, the TDM bundle became the basis for evaluating the cumulative impacts of the I-89 corridor bundles in the context of reaching the target VMT reductions resulting from successful TDM program implementation.

5.2.2 Safety Recommendations

Understanding of the safety assessments and interchange evaluations provided the framework for safety focused recommendations for the corridor.

Interchange Recommendations

The interchange assessments, coupled with an understanding of already programmed projects, provided a framework for evaluating recommendations for the interchanges along the corridor aside from those recommendations resulting from the interchange evaluation process previously discussed.

» At Exit 11, geometric deficiencies on the southbound on-ramp, northbound on-ramp, and northbound off-ramp should be remedied to meet current AASHTO standards. Extending these ramps by 500', 590', and 90' respectively, while realigning the northbound off-ramp to depart from the mainline segment at a tangent. Improvements to the northbound on-ramp lane will require widening of the bridge over the Winooski River just north of Exit 11. As such, an interchange project to address these geometric deficiencies should be coordinated with bridge improvements.
» At Exit 12, it is anticipated that the interchange will be reconstructed to be a Diverging Diamond Interchange and is programmed as such. One geometric deficiency that should be addressed that may not be included in the reconfiguration of the interchange is the length of the southbound on-ramp. To meet current AASHTO standards, the lane should be extended from 1900' to 2500'.
» At Exit 13, although a full-service interchange has been contemplated, the geometric deficiency identified for the northbound off-ramp should be addressed. To meet current AASHTO standards, the northbound off-ramp should be extended from 200' to 380'. Like Exit 11, this ramp remedy will require a bridge widening and thus should be coordinated, if possible, with any work required on the I-189 overpass.
» At Exit 14, a scoping study to identify the preferred alternative for Exit 14

improvements should be conducted. The geometric deficiencies for the on-ramp acceleration lane lengths and merging tapers should be considered in the supplemental scoping to address these obsolete elements in the preferred interchange configuration going forward.

» At Exit 15, the interchange does not have any geometric deficiencies based on current standards.

» At Exit 16, the interchange is slated for construction to update the configuration to a Diverging Diamond Interchange.

» At Exit 17, the interchange is slated for reconstruction.

Other Safety Considerations

Review of the safety data along the mainline revealed that there were a number of identified high crash location segments. The highest concentration of crashes occurs on the segment between Exit 14 and 15. In addition, it is noted that the northbound barrel at Exit 13 has a radar speed feedback sign. This section of the interstate corridor between Exits 13 and 16 have been the focus of enforcement activities to curb speeding and increase safety awareness as part of Operation Safety Corridor. Although specific engineering countermeasures were not identified for the area, a continued enforcement effort through this section is recommended.

5.2.3 ITS Recommendations

An understanding of the current ITS infrastructure, close coordination with VTrans staff in TSMO, and the recent development of a statewide ITS plan provided the framework for ITS recommendations.

Changeable Message Boards

VTrans is currently installing 4 new changeable message boards and 4 new road weather information stations (RWIS) each year. This rate of installation of new equipment and the potential request for a higher rate in future years, depending on funding, sets the environment for ITS improvements along the I-89 corridor. To better inform the traveling public and create opportunities for re-routing in emergency cases, one permanent changeable message board should be installed between each interchange, one in each direction. The detailed recommendations based on the current installation locations and their permanent or temporary status are included in the Table below.

Table 25: Recommended Changeable Message Boards (CMBs) on Segments of I-89

	Northbound	Southbound	Recommendation
Exit 10-11	Temporary	Temporary	Install permanent CMBs in both directions
Exit 11-12	Permanent (w/ RWIS)	Permanent	None
Exit 12-13	Temporary	Temporary	Install permanent CMBs in both directions
Exit 13-14	None	None	Install permanent CMBs in both directions
Exit 14-15	None	None	Install permanent CMBs in both directions
Exit 15-16	None	None	Install permanent CMBs in both directions
Exit 16-17	Temporary	Permanent (w/ RWIS)	Install permanent CMBs in NB directions
Exit 17-18	None	None	Install permanent CMBs in both directions

RWIS Stations

The five RWIS stations along the corridor were viewed as currently sufficient in serving this corridor. The camera systems installed at each of these locations should be maintained and upgraded as needed.

Traffic Detection and Counting

There are currently 3 permanent, continuous traffic counters along the corridor. These counters are seen as sufficient in serving the purposes of the corridor. However, the ramps at interchanges are infrequently counted as part of the short duration count programming. Installing loop detection on each of the ramps along this corridor would serve to provide accurate counts to use in future operational evaluations and to inform the work of the Corridor Monitoring Committee.

There is existing queue detection equipment at Exit 12, Exit 10, and Exit 17. There are no further queue detection needs identified for the corridor.

Other ITS Considerations

Although fiber optic cable connections were contemplated, fiber within the median of the highway was seen as serving other uses beyond the corridor system and therefore not recommended.

5.2.4 Park & Ride Recommendations

There are currently three state run Park and Ride lots located along I-89 in Chittenden County immediately adjacent to Exit 11 in Richmond and Exits 16 and Exit 17 in Colchester. Currently in the planning stages are a new Park and Ride west of Exit 17 and a new Intercept Lot/Multimodal Facility in Burlington's South End. Additionally, as this plan was being finalized, a new Park and Ride lot was under construction adjacent to Exit 12 in Williston with 142 spaces, which is slated for completion in the summer of 2023.

In addition to the existing and planned Park and Ride lots, there was significant interest among the project committees and the public to investigate locations for additional Park and Ride or Intercept facilities.[8] The CCRPC is currently in the process of updating their Regional Park and Ride Plan, and any recommendations from that planning process that are proximate to the I-89 corridor should be integrated into the Implementation Plan.

5.3 Recommendations Development & Evaluation

5.3.1 Bundle Overview

Following the completion of the interchange evaluation and the identification of corridor and TDM recommendations, five distinct "bundles" of improvements were assembled and evaluated to identify the optimal package of improvements to carry forward into the Implementation Plan. Each of the improvement bundles builds off the elements in the previous bundle except for Bundle 5 which builds off of Bundle 3. Each of the bundles is described in more detail on the following pages.

8 While Park and Ride lots are generally located closer to residences and commute trip origins, Intercept lots are typically located close to employment centers, with the goal of intercepting commuters as they near their final destination (e.g. downtown Burlington) and provide a location for the commuters to transfer to a shuttle or carpool to complete their commute trip.

Bundle 1: 2050 Base

This bundle represents the 2050 Base conditions and includes all of the transportation improvement projects currently programmed in the CCRPC's Transportation Improvement Program (TIP) and Metropolitan Transportation Plan (MTP), except for the widening of I-89 between Exits 14 and 15 and the addition of Exit 12B. The 2050 base land use utilizes the demographic projections developed for the MTP and assumes that 90% of future household growth occurs in areas designed for growth. The 2050 base scenario also includes major investments and policy decisions from the MTP including investments in Transportation Demand Management (TDM) measures, significant investment in bicycle and pedestrian infrastructure, a doubling of transit service, and assumes that 90% of the light vehicle fleet is electrified by 2050.

Bundle 2: Transportation Demand Management (TDM) + Telework

Bundle 2 builds off of the 2050 Base with the addition of significant TDM measures focused on maximizing the reduction of county-wide Vehicle Miles Traveled (VMT). The TDM measures were identified by the TDM Focus Group and include the following elements:

- Increase telework share by 50%
- Double walking & biking trips
- Triple transit service and shorten headways
- Double participation in TDM programs and increase cost of parking
- Reduce supply of residential parking and increase cost of paid parking
- Implement a 5 cents per mile mileage-based user fee.

Based on the results of the Strategic Model and Regional Model evaluations, the full implementation of the identified TDM measures in Bundle 2 is anticipated to reduce future VMT by between 10 and 20%.

Bundle 3: TDM + Exit 14 Diverging Diamond Interchange (DDI)

Bundle 3 builds off of Bundle 2 to include reconstruction of Exit 14 as a Diverging Diamond Interchange (DDI). Bundle 3 was evaluated with the following two "sub-bundles" to assess the range of outcomes with and without the implementation of the TDM recommendations from Bundle 2:

- **Bundle 3a:** TDM Recommendations (Bundle 2) + Exit 14 DDI
- **Bundle 3b:** 2050 Base (Bundle 1) + Exit 14 DDI

Bundle 4: TDM + Exit 14 DDI + Exit 12B

Bundle 4 builds off of Bundle 3 to include construction of a new Exit 12B at the VT 116 overpass of I-89 in South Burlington. Bundle 4 was evaluated with the following two "sub-bundles" to assess the range of outcomes with and without the implementation of the TDM recommendations from Bundle 2:

- **Bundle 4a:** TDM Recommendations (Bundle 2) + Exit 14 DDI + Exit 12B
- **Bundle 4b:** 2050 Base (Bundle 1) + Exit 14 DDI + Exit 12B

Bundle 5: TDM + Exit 14 DDI + Exit 13 Single Point Diamond Interchange (SPDI)

Bundle 5 builds off of Bundle 3 to include reconstruction of Exit 13 as a Single Point Diamond Interchange (SPDI). Bundle 5 was evaluated with the following two "sub-bundles" to assess the range of outcomes with and without the implementation of the TDM recommendations from Bundle 2:

- **Bundle 5a:** TDM Recommendations (Bundle 2) + Exit 14 DDI + Exit 13 SPDI
- **Bundle 5b:** 2050 Base (Bundle 1) + Exit 14 DDI + Exit 13 SPDI

5.3.2 Bundle Evaluation

Through consultation with the project Technical and Advisory Committees and members of the public, a set of metrics were developed and used to evaluate the degree to which each of the identified bundles improve or degrade operations on the region's transportation network. The following metrics were used to evaluate the identified bundles:

- **Vehicle Miles of Travel (VMT):** This metric, which was obtained through the regional travel demand model, reflects the estimated total miles traveled by all vehicles in Chittenden County during a typical day in 2050 for each bundle.

- **Fuel Consumption/Greenhouse Gas Emissions:** This metric was calculated by dividing the estimated 2050 daily VMT for Chittenden County by an approximation of the average 2050 vehicle fleet fuel economy of 128 miles per gallon (assuming 90% of all light-duty vehicles are transitioned to electric vehicles).

- **Total Trips through Exit 14 Interchange:** This metric, which was obtained through the regional travel demand model, reflects the total number of daily vehicles estimated to travel through one or more of the Exit 14 interchange ramps in 2050.

- **Miles of I-89 with V/C > 0.90 During the PM Peak Hour:** This metric, which was obtained through the regional model, quantifies the total mileage of the I-89 main line in Chittenden County projected to have a volume-to-capacity ratio greater than 0.9 during the evening peak hour. The particular interstate segment(s) that exceed the threshold are also noted in the table.

- **Miles of I-189 with V/C > 0.90 During the PM Peak Hour:** Similar to the previous metric, this metric quantifies the total mileage of the I-189 main line in Chittenden County projected to have a volume-to-capacity ratio greater than 0.9 during the evening peak hour. The particular segment(s) that exceed the threshold are also noted in the table.

- **Change in Volume on Arterial Corridors:** This metric, which is evaluated for segments of Williston Road, Dorset Street, Winooski Main Street, and Lime Kiln Road, reflects the total estimated daily traffic volumes on the four arterials as well as the estimated change in daily traffic volumes on the segments compared with the 2050 Base scenario (i.e. Bundle 1).

Table 26 shows the results of the bundle evaluation for each of the evaluation metrics described above.

Table 26:

Summary of Bundle Evaluation Matrix

		2050 No Build TIP Only	2050 Base MTP *(except I-89 placeholders)*	Bundle 2 TDM + Telework	Bundle 3a Bundle 2 + Exit 14 DDI	Bundle 3b Exit 14 DDI	Bundle 4a Bundle 2 + Exit DDI + Exit 12B	Bundle 4b Exit 14 DDI + Exit 12B	Bundle 5a Bundle 2 + Exit 14 DDI + Exit 13 SPDI	Bundle 5b Exit 14 DDI + Exit 13 SPDI
Model Wide										
Vehicle Miles of Travel (VMT)		5,397,421	5,197,692	4,189,124	4,197,730	5,154,464	4,203,166	5,169,913	4,187,948	5,158,763
Fuel Consumption/GHG Emissions		42,167	40,607	32,728	32,795	40,269	32,837	40,390	32,718	40,303
Exit 14 Volume										
Total Trips through Exit14 interchange (vehicles/day)		55,092	51,823	42,258	38,998	47,181	35,331	42,619	31,252	38,069
I-89 & I-189 Mainline										
Miles off I-89 with v/c > 0.9 PM Peak Hour	Segment	1.34 *Exit 14-15*	1.34 *Exit 14-15*	0	0	1.34 *Exit 14-15*	0	1.34 *Exit 14-15*	0	1.34 *Exit 14-15*
Miles off I-189 with v/c > 0.9 PM Peak Hour	Segment	0.28 *E of Shelburne Rd*	0.28 *E of Shelburne Rd*	0	0	0.28 *E of Shelburne Rd*	0	0.28 *E of Shelburne Rd*	0	0
Change in Volume on Arterial Corridors (vehicles/day)										
Williston Road (east of Dorset St)	Change vs. 2050 Base	29,326	25,826	22,334 **-14%**	21,688 -16%	24,571 -5%	17,752 -31%	20,445 -21%	19,491 -25%	22,624 -12%
Dorset Street (south of Williston Road)	Change vs. 2050 Base	24,760	20,715	16,978 -18%	16,215 -22%	19,042 -8%	14,634 -29%	17,286 -17%	12,213 -41%	14,301 -31%
Winooski Main Street Bridge over Winooski River	Change vs. 2050 Base	44,380	38,338	32,288 -16%	33,745 -12%	38,535 **1%**	33,057 -14%	37,985 -1%	32,681 -15%	37,716 -2%
Lime Kiln Road	Change vs. 2050 Base	12,374	12,523	10,067 -20%	10,268 -18%	12,576 **0%**	9,603 -23%	11,778 -6%	9,801 -22%	12,034 -4%

Some observations from the bundle evaluation results include the following:

» Looking at projected background growth in traffic volumes across Chittenden County, total daily VMT is estimated to increase by **28%** from 2020 to 2050 (with no bundles in place)

» The TDM, bicycle/pedestrian, and transit expansion elements of the MTP (included in Bundle 1) reduce the projected 2050 VMT by **4%**

» The additional TDM measures included in Bundle 2 reduces VMT another **20%** compared to the 2050 Base scenario, bringing County-wide VMT down to 2020 levels

» Both Exit 12B and the Exit 13 SPDI are projected to reduce volumes through Exit 14 (**18%** and **27%**, respectively) compared with the 2050 Base scenario

» Both Exit 12B and the Exit 13 SPDI are projected to reduce volumes along Williston Road and Dorset Street compared with the 2050 Base scenario

» The Exit 13 SPDI reduces total traffic traveling through Exit 14 more than the new Exit 12B does

» Without the VMT reductions that result from the TDM measures included in Bundle 2, Bundle 3b, 4b, and 5b all result in the segment of I-89 between Exits 14 and 15 exceeding 0.9 v/c during the evening peak hour

The bundle evaluation and draft I-89 Implementation Plan was presented to the project Technical Committee in April 2022, then to the public at a public meeting in May, and then finally to the project Advisory Committee on May 18, 2022 for action.

SECTION 6

6 Implementation Plan

Implementation Plan

The Implementation Plan presents the identified strategies and actions recommended for the I-89 corridor and establishes the set of actions to be taken along the I-89 corridor in Chittenden County through 2050. The plan, which outlines recommended infrastructure, operations, and policy-level actions, was developed based on the results of the bundle evaluation as well as through extensive input from the Technical and Advisory Committees and members of the public.

At their final meeting on May 18, 2022, the Advisory Committee reviewed the results from the I-89 corridor bundle evaluation and discussed extensively the draft I-89 Implementation Plan that included proposed short, medium, and long-term actions to meet the Vision and Goals of the I-89 Corridor. The committee debated and agreed on a number of edits to the draft plan that were incorporated in the Final Implementation Plan (Table 28) included in this report. The Final Implementation Plan was accepted unanimously by the I-89 Advisory Committee.

The Implementation Plan acknowledges the uncertainty inherent in planning 30 years into the future, which was particularly relevant as the COVID-19 pandemic transpired during the development of this study, and presents the following overarching commentary to the Plan:

> There is significant uncertainty about long-lasting changes on where people will live and how they will travel in the future due to the COVID-19 pandemic, technology, demographics, and other dynamics. We recognize that the I-89 Vision, Goals, Objectives and implementation actions that will follow will need to be reassessed periodically to ensure that they address the evolving situation.

The Implementation Plan is organized into short-term (1-5 years), medium-term (6-15 years), and long-term (15+ years) recommendations. For each identified recommendation, the Implementation Plan summarizes the following information: project description, implementation timeframe, conceptual cost estimate, implementing agency/partners, and next steps.

The implementation plan also calls out two short-term and two medium-term projects that were not identified through this study but are projects along the I-89 corridor in Chittenden County that are currently programmed for action in the VTrans Capital Program. The Advisory Committee reviewed the final Implementation Plan at their May 18, 2022 meeting and voted unanimously to approve the Plan.

The final I-89 Implementation Plan is presented on the following pages.

Table 27:
Implementation Plan

	Recommendation	Description	Cost Estimate	Implementing Agency	Implementing Partners	Next Steps
Short Term (1-5 Years)						
S.1	**Form an I-89 Corridor Monitoring Committee to meet regularly to monitor the Implementation Plan**	The I-89 Corridor Monitoring Committee will meet regularly (possibly annually) with VTrans and the CCRPC to review the status of the Implementation Plan including updated metrics, considerations, TDM implementation, etc.	N/A	CCRPC	N/A	Schedule first committee meeting in late Spring/early Summer 2023.
S.2	**Develop a Plan and initiate implementation of the Transportation Demand Management (TDM) Measures**	Develop a plan to advance identified TDM measures to maximize VMT reduction. These measures could include: Increase telework share by 50%; 90% of households in Existing Developed Areas; Double walking & biking trips; Triple transit service; Increase employer-sponsored TDM participation; Reduce supply of residential parking and increase cost of paid parking; Implement a mileage-based fee. Work with partners to begin implementation of measures identified in the TDM Plan.	$250,000	CCRPC	CATMA, Municipalities, GMT, Local Motion, and Other Partners	Program TDM Plan in the FY24 UPWP (starting July 1, 2023). Develop the plan and work with partners to start implementing the TDM measures.
S.3	**Conduct Exit 14 Supplemental Scoping Study**	Conduct Supplemental Scoping Study to identify a preferred alternative for Exit 14 that enhances overall safety and operations for all users.	$100,000	CCRPC/VTrans	City of South Burlington	Program Supplemental Scoping Study in FY24 UPWP (starting July 1, 2023).
S.4	**Monitor Electric Vehicle (EV) Fleet Market Penetration**	Work with partners to gather data on the EV market share.	N/A	CCRPC	VTrans, VEIC	Monitor EV market share.
S.5	**Implement Mileage-Based Fee**	Implement a mileage-based user fee for electric vehicles when EVs are 15% of new vehicle sales (estimated to occur by 2026).	TBD	State of Vermont	N/A	Continue to follow progress of mileage based user-fee legislation and provide information to the Legislature and other entities as needed.
S.6	**Improve Exit 12 On-Ramp Geometric Improvements**	Extend Exit 12 Southbound On-Ramp Lane from 1,900' to 2,500' to meet AASHTO standards.	$700,000	VTrans	N/A	Monitor for high crash rates, interchange reconstruction
S.7	**Install Loops on Interchange Ramps**	Install traffic count loops on all interchange ramps in Chittenden County (31 new loops)	$200,000	VTrans	N/A	Order and install traffic count loops as funding becomes available.
S.8	**Enhance Speed Enforcement Activities between Exits 13 & 16**	Enhance speed enforcement monitoring on high volume segment of I-89. Speed-related crashes represent about 32% of crashes between Exit 14 & 15 vs. 15% average.	N/A	Vermont State Police	N/A	Communicate recommendation to Vermont State Police.
Interstate Projects on the VTrans Capital Program						
	I-89 Exit 16 Reconstruction	Reconstruct Exit 16 into a Diverging Diamond Interchange (DDI). This is a CIRC Alternative Phase I Project	$17,000,000	VTrans	N/A	Exit 16 interchange reconstruction planned for 2023.
	Exit 12 Park & Ride in Williston	A regional Park & Ride facility at the I-89 Exit 12 in Williston is currently under construction.	$7,500,000	VTrans	N/A	Monitor utilization of the facility.

	Recommendation	Description	Cost Estimate	Implementing Agency	Implementing Partners	Next Steps
Medium Term (6-15 Years)						
M.1	**Install Changeable Message Boards**	Install permanent Changeable Message Signs in both directions between each interchange (13 new message boards) to inform the public on incidents so they may seek alternative routes, and roadway conditions so they moderate their speeds, etc.	$700,000	VTrans	N/A	Order and install Changeable Message Boards as funding becomes available.
M.2	**Continue Implementing TDM Plan Recommendations and Monitor Outcomes**	Work with VTrans, municipalities, other to partners to advance and monitor implementation of TDM recommendations (see S.2).	TBD	CCRPC, VTrans, Municipalities, GMT, CATMA	N/A	Gather data on teleworking, land use, walk, bike, transit; parking pricing trends; mileage-based fee; and evaluate the impact on VMT.
M.3	**Relocate Exit 14 Northbound Off-Ramp & Signal**	Depending on outcome of the Exit 14 Supplemental Scoping Study, relocate Exit 14 NB off-ramp signal away from Dorset Street.	$1,000,000	VTrans	City of South Burlington, CCRPC, FHWA	Monitor effectiveness of the improvement.
M.4	**Implement Safety & Operational Changes at Exit 14 Ramps**	Depending on outcome of the Exit 14 Supplemental Scoping Study, reduce radii at all Exit 14 on- and off-ramp merge/diverge points with US 2 to slow vehicular speeds and enhance safety for crossing pedestrians and cyclists.	$500,000	VTrans	FHWA	Monitor effectiveness of the improvement.
M.5	**Increase Share of Electric Vehicles in Commercial Fleet**	Increase share of electric vehicles to account for 95% of the commercial fleet.	N/A	Commercial Fleet Managers	N/A	Support programs to expand electric charging infrastructure and encourage incentives to transition commercial fleets to electric vehicles.
M.6	**Construct Additional Park & Ride and Multimodal Transit Intercept Facilities along the I-89 Corridor**	Construct/expand Park & Ride lots along I-89 and construct multimodal intercept facilities at major gateways into Burlington.	TBD	VTrans, Municipalities, GMT	FHWA	Implement recommendations from updated Regional Park & Ride Plan
M.7	**Initiate a NEPA Process for Exit 12B & Exit 13**	Once the effectiveness of the implemented TDM measures are evaluated, a preferred alternative for Exit 14 is selected and the key factors considered, a NEPA process will be initiated to identify a preferred alternative to alleviate congestion at Exit 14. Alternatives to include (at a minimum) No Build, New Exit 12B, and Full-Service Exit 13.	TBD	VTrans	FHWA, CCRPC, City of South Burlington	Monitor key factors: 1. Implement TDM Plan (S.2) 2. Actual / Critical Crash Rate > 1 during previous 2 years 3. Williston Rd/Dorset St intersection v/c >0.9 for 2+ hours The I-89 Corridor Monitoring Committee will meet with the CCRPC & VTrans to review data, trends, and key factors periodically.
Interstate Projects on the VTrans Capital Program						
	I-89 Exit 17 Reconstruction	Reconstruction of the bridge structure off-alignment to the north of the existing bridge, reconfiguration of the southbound interchange ramps, modification of the existing northbound off-ramp, reconstruction of all three signalized intersections, and roadway widening to accommodate additional turning lanes at the Chimney Corners Intersection.	$25,000,000	VTrans	N/A	Exit 17 interchange reconstruction planned for 2025
	I-89 Exit 12 Reconstruction	Reconstruct Exit 12 into a Diverging Diamond Interchange (DDI). This is a CIRC Alternative Phase III Project	$21,000,000	VTrans	N/A	Design and implement preferred alternative from Scoping Study (2014).

	Recommendation	Description	Cost Estimate	Implementing Agency	Implementing Partners	Next Steps
Long Term (15+ Years)						
L.1	**Implement Exit 11 Southbound On-Ramp Geometric Improvements**	Extend Exit 11 Southbound On-Ramp Lane from 500' to 1,000' to meet AASHTO standards.	$600,000	VTrans	N/A	Monitor for high crash rates, interchange reconstruction
L.2	**Implement Exit 11 Northbound On-Ramp Geometric Improvements**	Extend Exit 11 Northbound On-Ramp Lane from 630' to 1,220' to meet AASHTO standards.	$15,000,000 *Bridge Widening Needed*	VTrans	N/A	Monitor for high crash rates, interchange reconstruction
L.3	**Implement Exit 11 Northbound Off-Ramp Geometric Improvements**	Extend Exit 11 Northbound Off-Ramp Lane from 300' to 390' and straighten ramp alignment to depart tangent to mainline segment.	$200,000	VTrans	N/A	Monitor for high crash rates, interchange reconstruction
L.4	**Implement Exit 13 Northbound Off-Ramp Geometric Improvements**	Extend Exit 13 Northbound Off-Ramp from 200' to 380' to meet AASHTO standards.	$5,600,000 *Bridge Widening Needed*	VTrans	N/A	Monitor for high crash rates, interchange reconstruction
L.5	**Initiate a NEPA Process for the I-89 Mainline**	Once the effectiveness of the implemented TDM measures are evaluated, a preferred alternative for Exit 14 is selected and key factors considered, a NEPA Process will be initiated to identify alternatives to alleviate congestion on the I-89 Mainline. Alternatives to include (at a minimum) No Build, Advanced Transit System, Widening of the Interstate.	$1,000,000	VTrans	FHWA, CCRPC, City of South Burlington	Monitor key factors: 4. Implement TDM Plan (S.2) 5. Segment AADT trend exceeds 70,000 within 15 years 6. Peak hour segment v/c trend exceeds 0.9 for 2+ hours within 15 years 7. Segment Actual / Critical Crash Rate > 1.0 8. Level of Travel Time Reliability (LOTTR) < 90% The I-89 Corridor Monitoring Committee will meet with the CCRPC & VTrans to review data, trends, and key factors periodically.

6.1 Corridor Monitoring Committee

As articulated in the project Vision statement, due to the recognized uncertainty about future travel trends resulting from the COVID-19 pandemic, technology, demographics, the effectiveness of the identified transportation demand management measures, and other dynamics, it is important to establish a regular process for reviewing corridor data and reassessing implementation actions as needed.

To that end, this study recommends the formation of an I-89 Corridor Monitoring Committee (*recommendation S.1 in the Implementation Plan*) to meet periodically with VTrans and the CCRPC to review updated corridor data and the status of the Implementation Plan. The Corridor Monitoring Committee members will be selected by the CCRPC and is anticipated to be comprised of 5-9 members representing diverse interests. In order to best align the Corridor Monitoring Committee's review and potential actions with VTrans' funding cycle, the committee is anticipated to meet in the late Spring/early Summer of each year.