

# North Avenue Corridor Redesign: Potential Health Impacts

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June 6, 2014

**FINAL**



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# Acknowledgments

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## Introduction

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An ongoing corridor study is examining possible ways to make North Avenue, situated in Burlington's New North End, a more complete street that provides "safe, inviting, and convenient travel for all users of all ages and abilities." <sup>1</sup> The study is led by Parsons-Brinkerhoff consulting and directed by the Burlington Department of Public Works and Chittenden County Regional Planning Commission. The corridor study encompasses North Avenue from the North Street intersection to the intersection with Plattsburg Avenue. The nature of this project is closely tied to public health because it has the potential to impact chronic disease, injury, health equity, and mental wellbeing.

Including the public health perspective in planning ensures that the physical and mental wellbeing of residents is considered when developing and implementing policies that impact health. One approach for incorporating public health is through the use of Health Impact Assessments (HIA), which is a process for considering the health effects of a decision and providing recommendations. HIA is a systematic, flexible approach that uses data, research, and stakeholder input to assess the potential health impacts of policies or projects. As a "desktop" or "rapid" HIA, this report draws from existing data such as local reports, public meetings, and published literature about similar scenarios, rather than creating new data.

This HIA complements the ongoing North Avenue corridor study by answering the following questions:

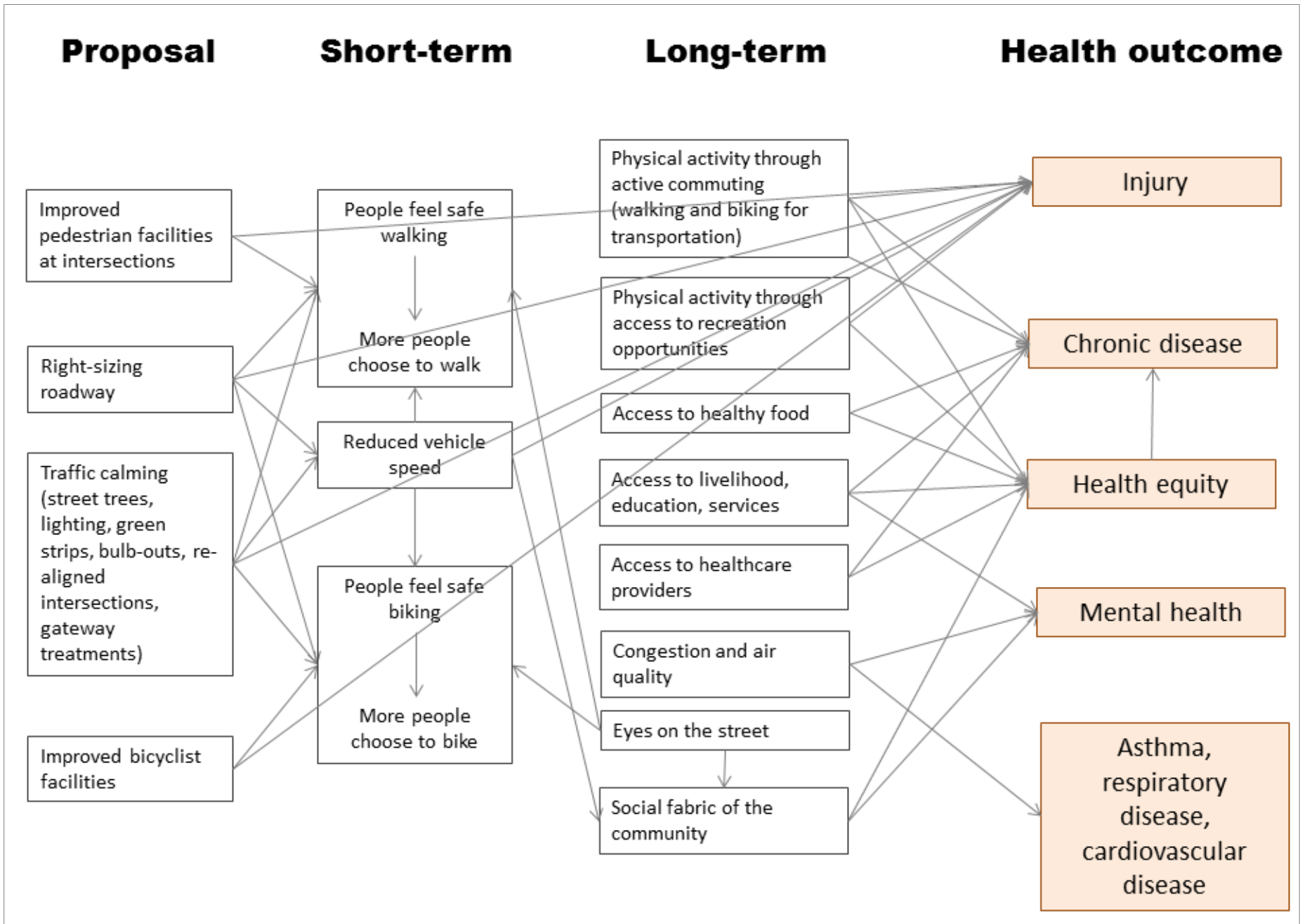
- What are the potential health impacts of proposed changes to North Avenue?
- Which proposals have the most potential to improve the health of vulnerable populations?

The pathway diagram on the next page explores the relevant components of the proposals, the most important health impacts, and the linkages between the two. The current burden of disease from the health outcomes that are most impacted are discussed in the first half of the report. The relationship between the proposals and those outcomes is explored in the second half.

It is important to note several limitations of this HIA. Though air quality may be affected and has negative impacts on conditions such as asthma, other respiratory conditions, and cardiovascular disease, there is not enough data available to comment on whether air quality will improve, decline, or remain constant as a result of the proposed changes. Similarly, little information is available on the relationship between the design of communities and the mental health and wellbeing of residents, so these outcomes are discussed only briefly and in broad terms. The current proposals do not include significant changes to motorist or transit facilities, so there are correspondingly fewer health impacts that might be expected. Motorist and transit facilities are therefore not shown explicitly in the pathways diagram, though they are discussed later in the report. Finally, the proposals that were considered (Appendix 2) are the proposals presented at the second public workshop. They are not yet developed in detail so only broad conclusions can be drawn about potential health impacts.

## Potential Health Impact Pathways

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# Population Health Profile

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## Chronic Disease

Chronic diseases are persistent, life-changing conditions that can be controlled but not cured.<sup>2</sup> They impact an individual's quality of life, risk of premature death, and healthcare costs. Chronic diseases are widespread; among Chittenden County adults 22% have ever been diagnosed with arthritis, 28% have been told they have high cholesterol, 23% have hypertension, 6% have been diagnosed with cardiovascular disease, and 6% have diabetes.<sup>3</sup>

Being overweight or obese increases an individual's risk of developing serious health problems such as heart disease, diabetes, stroke, cancer, and arthritis.<sup>2</sup> Nearly one quarter of high school students in the Burlington School District are overweight (13%) or obese (10%).<sup>4</sup> Six in ten Chittenden County adults are overweight (37%) or obese (21%).<sup>3</sup>

Though most chronic diseases have multiple causes and risk factors, the three that are most pertinent to the proposed changes to the North Avenue corridor are physical inactivity, poor diet, and lack of access to healthcare.

## Physical Activity

Physical activity is a key component of weight management and is associated with lower rates of chronic disease. To stay healthy, adults should participate in at least 150 minutes of moderate activity or 75 minutes of vigorous activity each week.<sup>5</sup> Only 62% of adults in Chittenden County meet physical activity recommendations and 13% participate in no leisure time physical activity.<sup>3</sup>

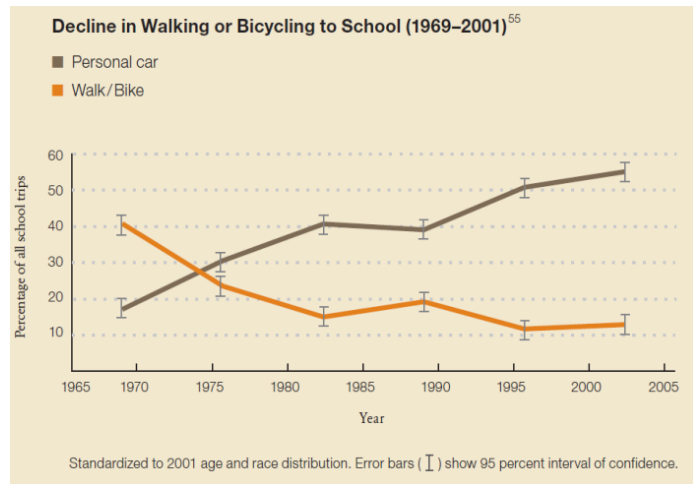
The U.S. Department of Health and Human Services recommends that young people ages 6–17 participate in at least 60 minutes of physical activity every day.<sup>5</sup> In the Burlington School District, 61% of middle school students were physically active for one hour each day for the past 7 days.<sup>4</sup> Rates for boys meeting the physical activity recommendations (65%) were higher than for girls (56%). Only 23% of high school students were physically active for one hour each day for the past 7 days. Again rates for boys (32%) were higher than for girls (13%).

A 2009 policy statement by the American Academy of Pediatrics highlighted the importance of the built environment (including street design, green spaces, and neighborhood layout) in enabling children and adolescents to achieve the 60 minutes of activity they need each day to stay healthy.<sup>6</sup> In particular, they highlighted that neighborhood design that promotes utilitarian physical activity, such as walking or biking to school, to a park, or to a friends' home, is "sustainable and important to health." Rather than allotting separate time during the day to be physically active, more families will be active if opportunities for walking and biking are built into their neighborhoods through attractive streetscapes, traffic calming, and safe and attractive sidewalks and bicycle routes.

Living in a community that helps build physical activity into the daily structure of life, such as safe routes for walking or biking to school or errands and proximity to parks and bicycle paths, can help children and their families get more physical activity each day.<sup>6</sup> More than 70% of Chittenden County adults report using community resources for physical activity.<sup>3</sup> Walking and biking figure prominently as popular

forms of physical activity, as they are accessible, affordable, and readily incorporated into one's daily routine.<sup>7</sup>

Nationally, children who walk or bicycle to school have higher daily levels of physical activity and better cardiovascular fitness than do children who do not actively commute to school.<sup>8,9</sup> Four decades ago, 48% of K-8th grade students usually walked or bicycled to school. By 2009, only 13% of K-8th grade students usually walked or bicycled to school.<sup>10</sup> This graph, taken from an Active Living Research brief, shows this trend across three decades.<sup>11</sup>



Data from the National Walking Survey (2011) demonstrated that school children tend to walk more if 1) their parents walk more or 2) if the children live in a more walkable community. Taken together, the effect is additive; children whose parents are frequent walkers AND who also live in a more walkable community are considerably more likely to walk to school than if only one of these influences is present.<sup>12</sup>

### Nutrition

Together, physical inactivity and poor diet are the second leading cause of preventable death nationally.<sup>13</sup> In Chittenden County, 40% of adults consume two or more servings of fruit daily and only 21% consume three or more servings of vegetables daily.<sup>3</sup>

More detailed information about dietary habits is available for students in the Burlington School District.<sup>4</sup> Among high school students, 43% ate fruits or fruit juice twice a day, 29% ate vegetables three or more times per day. Only 40% of students had breakfast every morning for the past seven days. High school students were also asked about what they drank. Every day in the past seven days, 11% of students drank at least one can, bottle, or glass of soda and 13% drank at least one can, bottle, or glass of another type of sugar-sweetened beverage.

Given the importance of appropriate nutrition to public health, access to food stores and full-service grocery stores are discussed in detail later in the report.

### Access to healthcare

Access to healthcare plays an important role in ensuring that chronic diseases are diagnosed early and managed appropriately to keep people as healthy as possible. Among adults in Chittenden County, 63% had a routine doctor's visit and 77% had a dental visit in the last year.<sup>3</sup> Cancer screenings, though not significantly different from the state, there is room for improvement: 81% of women are up to date on breast cancer screening, 84% of women are up to date on cervical cancer screening, and 76% of men and women meet guidelines for colorectal cancer screening.

## Injury

On average, there are nearly 350 injury deaths, more than 4,250 injury-related hospitalizations and 68,420 injury-related emergency department visits each year among Vermont residents.<sup>14</sup> Motor vehicle-related hospitalizations are the second leading cause of injury-related hospitalizations in the state, accounting for about one in eight injury-related hospitalizations (13%). Of those hospitalized 6% were pedestrians or bicyclists while the rest were passengers or drivers of motor vehicles.

In Vermont, the highest rates of hospitalization for motor vehicle injuries occur among 15 to 24 year olds and among those 85 years of age and older.<sup>14</sup> Of those aged 15 to 24, the motor vehicle hospitalization rate is 159.3 per 100,000, more than one and a half times that of the next oldest age group (25 to 44 year olds, 95.5 per 100,000). Injury rates also spike among Vermont's oldest citizens, with 167.8 per 100,000 of those 85 years and older being hospitalized for a motor vehicle injury. Between the ages of 15 and 24 the rate of injury hospitalization for males is slightly higher – 192.6 per 100,000 men compared to 124.2 per 100,000 women. Among the oldest Vermonters, men are hospitalized at more than three and a half times that of women (336.1 per 100,000 for males, compared to 87.0 per 100,000 females).

Motor vehicles are the leading cause of injury-related death in Vermont.<sup>14</sup> Between 2001 and 2005, there were an average of 77 motor vehicle deaths per year. This equates to an annual average rate of 12.5 deaths per 100,000 Vermonters. More than half of those motor vehicle injury deaths are among Vermonters between the ages of 15 and 44. Two-thirds of the motor vehicle deaths are male (68%).

Personal behaviors such as using a bicycle helmet, wearing a seatbelt, and not using cellphones while on the road can reduce injury risk. Among high school students in the Burlington School District, 27% have texted or e-mailed in the past 30 days while driving a car or other vehicle.<sup>4</sup> Vermont has traffic laws in the books that prohibit texting and handheld cellphone usage, but use of electronic devices by motorists, and to a smaller extent, bicyclists and pedestrians is a growing concern. Among students in the Burlington School District, 53% of high school students and 35% of middle school students who rode a bicycle reported never or rarely wearing a bicycle helmet in the past 12 months. Seatbelt use is a more widely used personal injury prevention measure – 6% of high school students and 3% of middle school students reported never or rarely wearing a seatbelt while riding in a car. Though unintentional injury to pedestrians, bicyclists and motorists is remediable, in part, through individual behavior change, transportation planning to reduce injury risk is an essential strategy.

## Mental health

In Chittenden County, 10% of adults reported that they are in poor mental health, meaning they experienced 14 or more poor mental health days in the last month.<sup>3</sup> The same survey found that 22% of Chittenden County adults have ever been diagnosed with a depressive disorder.

Students in the Burlington School District were asked whether they had, over the past 12 months, felt so sad or hopeless almost every day for two weeks or more in a row that they stopped doing some usual activities.<sup>4</sup> Among middle school students, 23% of girls and 15% of boys answered yes. For high school students, 35% of girls and 15% of boys answered yes.



Clearly, mental health is an important public health issue, but it will not be discussed at length given the lack of research exploring the relationship between mental health and the built environment. However, physical activity – which is discussed extensively in this report – does play an important role in reducing stress and improving mental health.<sup>15</sup>

## Health Equity

The New North End is home to a vibrant and diverse community. In the North Avenue corridor vision statement, health equity is implied by the goal to “provide safe, inviting, and convenient travel for all users of all ages and abilities.”<sup>1</sup> Transportation is an important component of health equity: access to transportation options other than driving is essential for people with disabilities, children too young to drive, older seniors, and those unable to afford cars. These groups represent a significant proportion of Chittenden County’s population. Of all residents, 10% have a disability, 16% are less than 15 years old, 12% are seniors, and 12% live in poverty.<sup>16</sup> The American Public Health Association recommends expanding transportation options for these groups wherever possible.<sup>17</sup>

Through its nature as a Complete Streets transportation study, the North Avenue corridor has the potential to better meet the needs of all of groups that disproportionately experience poor health. The report, “The Path to Complete Streets in Underserved Communities” summarized this, saying: “The transportation disadvantaged, including communities of color, the poor, older adults, youth and people with disabilities, are at a significant disadvantage without access to convenient, safe, well integrated transportation alternatives. All of these groups are often without easy access to cars and live in locations without convenient, safe transportation alternatives, which severely hampers their ability to function as productive members of society. Furthermore, statistics indicate that these demographic groups are growing in numbers, and are not currently being accommodated by the existing transportation system.”<sup>18</sup>

### Elderly residents

Twelve percent of Chittenden County residents are over the age of 65.<sup>16</sup> Additionally, the North Avenue Corridor has two subsidized housing facilities with units reserved specifically for seniors. (Map 1).

Among the chief concerns of Burlington’s elderly residents related to transportation are elderly pedestrian deaths<sup>14</sup> and the need to have a range of transportation options that support aging in place.<sup>15</sup>

The *Burlington Livability Project: An Action Plan for Burlington* encourages Burlington residents and service providers to participate in development of Burlington’s Transportation Plan in order to ensure that stakeholder mobility recommendations are incorporated.<sup>20</sup> Their principal mobility recommendation was to support roads designed primarily for pedestrians, not cars. Further recommendations include adequately timed crosswalk signals; safer bicycle lanes; better lighting and security at bus stops and parking lots; and placement of more resting spots such as benches along walking routes and at bus stops – with priority given to routes that connect senior housing to services and in high volume pedestrian routes on hills.

In 2009, the AARP led a walking audit of several neighborhoods within Burlington, including a route along North Avenue from the Heineberg Senior Center to Ethan Allen Parkway and back.<sup>21</sup> The results of

their findings are included throughout the Potential Health Impacts section of this report to highlight the perspective of older residents of the New North End.

### *Children*

The New North End is home to 7 schools with a total student population of more than 2,400 children. (Map 2) As discussed earlier, physical activity is critical for children, but they are often reliant on their immediate neighborhoods, parks, and routes to school for their physical activity. C.P. Smith, which serves an economically and ethnically diverse group of K-5 students including 51% free and reduced lunch and 14% English language learners, participates in the Safe Routes to Schools program (SR2S).<sup>22</sup> Their participation in SR2S has generated a wealth of detail about how the ability of elementary school children in the New North End to walk and bike to school is affected by transportation infrastructure.

Most relevant to the North Avenue Corridor is the work C.P. Smith's Safe Routes to School team has done to identify engineering changes that can improve student safety. In their April 2013 School Travel Plan, C.P. Smith identified the intersection of North Avenue and Route 127, less than a mile from the school, as a top priority.<sup>22</sup> The travel plan states: "The #1 priority is to implement pedestrian improvements at intersection of North Avenue and Route 127. Improvements include installation of crossing signals and construction of a greenbelt and new curb to accommodate for snow removal during winter months. The residents and the City are also exploring the possibility of closing one of the slip ramps." Additionally, they noted the need for current crosswalk signals to be replaced with countdown signals at several North Avenue intersections: a) Shore Rd. b) Woodbury Rd. c) Ethan Allen Shopping Center. (Map 3)

Parents of children who walked and biked to school were most concerned with traffic speed, distance, adults to go with, weather, intersection safety, and time.<sup>22</sup> Many of these barriers are beyond the scope of the North Ave Corridor Study, but decreasing traffic speed and increasing intersection safety are possible through road and intersection design. This is discussed further in the Potential Health Impacts section of this report.

### *New Americans*

Research conducted with Burlington's refugee population reveals that lack of transportation access is a particular challenge, with unique burdens, for New Americans.<sup>23</sup> Beyond the costs of purchasing a car, refugees and immigrants face the additional time, cost, and linguistic barriers of obtaining a driver's license and learning to drive. In lieu of driving, many refugee families must rely on public transportation or walking for all of their travel needs, which can be time-consuming and unsafe, particularly in poor winter weather or for those with young children.

The impact of being unable to access transportation is acute for recently arrived refugees: "This gap acts as a significant barrier in the adaptation of refugees to their new homes and their acculturation to their new host communities. Furthermore, limited transportation options can in substantial ways restrict the autonomy and independence of refugees, leaving them dependent on the services and schedules of others, which in turn can adversely affect their ability to seek and secure gainful employment, receive necessary medical care, and access other goods and services vital to survival, such as food and clothing."<sup>23</sup>

More than 6,200 refugees have been resettled in Vermont since 1989, with the majority settling in and around Burlington.<sup>24</sup> The exact number of resettled refugees living in the New North End is difficult to determine, but census estimates for Chittenden County show that 7% of the population is foreign born

and 8.5% of the population speaks a language other than English at home.<sup>16</sup> For younger generations, the number of New Americans is an even larger part of the population; 32% of students at Burlington High School are racial or ethnic minorities, 30% have a home language other than English, and 12% take English Language Learner classes.<sup>25</sup>

### *Residents with disabilities*

Physical or mental disabilities that impair mobility are a noteworthy concern that is not limited to one age group. Just over 10% of Chittenden County residents report having a disability. Specific disabilities that may reduce transport choice include ambulatory, visual, and auditory limitations. Roughly 17% of those over 65 years report an ambulatory disability with visual and auditory disabilities at 6% and 15% respectively.<sup>16</sup> The Special Services Transportation Authority (SSTA) is a private non-profit corporation that provides transportation for those with disabilities.<sup>26</sup> SSTA has 53 vehicles and provided 133,000 rides last year, making it an invaluable resource for those with disabilities that affect their mobility.

### *Low-income residents*

Poverty makes people vulnerable to poor health.<sup>27</sup> In Chittenden County, residents with incomes below 250% of the federal poverty level are three times more likely to be diagnosed with diabetes, cardiovascular disease, and asthma and are twice as likely to be diagnosed with depression.<sup>28</sup>

Families living in poverty, regardless of age, ethnicity, or disability, may be heavily impacted by transportation decisions. In Chittenden County nearly 21,000 individuals – 12% of the population – live in poverty. Of households receiving 3SquaresVT benefits in Chittenden County, 44% are home to children under 18 years of age while 21% are home to individuals over 60 years of age.<sup>16</sup>

Burlington-specific indicators of low socio-economic status include the percentage of students in the Burlington school district receiving free and reduced lunch and the number of affordable housing units in neighborhoods adjacent to North Ave corridor. In the 2012-13 academic year just over 53% of students in Burlington School District received free or reduced school lunch benefits. Nearly 65% of these students attend schools in neighborhoods immediately adjacent to the North Avenue corridor.<sup>29</sup> Within the New North End there are 6 subsidized housing facilities with a total of 553 subsidized units for low-income, elderly, or disabled residents.<sup>30</sup> (Map 1)

# Potential Health Impacts

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## Access to multimodal options for all ages, abilities

The National Physical Activity Plan advises communities to prioritize resources to increase active transportation and other physical activity through community design, infrastructure projects, systems, policies, and initiatives.<sup>31</sup> When people have safe active transportation options, every trip taken becomes an opportunity for physical activity. But there are many physical and social barriers to walking and bicycling, which can be grouped into three major categories: long distances, lack of facilities and traffic safety concerns. These barriers are the product of engineering, zoning, land use and urban design trends prevalent in United States transportation systems for the last half century. Eliminating these barriers means changing the way we think about transportation; a more inclusive and equitable approach requires shifting the paradigm from mobility to accessibility.<sup>32</sup>

One stated project goal is to “remake the North Ave corridor into a “Complete Street” that accommodates the safe and efficient travel of all users of all abilities and provides transportation choices.”<sup>1</sup>

Roads that support active transportation options such as biking and walking, promote physical activity. In a study examining the environmental and policy determinants of physical activity, when participants were asked where and how they engaged in physical activity, the most common responses were as follows: on neighborhood streets (66%), at shopping malls (37%), at parks (30%), on a walking and jogging trail (25%), on a treadmill (25%), and at an indoor gym (21%).<sup>33</sup>

Infrastructure adaptations and policies that support bicycling can significantly increase levels of bicycling for daily travel.<sup>34</sup> Accumulated evidence strongly suggests, perhaps intuitively, that creating activity-friendly communities will increase levels of recreational and destination-driven physical activity over time.<sup>7</sup> The National Institute for Health and Clinical Excellence provided recommendations on the most promising transportation changes that can increase the number of people in a community who are physically active.<sup>35</sup> These include:

- re-allocation of road space to support physically active modes of transport (as an example, this could be achieved by widening pavements and introducing cycle lanes)
- restrict motor vehicle access (for example, by closing or narrowing roads to reduce capacity).”

Access to a variety of transportation options is important to public health because not all members of a community are able to drive – nor are all members of a community able to use active transportation. The factors that determine people’s transportation options include age, disability, cost, and convenience.<sup>18</sup> The *Burlington Livability Project* reported that seniors who used multiple forms of transportation were more mobile than seniors who used a single mode.<sup>20</sup> The availability of a wide variety of options ensures that all road users are accommodated. Arguments using pedestrian and bicycle counts that show low use/ridership as a defense to maintain a current infrastructure configuration is not an accurate perception. “Lack of pedestrians or bicyclists using a street does not equate to a lack of demand.”<sup>36</sup> This lack of use is more attributable to safety concerns than lack of demand.

## Current Bike Facilities

Here, the term bike facilities refers to the transportation infrastructure that supports biking, such as sharrows (painted markings that remind cars to share the road and bicyclists to ride predictably), bike lanes (a separate lane painted onto the roadway that is reserved for cyclists), and protected bike lanes. The term *cycle track* is often used by transportation professionals to refer to a one or two-way bike lane that is separated from motor (and sometimes pedestrian) traffic by a physical barrier.

### *Bike Facilities on North Avenue*

Perceptions of safety and convenience determine an individual's decision to walk or bike. Important considerations include: distance to destination, vehicular speed, number of lanes, slope (elevation), presence of sidewalks, bike lanes and traffic volume.<sup>7</sup>

Improved bicycle facilities along North Avenue are necessary despite the nearby presence of the Lakeshore and Route 127 Bike Paths. To compare these routes more rigorously, distance and elevation slope were measured in MapMyRun to evaluate the three potential biking routes between the northern and southern endpoints of the corridor study (Plattsburg Avenue and North Street respectively). This start and endpoint, though not representative of a given individual's actual commute, were used because they delineate the study corridor and because they serve as an approximation of commuting from the New North End into the core of Burlington. The three potential biking routes that were evaluated were 1) along the Lakeshore bike path, 2) along the Route 127 bike path, and 3) along North Avenue itself. (Map 4)

Travel distance was calculated for each of the three routes:

- Lakeshore bike path: 3.8 miles
- Route 127 bike path: 5.0 miles
- Biking along North Avenue: 2.8 miles

Elevation profiles of the three different routes were evaluated to compare the steepest grade of the three routes:

- Lakeshore bike path: 4% grade
- Route 127 bike path: 3% grade
- Biking along North Avenue: 2% grade

These results are summarized in Appendix 1.

Though flatter, shorter routes are desirable for all cyclists<sup>37</sup>, novice, young, and elderly cyclists may be disproportionately affected by long, steep routes. Both in terms of shorter distance and flatter terrain, North Avenue is the preferable option.

Finally, it should be noted that while the Lakeshore and Route 127 bike paths offer excellent recreational opportunities for cycling, they do not provide the efficiency and connectivity that are essential to successful efforts to building physical activity into activities of daily living.<sup>37</sup> In addition to incorporating the need of New North End residents to commute to services in the core of Burlington, biking must be an option for accessing essential services within the New North End itself. The schools, grocery stores, pharmacies, and parks that line North Avenue must be accessible by bicycle as well as by car. If the majority of bicyclists only feel comfortable riding on the lakeshore or route 127 bike paths, then they will not have access to the businesses and services along North Avenue.

## Separate Bike Facilities

The images below, from the consulting team's second presentation to the advisory committee on September 17, 2013, represent the current conditions of North Avenue and are provided here to highlight current bicycle facilities.<sup>38</sup>

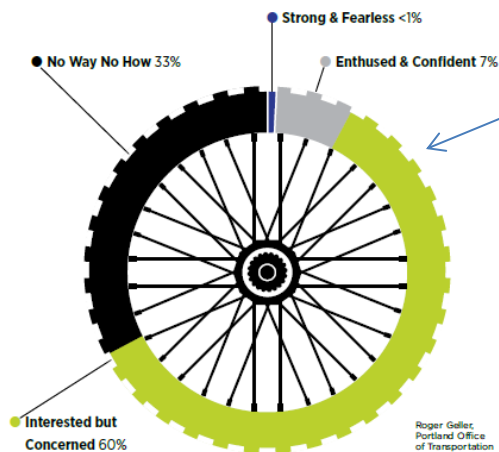


Note that Section One currently lacks a southbound bike lane, which disrupts the continuity and widespread usability of North Avenue by bicyclists. Only Section Two has bicycle lanes in both directions, allowing bicyclists to use the road more safely by demarcating car and

bike paths of travel. Mixed travel lanes in which bikes and cars must share space, the current situation in Sections Three, Four, and Five, may be suitable for bicyclists with advanced skills, but do not allow sufficient access to the North Avenue corridor for novice, young, elderly, or disabled cyclists. Where there are existing bicycle lanes in the North Avenue Corridor, the lanes are delineated only by painted lines. **Compared to bikes and motorized vehicles sharing the same lane, painted bike lanes can calm traffic, provide an organized road space for bicyclists, and can help make the movements of people on bikes more predictable for people on foot or behind the wheel.**

Currently, many bicyclists resort to travelling on the sidewalk, particularly in the corridor segment extending northward from VT 127. Despite a perception of safety, bicyclists on a sidewalk incur greater risk than those on the roadway (on average 1.8 times as great), most likely because of blind conflicts at intersections. Sidewalk bicycling appears to increase the incidence of wrong-way travel once the bicyclist re-enters the roadway or bike lane.<sup>39</sup> Data for cyclist-pedestrian collisions is not nearly as well documented as collisions involving automobiles.

**A physical barrier such as a green strip or other barrier, would offer an additional level of safety for cyclists and other road users. Residents are more likely to choose to bike when there are dedicated cycle routes and cycle traffic is physically separated from vehicle traffic.**<sup>29</sup> Studies have found that cycling in protected lanes is safer than riding on streets without bicycle facilities. Bike lanes can help improve safety for all road users.<sup>40</sup> Protected bike lanes make bicycling a more viable option for everyone, particularly children, seniors, or new riders who would be interested and willing to ride bicycles more if it felt safer. A study of the general public in Portland, Oregon found that 60% of residents were "interested but concerned" about riding bikes; for this group, a line of paint on the street isn't enough to get them onto a bike. Bike lanes with physical separation from roadway traffic were most appealing to the interested but concerned group. People are 2.5 times more likely to ride on the protected lanes than on the streets.<sup>40</sup>



A physically separated bike lane is disproportionately attractive to the interested but concerned segment of the population; those who fear for their safety on the road.<sup>40</sup>

Creating separated bicycle facilities promotes health equity by creating a viable and attractive place for physical activity for residents of all ages, income levels, and abilities. While creating additional, better-connected painted bicycle lanes

would help to allow advanced cyclists to safely negotiate the road, the greatest health gains would be achieved by creating a continuous, separated bicycle facility along the length of the corridor. Higher levels of bicycle infrastructure are positively and significantly correlated with higher rates of bicycle commuting.<sup>41</sup>

Infrastructure that promotes more of the population to walk and bike can reduce injuries through a “safety in numbers” effect. A study in California examined per capita injury rates to commuting pedestrians and bicyclists in 68 cities and towns, each with a very different proportion their populations that use these active modes. As bicycling and walking increased, the rates of injury went down. Similar studies in the United Kingdom, the Netherlands, and Denmark, all of which have greater cycling and walking rates than the US, yielded the same result. In all cases a motorist is less likely to collide with a pedestrian or bicyclist when there are more people walking or bicycling.<sup>42</sup>

**Public Transportation**

Creating an efficient, safe, and inviting experience for those who travel by public transportation is an important component of an equitable corridor. Public transportation promotes health by taking cars off the road, which can improve air quality. Less widely known is the fact that public transportation is a healthy option for the travelers themselves because it’s generally necessary to walk or bike a short distance to reach a bus stop. This builds physical activity into daily life, increases the number of “eyes on the street”, and promotes casual interactions among neighbors. People who used public transportation for any reason were less likely to be sedentary or obese than adults who did not use public transportation. With few exceptions, proximity to public transit stops was linked to higher transit use and higher levels of physical activity among adults.<sup>11</sup> Hybrid commutes, that is, trips completed using several modes are an effective option when distance and areas not served by transit are barriers to a single-mode active commute.

The Burlington Liveable Communities Project found that efforts such as expanded span of service (especially during nighttime and weekends), improved access to bus stops, comfortable, safe, and well-lit stops, and efficient flow of buses all improve the experience of transit users and make it more likely that additional residents will consider using transit instead of cars.<sup>20</sup> The American Community Survey (2012) commuter statistics for Chittenden County show that of nearly 87,000 commuters just over 8,000 rode to work in a car or van pool and just under 2,000 used transit services.<sup>16</sup>

The North Avenue corridor study has not proposed drastic changes to public transportation, so health impacts are not likely to be significant. Proposals include some new stops and better integrating transit stops with pedestrian facilities, such as crosswalks, to make it easier for residents to safely walk to bus stops. It will be important to maintain a balance of frequent stops (to reduce the distance residents need to walk to access buses) and bus speed (too many stops can make bus commutes unnecessarily time-consuming). **In order for North Avenue to be a truly complete street, any proposed changes to the lane structure (such as right-sizing and incorporating bike lanes), need to consider and mitigate any potential for increased crashes between buses and other users.**

## Pedestrian Facilities

**Walking is the preferred form of physical activity by an overwhelming majority of the population. This preference spans a spectrum of age, gender and income groups. Importantly for public health, walking is the favored choice for physical activity among typically inactive segments of the population.**<sup>7</sup> Local streets are the most commonly used places for physical activity. Of the nearly 7,000 people who participated in the National Walking Survey, 64% reported walking exclusively on sidewalks or streets.<sup>12</sup> An aesthetically appealing street can increase residents' perceptions of safety on streets. The odds of achieving recommended levels of walking were nearly 50% higher among those who lived on a street with trees and/or lighter traffic than for residents in neighborhoods with heavier traffic and no street trees.<sup>43</sup>

Residents who report living in a neighborhood with no nearby nonresidential destinations, absent or poorly maintained sidewalks, unpleasant community, or lack of interesting sites are more likely to be obese. Perceived and observed indicators of land use and aesthetics are also associated with obesity.<sup>44</sup> The presence of houses, pharmacies, a grocery store, schools, and parks along North Avenue all contribute to an engaging land-use mix, which is associated with increased walking.<sup>45</sup> In the North Avenue walking audit conducted by AARP, participants rated the corridor as being generally attractive and having interesting features.<sup>21</sup> **Building on this foundation, more contiguous and well-maintained sidewalks would enhance the walkability of the New North End and support adults in achieving physical activity recommendations.**<sup>44, 11</sup>

**Facility improvements for pedestrians might include wide, well-lit sidewalks on both sides of every street; pedestrian refuge islands for crossing wide streets; clearly marked crosswalks, often raised and with special lighting for visibility; and pedestrian-actuated crossing signals, both at intersections and midblock crosswalks.** These infrastructure upgrades adhere to the Complete Streets model of accommodating users of all ages and abilities.<sup>46</sup>

## Motorist Facilities

Injury prevention is one of the major public health concerns relating to automobile usage. The rate of injurious crashes is the largest public health concern because these are the crashes that go beyond property damage and result in physical injuries. The North Ave corridor has four high crash locations.<sup>38</sup> Two hundred nineteen crashes occurred at these intersections, collectively from 2006-2010.

One of the largest factors behind crashes is vehicular speed. While the speed limit in Burlington is 25 mph, the current roadway configuration of North Ave includes few if any traffic calming amenities. The current speed limit on North Avenue between Vermont Route 127 and Plattsburg Avenue is 30 mph. The Burlington Police Department reported that nearly 800 drivers were ticketed or warned for speeding along the corridor in 2013; an increase of over 32% from the previous year.<sup>47</sup> Faster speeds reduce a



driver's ability to steer safely around curves or objects in the roadway, extends the distance necessary to stop a vehicle, and increases the distance a vehicle travels while the driver reacts to a dangerous situation.<sup>48</sup> Reducing vehicle speed is discussed in the traffic calming section.

The common feature of the high crash locations identified along North Avenue are un-signalized intersections – often a cluster of intersections providing entry/egress from peripheral roadways or retail establishments.<sup>38</sup> **Right-sizing the road (also known as a road diet) is one infrastructure improvement that can improve the safety of drivers under such conditions.** Right-sizing a road means eliminating a lane and including a shared center turning lane; this provides a protected road space for turning cars and maintains more consistent vehicle flow in the travel lanes. Estimates for the reduction in crashes after right-sizing a road range from 19% in urban areas to 47% on rural highways.<sup>49</sup>

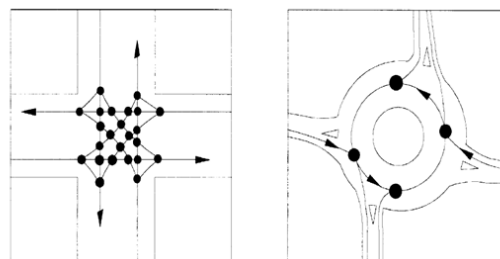
### Intersections: Safety and Air Quality

Intersection safety is a critical health concern for all roadway users. As described above, intersection safety was noted as a concern by C.P. Smith elementary school's School Travel Plan<sup>22</sup>, highlighting the disproportionate impact it has on the ability of children or other groups to safely walk and bike. Improving intersection safety makes roads more accessible to multimodal users of all abilities by increasing the perception of safety and decreasing injury rates.

Research indicates that well-designed roundabouts can be safer and more efficient than conventional intersections. Roundabouts create less delay for motorists than conventional stop- or signal-controlled intersection<sup>50</sup> and can be designed to accommodate emergency vehicles or traffic trailers through engineering features such as truck aprons.<sup>51</sup>

A recent review of 23 studies relating to bicycle safety at intersections and on straightaways found that cycle tracks through single-lane roundabouts resulted in the greatest reduction in crashes for people riding bikes.<sup>52</sup> Multi-lane roundabouts, bikes riding on roadways with cars through roundabouts, and high volumes of traffic at roundabouts were found to be more dangerous configurations. Additionally, a review of 28 studies of motorist safety at roundabouts found that converting intersections to roundabouts decreased both the frequency and severity of vehicle crashes.<sup>53</sup> Indeed, injury and fatal crashes can be reduced by as much as 70% for traffic flows of single-lane roundabouts up to 20,000 cars per day.<sup>50</sup>

Roundabouts reduce the number of decision points motorists encounter while driving into the intersection. A decision point is a place in an intersection in which a driver is required to make a decision about their travel path. Reductions in decision points means a reduction in the number of potential crash scenarios.<sup>54</sup>



*Number of decision points comparison*

Though these results are promising, it is beyond the scope of the authors' technical knowledge to comment on the engineering details of intersections that will best ensure safety for users of all travel modes in North Avenue. Not all intersections along the North Avenue corridor can be addressed in the same manner. **Ultimately, the corridor may have a variety of intersection including pedestrian-actuated crosswalks signals, roundabouts, and traditional signalized intersections.**

An additional element of intersection design that impacts health is traffic congestion, which is associated with poor air quality. Evaluating the impact of intersection changes on queuing, congestion, and air quality will be an essential step of the proposal evaluation to ensure sufficient air quality for those living near or traveling along North Avenue, but is beyond the scope of this report.

## On-street Parking

In addition to the convenience for drivers, on-street parking can improve the pedestrian experience of roadways by serving as a buffer. A study that evaluated parking types in six New England towns, one of which was Brattleboro, VT, showed that towns with on-street parking and other compatible characteristics, such as mixed land use and higher density, recorded more than six times the number of pedestrians compared to sites that lacked these traits.<sup>55</sup>

Free-flow speed on streets with on-street parking was reduced by 2.3 mph as compared to streets without on-street parking. The study showed that the largest decrease in speed occurred on those roadways with a combination of factors complementary to a street type facility with smaller building setbacks and on-street parking.<sup>56</sup> The resultant traffic calming seen is comparable to that seen in a study of driver's perceptions of street edges and the effects on travelling speeds.<sup>57</sup>

Removal of curbside parking prohibitions has generally yielded a decrease in traffic collisions. One study conducted in Hamilton, Ontario found that non-intersection crash rates reduced by an average 37%.<sup>58</sup> However, an extensive study in Copenhagen, Denmark, found an increase in injurious crashes when a prohibition of curbside parking shifted parking onto side streets, which increased turning traffic.<sup>59</sup>

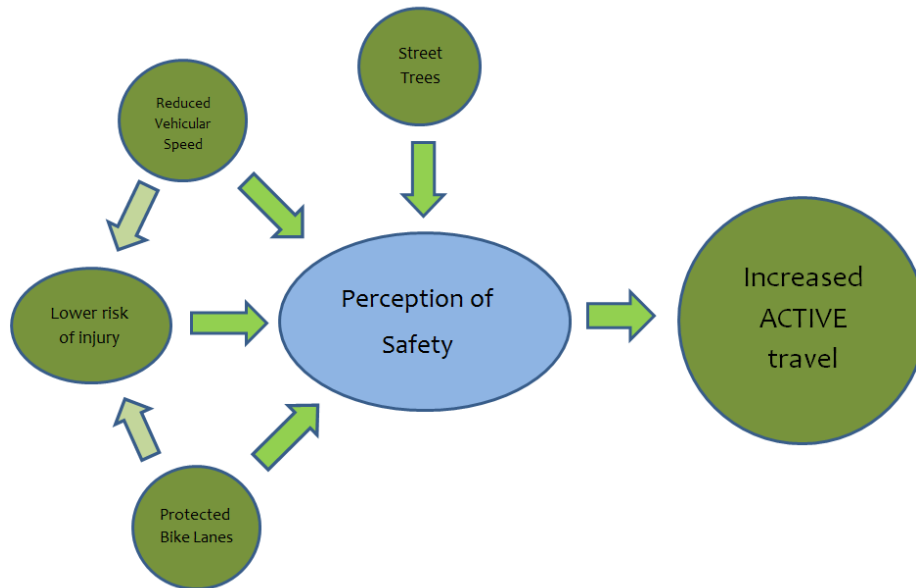
On-street parking is one tool to help create a street that accommodates all users. However, reductions in on-street parking on North Avenue are unlikely to have large health impacts if they are balanced with other traffic calming features. Residents who drive cars are unlikely to be inconvenienced by any reduction in on-street parking because the number of spaces that may be affected is quite low.

**In the long term, increased bicycling rates, pedestrian rates, transit use and car sharing may result in decreased demand for parking along North Avenue since those living on the corridor will have greatest access to all of these transport options.** Demographic and cultural trends may also lead to a decrease in demand for automobile facilities; young adults are less likely to have driver's licenses<sup>60</sup> (particularly when alternative transportation is available<sup>61</sup>) and are more likely than other generations to prefer walkable neighborhoods.<sup>62</sup>

## Traffic Calming

Traffic calming impacts health and wellness through multiple routes. Firstly, crashes at lower speeds are less likely to result in severe injury or death.<sup>63</sup> Fast and heavy traffic is commonly cited by youth and adults as a barrier to walking and cycling. Infrastructure changes that decrease vehicle speeds, increase the attention of drivers and enhance pedestrian safety are known as traffic-calming devices. Devices such as speed bumps and visibility aids can improve pedestrian and bicyclist safety. Other devices, include reductions in the number or width of car lanes and sidewalk extensions into traffic lanes at street crossings to shorten the crossing distance.<sup>11</sup> Extensive reviews suggest that area-wide traffic calming in towns and cities may be a promising intervention for reducing the number of road traffic injuries, and deaths.<sup>64</sup>

Secondly, when traffic is moving more slowly, people perceive the street to be a safer place.<sup>65</sup> Traffic speed was noted as an issue by C.P. Smith’s Safe Routes to Schools parent surveys<sup>22</sup> and in the AARP’s livability study<sup>21</sup>, suggesting that this barrier affects all ages. The AARP study participants noted both traffic volume and traffic speed as major barriers to the walkability of their route through the New North End.<sup>16</sup> Lower vehicular speeds, protected bike lanes, and clear edge demarcation with trees can reduce injury risk, but the increased perception of safety is even more impactful.<sup>40, 58, 63, 65, 66</sup>



Calming traffic through engineering measures is most practical on moderate and low speed roadways. Once implemented, they are effective without constant attention (such as enforcement), and they can be placed in areas where regular enforcement is cost prohibitive. Also, they require little maintenance, so engineering changes can be implemented as funding is available without placing burdens on future budgets. The US DOT National Highway Safety Administration recommends a multi-faceted approach to reducing traffic speeds and thereby increasing safety. Some key elements are regulation (speed limits), signage, public information and education, enforcement, and engineering modifications.<sup>63</sup>

The street edge acts as a structural reference for motorists, it enables them to distinguish the roadway from the surrounding environment.<sup>66</sup> Presence of street trees along that edge increase perception of safety. In a study of simulated driving environments, the significant reduction in driver speeds noted in the treed landscape indicates that street trees may provide positive operational values such as traffic calming as well as a potential driver “calming” effect. Although collisions with trees have a high rate of injuries, there may be fewer crashes overall.<sup>58</sup> This may partially explain reductions in severity and frequency of crashes on streets that have streetscape enhancements.<sup>67, 68</sup>

One traffic calming measure that can be applied to four-lane roads is right-sizing, eliminating a lane and introducing a central turning lane. The only area of North Avenue that is currently four lanes is the segment between Route 127 and Shore Road. This segment has the highest volumes of traffic, four car lanes, no provision for bicyclists, the largest concentration of retail (including the only full-service grocery store), and one of the busiest intersections (Ethan Allen Parkway).

As discussed above, **right-sizing this segment could reduce congestion caused by vehicles waiting to turn into side streets or the shopping plaza and provide a less stressful driving experience.** Importantly for traffic calming, it could also reduce speeds. Insights on the potential speed impacts of right-sizing the road can be drawn from Colchester Avenue, which eliminated a lane and introduced a central turning lane in 2010-2011.<sup>69</sup> They found that there was no significant decrease in overall speeds to the restriping of the corridor, though vehicles traveling at the highest speeds did slow down. Eastbound traffic speeds actually increased by 8% which they noted as is likely due to “more uniform traffic flow” and “associated with increased driver expectancy and lower crash rates.”

The City wide speed limit for Burlington is 25 mph (unless otherwise posted). The current posted speed limit on North Avenue between Vermont 127 and Plattsburg Avenue is 30 mph, but this is targeted to be redesigned with a 25 mph speed limit. Adding traffic calming features to this equation will increase safety and encourage non-local, higher-speed traffic to forgo the North Avenue corridor for Route 127.

## Access to physical activity assets

Active transportation like walking and biking as a form of physical activity was discussed in prior sections, but there is also evidence that access to parks and recreation opportunities is important for physical activity. The National Institute for Health and Clinical Excellence has set forth the following guidance: *“Ensure public open spaces and public paths can be reached on foot, by bicycle and using other modes of transport involving physical activity. They should also be accessible by public transport. Ensure public open spaces and public paths are maintained to a high standard. They should be safe, attractive and welcoming to everyone.”*<sup>35</sup>

These recommendations are particularly relevant for intersections along North Avenue that are access points to parks or recreational facilities. (Map 5) The **intersections of North Ave with Shore Road, Staniford Road, and Starr Farm Road** are all initial points of access to the Lakeshore bike path that must be negotiated by visitors or residents from the Eastern side of North Avenue. Starr Farm Park also has outdoor ice skating, playground, soccer fields, and a widely used dog park<sup>70</sup>, so ensuring intersection safety for those trying to access these resources is important to make sure that residents traveling by any mode can take advantage of these features.

It is critical that **the intersections of North Avenue with Leddy Park Road, Institute Road, and Ethan Allen Parkway** are safe for users of all ages, abilities, and modes because these intersections provide access to Leddy Park, North Beach, and Ethan Allen Park (respectively). These three parks are all considered regional parks because they are larger than 50 acres<sup>71</sup>. Leddy Park attracts a large number of people because of it has an indoor ice-skating arena, picnic area, beach, playgrounds, basketball court, tennis court, baseball diamond, and soccer fields.<sup>70</sup> Not only does the intersection of North Ave and Institute Road provide access to Burlington High School and Rockpoint School, it also allows people access to Arthur Park and the Sea Caves on the Eastern side of North Ave and to North Beach and Rockpoint Peninsula on the Western side.

Finally, Ethan Allen Park is a natural area that caters to families with picnic areas and a playground<sup>70</sup>, but which also provides a vital multi-use path that connects walkers and bikers to a large circuit of trails through the Ethan Allen Homestead. 1) Creating a safer means for pedestrians and bikers to travel from Ethan Allen Park’s trails and the Lakeshore bike path would drastically improve the connectivity of Burlington’s non-motorized multi-use paths. It could both encourage more physical activity and better

protect current users. 2) Improving Ethan Allen Parkway intersection safety is particularly important because the segment from 127 to Ethan Allen Parkway has the corridor's highest traffic volumes, with more than 19,000 cars each day<sup>72</sup>, Lakewood Parkway to Ethan Allen Parkway is a High Crash Location<sup>72</sup>, and the intersection has been noted as difficult to negotiate.<sup>73</sup>

Gosse Court, which provides access to the Miller Center, which provides recreational facilities for youth and the community, is another important intersection. The segment of North Ave from Gosse Court to Poirier Place is a High Crash Location<sup>72</sup>.

## Access to grocery stores

Residents in communities with a more imbalanced food environment typical of "food deserts" (large geographic areas with no grocery stores within reasonable proximity) have more health problems and higher mortality than residents of otherwise similar areas with a higher proportion of grocery stores.<sup>74</sup> The problem of food deserts is not limited to big cities; the rural nature of Vermont creates its own challenges for grocery store access. In 2013, Fletcher Allen Healthcare conducted a community health needs assessment of the Burlington Health Service Area (Chittenden County and adjacent towns).<sup>75</sup> Through discussion with focus groups and community leaders, access to food and nutrition was identified as one of the top priorities for maintaining a healthy community, with transportation to markets highlighted as a major community need. Similarly, the Burlington Healthy Food Assessment (BHFA) identified unreliable access to transportation as a significant barrier to food security.<sup>76</sup> Among Burlington residents who reported not always having enough or the kinds of food they want to eat, 10% said it was too hard to get to the store. These results are important to the North Avenue Corridor because they highlight how critical transportation to food resources is for the health of the residents of the New North End who rely on North Avenue to reach food stores.

The Burlington Healthy Food Assessment analyzed the number of residents within  $\frac{1}{4}$ ,  $\frac{1}{2}$ , and 1 mile of full-service supermarkets and other food stores for all of Burlington.<sup>76</sup> Specifically, for the BHFA Florence Becot conducted a network analysis to determine the geographic area that falls within  $\frac{1}{4}$ ,  $\frac{1}{2}$ , or 1 mile of each food store traveling along the existing road network (ie. *not* "as the crow flies"). To find results more relevant to the North Avenue corridor study, those areas were overlaid with the GIS file of New North End households to calculate the distance that households have to travel to reach a food store. Applying the methods used in the BHFA to the smaller geographic area of the New North End (Census Tracts 1 and 2), this section focuses on those households for whom North Avenue is the primary road they interact with in any errand – within or outside their immediate neighborhood. Residents of the Old North End living near the study area have more convenient access to services within Burlington and were hypothesized to be less directly impacted. Within the New North End, there are 3,937 households according to the E911 database, a geographic listing of households that is used by emergency responders. (Map 6A)

First, the analysis was conducted for all food stores – this included even very small convenience stores that sold some foods but were not full grocery stores. (Map 6B) By that measure, 789 households were within  $\frac{1}{4}$  mile, 882 were  $\frac{1}{4}$ -  $\frac{1}{2}$  mile, and 1395 were  $\frac{1}{2}$  - 1 mile. This means that 3066 total were less than 1 mile from some type of food store. Next, the analysis was repeated for just full-service supermarkets. (Map 6C) The Burlington Healthy Foods Assessment revealed that roughly three-quarters of residents shop for groceries at full-service supermarkets and that supermarkets and food coops have the highest availability of healthy foods including produce, protein, dairy, bread, and grains.<sup>76</sup> This means that access to a full-service supermarket, not a food store of any type, is most important for full access to a

range of affordable healthy foods. The only full-service market in the New North End is the Hannaford's, so all distances relate to the Hannaford's. Using just this single full-service supermarket, 99 households are within ¼ mile, 421 are ¼ - ½ miles, and 1280 are ½ - 1 mile from the full-service supermarket. In total 1800 households are less than 1 mile from the supermarket. For healthy adults, within a half mile is generally considered walkable and within one mile is considered bikeable<sup>76</sup>, so these results demonstrate that 45% of New North End households could walk or bike to the Hannaford's if safe, inviting infrastructure is in place. The majority of residents, 2,137 households, live more than a mile from Hannaford and likely need access to efficient public transportation and driving options to be able to reach the Hannaford's. Given Vermont's long winters that make walking difficult – and the additional challenges of walking with grocery bags in any season – those without access to a car may need to make more frequent trips to grocery stores, further highlighting the importance of easy, multi-modal access.

Finally, this analysis was then repeated from a health equity perspective to look at the proximity of subsidized rental units to full-service supermarkets to better understand the options available to lower-income residents. (Map 6D) Avenue Apartments (33 affordable units) and Thayer House (36 units for elderly residents) are less than ¼ mile of the Hannaford's. Heineberg Senior Housing (82 units for elderly residents) is less than ½ mile from the Hannaford's. With well-maintained sidewalks and pedestrian intersection signals, this proximity presents an excellent opportunity for many older or lower-income residents of the New North End to easily access a full-service supermarket. Franklin Square (60 affordable units) is within 1 mile, but the remainder of subsidized housing in the region (the 336 affordable units at Northgate and 6 units for residents with disabilities at Pennington house) are more than 1 mile from the grocery store. This points to the need for sufficient car and bus accommodation along North Avenue for those who are beyond a walkable distance from the grocery store. Public transportation scheduling was a particular concern cited for transportation challenges that cause food insecurity in Burlington.<sup>76</sup>

## Access to healthcare

Good access to health care can influence a person's use of health care services and improves overall health.<sup>69</sup> Although behaviors contribute far more to a person's health than does healthcare access,<sup>77</sup> it is important to ensure that everyone is able to access the healthcare system regardless of the transportation they choose or can afford.

The New North End houses several pharmacies, two primary care practices (one pediatric and one general), and two long-term care facilities. (Map 7) However, the nearest federally-qualified healthcare center, hospital, and medical specialists are all outside of the New North End. To provide for access to healthcare, North Avenue thus must allow for safe, efficient travel to pharmacies and healthcare providers in the neighborhood as well as these and other services in the greater Burlington area. A well-balanced transportation system that allows people to drive, take public transportation, walk, or bike to their medical appointments or to refill prescriptions will best suit everyone's needs.

## Mental Health and Wellbeing

The design of a community can contribute to overall mental health and social capital.<sup>78</sup> Closeness to green space and nature can relieve stress, so street trees and green space should be preserved or installed wherever possible.<sup>79</sup> AARP's livability study noted that there was insufficient shade on the route they evaluated between the Heineberg Senior Housing Complex along North Avenue to Ethan Allen parkway.<sup>21</sup>

A study which investigated the relationship between illness and the amount of natural land around a residential environment found that the prevalence rates for several diseases were lower where there were more natural environments. Furthermore, there was a strong association between depression and anxiety and the amount of nature in people's lives, especially for children.<sup>80</sup> Areas with sprawl, congested traffic, and high dependency on cars for transportation may increase the stress and social isolation of those who commute by car.<sup>79</sup>

Perceptions of safety can be improved through pedestrian-scale lighting and consistent maintenance of roads, parks, and bus shelters.<sup>81</sup> Overall corridor improvements that encourage more pedestrians and cyclists to use North Avenue may also increase the number of "eyes on the street", neighbors looking out for one another, which is another important component to a sense of safety.<sup>82</sup>

## Conclusions

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The strategies for making the North Avenue Corridor provide “safe, inviting, and convenient travel for all users of all ages and abilities” are the same strategies that promote health by increasing safe opportunities for physical activity among those currently inactive.

- Continuous, **protected bike facilities**, those physically separated from the roadway, (proposed Options D, E and F in Appendix 2) would allow a larger number of inexperienced bicyclists to travel North Avenue. These configurations allow for safer travel than the current configuration. Any of these options may lead to an increase in the number of people making the choice to bicycle more frequently for utilitarian and recreational purposes. The corollary to this increase is potential improvement in the health of residents.
- Care should be taken in the **design of facilities**, particularly at intersections, driveways, crossings and transit stops to reduce any potential for increased crashes. Intersections designed to minimize injuries for users of all modes, may serve to increase the willingness of residents to be more physically active, and improve the quality of life of those who live along and travel through North Avenue.
- An array of **traffic calming** strategies can help reduce the severity of injuries and increase the number of people willing bike and walk in the New North End, due to a heightened perception of safety.
- **Right-sizing** can make roadway conditions safer – both for motorists and other users of the roadways – by limiting excessive speed and providing protected center turn lanes.
- **Pedestrian-scale details** like street trees, green space, and lighting, can contribute to a sense of mental wellbeing, safety and connectedness among residents in addition to amplifying the traffic calming effect.
- **Providing multi-modal transportation** options increases access and the potential that children, seniors, people with disabilities, New Americans, or those with limited financial resources can access a range of essential services such as grocery stores, pharmacies, parks, and places of employment.

The greatest gains in public health, through improvements in physical activity, social connectivity and equitable access to services will be attained through a truly multi-modal street that accommodates people of all ages and abilities.

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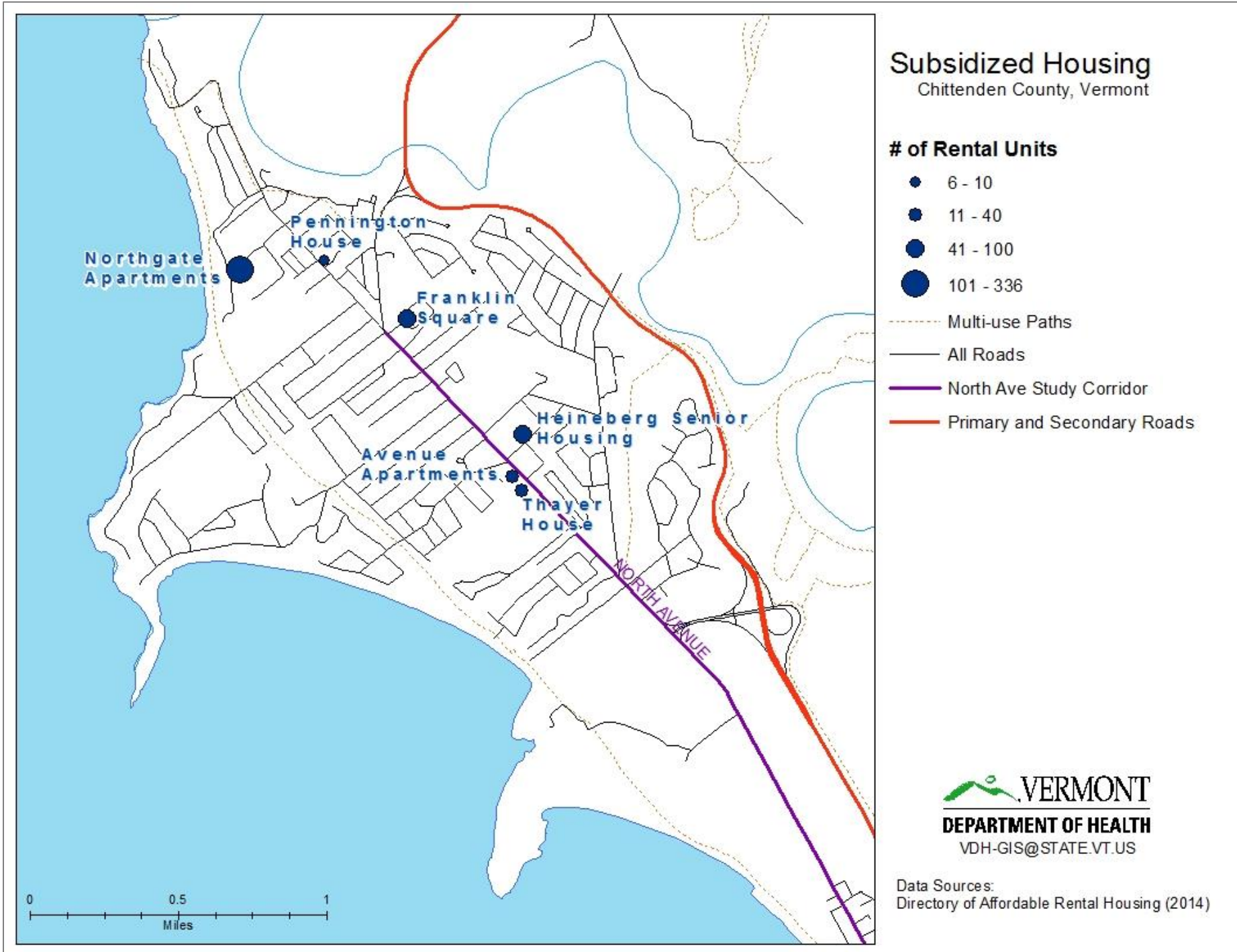
## Limitations

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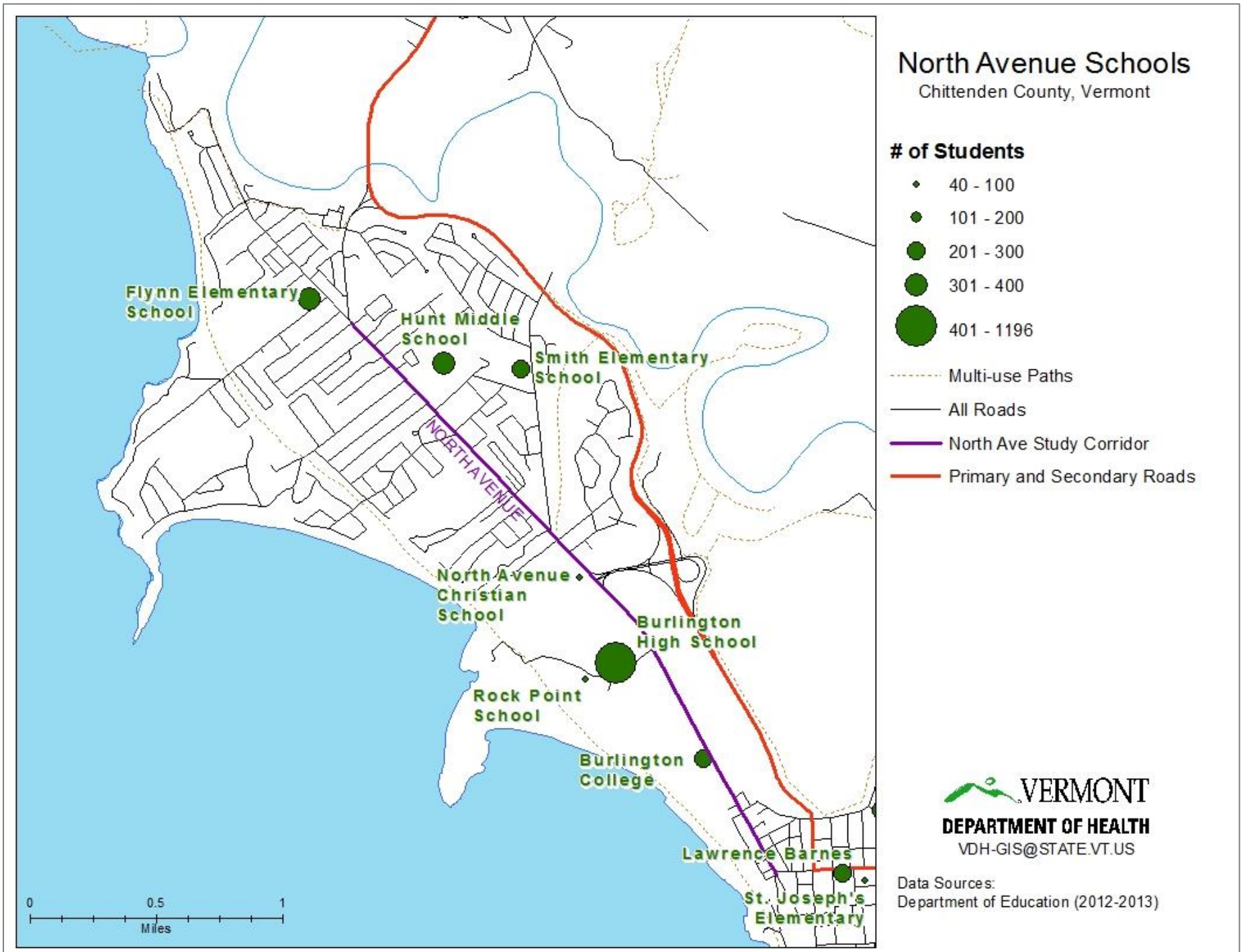
The proposals that were reviewed to create this report are, themselves, still under development and will continue to be shaped by the public, the advisory committee, and more detailed technical reviews throughout implementation. It is beyond the scope of this assessment to comment on the details of how any change is implemented, but consideration of the impacts on injury, air quality, access to services regardless of income, age, sex, or disability, and opportunities for physical activity should be emphasized throughout the course of the corridor study and the implementation of its recommendations.

Many of the proposals for North Avenue could improve health by reducing injury risk and improving access to physical activity opportunities. However, through lack of applicable research, ambiguity in the current proposals, or unexpected outcomes of changes to the corridor, there is potential for health to be adversely affected too. The list below explores potential unintended and unforeseen negative health impacts on health that could arise.

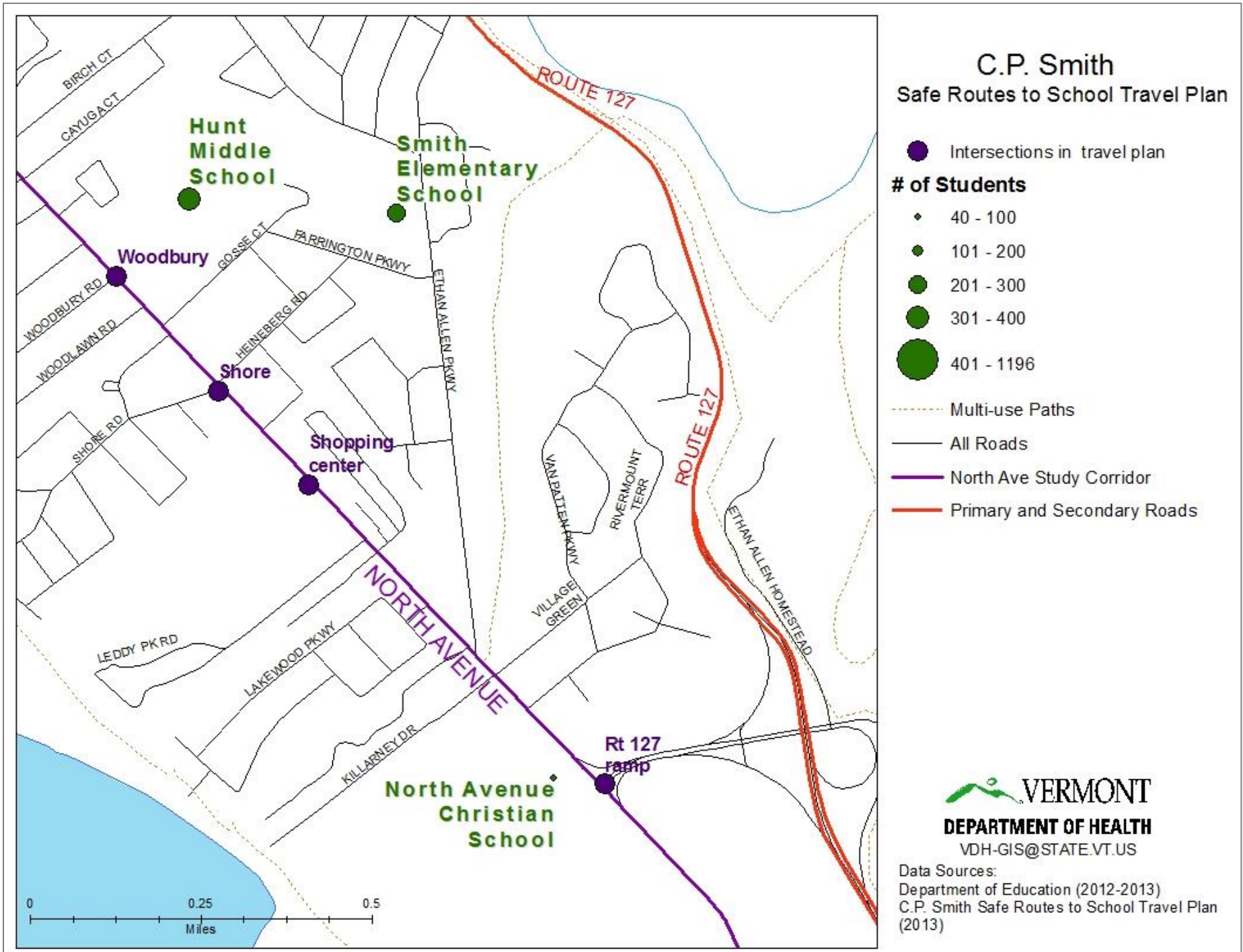
- Increasing the numbers of people walking and biking on the street could increase the number of injuries, particularly at driveways and intersections. Though traffic calming, increased driver expectation of encountering other road users, and physically separated bike and pedestrian facilities are shown to mitigate this danger, the number or severity of injuries on North Avenue should be monitored and responded to appropriately.
- Separating bikes from car traffic can increase the risk of bicyclists being struck by cars while making left-hand turns. Intersections should be designed to accommodate such turns and make them as safe as possible to reduce injury risk.
- If physically separated bike lanes are implemented, the interactions between cyclists and buses pulling out at transit stops should be carefully designed so as to reduce the risk of crashes and injury. As above, injuries should be monitored and adjustments to the corridor should be made if necessary.
- The safety of roundabouts or other intersection treatments is dependent on details of their design that are beyond the scope of this report. Planners and engineers should consider and mitigate any potential for increased injury risk at intersections to ensure that all road users are safe and that residents can use North Avenue for physical activity.
- Air quality is beyond the scope of this health impact report because there is insufficient data to project changes in air quality based on the proposed roadway changes. However, because of the importance to asthma, respiratory disease, adverse birth outcomes, and cardiovascular disease, planners should consider potential changes in air quality before implementing corridor changes.
- Proposed changes to North Avenue may result in increased traffic on Route 127. Though Route 127 is intended to accommodate higher-speed, pass-through traffic, the potential for increased car crashes, congestion, poor air quality, increased traffic at Route 127 access points, and negative impacts to users of the Route 127 bike path should be considered.



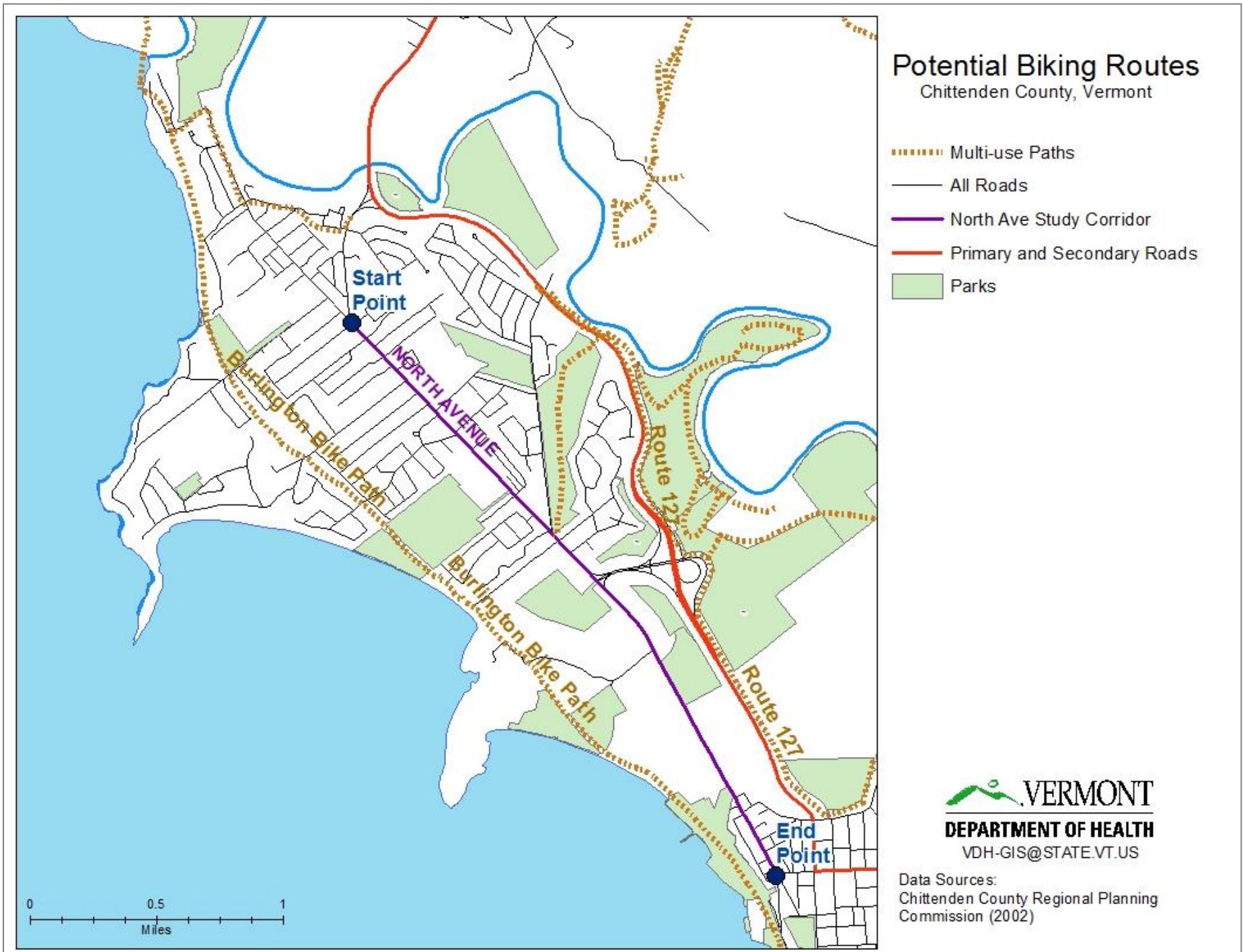
## Map 2 - Schools



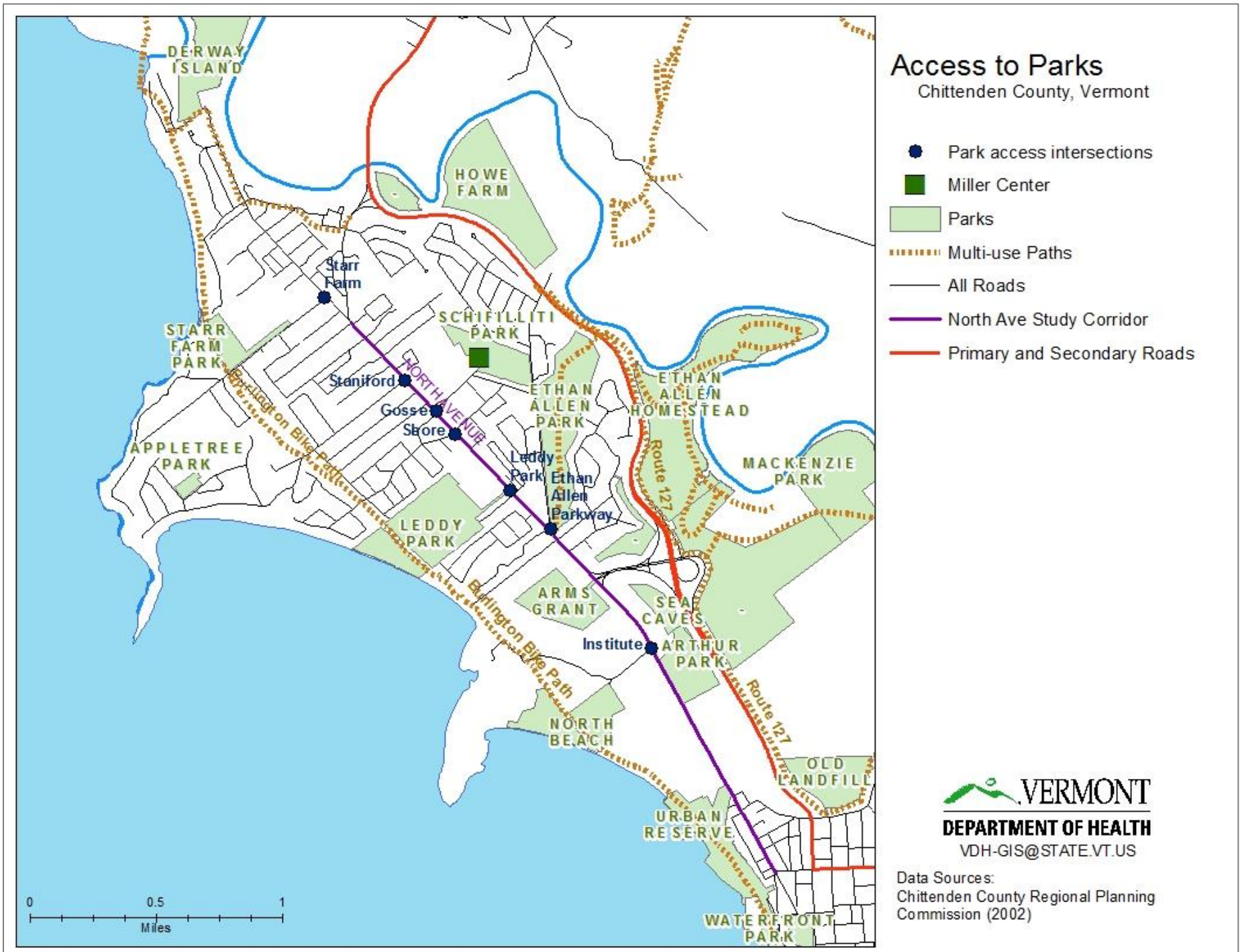
Map 3 - C.P. Smith School Travel Plan: Intersections of Concern



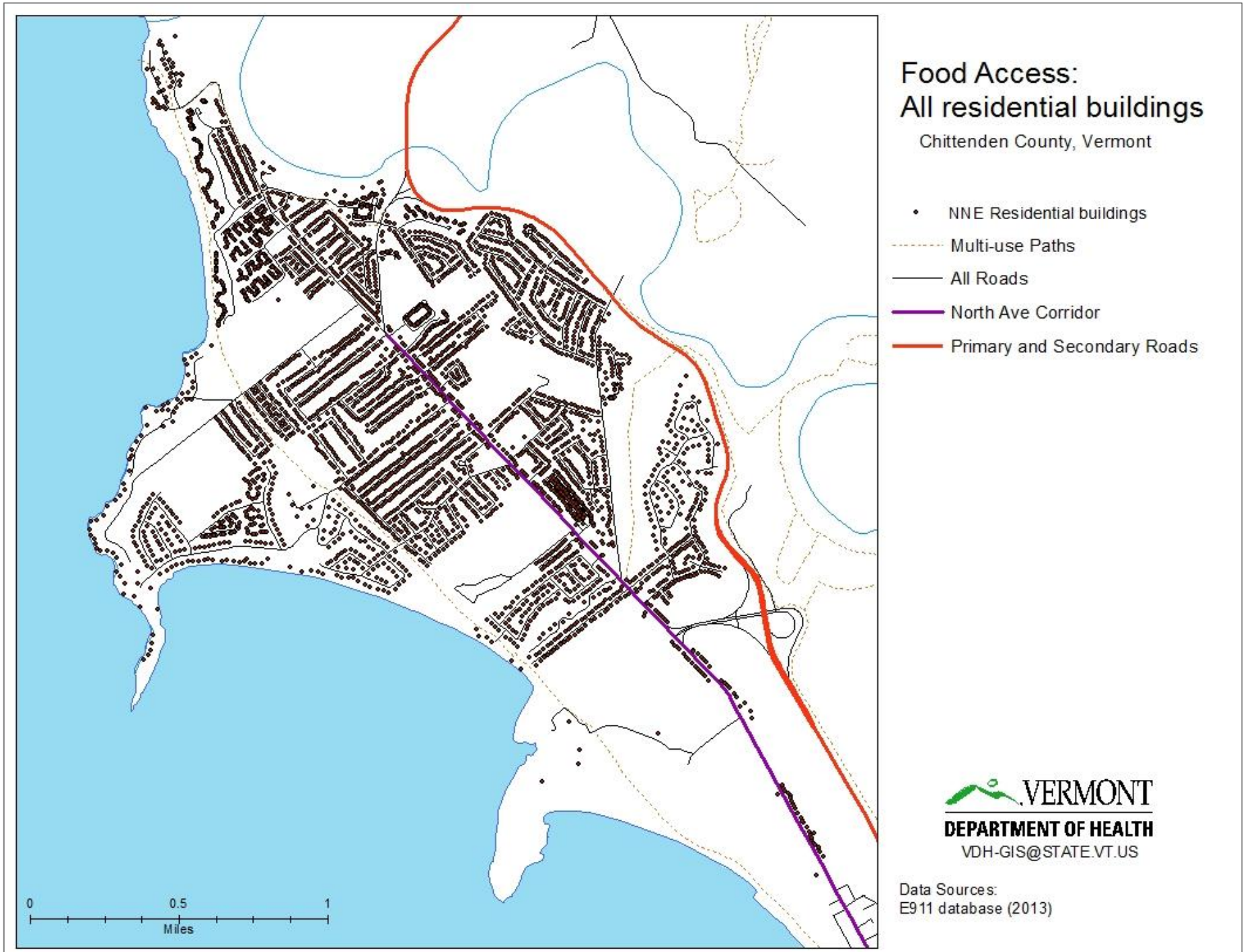
Map 4 - Potential Bike Routes



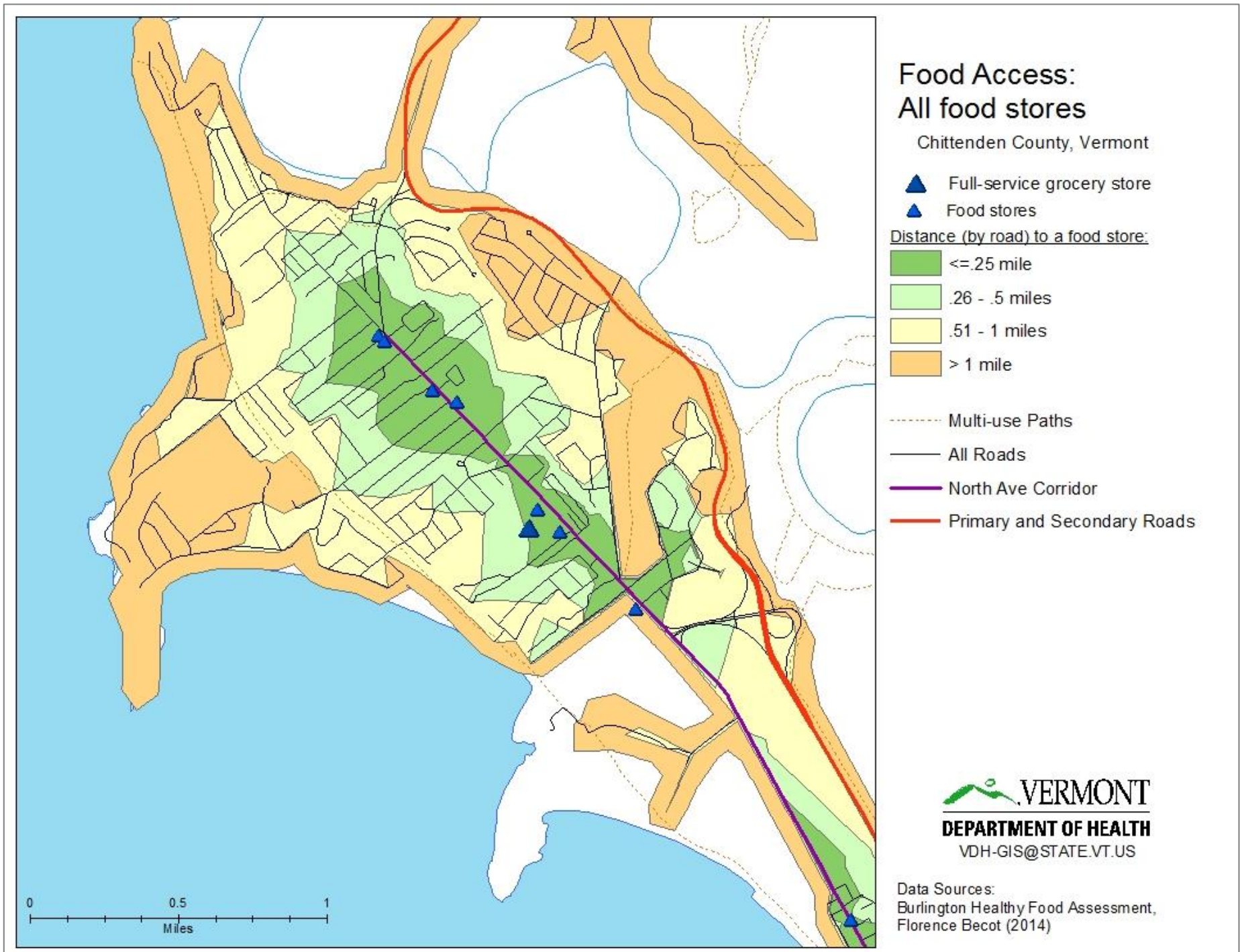
Map 5 - Access to Parks and Recreation Opportunities



Map 6A -All Residential Locations Used in Analysis

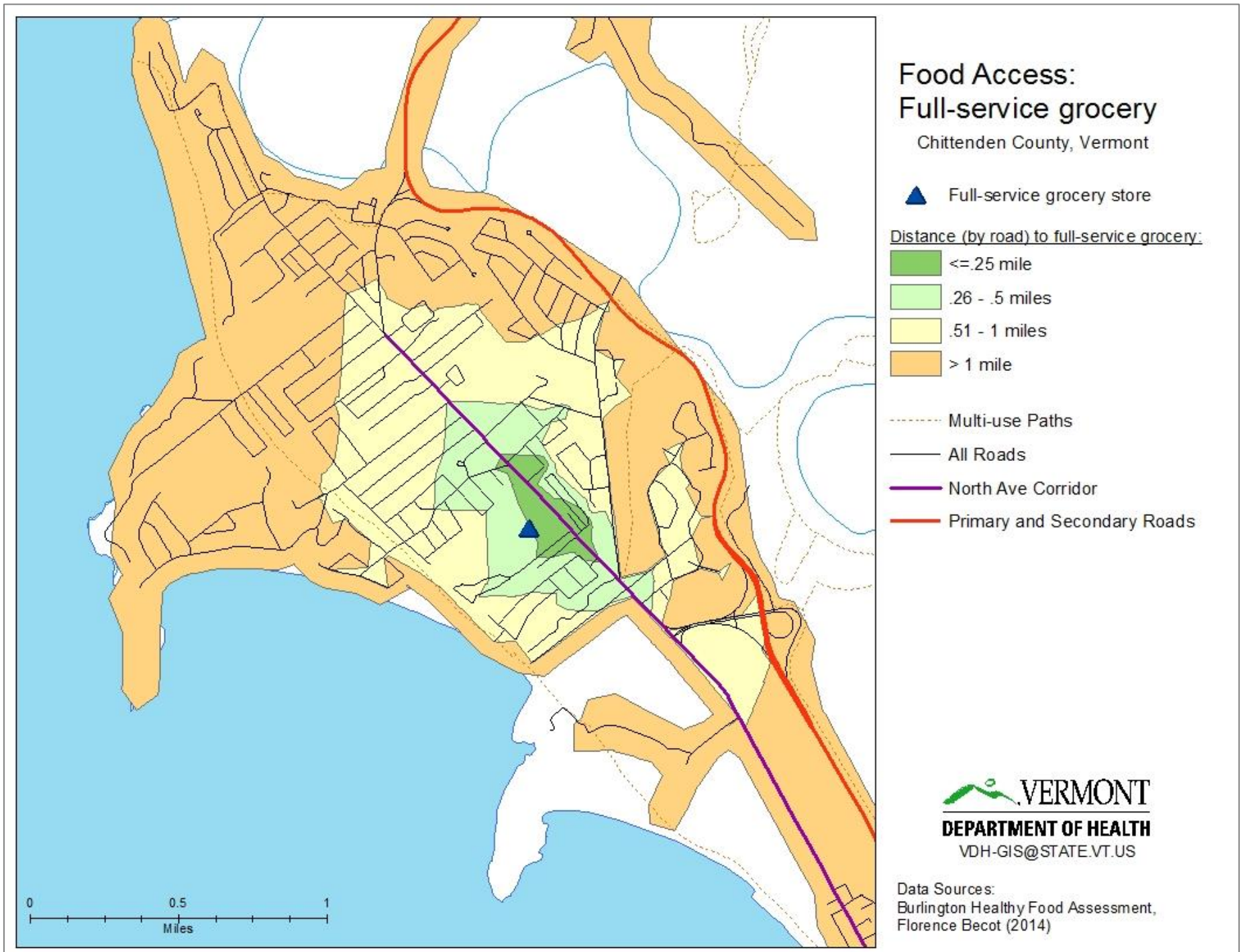


Map 6B - Access to all food stores

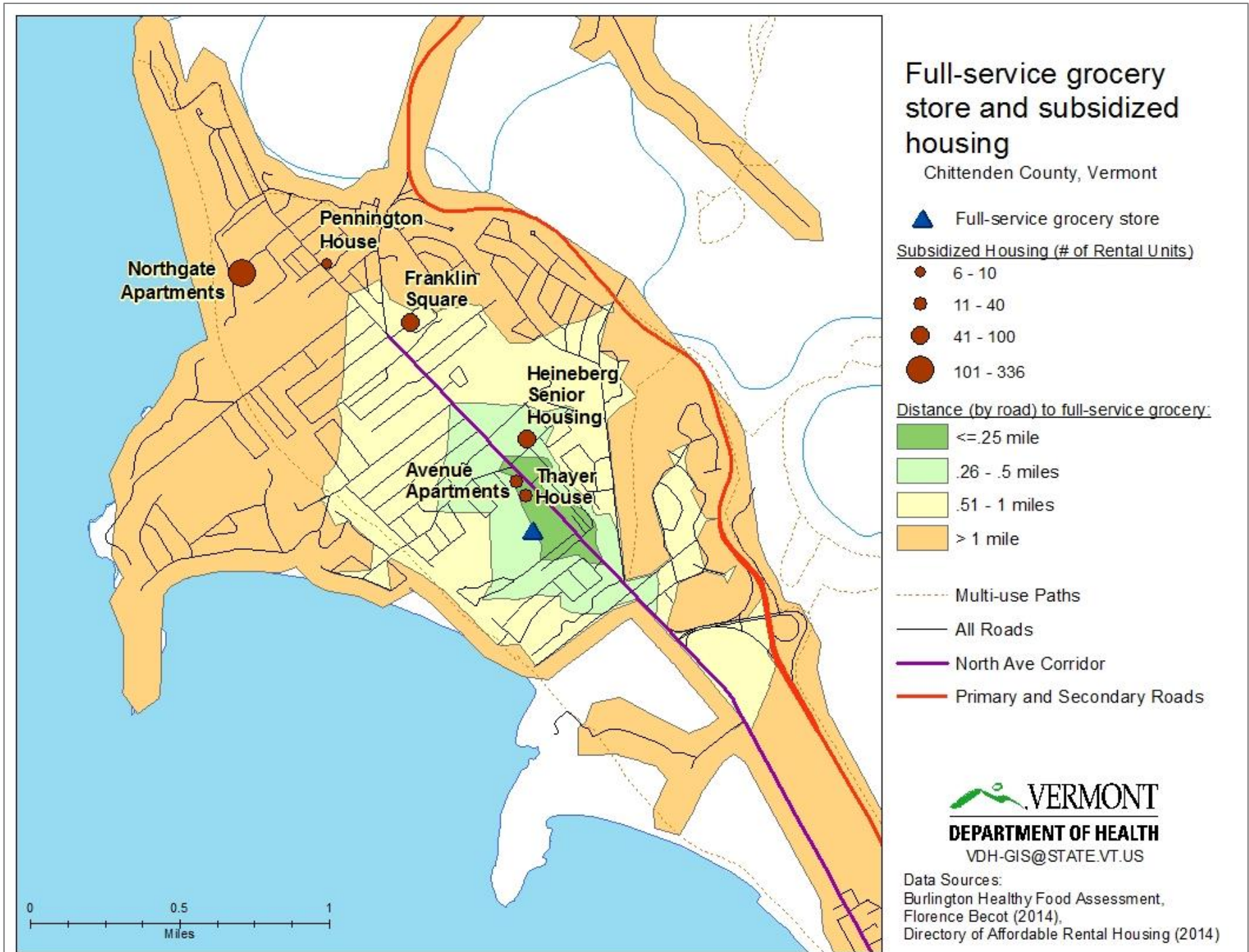




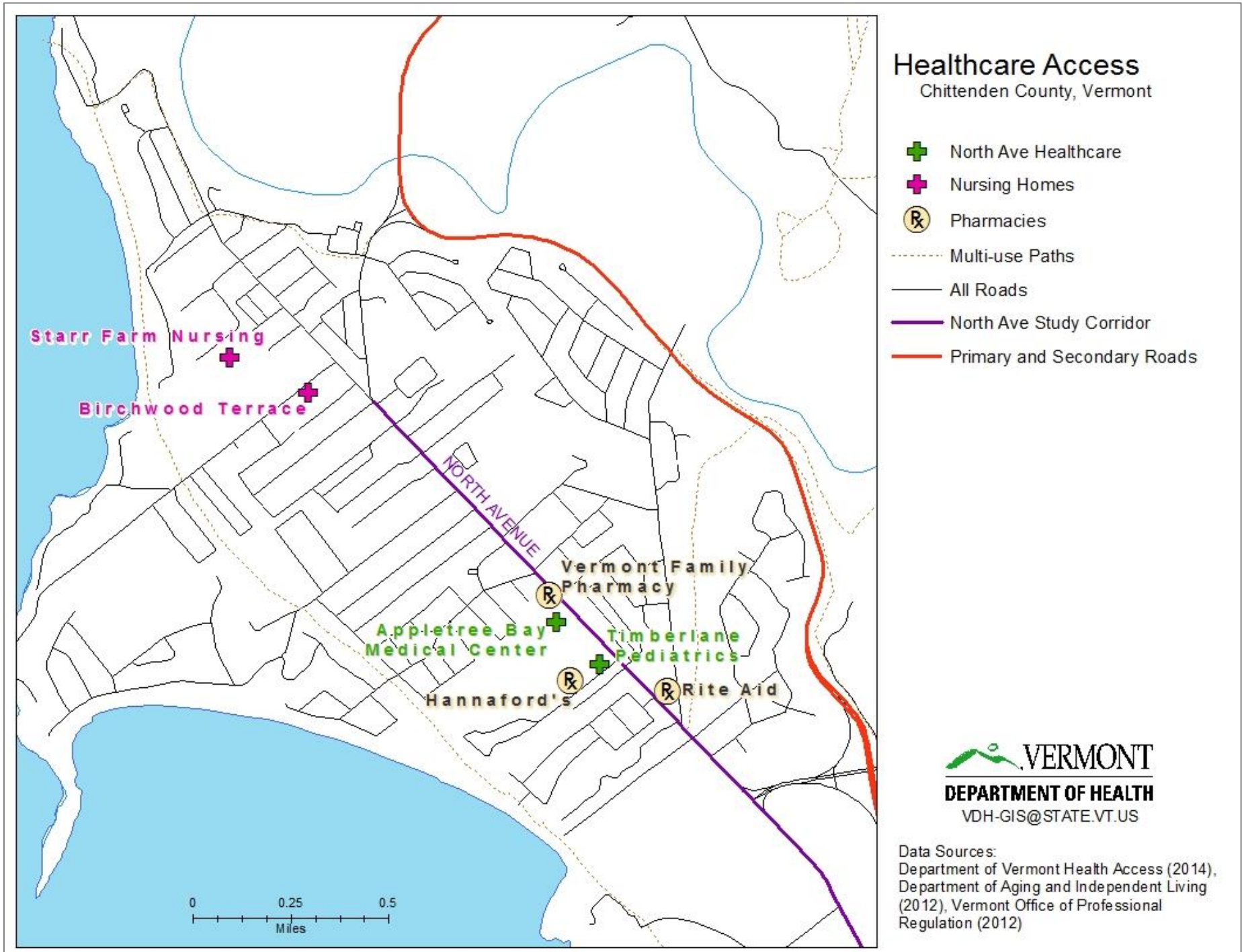
Map 6C - Access to full-service grocery stores



Map 6D – Full service grocery stores vs. subsidized housing locations



Map 7 - Access to Healthcare



## Appendix 1:

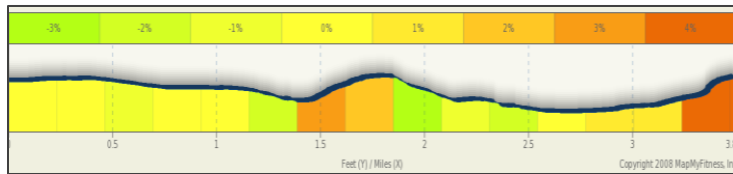
### Elevation Profiles of Routes along North Avenue Corridor

Elevation profiles of routes were evaluated using MapMyRide with a starting point at North Ave and Plattsburgh Ave and an ending point at North Ave and North Street.

- The distances of the various routes is proportional to the width of the boxes.
- The grade (slope) of the routes is indicated by the shading: green represents a downhill, yellow is relatively flat, and orange represents a steep climb.

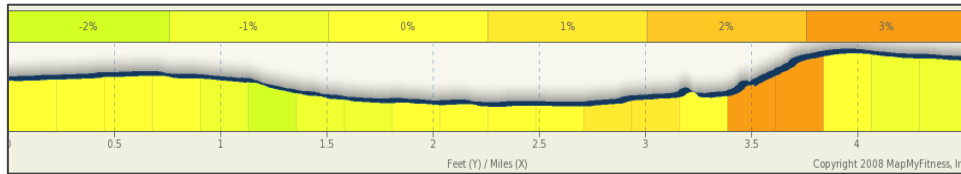
#### Lake Shore Bike Path (3.78 miles):

Southbound



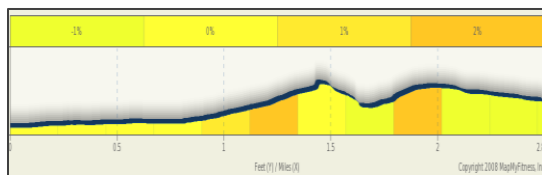
#### Route 127 Bike Path (4.99 miles):

Southbound



#### North Avenue (2.79 miles):

Southbound



## **Appendix 2:**

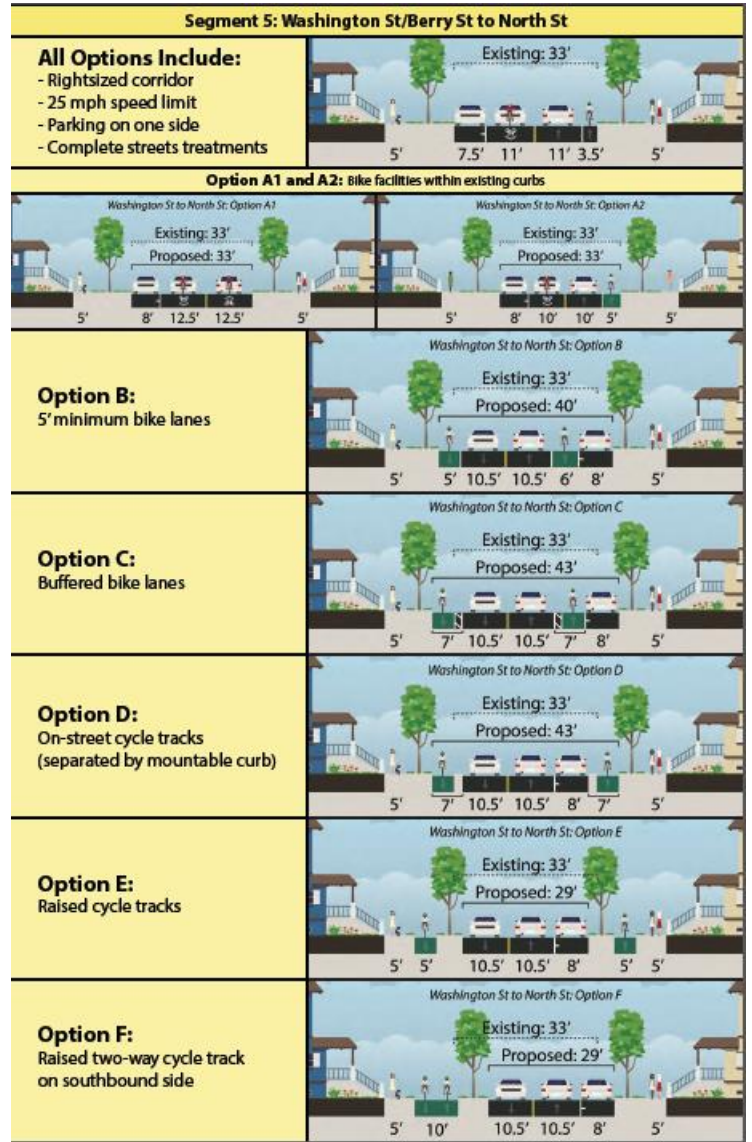
### **Current Conditions and Proposed Alternatives**

The development of the preferred alternative should consider the potential health impacts of the road configuration in detail. This appendix is included so the reader can compare the current conditions and proposed alternatives as they read the health impact report. Current conditions images are taken from second presentation to the North Avenue advisory committee and the proposed options images are taken from handouts disseminated at the advisory committee meeting of 05/01/2014.

# Washington/Berry Street to North Street



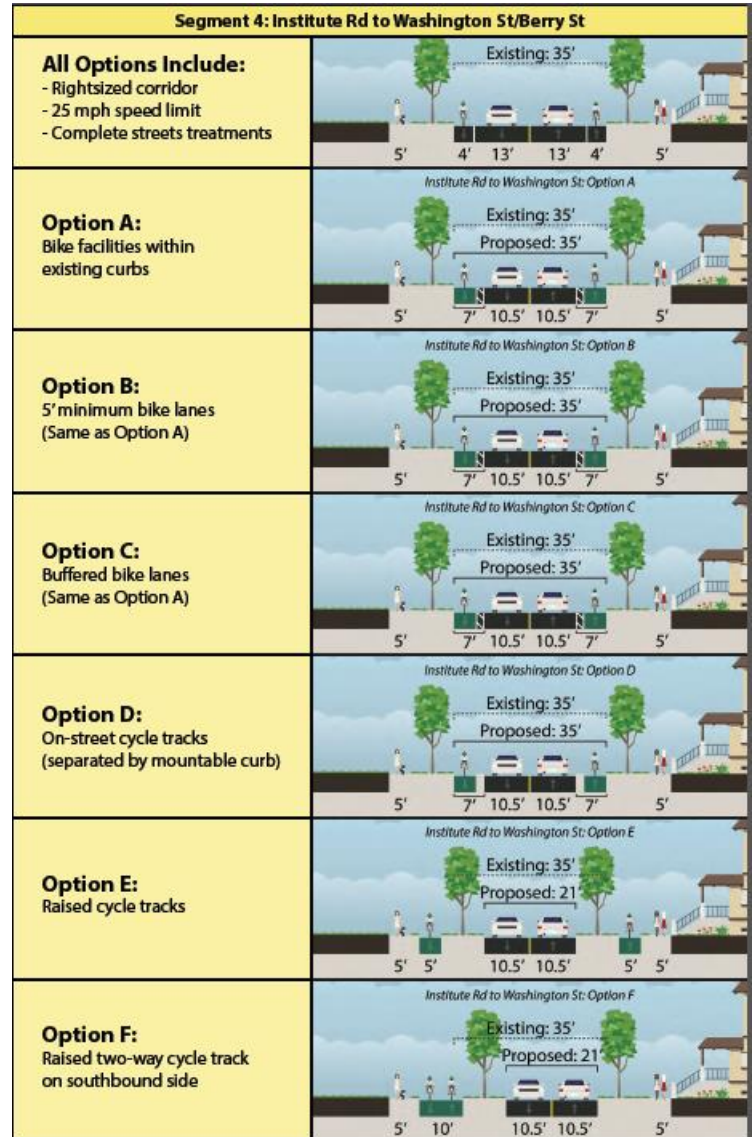
Figure 1. Current conditions



## Institute Road to Washington/Berry Street



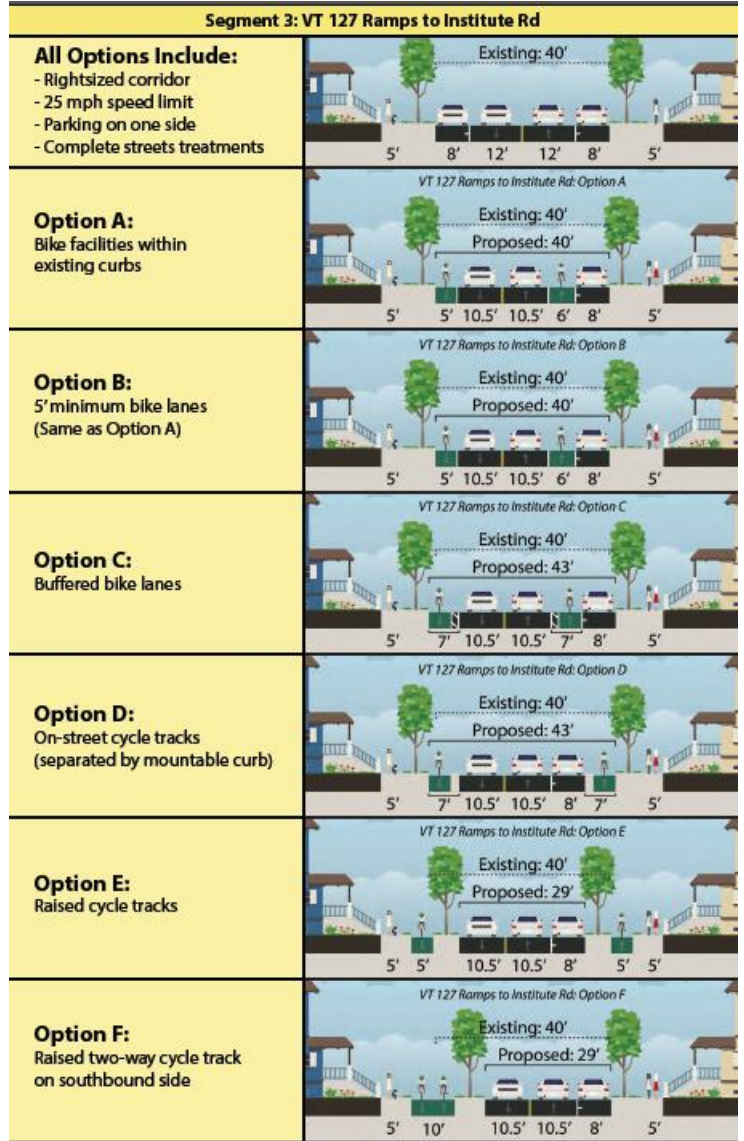
Figure 2. Current conditions



# VT 127 Ramps to Institute Road



Figure 3. Current conditions

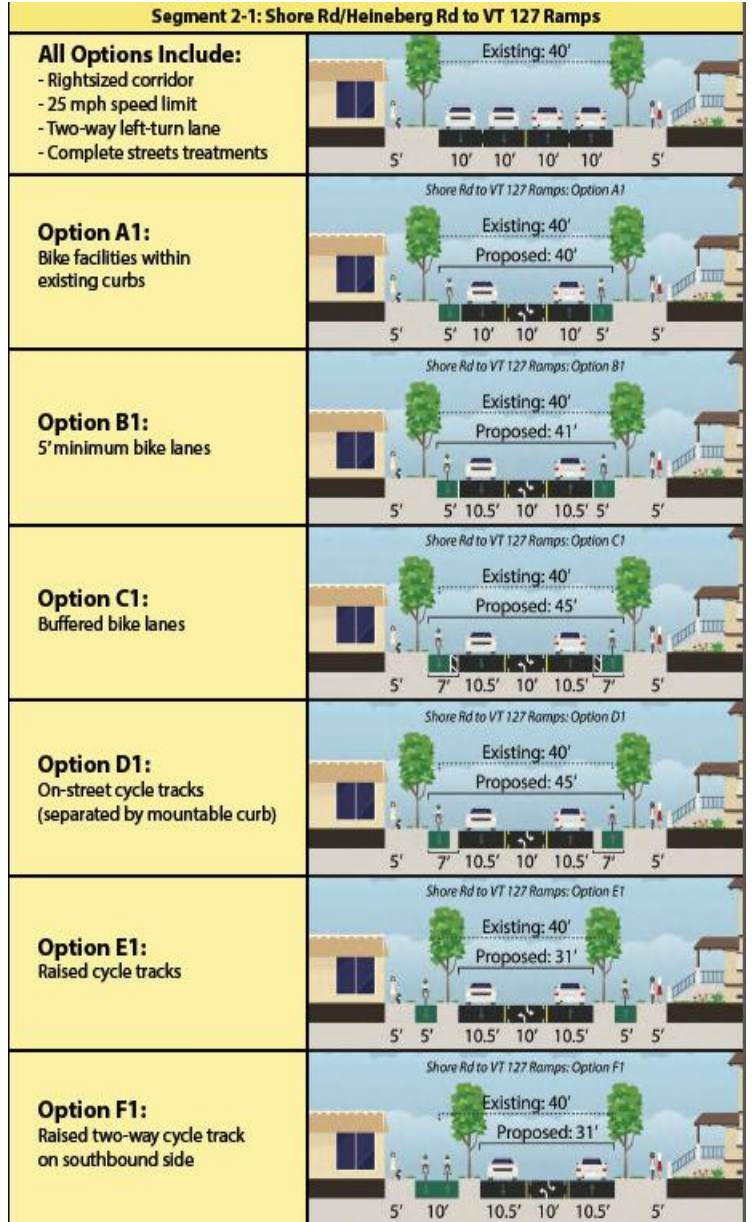




## Shore/Heineberg Road to VT 127 (Var.1)



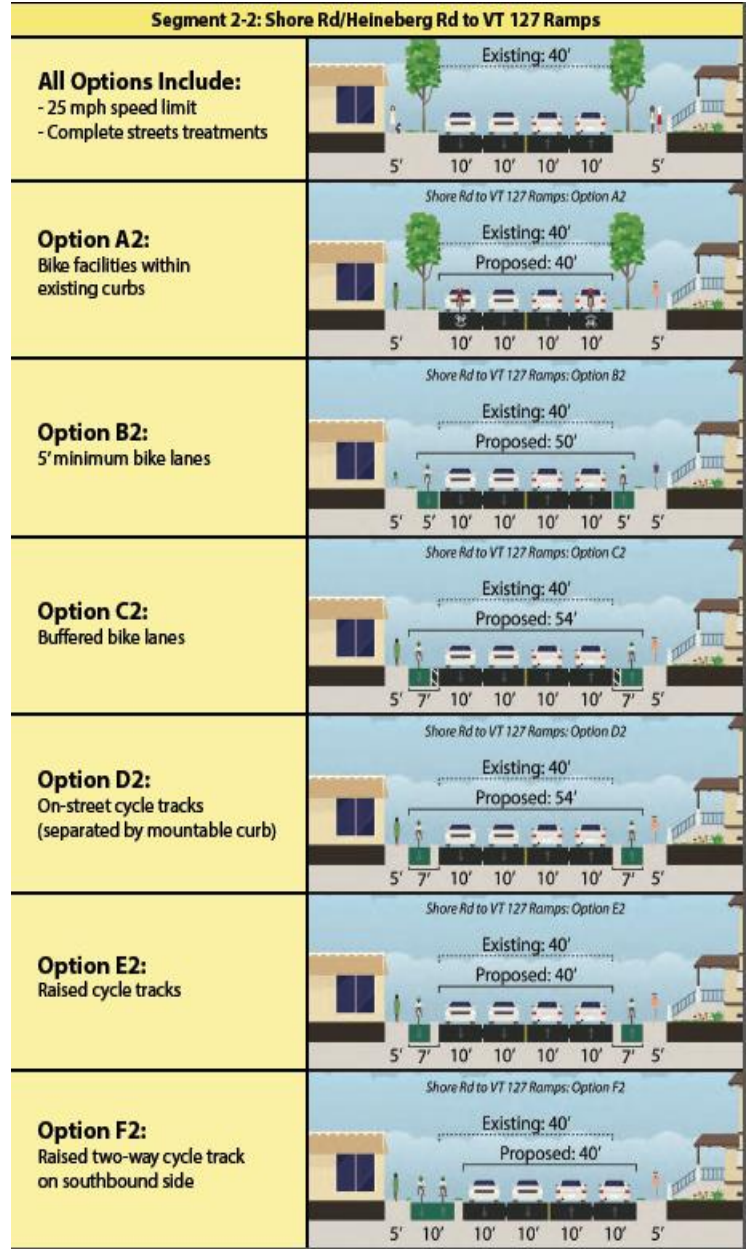
Figure 3. Current conditions



## Shore/Heineberg Road to VT 127 (Var. 2)



Figure 4. Current conditions



# Plattsburg Avenue to Shore/Heineberg Rd



Figure 5. Current conditions

Segment 1: Plattsburg Ave to Shore Rd/Heineberg Rd	
<p><b>All Options Include:</b></p> <ul style="list-style-type: none"> <li>- Rightsized corridor</li> <li>- 25 mph speed limit</li> <li>- Parking on one side</li> <li>- Complete streets treatments</li> </ul>	<p>Existing: 40'</p>
<p><b>Option A:</b> Bike facilities within existing curbs</p>	<p>Plattsburg Ave to Shore Rd: Option A</p> <p>Existing: 40'</p> <p>Proposed: 40'</p>
<p><b>Option B:</b> 5' minimum bike lanes (Same as Option A)</p>	<p>Plattsburg Ave to Shore Rd: Option B</p> <p>Existing: 40'</p> <p>Proposed: 40'</p>
<p><b>Option C:</b> Buffered bike lanes</p>	<p>Plattsburg Ave to Shore Rd: Option C</p> <p>Existing: 40'</p> <p>Proposed: 43'</p>
<p><b>Option D:</b> On-street cycle tracks (separated by mountable curb)</p>	<p>Plattsburg Ave to Shore Rd: Option D</p> <p>Existing: 40'</p> <p>Proposed: 43'</p>
<p><b>Option E:</b> Raised cycle tracks</p>	<p>Plattsburg Ave to Shore Rd: Option E</p> <p>Existing: 40'</p> <p>Proposed: 29'</p>
<p><b>Option F:</b> Raised two-way cycle track on southbound side</p>	<p>Plattsburg Ave to Shore Rd: Option F</p> <p>Existing: 40'</p> <p>Proposed: 29'</p>



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