



VERMILLION

BICYCLE MASTER PLAN

December 2018

Vermillion Bicycle Master Plan

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The project team would like to acknowledge the contributions of the residents of Vermillion, who gave their time, ideas, and expertise for the creation of this plan. It is only with their assistance and direction that the plan gained the depth necessary to truly represent the spirit of Vermillion and it is with their commitment that the plan will be implemented.

A special thanks to everyone involved including the South Dakota Department of Transportation and the City of Vermillion for their funding and leadership in the development of this master plan.

STUDY ADVISORY TEAM

Robert Oehler
Jose Dominguez
Kelsey Collier-Wise
Steve Ward
John Prescott
Rich Holland
Pete Jahn

SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION

Steve Gramm
Derek Englund
Jeff Brosz
Scott Jansen



CONSULTING TEAM



RDG Planning & Design
Omaha and Des Moines
www.RDGUSA.com



Toole Design Group
www.tooledesign.com



FORWARD

Welcome
Historic
Downtown
VERMILLION

R-Pizza
EST. 1968

CHICK FLICK SERIES
JULY 10 7PM
THE COYOTE TWIN

Chickadee

Silt Road Cafe

PARKING →



INTRODUCTION

How we move is important to how well we live - affecting the health of our cities, our environment, and ourselves. We have been given the power of self-propulsion. Many of us can cover substantial distances on foot for transportation, recreation, and time to think and notice our surroundings. We can travel even farther and faster by bicycle, a remarkable vehicle that we can easily carry, travels at a reasonable percentage of automobile speeds in city traffic, and uses no fossil fuels and produces no emissions. It also makes almost no noise, can be parked outside the door of our destinations or even inside our homes or offices, gets the equivalent of hundreds of miles per gallon of fuel, and makes us healthier. The introduction of new technologies, like the e-bike with small electric motors that provide pedal assists, can bring bicycling as an efficient form of transportation within the capability of a greater number of people. Our ability and efficiency to transport ourselves is indeed a gift.

It is also a tool that makes economic sense. Infrastructure for people on foot or bike costs much less per mile than for motor vehicles. Pedestrians and cyclists travel by mechanisms that put almost no stress on sidewalks, streets, and trails. These same mechanisms have no impact on the environment, and are inherently enjoyable, encouraging us to see each other as people and our communities for what they are, collections of gardens, houses, streets, yards, schools, and social centers.

Let us now consider Vermillion, a city with a strong understanding of itself, its people, and its unique personality characterized both by its South Dakota hardiness but also its intellectual tendency toward self-improvement and reflection. In Vermillion, 18.85% of employees commute less than 5 minutes to work and 61.38% commute less than 9 minutes.

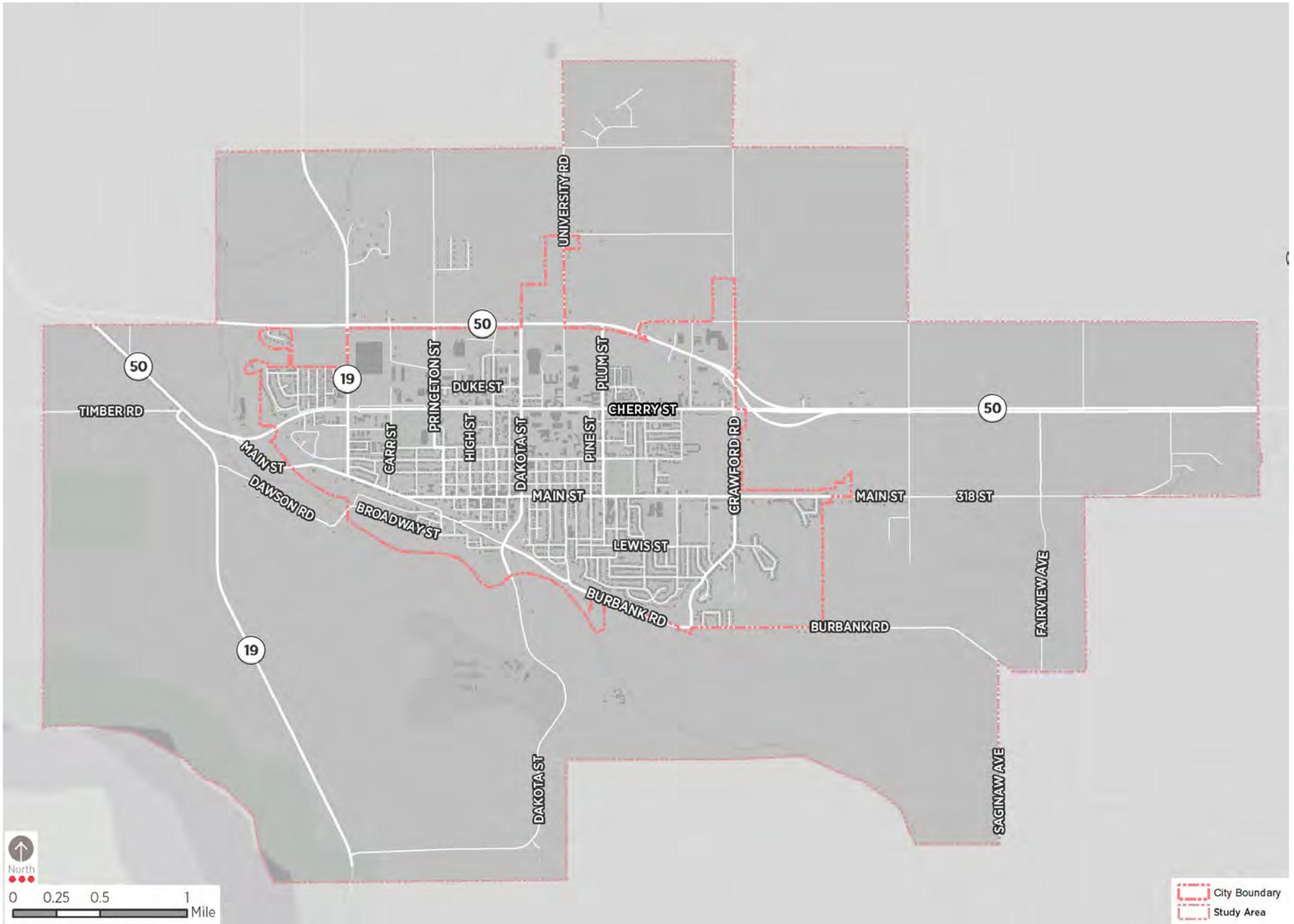
These short trips are ideally suited to the modes that we call “active transportation.” The average cyclist can travel three miles in only 15 minutes; for reference, virtually everything in Vermillion is less than 3 miles away from any other point in the city.

Vermillion understands these possibilities and has acted on this understanding by:

- Developing and maintaining the foundation of a strong trail system, including the Vermillion River Trail, a peripheral path along its highways with connections in parts of the city.
- Creating a bicycle culture in which a substantial number of basic transportation trips are made by bike, even in a winter climate.
- Establishing an initial system of shared bike routes, and expressing support for adapting local streets to bicycle travel and incorporating bicycle facilities into new street construction projects.
- Initiating through the University of South Dakota and its student sustainability committee a highly successful pilot bike-share program.

Walking and biking are very much parts of life in Vermillion, evidenced by routine observations, such as the large number of students of all ages who walk or bike to school and routine use of bikes by residents. The Vermillion area’s characteristics, including its compact nature, strong downtown, complete street grid, and easy topography above the bluff, provide the opportunity to integrate enjoyable, healthy, active transportation into the everyday lives of its citizens.

This *Bicycle Master Plan Study* is dedicated to encouraging its citizens to make healthy, low-impact, and intrinsically pleasant transportation a greater part of their daily routines. While we know that most trips will continue to be made by car, the region’s transportation system should offer choices, including the option to feel safe and comfortable using the healthy, sustainable, and socially satisfying means of mobility that the bicycle offers.



BICYCLE MASTER PLAN

An effective bicycle transportation system requires thoughtful planning and does not emerge by random actions. In partnership with the South Dakota Department of Transportation, the City of Vermillion has invested in creating this document, the city's first bicycle master plan to integrate bicycle transportation seamlessly into city life both as a practical transportation option and as a guiding influence toward human-scaled, efficient community development.

The master plan proposes a bicycle transportation network that links the city's neighborhoods and major destinations and is safe, pleasant, and comfortable for a range of users. It recognizes that this network must be practical and affordable to the community and must deliver benefits far greater than its costs.

GOALS OF THE PLAN

Vermillion has completed major projects that offer both a recreational asset and the basis for a broader bicycle transportation system. The Vermillion Bicycle Master plan will help the city achieve the following goals:

GOAL 1: INCREASE THE NUMBER OF PEOPLE WHO USE BICYCLES FOR TRANSPORTATION AS WELL AS RECREATION

Bicycling in Vermillion today focuses on two primary groups: utilitarian riders including students interested in riding for transportation and recreational cyclists interested in longer rides and casual trips. A third group is prospective riders who could be convinced to ride, or ride more if the transportation environment were made more comfortable. A measurement of success for this plan will be significantly increasing the percentage of trips made by bicycle. Chapter 2 includes estimates of current and future bicycle ridership.

GOAL TWO: IMPROVE BICYCLE ACCESS TO KEY COMMUNITY DESTINATIONS

Vermillion's bicycle system should get people comfortably and safely to where they want to go. Therefore, the bicycle system should be destination-based, providing clear and direct connections to key community features. Vermillion has the foundation of an off-road trail system, which participants in the planning process consider important. However, this system has gaps that limit its utility. Participants identified access to major commercial destinations on the Cherry Street corridor and more direct connections between the USD campus area to Downtown as important priorities.

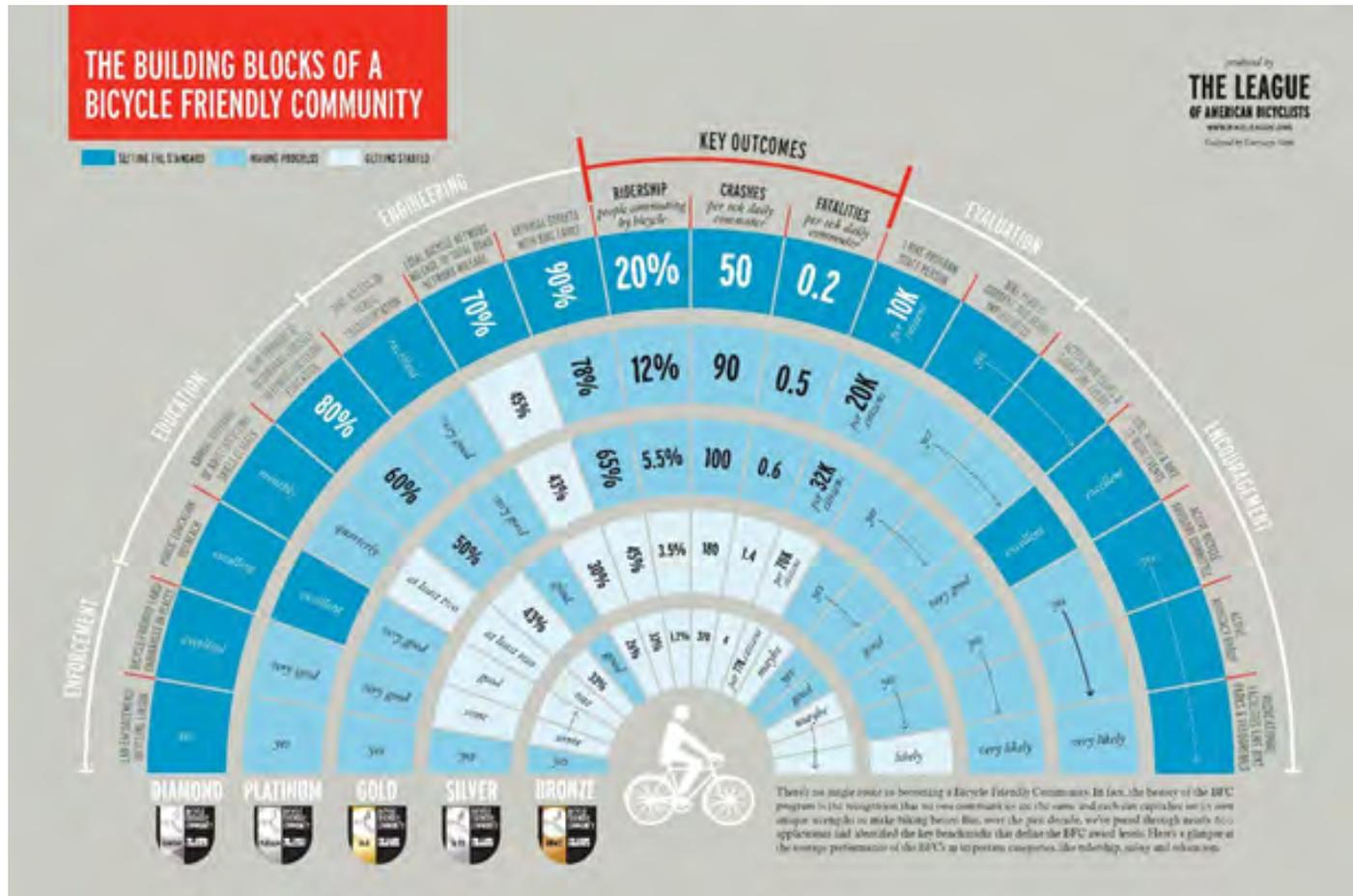
The plan will focus on removing gaps in the system, overcoming barriers and difficult crossings, and creating comfortable and safe access to destinations throughout the community.

GOAL THREE: IMPROVE ACCESS TO THE CITY'S PATHWAY SYSTEM BY PROVIDING CONNECTING LINKS BETWEEN NEIGHBORHOODS AND TRAILS

As mentioned earlier, the perimeter trail loop is beginning to develop, but is currently incomplete. Completion, requiring both reconstruction of flood-damaged sections and construction of missing parts of the loop, will serve both recreational and transportation needs. Better links between the urban system and the trail loop will allow the system the best of both worlds – more residents connected to trails,

trails connected to more destinations, and opportunities to safely navigate from place to place on comfortable paths and roadways.

The path system also includes segments of the central Cherry Street corridor, campus connections, and other short links to important destinations. While off-street trails are relatively high in cost, their level of comfort and protection for users makes them central to the overall goal of increasing routine bicycle use.



The Tenants of Bicycle Friendliness:

Engineering: Creating safe and convenient places to ride and park

Education: Giving people of all ages and abilities the skills and confidence to ride

Encouragement: Creating a strong bicycle culture that welcomes and celebrates bicycling

Enforcement: Ensuring safe roads for all users

Evaluation & Planning: Planning for bicycling as a safe and viable transportation option

In South Dakota

- Bicycle-Friendly Communities: Brookings and Sioux Falls
- Bicycle-Friendly Universities: Black Hills State University, Spearfish
- Bicycle-Friendly Businesses: A total of six, five in Sioux Falls and one in Watertown

GOAL FOUR: INCREASE SAFETY FOR MOTORISTS, BICYCLISTS, AND PEDESTRIANS

Improved safety is a critical goal for any transportation improvement and is fundamental to efforts to increase the number of people who walk and bike in the city. In addition, national research indicates a strong relationship between the number of cyclists and motorists crash rates (Jacobson, Injury Prevention 9:205-209 [2003]). Infrastructure must also be supported by education, enforcement, and encouragement programs, and its effectiveness measured by evaluation.

GOAL FIVE: CAPITALIZE ON THE DEVELOPMENT BENEFITS OF A DESTINATION-BASED BICYCLE TRANSPORTATION SYSTEM

Vermillion has many exceptional features that appeal to residents and businesses. It has become increasingly clear that walkability and bikeability are highly valued by a new generation of homeowners and investors. The dramatic impact of projects such as Atlanta's Belt Line, Minneapolis' Midtown Greenway, Indianapolis' Culture Trail, and the investments made by cities large (such as New York and Chicago), medium sized (such as Portland and Cedar Rapids), and small (like Mason City) underscore the importance of active transportation to continued growth and prosperity. Vermillion, as a bicycle-friendly community, will maintain its status as one of America's great places to live, work, play, shop, and study.

GOAL SIX: INTEGRATE BICYCLE-FRIENDLY PRINCIPLES INTO COMMUNITY DEVELOPMENT POLICIES AND ACHIEVING SILVER STATUS FROM THE LEAGUE OF AMERICAN BICYCLISTS

The term "bicycle-friendly" was adopted by the League of American Bicyclists to articulate the many dimensions of what a community, business, or university can do to make their environments more comfortable and welcoming for people who want to ride bicycles as part of their lifestyle. By viewing urban growth from a perspective of whether each decision will promote an integrated bicycle network, Vermillion will retain its small-town character as it continues to grow.

MEASURES OF SUCCESS

GUIDING CRITERIA FOR AN EFFECTIVE TRANSPORTATION NETWORK

The design of a bicycle transportation system should be guided by criteria that can be used to evaluate individual components and the effectiveness of the entire network.

We elaborate on these criteria in Chapter Three, which are based on the work of the Netherlands' Centre for Research and Contract Standardization in Civil and Traffic Engineering (C.R.O.W.), one of the world's leading authorities in the design of bicycle-friendly infrastructure. Drawing on its exceptional design manual, "Sign Up for the Bike," Vermillion's bicycle network should be guided by six basic requirements:

INTEGRITY:

The bikeway network should, at all points in its evolution, form a coherent system that links starting points with destinations. The network should be understandable to its users and fulfill a responsibility to convey them continuously on their paths.

DIRECTNESS:

The bikeway network should offer cyclists as direct a route as possible, with minimum detours.

SAFETY:

The bikeway network should maximize the safety of using a bicycle for transportation, minimize hazardous conditions and barriers, and in the process improve safety for pedestrians and motorists.

COMFORT:

Most bicyclists should view the network as being within their capabilities and not imposing unusual mental or physical stress. As the system grows, more types of users will find that it meets their needs comfortably.

EXPERIENCE:

The bikeway network should offer its users a pleasant and positive experience that capitalizes on the city's built and natural environments.

FEASIBILITY:

The bikeway network should provide a high ratio of benefits to costs and should be viewed as a wise investment of resources. It can be developed in phases and grow over time.

PLAN METHODOLOGY AND STAKEHOLDER INVOLVEMENT

From the outset, it was essential to structure a planning process that maximized both public involvement and our understanding of the physical structure and community character of Vermillion. A Study Advisory Team, representing city and state staff, bicyclists, and other community interests met throughout the planning process, beginning in November, 2017.

STUDY ADVISORY TEAM

The Study Advisory Team met monthly to guide the direction of the plan, to coordinate public events and input, and to provide their feedback and leadership to the project.

FIELD RECONNAISSANCE

An essential element of any project is to understand the character of the environment that is under study – as such, for a bicycle plan, the best way to understand the bicycling environment is by bicycle. At several points throughout the project, the planning team explored potential routes using their bicycles.

STAKEHOLDER GROUP DISCUSSIONS

In much the same way as the exploration of a community by bike is the best way to understand its bicycle environment, the best way to learn about its social environment is by talking to its residents - those who know it best. A series of eight stakeholder groups were led to explore issues, challenges, and

possibilities. In many cases, these groups were organized by interest area (e.g.: university life) to allow the conversation to delve more deeply into specific topic areas.

COMMUNITY KICK-OFF AND OPEN HOUSE

In November of 2017, members of the community were invited to a public open house event at the Vermillion Public Library. During the event, more than 45 attendees learned about the project, various types of bicycle facilities, and contributed their ideas and opinions about what a bicycle network in Vermillion should include and address.

BICYCLE SURVEY

Stakeholders were invited to take an online survey specifically designed to understand their priorities, preferences, and most common destinations. The survey asked respondents to react to local and national examples with how comfortable they would feel in a specific street environment.

INTERACTIVE MAP SURVEY

Stakeholders were invited to contribute to an interactive map forum. The interactive map asked users to identify: routes they ride today, routes they would like to ride, barriers/ problem spots, and areas that would benefit from improved bicycle parking.

SECTOR WORKSHOPS

Stakeholders were invited to four neighborhood meetings to delve into specific issues in their area of the city. The northeast sector was hosted at First Dakota Bank, the southeast sector at the high school, the western sector at the middle school, and the University of South Dakota.

PUBLIC HEARINGS AND APPROVAL MEETINGS

Near the end of the process, stakeholders were invited to review the draft plan and to comment on its findings at the public hearings before the Planning Commission and the City Council.

PLAN ORGANIZATION

The Vermillion Bicycle Master Plan presents an analysis and recommendations in the following sequence:

CHAPTER 1: ACTIVE TRANSPORTATION ENVIRONMENT

This chapter examines the existing conditions in Vermillion that are pertinent to bicycling including factors such as key destinations, existing bicycle facilities, and opportunities. It also addresses the human element of local preferences and the propensity to ride for transportation and recreation. As such, this chapter includes an atlas approach to detail physical conditions and a summary of community involvement including the survey, the interactive map, and themes from personal interactions.

CHAPTER 2: MARKET ANALYSIS

This chapter estimates current ridership and forecasts future ridership to understand the role of bicycling in Vermillion's future. It reviews preferences and desires established from the community survey and the interactive map survey. Finally, it combines these factors in the form of a composite demand model to highlight the areas with the greatest demand for bicycle facilities and initiatives.

CHAPTER 3: BICYCLE NETWORK

This chapter uses the analysis from Chapter 1 and Chapter 2 to establish general principles that guide the creation of a bicycle network. It elaborates on the measurement criteria articulated in the introductory chapter to help guide the components of the system. Finally, the chapter presents a complete conceptual system of bicycle facilities.

CHAPTER 4: SUPPORT FACILITIES

This chapter investigates needs and establishes concepts and locations for support facilities such as trailheads, open space nodes, linkages to community features (existing and planned), and wayfinding features.

CHAPTER 5: CONTEXT SPECIFIC STREET SECTIONS AND DESIGN GUIDELINES

This chapter delves into the details of implementing bicycle facilities both in specific locations and by articulating standards to incorporate bicycle-friendly features into new public and private projects.

CHAPTER 6: PRIORITIES, SEQUENCING, AND FUNDING

This chapter includes a route-by-route facility program showing proposed design solutions for each segment of the system. It discusses criteria for determining the sequence for implementation, along with the probable costs for different facility types. Finally, it proposes an initial pilot network designed to serve all parts of the city with early feasibility.

CHAPTER 7: SUPPORT PROGRAMS

The League of American Bicyclists describes the six “E’s” as components of a bicycle-friendly community (BFC) program and judge performance in each component in BFC applications accordingly. These program categories are Engineering, Education, Enforcement, Evaluation, Encouragement, and Equity.

Chapters One through Six largely focus on engineering features. Chapter Seven recommends initiatives that support these infrastructure investments to achieve the full potential of a bicycle transportation network.

CHAPTER 8: MAINTENANCE AND POLICIES

The creation of infrastructure is one thing, the appropriate maintenance and governance of the system is another. This chapter outlines the necessary policy considerations to ensure the system continues to serve the community, long-term.

1

ACTIVE TRANSPORTATION ENVIRONMENT



INTRODUCTION

This chapter examines the existing conditions pertinent to bicycling. It examines physical factors such as key destinations, existing bicycle facilities, and local user preferences. It includes an atlas that illustrates the physical conditions of the active transportation environment and summarizes community involvement including the survey, the interactive map, and themes from personal interactions.

EXISTING CONDITION ATLAS

The existing conditions in Vermillion serve as the foundation of the active transportation network that will emerge from this document. The structure and character of the community are comprised of its streets, destinations, and neighborhoods. The areas of the analysis are broken into two general areas:

DEMAND

Factors that suggest a need for facilities and can be analyzed together to suggest the structure of the network. These factors include both points of origin such as population density and destinations such as parks, schools and places of employment. Area of analysis include:

- Current Land Use
- Future Land Use
- Population Density
- Employment Density
- Parks and Trails
- Schools and the University

FACILITIES

These factors analyze aspects of existing infrastructure and their suitability for a future active transportation network.

Areas of analysis include

- Functional Street Classification
- Trails and Bike Routes
- Average Daily Traffic
- Crash Incidence and Traffic Control
- Low Traffic Streets with Continuity
- Barriers



DEMAND

EXISTING LAND USE

Land use patterns drive the structure of the active transportation network. Major determinants include concentrations of higher density housing, major employers, medical complexes, civic and cultural uses, and commercial concentrations. The streets that serve some of these key areas may not be fully compatible with bicycle transportation, but should provide secondary routes for bicyclists. Key features include:

DOWNTOWN VERMILLION

Downtown is an important destination for students and residents alike.

UNIVERSITY OF SOUTH DAKOTA

The USD campus is a central feature of Vermillion. It is a major origin and destination for bicycle trips.

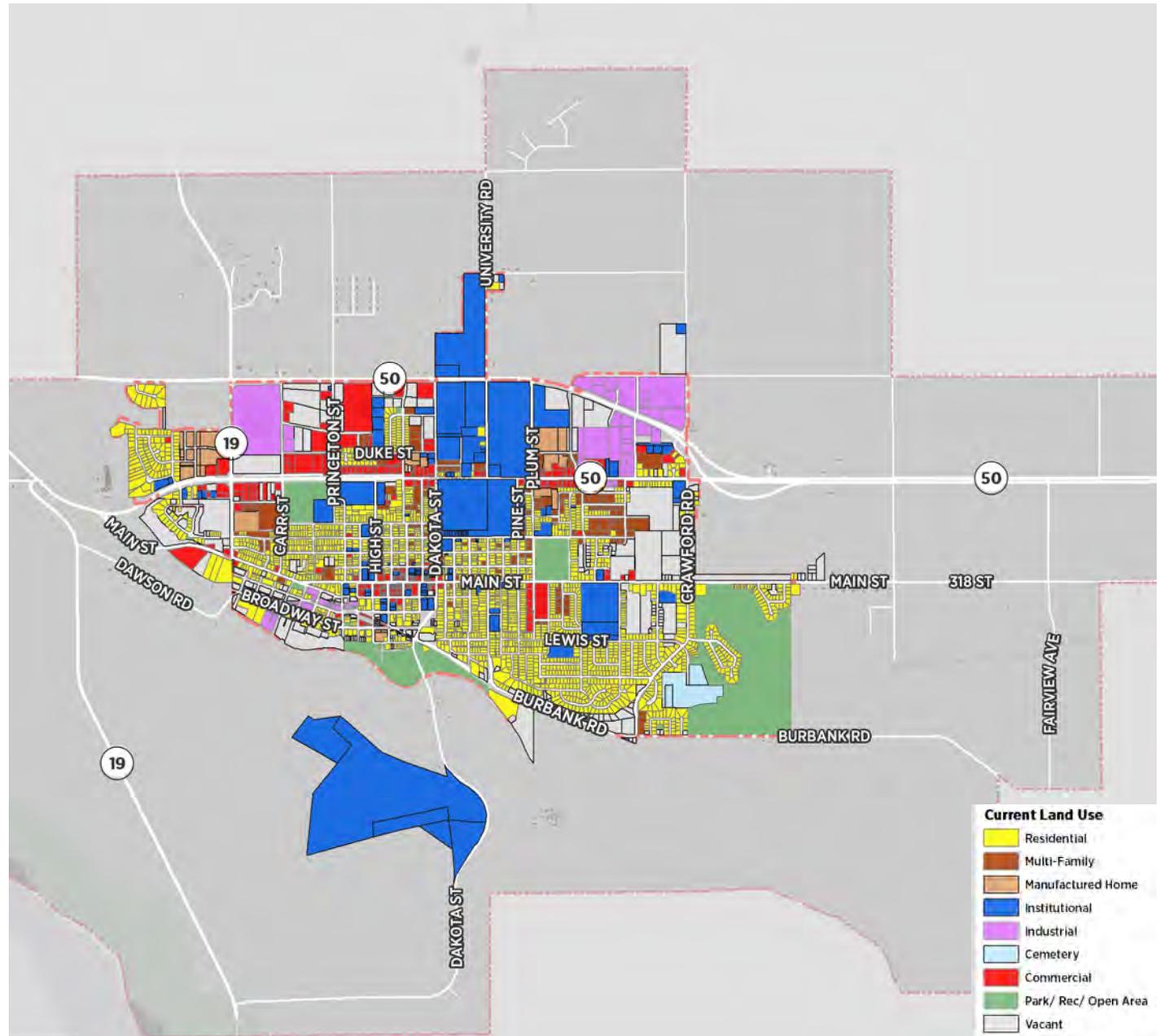
CHERRY STREET

A principal east-west artery with many of the retail and restaurant destinations outside of downtown. The importance of this corridor is reinforced by USD.

INDUSTRIAL EMPLOYMENT CENTERS

Situated at the northeast and northwest corners of the community are two industrial employment centers. These should be considered bicycle destinations.

FIGURE 1.1: Existing Land Use

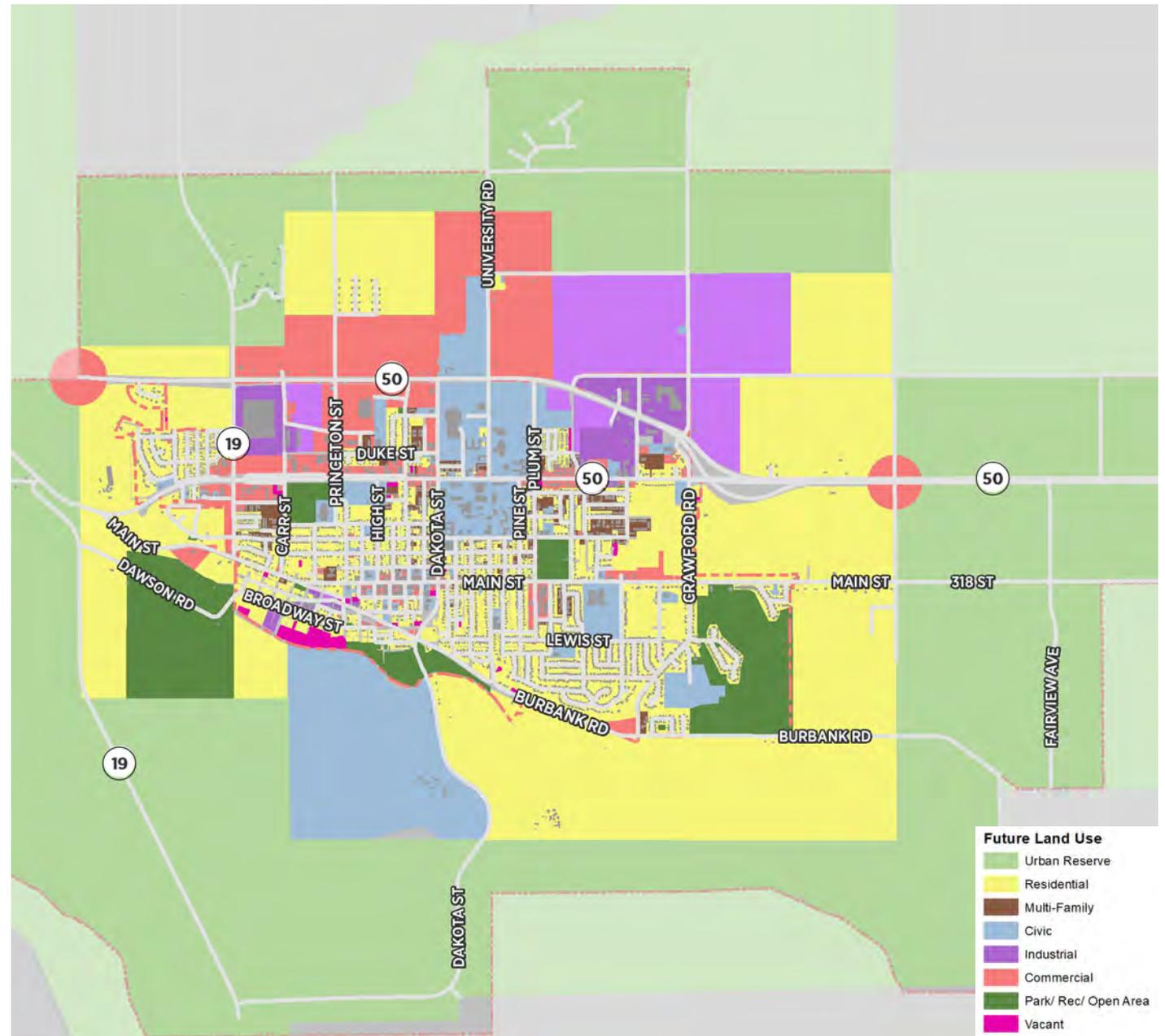


FUTURE LAND USE

An active transportation network should be master planned to serve projected growth directions, illustrated by the City's Future Land Use Map. Key directions include:

- Contiguous neighborhood development to the south, east, and to the west. These areas should extend the existing roadway network and be designed to avoid landlocking future land development.
- The expansion of the Masaba industrial center to the north. The area should extend the existing roadway network and should encourage complementary business ventures to reduce the number and cost of unnecessary freight movement.
- The creation or preservation of a major park/open space resource extending north and south of Dawson Road. This resource should be positioned as a community amenity that is accessible for bicyclists and pedestrians alike.

FIGURE 1.2: Future Land Use

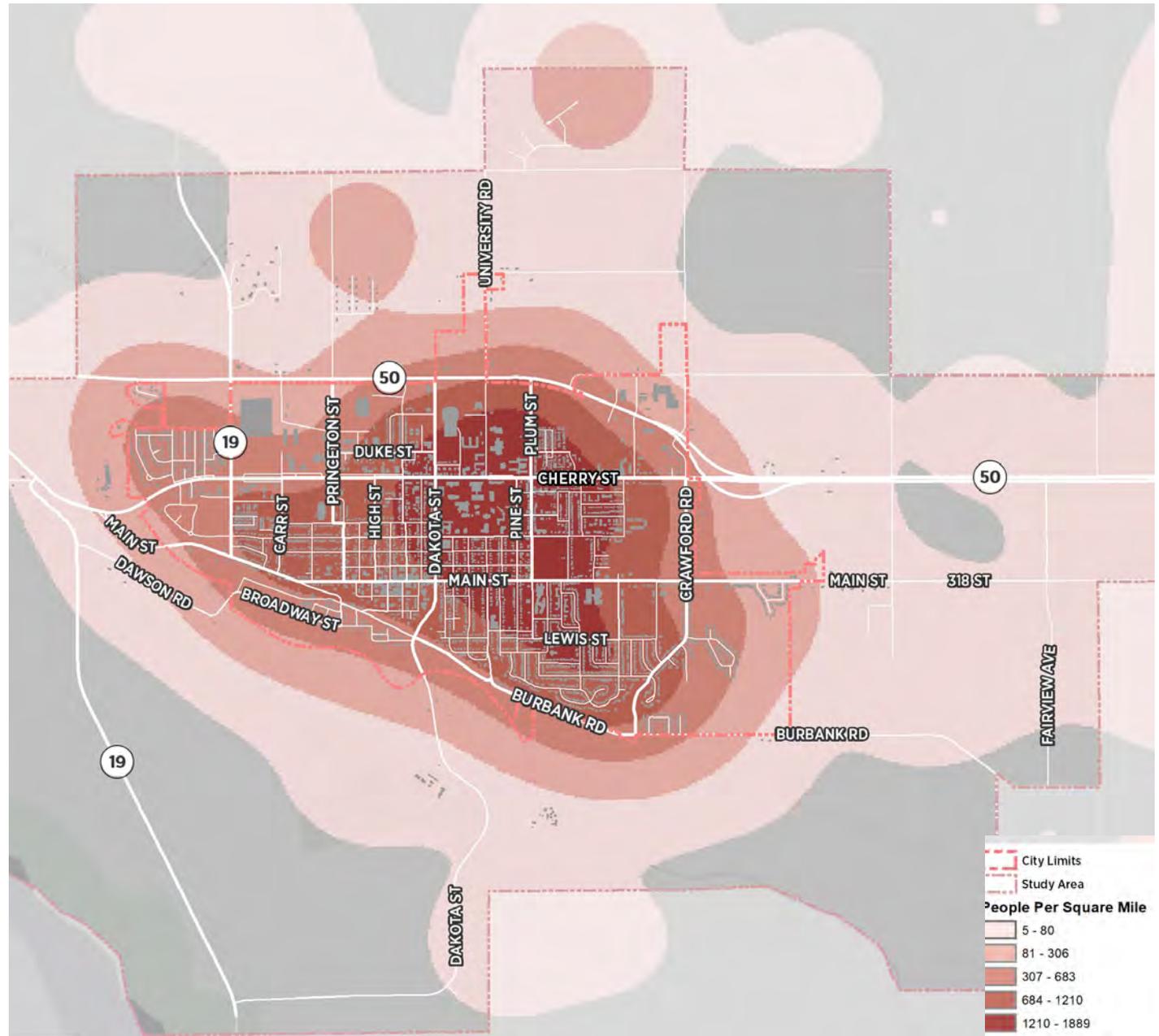


POPULATION DENSITY

Population density is correlated to active transportation demand. As density increases, more destinations are located closer to more people, bringing biking within the capability of a larger population. The map uses block group data to show population per square mile. The city displays a smooth concentric gradation, with the highest density drifting from the USD Campus southeast toward the intersection of Catalina and Lewis Streets.

Vermillion's housing character is comprised of 60% rental units and 40% owner-occupied units. The impact on population density comes primarily through the form of the rental units generally located in large apartment complexes. The location of these complexes typically drives the shape of the highest density ring with several located in the second ring.

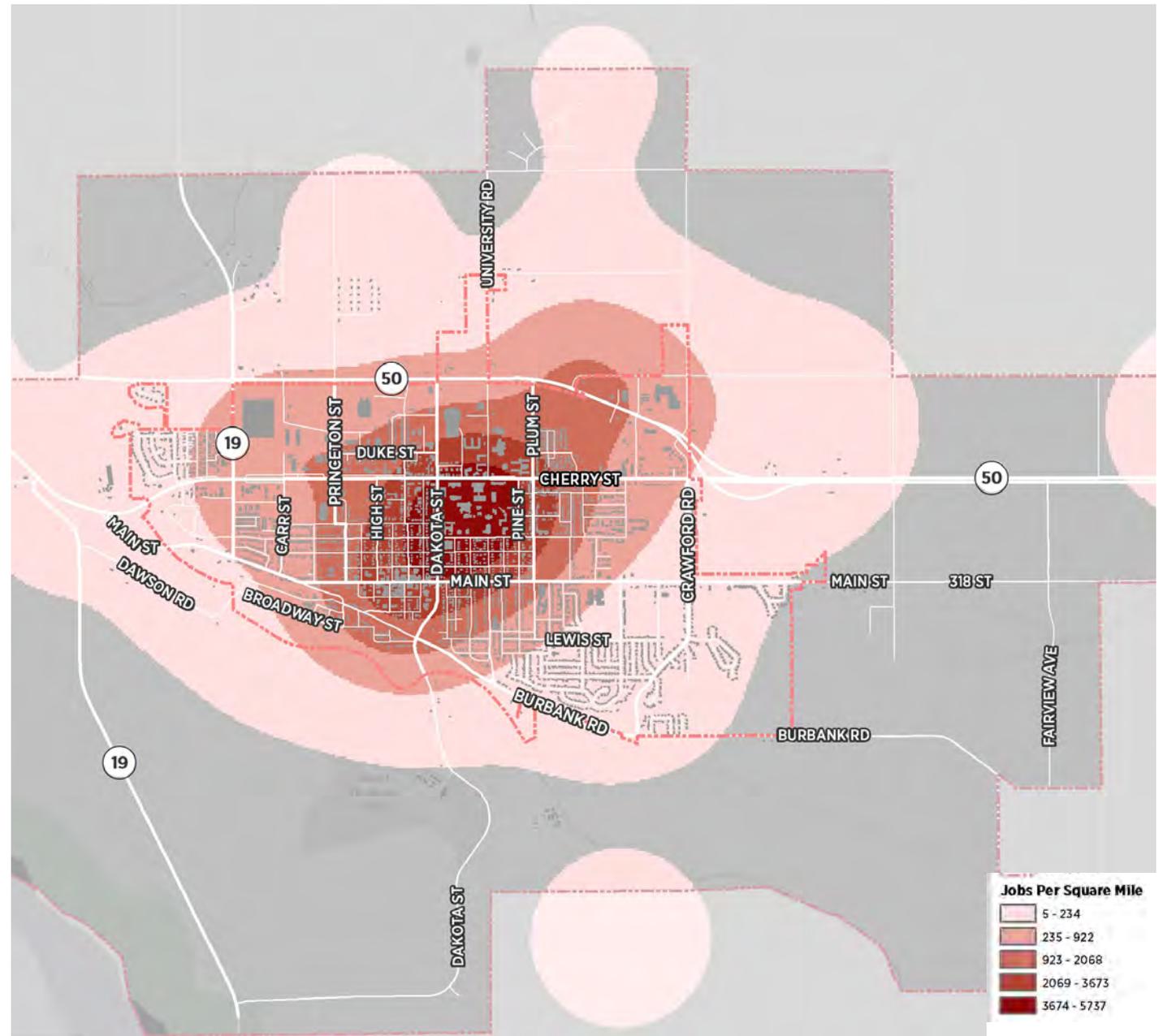
FIGURE 1.3: Population Density



EMPLOYMENT DENSITY

Employment density is also correlated to active transportation demand by identifying concentrated job centers. The map uses census data to illustrate jobs per square mile in the city. The greatest concentration radiates from the Dakota Street corridor through the USD Campus toward the Masaba employment area, a pattern that combines major industrial, institutional, and retail employment. This pattern underscores the value of providing a strong bicycle and pedestrian connection throughout the core of the city and into industrial employment centers.

FIGURE 1.4: Employment Density



PARKS AND TRAILS

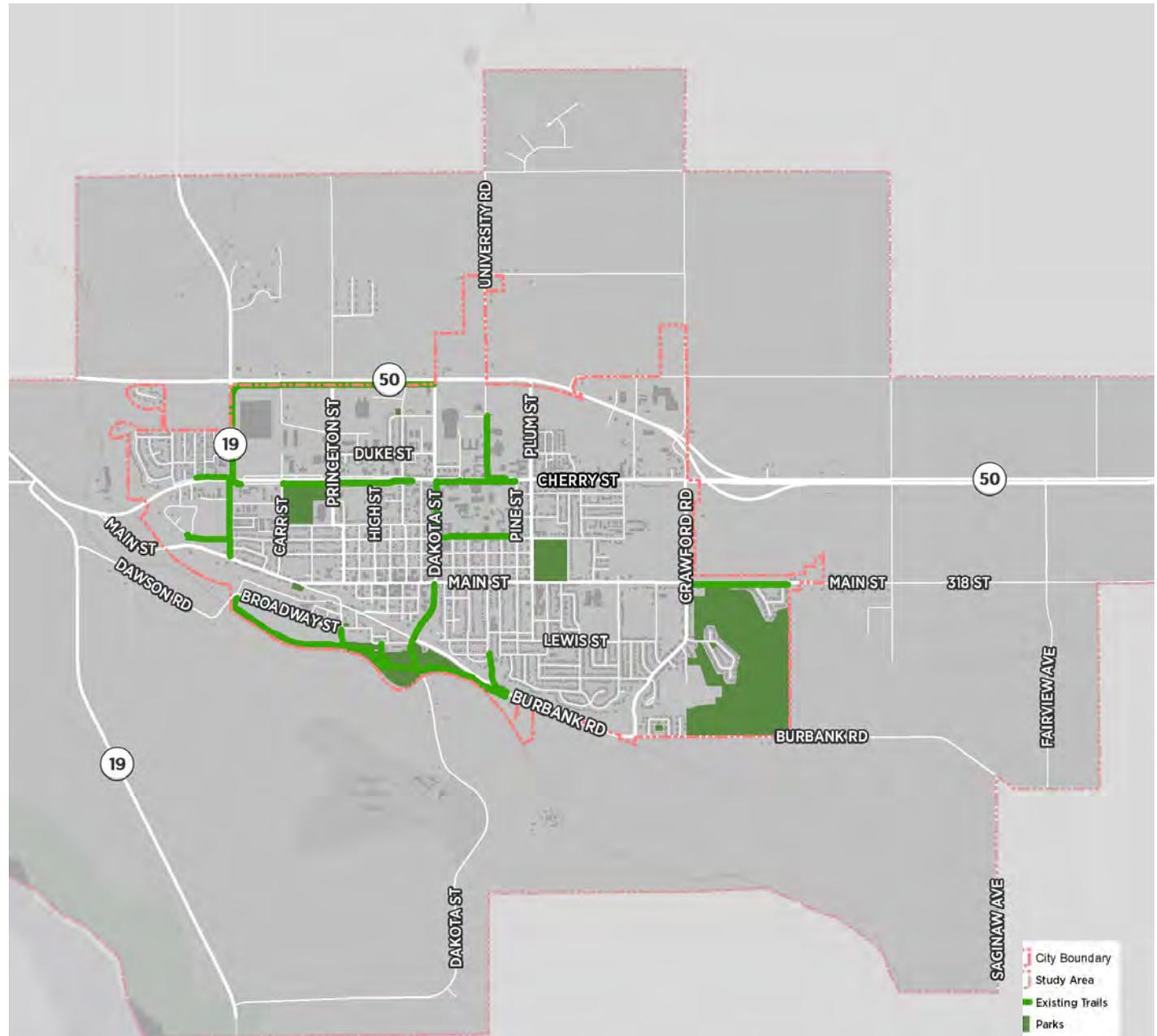
Parks and trails are among the most important destinations for an active transportation network. Indeed, trails are uniquely both destinations and means of reaching destinations such as parks and recreation assets. Ideally, all parks should be served by the active transportation network, and bicycle connections are especially important to major parks throughout the city and to neighborhood parks from areas outside of easy walking distance. Of the city's community parks, Lions Park, Barstow Park, and Cotton Park are directly served by trails.

The other parks are typically served by sidewalks and local streets, but not by trails or major bike routes. It is also important to note that many of Vermillion's school campuses function as neighborhood recreation facilities, and is therefore doubly important to provide strong bicycle and pedestrian access to these destinations.

Prentis Park is generally accepted as the center of the park system and boasts a strong collection of destination amenities including the water park, playgrounds, and a baseball field. However, the park is not currently served by trail access and is located on Main Street which was identified as a key barrier, uncomfortable to bicycle on or to cross as a pedestrian.

Existing segments mark an emerging trail system. These fragments should be connected to allow trail users to seamlessly navigate the system.

FIGURE 1.5: Parks and Trails



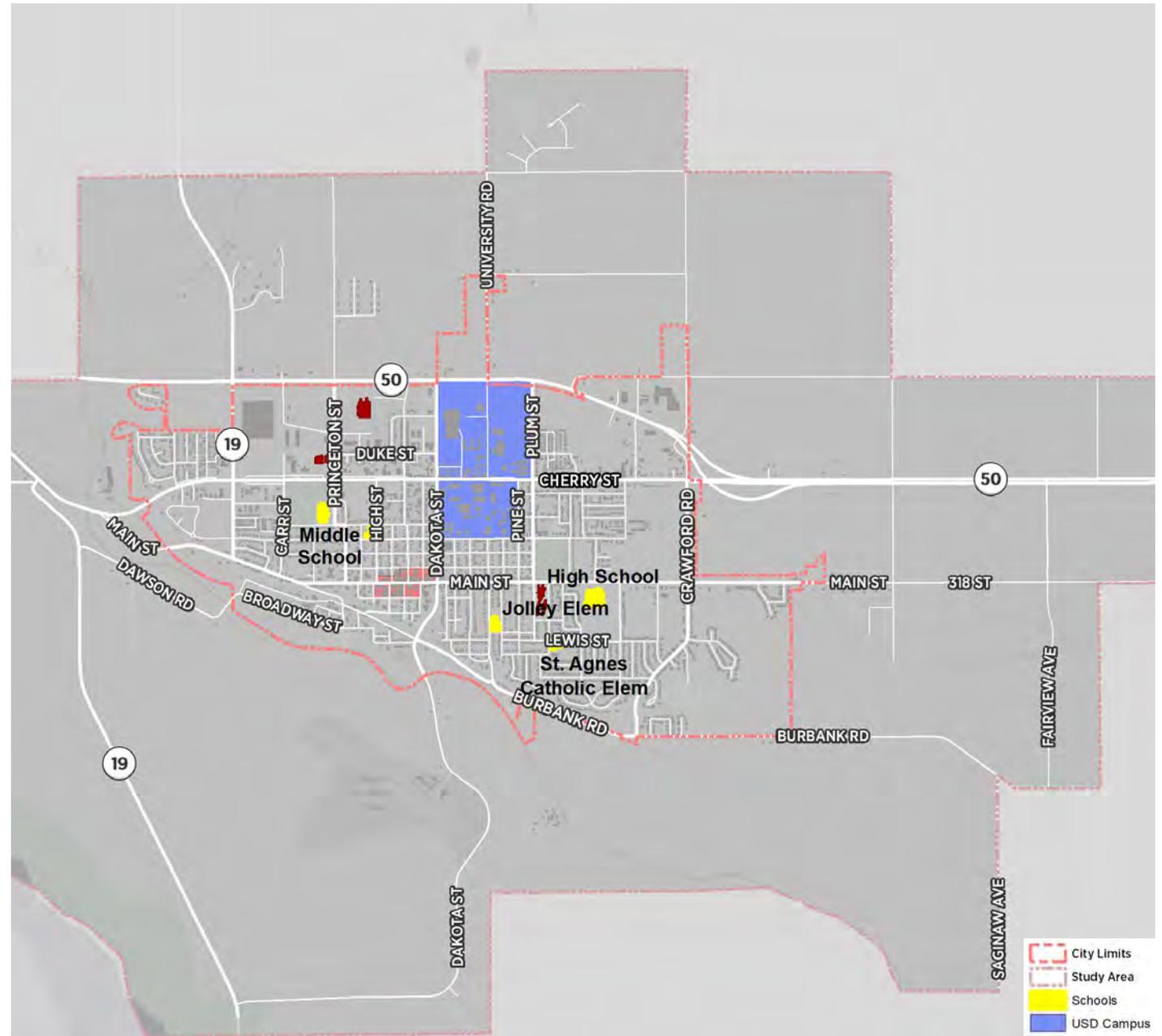
SCHOOLS AND THE UNIVERSITY

Schools, as mentioned prior, are primary destinations for Vermillion's active transportation network, with elementary and junior high students being especially important constituencies. High school students, many of whom drive to school, also present a possible growth market if bicycling is viewed as a contemporary trend.

While it is generally not recommended that bicyclists ride on sidewalks, it may be appropriate for the youngest bicyclists who ride in a way that is more akin to the behavior of a pedestrian (intersection crossings and overall pace) and therefore appropriate to examine the sidewalk network surrounding elementary schools.

The USD Campus is designed as a walking environment, and the role of bicycles has emerged primarily as a longer distance transportation vehicle such as to get students from their home to campus and to more remote campus facilities. While many of the interior sidewalks are designed for short walking distances, the campus perimeter, central green, and Cherry Street are served by wide (8-12') enhanced sidewalks and paths that function as shared uses during all but the busiest pedestrian times. The Pine and Plum Street edges are served by standard width sidewalks.

FIGURE 1.6: Educational Facilities



FACILITIES

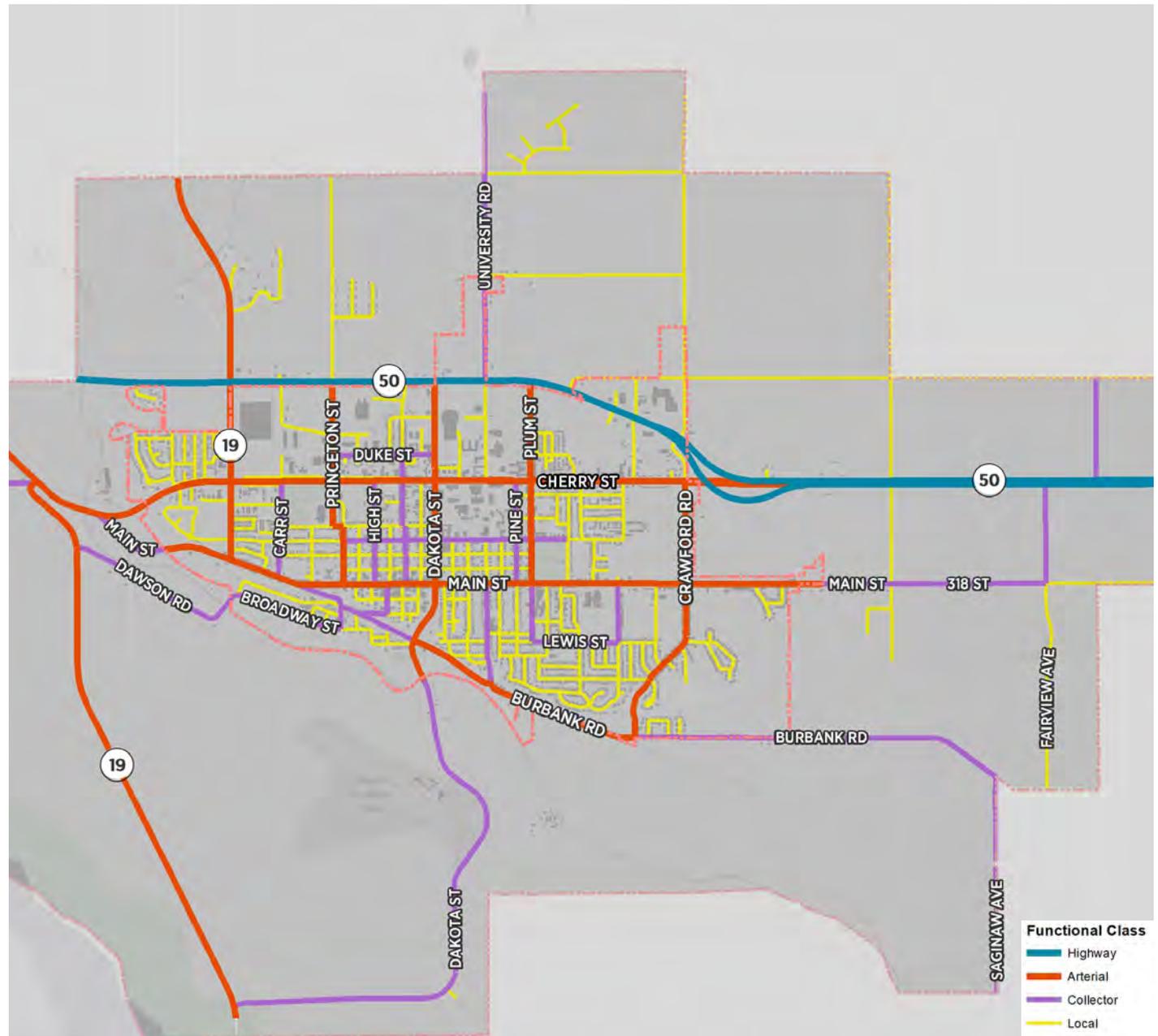
FUNCTIONAL STREET CLASSIFICATION AND EXISTING FACILITIES

Vermillion's major street network is the framework of the community with access to all the city's destinations. However, many of the major streets have traffic volumes that many prospective bicyclists may find uncomfortable for themselves and their families. These streets are often difficult or uncomfortable to cross and may deter people from riding a bicycle or allowing their families to ride in these areas.

Existing bicycle facilities include: the multi-use path segments described previously; a segment of Norbeck Street that is marked as a shared use street; and bicycle parking situated on campus, at school facilities, the library, and in the downtown district.

The most popular existing bicycle facility is undoubtedly the riverfront trail. This trail is viewed with the greatest level of anticipation and impatience; due to its natural beauty and meandering, the trail functions as a park resource. In 2010, a segment of the riverfront trail was undermined by floodwaters, collapsed into the river, and construction is planned to reopen the trail in 2019. A completed trail loop of the city, coupled with an on-street bicycle network, would position the riverfront trail as an exceptional quality of life feature that will certainly be well-used.

FIGURE 1.7: Functional Street Classifications

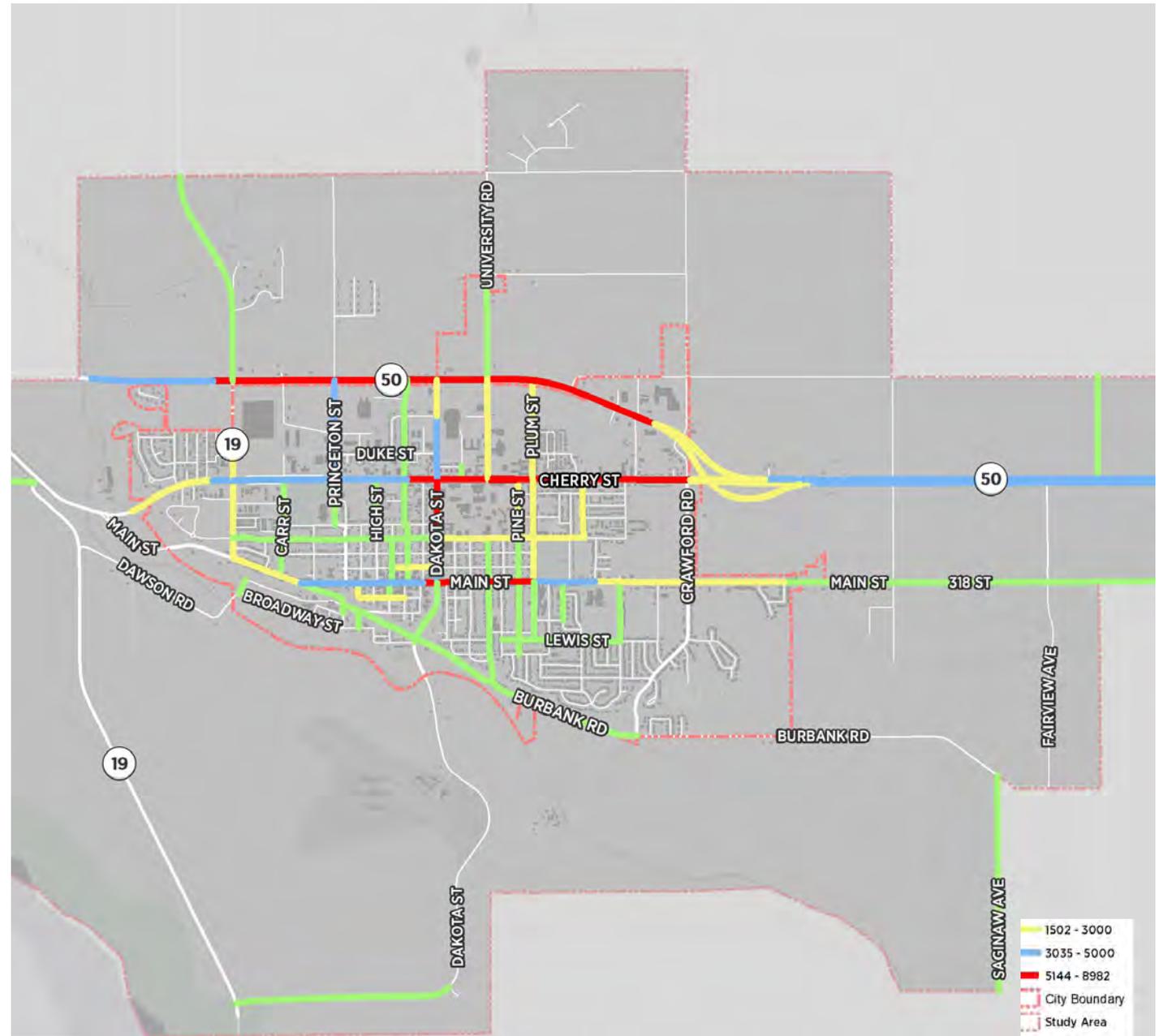


AVERAGE DAILY TRAFFIC

The type of bicycle facility applied to a given street should consider the volume of vehicle traffic present. Typically, higher traffic volumes warrant a greater degree of accommodation and separation from traffic.

- **0 to 1,500 vpd.** Comfortable for most cyclists without extensive infrastructure.
- **1,500-3,000 vpd.** May be uncomfortable for inexperienced cyclists. Shared lane markings and conventional bike lanes as volumes approach 3,000 vpd may be required for greater comfort.
- **3,000-5,000 vpd.** The typical threshold for conventional bike lanes. Requires well-defined crosswalks, caution signs, and possible traffic controls at key crossings.
- **5,000-10,000 vpd.** Requires substantial experience and comfort with shared traffic from cyclists. Conventional bike lanes are typically recommended, with protected bike lanes at higher levels. Traffic controls and refuge medians at key crossings are highly desirable.
- **Over 10,000 vpd.** Protected bike lanes, enhanced sidepaths or use of alternative routes for cyclists. Traffic controls and refuge medians at key crossings are highly desirable.

FIGURE 1.8: Average Daily Traffic Volume (Vehicles per Day (VPD))



CRASH INCIDENCE

Incidence of pedestrian and bicycle crashes pinpoint specific problems that system planning must address. The map on this page locates crash history between 2012 and 2016 detailing vehicle crashes in the following categories:

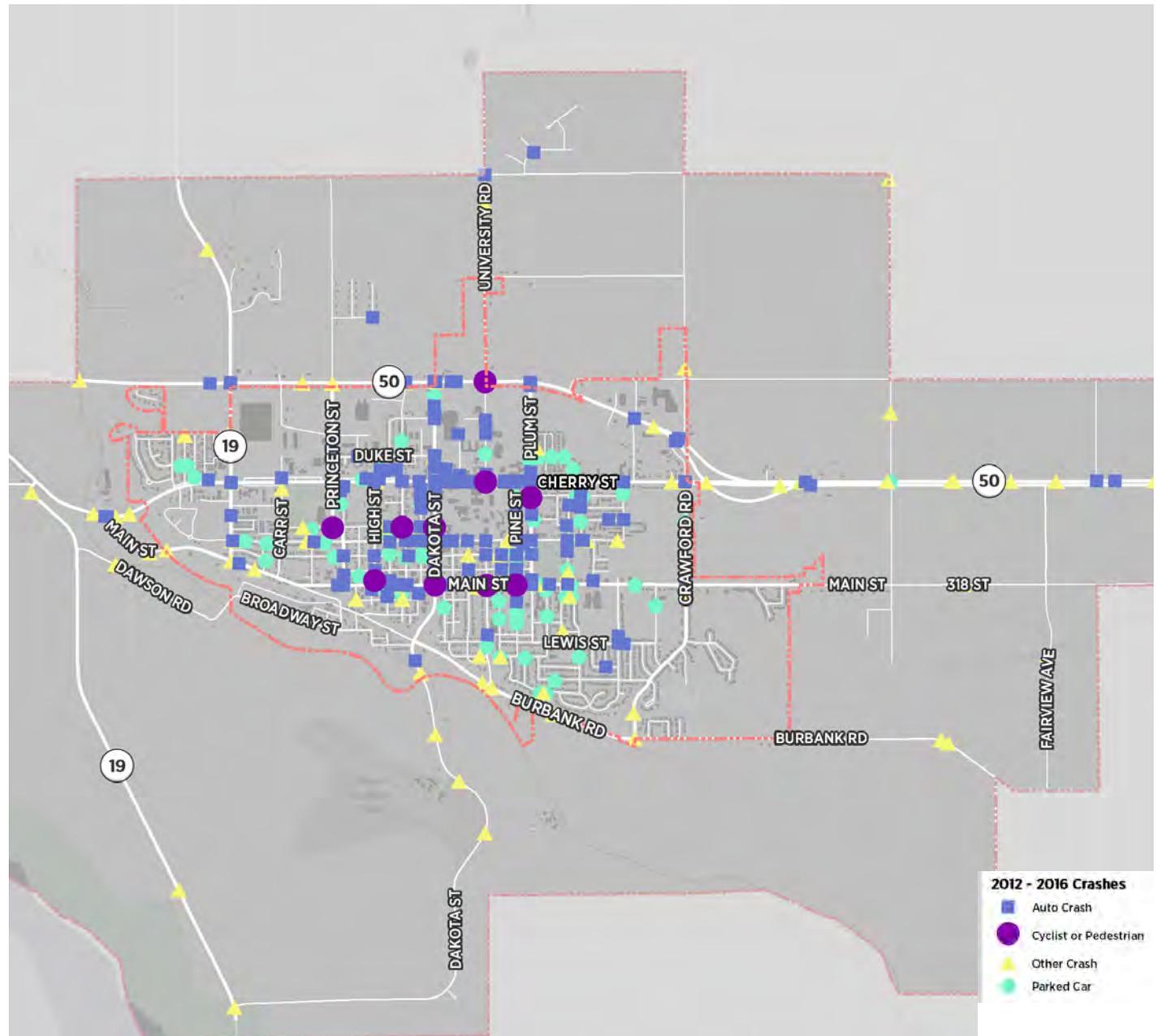
- Automobile crashes
- Crashes involving a bicyclist or pedestrian
- Other crashes, such as animal hits, single vehicle incidents
- Automobile crashes involving parked cars

High incident areas indicate problem areas and barriers regardless of the type of incident.

Analysis of the map indicates that:

- Traffic signals make a difference. Most crashes recorded occurred at intersections without signals.
- There is a concentration of all crash types in proximity to USD and the downtown. This concentration is especially true for pedestrian/bicycle crashes, and the majority of these incidents occurred near intersections.

FIGURE 1.9: Crash Incidents



STREET CONTINUITY

A central consideration of designing a bicycle network is directness. A direct route is easy to understand, offers little inconvenience, and the greatest utility as a transportation pathway. The value of continuous routes is increased when bicycle routes are both direct and host little vehicle traffic.

While it is sometimes necessary to direct bicycles onto higher volume routes, these streets often require more costly facilities to adapt them for comfortable bicycle use. Streets that are both continuous and low volume offer a low cost and comfortable alternative. The type of bicycle facility should be tailored to the context of the street including width and traffic volume, but the following streets are promising continuous routes:

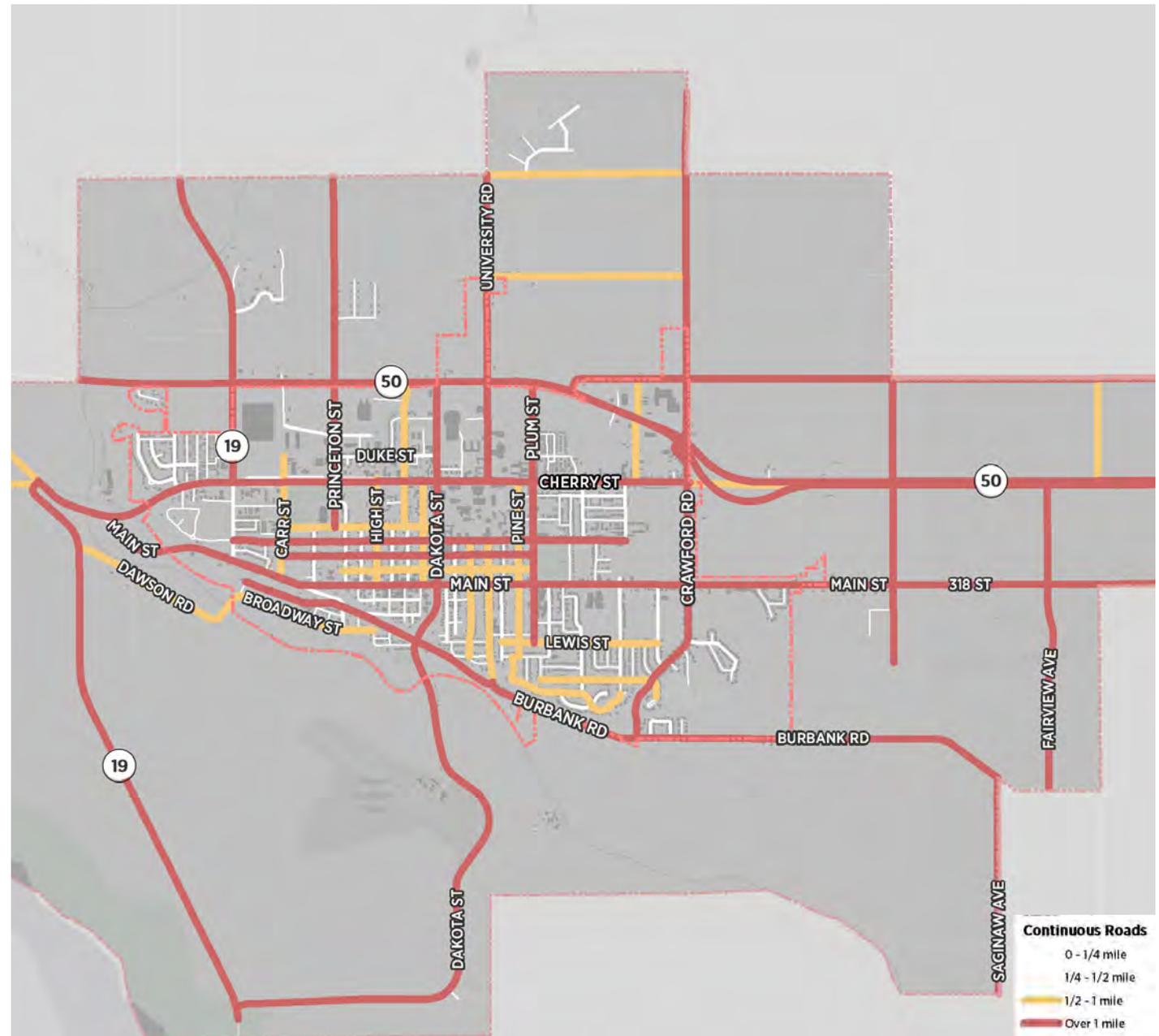
EAST-WEST ROUTES:

- Main Street
- Clark Street
- Cedar Street
- Dartmouth Street
- National Street
- Burbank Road

NORTH-SOUTH ROUTES:

- Stanford / Highway 19
- Princeton Street
- University Street
- Plum Street
- Crawford Road

FIGURE 1.10: Continuous Routes



BARRIERS

Physical barriers such as topography and busy roads pose a major challenge to designing a bicycle transportation system. The most important issues include:

LINEAR BARRIERS

The Bluff. The bluff marking the Vermillion/Missouri River floodplain is the only topographic barrier to bicycle ridership in the study area and separates the "old town" from the rest of the city. The bluff must be negotiated to complete the perimeter trail loop. In areas with steep grades, the direction of climbing traffic should typically have a separated bicycle facility to avoid friction with motor vehicles. Vermillion has off-street sidepaths climbing the bluff at three points: Crawford, University, and Dakota Streets. The bluff is a greater challenge for loop continuity at its west leg.

Cherry Street. Cherry Street is a barrier for several reasons. It has Vermillion's highest traffic volumes; its pattern of free-standing businesses creates many potential conflict zones among automobile, pedestrian, and bicycle traffic at intersections and driveways; and its five-lane section east of Plum Street relative to average daily traffic promotes higher than desirable speeds. As a result, it is viewed as a destination-rich but unfriendly path for bicycle travel, and a barrier to comfortable crossing.

Dakota Street. Dakota Street bisects Vermillion from east to west. With few traffic controls along its length, it is viewed as a difficult street to cross and an uncomfortable bicycling environment. Dakota is a continuous north-south route that connects to both the north and south legs of the trail loop. Dakota currently has sidepath segments, including a connection between Downtown and Cotton Park and along the campus edge, but significant gaps inhibit its use by cyclists. Two difficult crossing points are addressed in the 'point barrier' section.

Railroad. While the railroad is not an immediate barrier for creating a urban bicycle network, it may affect future facility development below the bluff, including the trail.

Main Street (through downtown). Main Street is viewed as a principal destination for bicycle traffic today and in the future; however, a combination of factors make it uncomfortable for bicyclists. These factors include conventional head-in diagonal parking that requires drivers to back out of their spaces blind and offset intersections that extend potential conflict zones. Not counting the parking, there is approximately 36' of travel lanes.

POINT BARRIERS

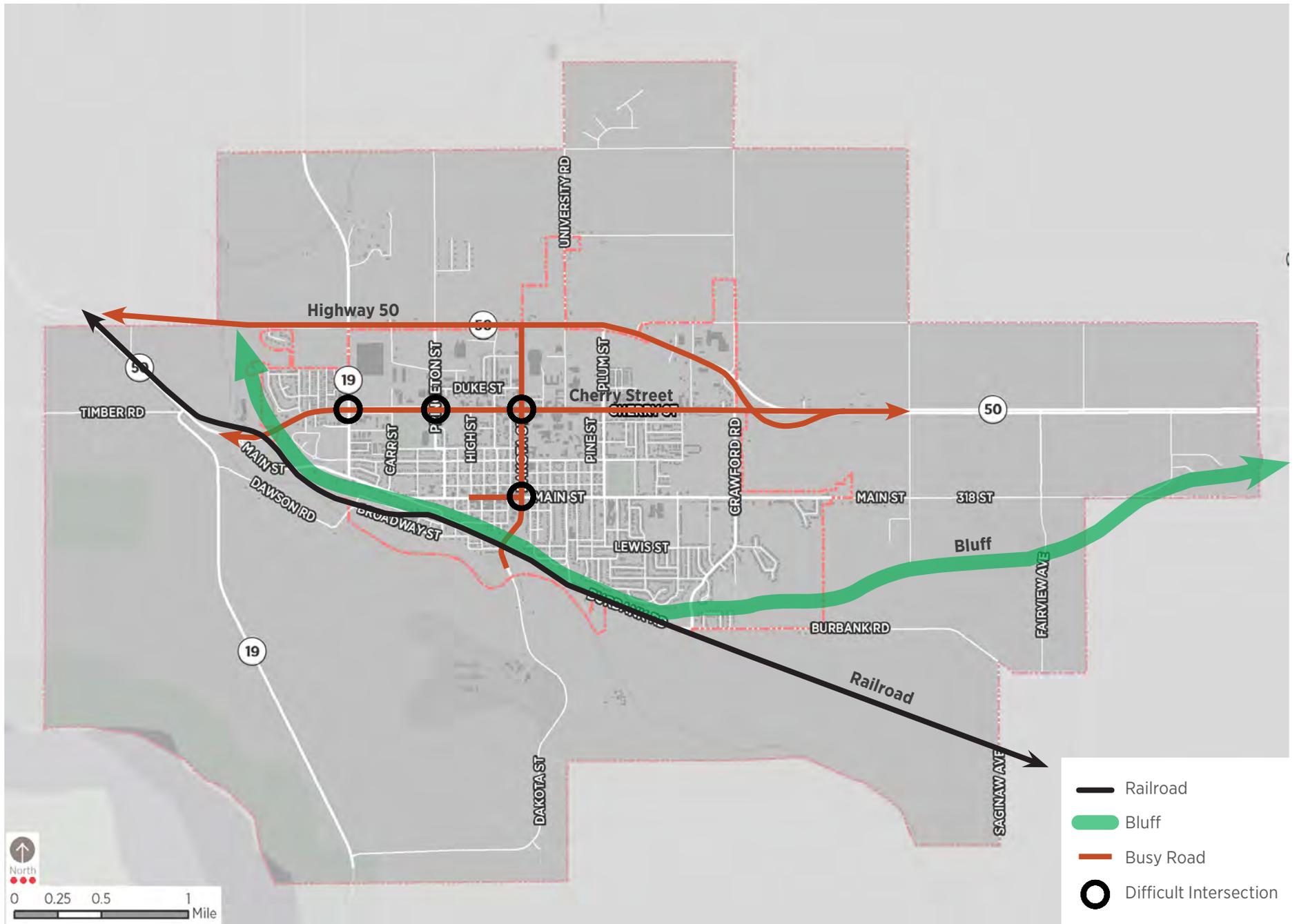
Trail Crossing – Stanford and Cherry. Intersecting multi-use paths and important commercial destinations make this an important potential bicycle node. However, heavy highway traffic and multiple travel lanes provide little clarity for safely negotiating the junction. Potential treatments include improving bicycle crossing markings such as striping and signage, reducing travel lanes, and realigning trail approaches.

Trail Crossing – Cherry and Princeton. This intersection has high traffic volumes, multiple lanes of vehicle traffic, a crossing multi-use path, and a concentration of major destinations that includes HyVee, the middle school, Barstow Park, and Lions Park. Potential interventions include improved bicycle crossing markings such as striping and signage, a reduction of vehicle lanes, and a realignment of trail approaches.

Main Street and Dakota. Difficulties at this intersection on the edge of Downtown include high traffic volumes and narrow street widths. The intersection is further complicated by the number of nearby commercial driveway accesses that increase the number of potential conflict zones. Potential interventions include diverting downtown bicycle access to a side street such as National, closing driveways near the intersection, and providing a dedicated bicycle facility.

Dakota and Cherry. Problems at this intersection include volume of motor, pedestrian, and bicycle traffic and the number of potential conflicts among these road users. The intersection should be closely evaluated to improve clarity, safety, and comfort for all road users.

FIGURE 1.11: Barriers to Bicycling



A large, multi-story stone building with a prominent arched entrance. The building features light-colored stone walls with dark red accents around the windows and archway. In the foreground, there is a concrete sidewalk, a red bicycle rack with two bicycles, and a red trash can. The scene is set outdoors with some bushes and a street lamp visible.

2 Market Analysis

INTRODUCTION

Before building a major shopping center or apartment project, a developer usually commissions a market analysis to determine whether enough people will shop or live there to support the effort and to define the features that will appeal to customers. Similarly, a bicycle master plan benefits by assessing the size and character of the potential market. This helps evaluate the impact of a bicycle transportation program on factors such as motor vehicle traffic and emissions. It also helps us understand what the existing and potential bicycling community wants from the program, which in turn increases the chances that bicycling can reach its potential in Vermillion.

This market study uses the below instruments:

- Existing Bicycle Demand Projections
- Community Engagement Survey
- Interactive Map Survey
- Composite Demand Model

EXISTING BICYCLE DEMAND PROJECTIONS

This section uses current population, demographic, and mobility trends published by the U.S. Census Bureau to forecast the use of a bicycle transportation system in the future. Primary sources of information include the 2012-2016 average computations of the American Community Survey (ACS) and the 2010 Census. The model (Figure 2.1) makes certain assumptions about transportation choices for key populations including K-12 and college students.

Vermillion now has an estimated 908 daily bicycle trips for all purposes including recreational activity. Bicycling has a 4.3% commuter mode share, an impressive number. For comparison, Minneapolis' bicycle mode share of about 3.9% is one of the nation's highest for large cities.

FINDINGS:

- Vermillion has a significant bicycle mode-share for transportation routes including those to/from work or school.
- At present, the model estimates approximately 908 daily bicycle trips.
- Based on the population projections contained in the Vermillion Comprehensive Plan and extrapolating ridership based on the current trend, the total number of trips is expected to increase to 1,215 daily trips in 2040, an increase of 33.8%.
- An improved bicycle system including engineering, education, and encouragement initiatives can be reasonably expected to increase ridership.
 - » University ridership may see a slight increase with better infrastructure however their ridership is already high.
 - » The greatest increase is likely to occur from populations with more transportation choices and greater interest in improved comfort and safety such as: families, concerned but interested riders, and K-12 students.
- It may be possible to increase ridership for Grades 9-12, but this increase would need to come from institutional initiatives such as increasing the cost of parking permits, improving bicycle parking facilities, and offering a greater focus on bicycle education and encouragement through the culture of the district.

FIGURE 2.1: Existing and Projected Bicycle Transportation Trips, 2016 - 2040

Age Cohort	2016 Base Year	2016 Share (%)	2020 Projection	2020 Mode Share	2030 Projection	2030 Mode Share	2040 Projection	2040 Mode Share	Assumptions / Sources
Total Population	10,778		11,314		12,772		14,419		Vermillion Comprehensive Plan
Total Commutes to Work	5,361	50%	5,627	50%	6,353	50%	7,172	50%	50% of Vermillion's population is employed in the workforce, ACS 2016
Bike to Work	231	4.3%	242	4.3%	273	4.3%	308	4.3%	ACS 2016
Work at Home	201	3.7%	211	3.7%	238	3.7%	269	3.7%	3.7% of Vermillion's workforce works from home, ACS 2016
Work at Home Bike Trips	10	5%	11	5%	12	5%	13	5%	Estimated
School K-8 Population	830	7.7%	871	7.7%	984	7.7%	1,110	7.7%	K-8 Students = 7.7% of the total Population
School K-8 Bike Trips	17	2.0%	17	2.0%	20	2.0%	22	2.0%	Safe Routes to School National Partnership, 2009. 2% of children bike to school
School 9-12 Population	237	2.2%	249	2.2%	281	2.2%	317	2.2%	9-12 students = 2.2% of the total population
School 9-12 Bike Trips	2	1.0%	2	1.0%	3	1.0%	3	1.0%	Estimated
University Enrollment	4,527	42.0%	4,752	42.0%	5,365	42.0%	6,056	42.0%	University Students = 42% of the total population
University Bike Trips	195	4.3%	204	4.3%	231	4.3%	260	4.3%	Estimated. Same as Total Bike to Work Percentage
Total Bike Commuters	454		477		538		608		
Total Daily Bike Commute Trips (Commuters 2X)	908		954		1,076		1,215		

COMMUNITY ENGAGEMENT

For a plan to be successful, it must be based on the contributions of residents because they will be the users and the driving force behind the implementation of the plan. To create this foundation of public involvement, the process included a series of opportunities to gather input, ideas, and insight including:

- A Community Survey
- An Interactive Map Survey
- A Public Open House Workshop
- 8 Stakeholder Group Discussions

The following section explores these themes that will serve as a foundational component of the bicycle master plan in three pieces:

- Community Survey Analysis
- Interactive Map Survey Analysis
- Bicycle Demand Analysis

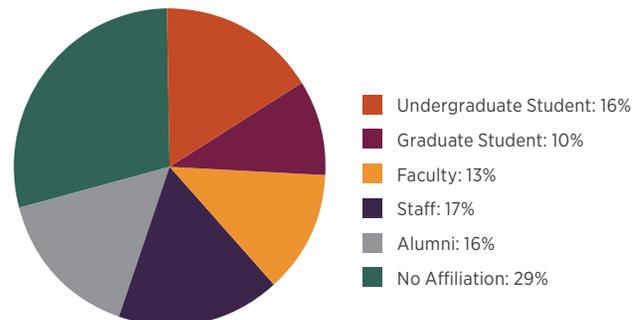
COMMUNITY ENGAGEMENT SURVEY

While the survey was not designed for scientific accuracy, the number and diversity of responses indicated that a fairly



Survey Highlights

- 222 responses (75% non-student; 25% student)



- **Self-Characterization.** Interested but Concerned (48%)
- **Frequency of Bicycle Use.** Several Times Per Week (24%)
- **Top Reasons to Ride.** Exercise (46%); Commuting to School or Work (54%); Trips to Parks (50%)
- **Top Destinations.** Schools and USD Campus; Downtown; Parks; Trails

broad representation of citizens interested in active transportation.

ORIGINS AND DESTINATIONS

Question. Indicate the area of Vermillion in which you live? Indicate the area of Vermillion in which your most frequent destination is located?

Results

- The largest percentage of respondents live in the southeast quadrant (40%)
- The largest percentage of respondents travel to the northeast quadrant as their most frequent destination (53%)
- While the greatest migration appears to exist between the southeast and the northeast sections of Vermillion, there is a relatively high level of movement between all sections of the city. This suggests a strong distribution of origins and destinations and a relatively short average trip distance that would support an active transportation network.

FIGURE 2.2: Interactive Map Survey Results: "Routes I Currently Ride"

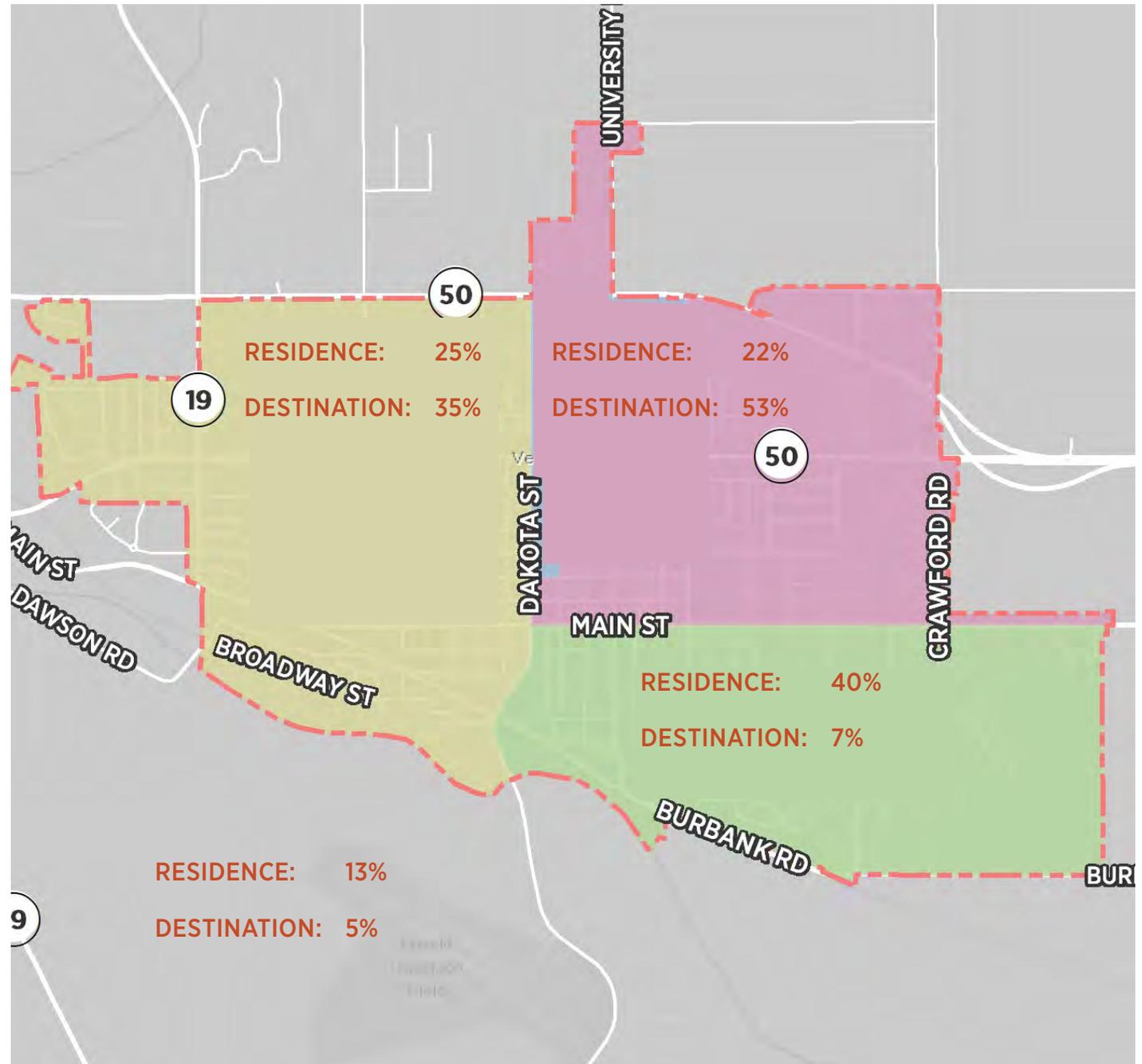


FIGURE 2.3: Reason for Bicycle Use

	All Responses	Response by Affiliation		
		USD Affiliation	Students	Non-Students (Unknown Affiliation)
Regular exercise or workout	55.87%	57.85%	65.12%	42.86%
Trips to parks or recreational facilities	53.52%	57.02%	44.19%	53.06%
Commuting to work or school	49.77%	47.93%	69.77%	36.73%
Trips to the library, museums, and similar places	39.44%	42.98%	34.88%	34.69%
Social visits	38.50%	42.15%	44.19%	24.49%
Family outings	29.58%	36.36%	13.95%	26.53%
Routine errands	29.11%	30.58%	27.91%	26.53%
Going to meetings or in the conduct of business	24.88%	26.45%	18.60%	26.53%
Bicycle touring	21.60%	23.97%	18.60%	18.37%
Shopping	20.19%	22.31%	25.58%	10.20%
I do not ride a bike	4.23%	2.48%	6.98%	6.12%

FIGURE 2.4: Frequency of Bicycle Use

	All Responses	Response by Affiliation		
		USD Affiliation	Students	Non-Students (Unknown Affiliation)
Frequently: Several times each week	24.20%	23.58%	30.23%	20.75%
Regularly: Once or twice each week	17.81%	19.51%	13.95%	16.98%
Occasionally: About once or twice each month	21.46%	24.39%	13.95%	20.75%
Infrequently: Maybe every few months	14.16%	19.51%	9.30%	5.66%
Very Infrequently: A few times each year	15.07%	10.57%	25.58%	16.98%
Never	7.31%	2.44%	6.98%	18.87%

REASON FOR BICYCLE USE

Question. If you ride a bike, which of the following describes why you use it?

Understanding why people ride bicycles in Vermillion helps define a bicycle system that will serve their needs and improve the system’s usefulness.

- The most popular reasons cited for bicycle rides included recreation and exercise (both “regular exercise or workout”) and trips to parks or recreational facilities.
- Following closely are transportation-related reasons including “commuting to work or school” selected in 50% of all responses (70% in all student responses) and “trips to the library, museums, and similar places” which was 39% of all responses.
- Accounting for 39% of all responses, “social visits” are relatively common for all user categories.

FREQUENCY OF BICYCLE USE

Question. How often do you ride a bicycle for enjoyment or travel to destinations?

The frequency that people ride a bicycle indicates a baseline measurement for the overall use of existing bicycle facilities and begins to suggest the type of initiatives (such as education and encouragement programs) that may be most appropriate for Vermillion.

- Most respondents (63%) indicated that they rode a bicycle at least once or twice per month including those who rode more frequently. This suggests a strong market for bicycle system improvements.
- The students expressed a more skewed pattern with a large share of “frequent” riders (30%) and a large share of “very infrequent” riders (26%). Contributing factors may include: an increased likelihood that some students will use a bicycle as their primary mode of transportation while there is also an increased likelihood that some students will walk as their primary mode of transportation without using a car or bicycle.

SELF-CHARACTERIZATION

Question. Which of the following best describes you as a bicyclist?

The comfort of a bicyclist in an urban environment determines the level of support they will require to incorporate bicycle transportation into their lifestyle. By examining how respondents answer the question in aggregate, we can understand the prototypical prospective cyclist in Vermillion.

Committed and Fearless:

I am a committed bicyclist who rides in mixed traffic on every street. I don't believe that any significant further action on bicycle facilities is necessary.

Committed Urban Cyclist:

I am a committed bicyclist who rides in mixed traffic on most streets, but believes that new facilities like bike lanes, bike routes, and trails are needed to improve Vermillion's biking environment for me and encourage other people to ride more often.

Interested but Concerned:

I am interested in bicycling and use low-traffic streets but am concerned about the safety of riding in mixed automobile traffic. More trails and bike lanes and routes would increase the number of trips that I make by bicycle.

Recreational Trail Users:

I am a recreational or occasional bicyclist and ride primarily on trails. I would like to see more trails, but am unlikely to ride on city streets even with bike lanes

Interested Non-Riders:

I do not ride a bicycle now but might be interested if Vermillion developed facilities that met my needs better or made me feel safer.

Non-Rider, Unlikely to Ride:

I do not ride a bicycle and am unlikely ever to do so.

These results suggest a relatively high proportion of riders who are comfortable in mixed traffic.

FIGURE 2.5: Self Characterization of Rider Type

	All Responses	Response by Affiliation		
		USD Affiliation	Students	Non-Students (Unknown Affiliation)
Committed and Fearless:	0.00%	0.00%	0.00%	0.00%
Committed Urban Cyclist:	26.73%	31.97%	23.26%	13.51%
Interested but Concerned:	47.52%	48.36%	41.86%	51.35%
Recreational Trail Users:	13.86%	11.48%	18.60%	16.22%
Interested Non-Riders:	9.41%	7.38%	13.95%	10.81%
Non-Rider, Unlikely to Ride:	2.48%	0.82%	2.33%	8.11%

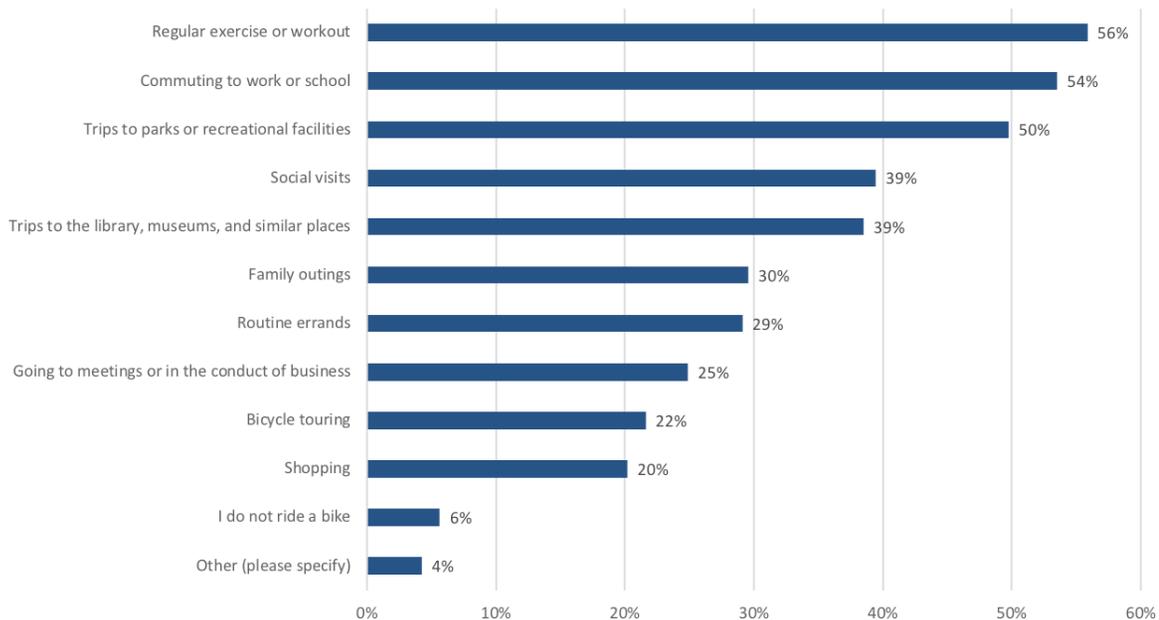
DESTINATIONS

Question. Rate how important you think good bicycle access is to each of the following destinations?

By asking residents to rate the relative importance of community destinations, it is possible to hone the priorities of the project. An active transportation network should get people to where they want to go.

- The figure sorts the destinations by the relatively percentage of “important” and “very important” ratings.
- The top priority destinations can be grouped into several major categories: USD campus and related student facilities; trails and community parks, and downtown.
- Other notable destinations include the school facilities and commercial centers such as Cherry Street, Walmart, and HyVee

FIGURE 2.6: Destinations Rated by Importance



VERMILLION STREETS - COMFORT RATING

Much of the survey was designed to assess the comfort of current and prospective bicyclists with different types of bicycle environments. The survey asked participants to respond to a gallery of photographs of Vermillion streets and infrastructure installations from other parts of the country.

Question. In response to specific street examples from Vermillion, individuals were asked to rate the environment by comfort based on:

- Whether the setting is comfortable for most or all cyclists
- Whether the setting is comfortable for the respondent but not necessarily for less capable cyclists.

Figure 2.7 compiles the images of various Vermillion Streets on the basis of their combined favorability ratings. Groupings are based on the percent of respondents who considered the facility comfortable for both other users and themselves, and show the following results:

- The most comfortable settings (over 85% favorable) included completely separated paths, both along roads or through parklike settings.
- The next most comfortable settings (between 70% and 80% favorable) included quiet neighborhood streets such as Prospect Street. This indicates a reasonable level of user comfort with quiet streets given the fact that relatively few of the respondents characterize themselves as fully comfortable in mixed traffic.
- Most people are uncomfortable with major arterial streets, two-lane corridors with significant traffic, and several major pedestrian crossings, including trail crossings with major streets.
- There was a large percentage who indicated “comfortable for me” for many of the mixed traffic street scenarios. This distinction is noteworthy and suggests situations experienced riders find satisfactory for themselves, but not suitable for less capable cyclists. One determining factor was the perceived or indicated amount of traffic for a particular situation. More experienced bicyclists were more comfortable dealing with higher traffic volumes than less experienced riders.

FIGURE 2.7: Local Street Favorability Ratings

LEAST FAVORABLE



MODERATELY FAVORABLE



MOST FAVORABLE

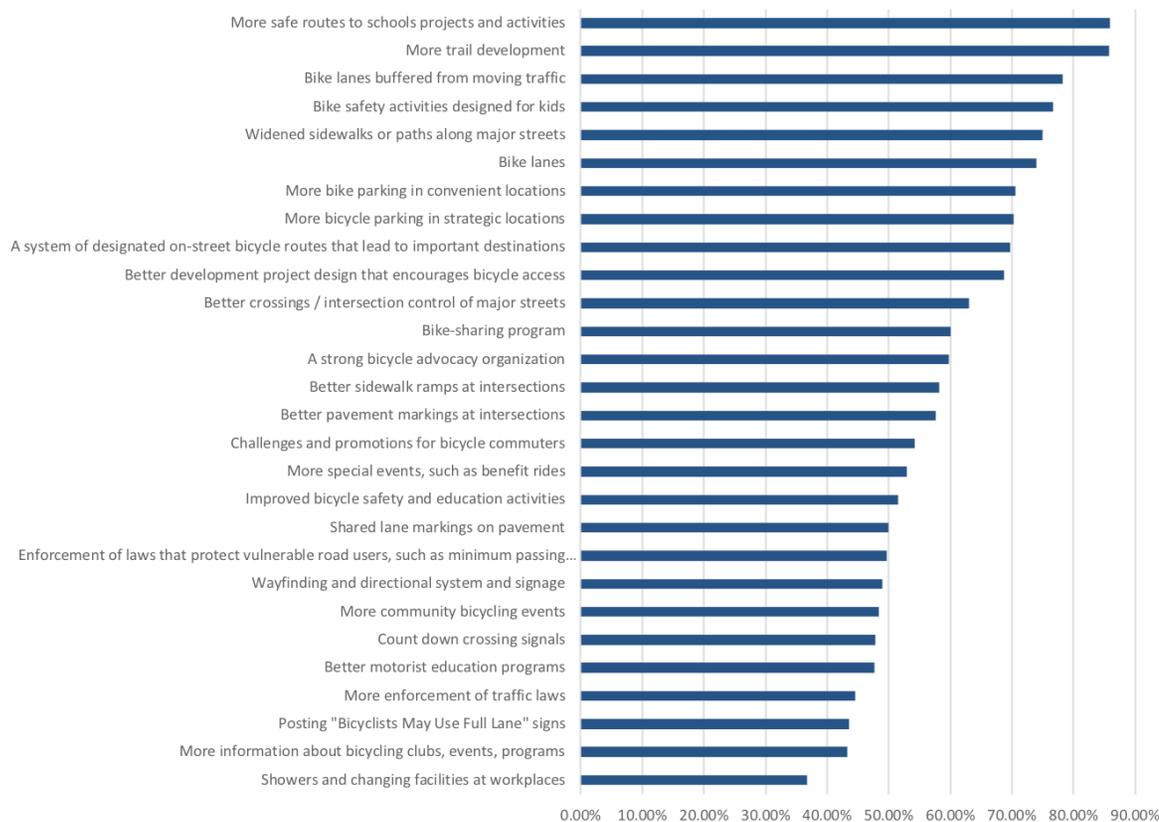


IMPORTANCE OF VARIOUS ACTIONS

Question. How effective do you believe each of the following improvements would be in increasing bicycling for transportation in Vermillion?

- The most highly rated programs (greater than 80% favorable) include targeting physical and educational programs to school children, building sidepaths along major roads and more trails, and bike lanes that are physically separated from traffic.
- The next most highly rated programs (between 70% and 80% favorable) include bicycle parking at key destinations, bike lanes and a system of designated bicycle routes, a bike share program, and development guidelines to integrate bicycle-friendly features.
- Other noteworthy actions include better crossings at major intersections and promotional events to encourage people to ride bikes in Vermillion.

FIGURE 2.8: Bicycle Actions Rated by Perceived Effectiveness



INFRASTRUCTURE APPROACHES

Figure 2.9 displays a series of bicycle infrastructure approaches in use around the country. These are grouped by the percentage of respondents rating each image as “comfortable for most or all users” – a higher standard of comfort than used to evaluate Vermillion streets in Figure 2.6.

This different, stricter measure is directed toward the goal of expanding the role of active modes in the overall transportation framework, rather than simply providing existing bicyclists with better or more comfortable facilities (a valid goal in itself, to be sure).

The results suggest:

- The highest level of comfort is associated with physically separated facilities – trails on exclusive right-of-way or on-street facilities that have a physical buffer or barrier between the bicycle/pedestrian environment and motor vehicle travel lanes.
- Views of enhancements to local and neighborhood streets are divided, with about half of respondents viewing them as comfortable for most users – a lower percentage than physically separated facilities. However, many of these respondents viewed these facilities as “comfortable” for themselves.
- Facilities with higher visibility (physical separation, vertical bollards, green paint) appear to make some difference in people’s perception of comfort for most users.
- Painted conventional bike lanes or shared lane markings on busy streets are not seen as comfortable for most users.

FIGURE 2.9: National Bicycle Facility Favorability Ratings

LEAST FAVORABLE



MODERATELY FAVORABLE



MOST FAVORABLE



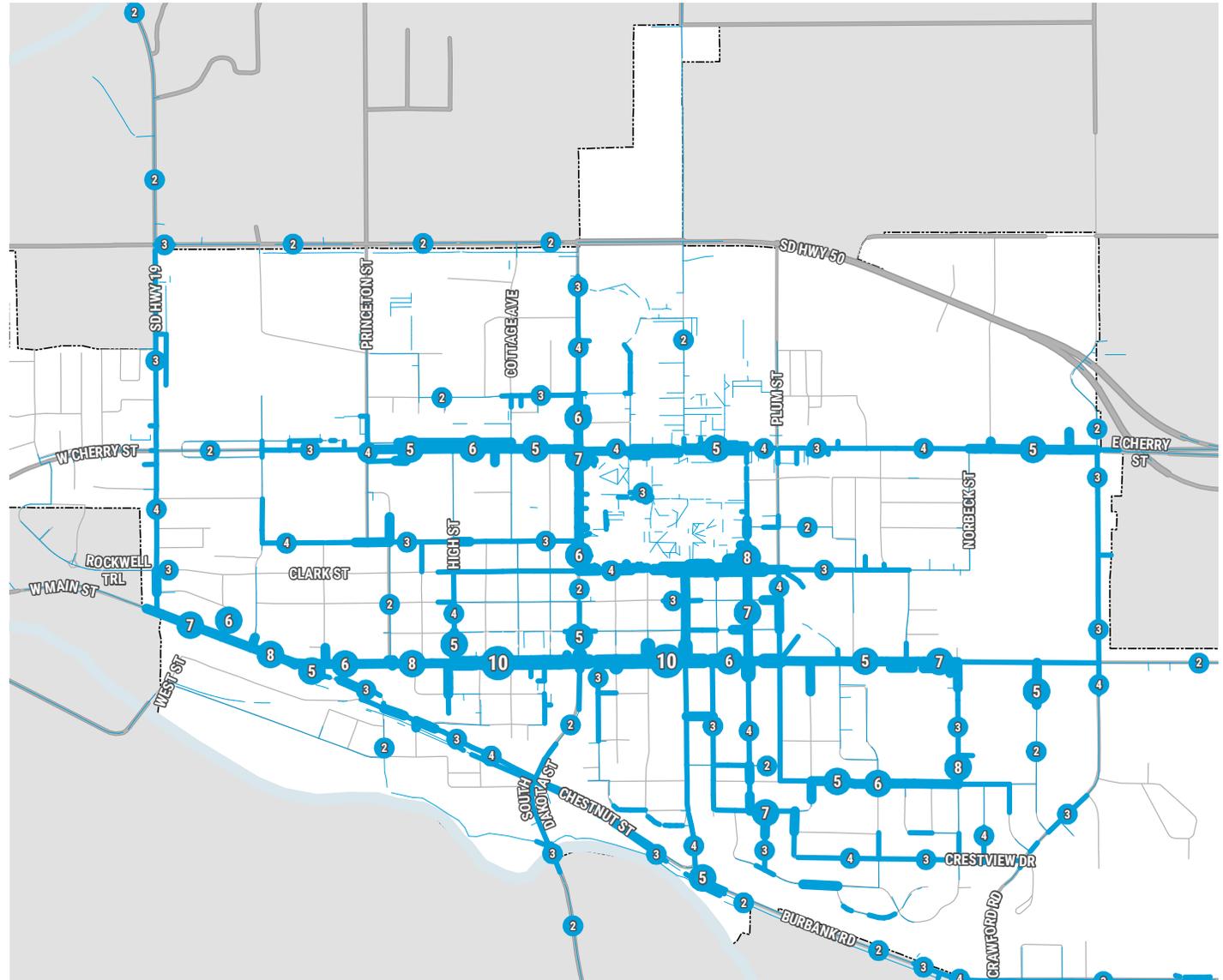
INTERACTIVE MAP SURVEY

Residents mapped their ideas through an interactive map survey. The purpose of the map was to allow stakeholders to share their insight regarding their patterns today and the desired outcomes they would like to see from the bicycle master plan. The survey received a strong response from the public with many individual contributions.

ROUTES I RIDE TODAY

- The pattern focuses primarily on the major streets, trails, and continuous neighborhood streets but to a lesser degree.
- East-west highlights include: Main Street, Clark Street (through the core of the city), Dartmouth Street extending west of USD, Cherry Street, Burbank Road, and segments of Lewis Street.
- North-south highlights include: Stanford, High Street, Dakota Street, University Street south of USD, Plum Street, and Crawford Road.

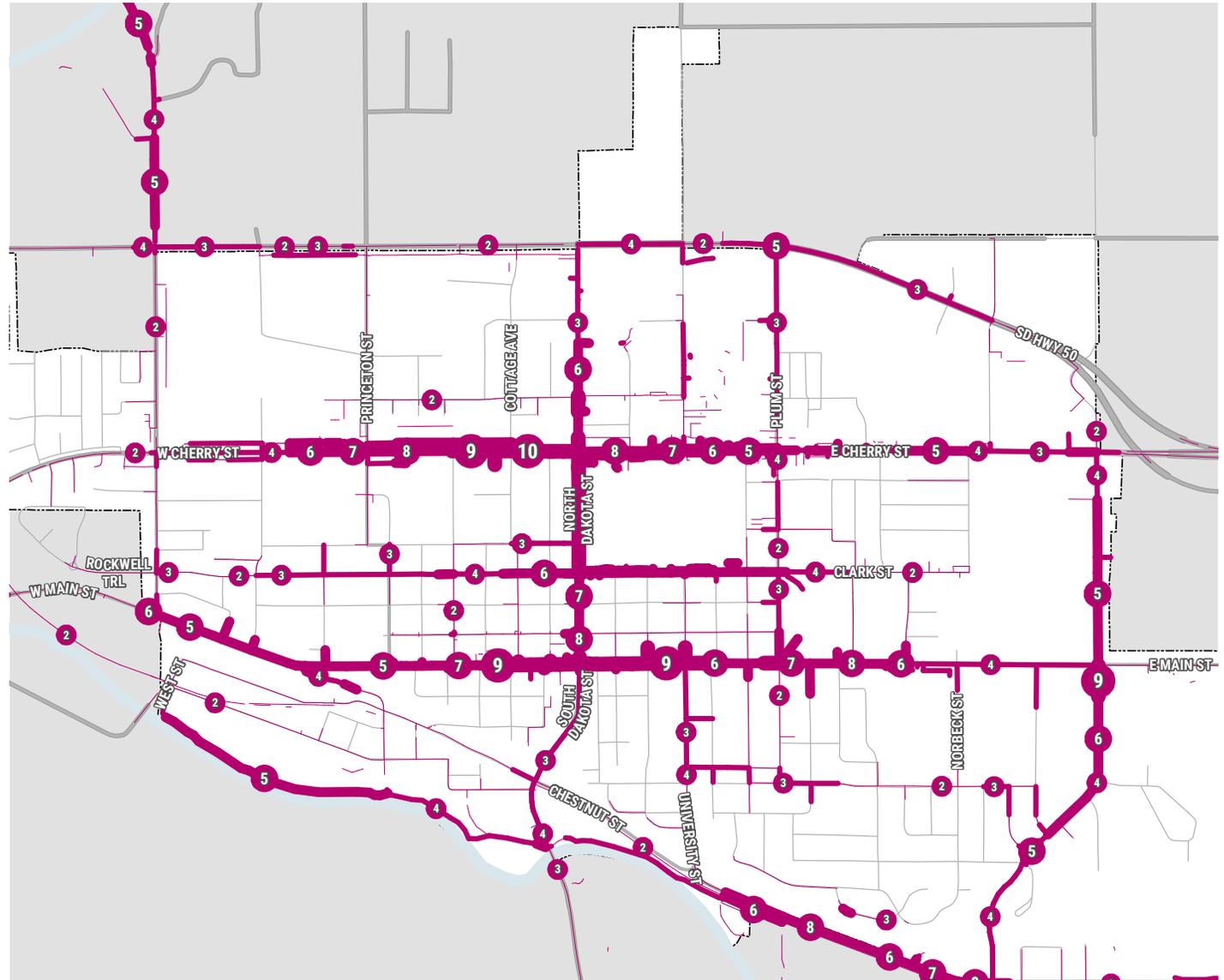
FIGURE 2.10: Interactive Map Survey Results: "Routes I Currently Ride"



ROUTES I WOULD LIKE TO RIDE

- While the general directions are similar to the routes that people are currently riding, the consolidated contributions reveal a more streamlined system and greater consensus on which corridors should be enhanced for bicyclists.
- East-west highlights include: Burbank Road / riverfront trail, Main Street, Clark Street, Cherry Street, and segments reinforcing a desire for a continuous trail along the Highway 50 bypass.
- North-south highlights include: Crawford Street, Plum Street, Dakota Street, and segments reinforcing a desire for a continuous trail along the western edge of the city.

FIGURE 2.11: Interactive Map Survey Results: "Routes I Would Like to Ride"



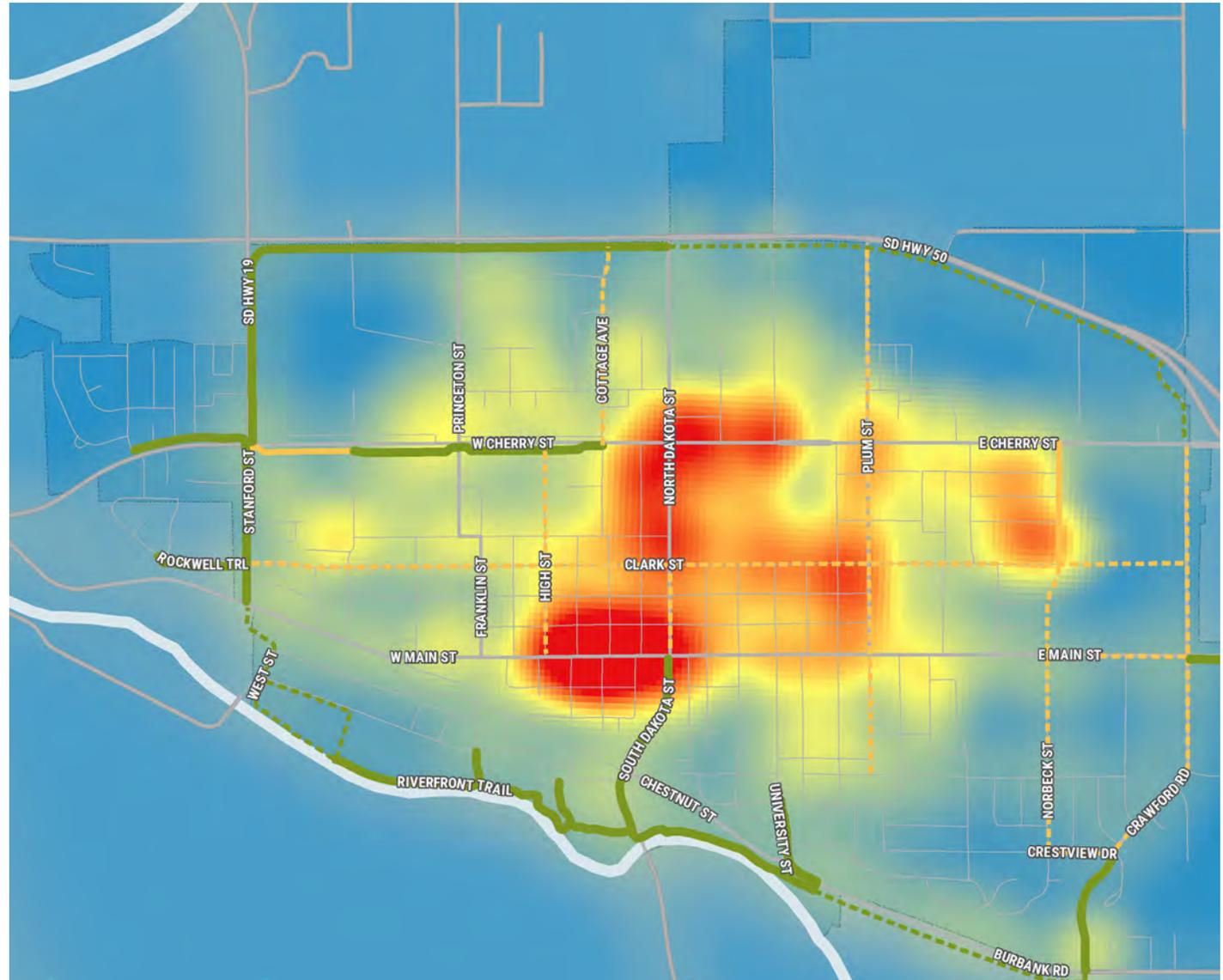
BICYCLE DEMAND ANALYSIS

The bicycle demand analysis illustrates areas that are likely to have the highest demand for bicycling. The resulting map is a tool that should be used to help prioritize bicycling projects and programs. Yet it is only one factor among others, including connectivity, equity, legal and cost restraints, safety, stakeholder input, and upcoming opportunity projects.

In the bicycle demand analysis performed for Vermillion (illustrated to the right), areas of red and orange show the highest demand for bicycling.

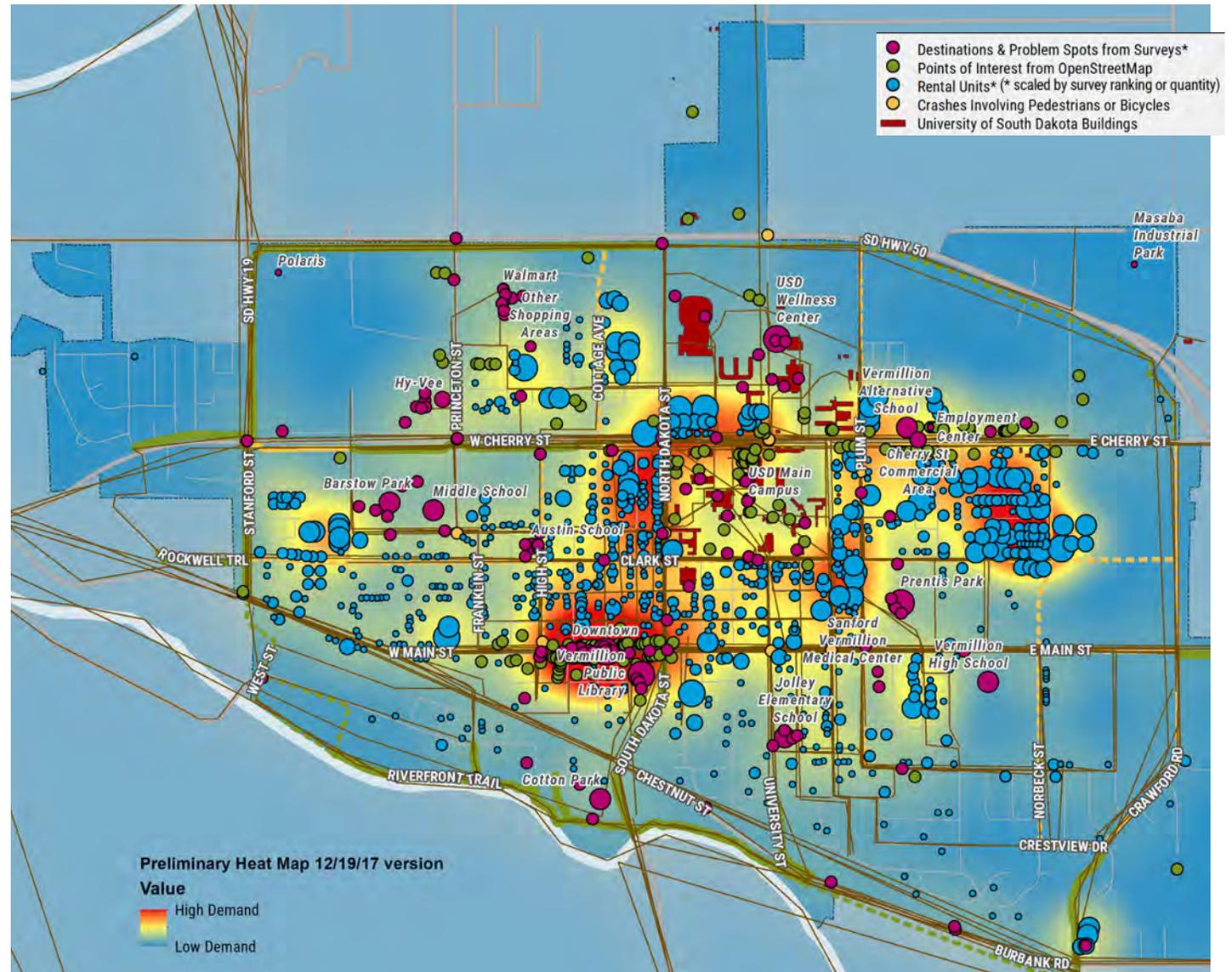
Vermillion's downtown and USD campus area, as well as its core neighborhoods, are places with the highest demand. Today there are no bicycle facilities connecting these areas, illustrating the opportunity that awaits once bikeways connect these popular destinations.

FIGURE 2.12: Bicycle Demand Analysis with Inputs



The demand analysis was created by generating factors that could lead to higher demand for bicycling. This list of factors was inspired by listening sessions held at the beginning of the planning process, and included items such as input from residents, bicycling infrastructure, crashes involving bicyclists, points of interest, and rental housing units. The following map provides contextual points and lines corresponding with each factor, layered on top of the previous map, to illustrate how data influenced the analysis.

FIGURE 2.13: Bicycle Demand Analysis with Inputs





3 The Bicycle Network



THE BIKEWAY NETWORK

An effective network of bicycle facilities is based largely on the characteristics of both the individual community and the nature and preferences of its users. But its design and operation should also be guided by specific principles and performance measurements. Some of the world's best work on identifying design principles was done by the Netherlands Centre for Research and Contract Standardization in Civil and Traffic Engineering. This plan adapts the Netherlands concepts to the contexts of American cities like Vermillion, identifying six guiding principles for an effective active transportation network:

Integrity. The ability of a system to link starting points continuously to destinations, and to be easily and clearly understood by users.

Directness. The capacity to provide direct routes with minimum misdirection or unnecessary distance.

Safety. The ability to minimize hazards and improve safety for users of all transportation modes.

Comfort. Consistency with the capacities of users and avoidance of mental or physical stress.

Experience. The quality of offering users a pleasant and positive experience.

Feasibility. The ability to maximize benefits and minimize costs, including financial cost, inconvenience, and potential political opposition.

These six principles express the general attributes of a good system, but must have specific criteria and even measurements that both guide the system's design and evaluate how well it works.

Figures 3.1 through 3.6 present criteria for each of the six guiding principles, and design guides and methods to manage performance. Each table includes:

- The **performance factors** relevant to each guiding principle. For example, the INTEGRITY principle addresses the ability of users to understand the system and use it to get to their destinations. Examples of performance factors that help satisfy this principle include clear wayfinding and directional information and continuity, ensuring that users do not confront dead-ends as they move along the route.
- The **measurements** that can be used to evaluate the success of the system and its ultimate design. For example, we can measure the effectiveness of a wayfinding system by its ability to guide users intuitively without creating too many signs.
- The **performance criteria** that establish the design objectives and guidelines for each of these factors. For example, a wayfinding system should avoid ambiguities that confuse users and follow graphic standards that are immediately and clearly understood.

These attributes help guide network design and evaluation, but they are clearly aspirational – no network in a real place can meet all of these criteria all of the time.



Integrity issues.

Far left: The excellent Riverfront Trail connects to Downtown and Cotton Park, but neither of its ends provide a return route to the city. The 2011 flood washed out the western end of the trail and its reconstruction is a high community priority.

Left: The southside frontage road along West Cherry Street suggests a bike lane that is not evident, and does not appear to have enough width for bike lanes in both directions. This is confusing to both bicyclists and motorists.

FIGURE 3.1: Development of the INTEGRITY Guiding Principle

Performance Factor	Measures	Performance Standard
Comprehensiveness	Number of connected destinations on system	Major destination types identified in the survey results and presented in the destinations analysis should all be accessible by the network. 100% of top destination types and 80% of all destinations should be served. New destinations should be developed along the network or served by extensions.
Continuity	Number of discontinuities along individual routes	Users headed on a route to a destination should not be dropped at a terminus without route or directional information. Even at incremental levels, route endings should make functional sense. Transitions between facility types should be clear to users and well-defined. Transitions from one type of infrastructure to another along the same route should avoid leading cyclists of different capabilities into uncomfortable settings. Infrastructure should be recognizable and its features (pavement markings, design conventions) consistent throughout the system.
Wayfinding/directional information	Completeness and clarity of signage; Economy and efficiency of graphics; Complaints from users	Signs should keep users informed and oriented at all points. Sign systems should avoid ambiguities that cause users to feel lost or require them to carry unnecessary support materials. Signs should be clear, simple, consistent, and legible, and should be consistent with the Manual on Uniform Traffic Control Devices (MUTCD).
Route choice	Number of alternative routes of approximately equal distance	The ultimate system should provide most users with a minimum of two alternatives of approximately equal distance. Maximum distance between alternative routes should be about 1/2 mile.
Consistency	Percentage of typical reported trips accommodated by the ultimate network.	Typically, a minimum of 50-70 percent of most trips to identified destinations should be accommodated by the bikeways network.

Directness issues.

Far right: Frequent stop signs on bicycle routes can cause delay and frustrate bicyclists, sometimes leading them to use less direct or preferred streets.

Right: Difficult-to-cross intersections can lead bicyclists to use indirect routes.



FIGURE 3.2: Development of the DIRECTNESS Guiding Principle

Performance Factor	Measures	Performance Standard
Access	Coverage Access to all parts of the city	The network should provide convenient access to all parts of the city. As a standard, all urban residential areas should be within one-half mile from one of the system's routes, and should be connected to those routes by a relatively direct local street connection.
Bicycling speed	Design and average speed of system	The network should permit relatively consistent operation at a steady speed without excessive delays. Systems should be able to deliver an average point to point speed between 12 and 15 mph for users, although a portion of routes should permit operation in a 15 to 20 mph range. (CROW adapted to American measurement)
Diversions and misdirections	Maximum range of detours or diversions from a straight line between destinations. "Detour ratio:" Ratio of actual versus direct distance between two points.	Routes should connect points with a minimum amount of misdirections. Users should perceive that the route is always taking them in the desired direction, without making them reverse themselves or go out of their way to an unreasonable degree. Maximum diversion of a straight line connecting two key points on a route should not exceed 0.25 miles on either side of the line. (NACTO)
Delays	Amount of time spent not moving	Routes should minimize unnecessary or frustrating delays, including excessive numbers of stop signs, and delays at uncontrolled intersections waiting for gaps in cross traffic. Routes should maximize use of existing signalized crossings.
Intersections	Bicycle direction through intersections	Bicyclists and pedestrians should have a clear and safe path through intersections. Two-stage crossings are sometimes necessary but should avoid conflicts between bicycles and pedestrians.



Safety issues.

Far left: Main Street in Downtown displays a cluster of crashes, many of which are related to backing up collisions or problems negotiating offset intersections. These can create safety concerns for bicyclists.

Left: Sidepaths are safest when interruptions like driveways and intersecting streets are infrequent. Caution signage to increase motorists awareness of bicycles in the area also adds to safety.

FIGURE 3.3: Development of the SAFETY Guiding Principle

Performance Factor	Measures	Performance Standard
Reduced number of crash incidents	Number of incidents; Reactions/perceptions of users	The network should reduce the rate of crashes over ten year periods. Data collection should be sufficient to trace baseline data and measure the impact of improvements.
Appropriate routing: mixing versus separation of traffic	Average daily traffic (ADT) criteria for mixed traffic; Traffic speed criteria for mixed traffic	System design should avoid encounters between bicyclists and incompatible motor traffic streams (high volumes and/or high speeds). Separation and protection of vulnerable users should increase as incompatibilities increase.
Infrastructure, visibility, signage	Pairing of context and infrastructure solutions; Mutual visibility and awareness of bicycle and motor vehicles	Infrastructure should be designed for utility by at least 80 percent of the potential market. The Vermillion Bicycle Survey indicates that a relatively large number of people prefer higher levels of separation. Infrastructure applications should be matched with appropriate contexts. Warning signage directed to motorists should be sufficient to alert them to the presence of cyclists along the travel route. Surfaces and markings should be clearly visible to all users. Obstructions, such as landscaping, road geometry, and vertical elements, should not block routine visibility of pedestrians, cyclists and motorists. Trail and pathway geometries should avoid sharp turns and alignments that hide cyclists operating in opposing directions or create crash hazards for pedestrians. Where these conditions are unavoidable, devices such as mirrors and advisory signs should be used to reduce hazards.
Door hazards and parking conflicts	Number of incidents; Parking configurations; Location of bicycle tracking guides	Component design should track bicycles outside of the door hazard zone. Back-out hazards of head-in parking should be avoided or mitigated when diagonal parking is used along streets.
Intersection conflicts	Location and types of pavement markings; Number of intersections or crossings per mile	Intersections should provide a clearly defined and visible track through them for cyclists and pedestrians. Sidepaths should generally be used on continuous segments with a minimum number of interruptions.
Complaints	Number of complaints per facility type	Complaints should be recorded by type of infrastructure and location of facility, to set priorities for remedial action.

Comfort issues.

Far right: On high-speed roads, even features such as paved shoulders and advisory signage are insufficient to create comfortable environments for many users.

Right: Service to all parts of the city sometimes make steep climbs unavoidable, as in the case of connecting Vermillion above the bluff with the old town and Cotton Park below. Here, it is important to provide alternative routes that minimize these physically stressful conditions.



FIGURE 3.4: Development of the COMFORT Guiding Principle

Performance Factor	Measures	Performance Standard
Road surface	Quality and type of road surface; Materials; Incidence of longitudinal cracking and expansion joints	The network's components should provide a reasonably smooth surface with a minimum of potholes and areas of paving deterioration. Roads should be free of hazardous conditions such as settlement and longitudinal cracks and pavement separation. All routes in the urban system should be hard-surfaced, unless specifically designated for limited use. Sidewalks in the network should be repaired or designed to minimize tripping hazards or obstructions such as equipment or poles.
Hills	Number and length of hills and inclines; Maximum grades on segments for both long and short distances	When compliance with directness or experience attributes make steeper climbs necessary, alternative routes with moderate grades should be provided in the network, even at the cost of greater length. Off-road or separated climbing facilities should be provided where slow-moving bike traffic can obstruct motor vehicles and increase motorist conflict. If possible, grades on approaches to overpasses and underpasses should not exceed 7% over a length not exceeding 400 feet in length; or 5% over the course of a mile. (AASHTO) If possible, grades on bicycle routes should follow these guidelines.
Traffic stress	Average daily traffic (ADT); Average traffic speed; Volume of truck traffic	Generally, the network should choose paths of lower resistance/incompatibility wherever possible and when the DIRECTNESS guideline can be reasonably met. The network should avoid mixed traffic situations over 5,000 vehicles per day (vpd) without separated facilities, or should use alternative routes where possible. (NACTO with modifications)
Stops that interrupt rhythm and continuity	Number of stop signs/segment	Network routes should avoid or redirect frequent stop sign controls. The number of stops between endpoints should not exceed three (1 per quarter mile average) per mile segment.



Experience issues.

Attractive residential streets (like Center Street at far left) and the USD campus environment provide attractive bicycle and pedestrian travel environments.

FIGURE 3.5: Development of the EXPERIENCE Guiding Principle

Performance Factor	Measures	Performance Standard
Surrounding land use	Neighborhood setting; Adjacent residential or open space use, including institutional campuses; Adjacent street-oriented commercial	Surrounding land use should provide the network user with an attractive adjacent urban environment. It is desirable for at least 75 percent of the length of the route to pass through such environments as residential, public or campus settings, open space, or street-oriented (Main Street) commercial environments. However, this guide is advisory and should not be taken to limit necessary connectivity or service to major employment centers. Routes should provide access to commercial and personal support services, such as food places, convenience stores, and restrooms.
Landscape	Location and extent of parks or maintained open space	Networks should maximize exposure or use right-of-ways along or through public parks and open spaces. Environmental contexts to be maximized include parks, waterways and lakes, and landscaped settings.
Social safety	Residential development patterns; Observability: Presence of windows or visible uses along the route; Population density or number of users	The network should provide routes with a high degree of observability – street oriented uses, residential frontages, buildings that provide vantage points that provide security to system users. Areas that seem insecure, including industrial precincts, areas with few street-oriented businesses, or areas with little use or visible maintenance should generally be avoided, except where necessary to make connections or serve major destinations like industrial employment centers.
Furnishings and design	On-trail landscaping, supporting furnishings	Network routes should include landscaping, street furnishings, lighting, rest stops, graphics, and other elements that promote the overall experience. These features are particularly important along trails.

Feasibility Opportunities.

Far right: Low-capital improvements could help improve the bicycling environment of cross-town streets like Clark Street.

Right: Short segments of shared-use paths and some additional redesign at the Stanford and Cherry intersection can create a much more satisfactory accommodation for bikes and pedestrians at this important intersection.



FIGURE 3.6: Development of the FEASIBILITY Guiding Principle

Performance Factor	Measures	Performance Standard
Cost effectiveness	Route cost;	The network should generate maximum benefit at minimum cost. Where possible, selected routes should favor segments that can be adapted to bicycle use with economical features rather than requiring major capital investments. Initial routes should be located in areas with a high probability of use intensity: substantial population density and/or incidence of destinations.
	Population/destination density	
	Maximum use of low-cost components;	Initial investments should integrate existing assets, extending their reach into other neighborhoods and increasing access to them. Major off-street investments should concentrate on closing gaps in an on-street system.
Phasing and incremental integrity	Self-contained value	The network should provide value and integrity at all stages of completion. A first stage should increase access and use in ways that make future phases logical.
	Ability to evolve	The network should be incremental, capable of building on an initial foundation in gradual phases. Phases should be affordable, fitting within a modest annual allocation by the city, and complemented by major capital investments incorporating other sources.
Neighborhood relationships and friction	Parking patterns	The network should avoid conflict situations, where a route is likely to encounter intense local opposition. Initial design should avoid impact on potentially controversial areas, such as parking, without neighborhood agreement.
	Development and circulation patterns	Involuntary acquisition of right-of-way should be avoided wherever possible. Detailed planning processes to implement specific routes should include local area or stakeholder participation.

NETWORK ATTRIBUTES

Based on this development of the six guiding principles presented in the tables, the Vermillion network design follows the following major attributes:

Tailored to User Groups. Planning a bicycle network for Vermillion and the surrounding area requires an understanding of the specific market groups for the system. These groups include:

- Recreational users, including people traveling to parks and recreational features, including trails, from their homes. It is important to understand that travel to recreational destinations are in fact transportation trips that substitute for trips by car.
- The university community, including staff and students traveling to class or to various destinations around the city. The success of USD's pilot bike share suggests that this can be a growing market, permitting students to avoid reparking.
- Local students walking or biking to school.
- Residents who are actively interested in walking or biking for transportation, but are discouraged by barriers, including major streets, highways, and railroad crossings.
- Workers at major industries like Polaris, who may find bicycle transportation to be an attractive and healthy transportation option.

Destination-Based. The Vermillion network should direct people of all ages to destinations such as parks, trails, schools, downtown, popular destinations for routine goods and services such as Walmart and grocery stores, and the library. Destinations identified by the community as important help generate the structure of the network. The proposed network is more than a map of streets and trails. It is in fact part of a transportation system that takes people to specific places.

Incremental Integrity. As shown in Figure 3.6 (Feasibility), incremental integrity – the ability of the network to provide a system of value at each step of completion – is an important

attribute. The first step in completion should be valuable and increase bicycle access even if nothing else is done. Each subsequent phase of completion follows the same principle of leaving something of clear value and integrity, even if no further phases were developed.

Evolution. As part of the concept of incremental integrity, the system should evolve and improve over time. For example, a relatively low-cost project or design element can establish a pattern of use that supports something better in the future. To use a cliché, the perfect should not be the enemy of the good.

Conflict Avoidance. Few important actions are completely without controversy, but successful development of a bicycle transportation system in Vermillion can and should avoid unnecessary controversy. On most streets, shared streets and signage can provide satisfactory facilities that focus on the positive and minimize divisive conflicts. Projects should demonstrate the multiple benefits of street adaptations. For example, bikeway design can slow motorists to create safer residential streets and conditions around schools, benefiting both cyclists and neighbors.

Use of Existing Facilities. Great local features like Cotton Park, Prentis Park, Barstow Park, USD facilities and museums, and regional destinations like Clay County Park and the Missouri River itself can help define the bicycle transportation system. Existing trails and paths also provide the foundation for a complete network.

Fill Gaps. In some cases, the most important parts of a network involve small projects that make connections rather than long distance components. Often, these short links knit longer street or trail segments together into longer routes or provide access to important destinations. These gaps may include a short trail segment that connects two continuous streets together, or an intersection improvement that bridges a barrier. The development of the overall network is strategic, using manageable initiatives to create a comprehensive system.



Routes of Least Resistance. The Vermillion Bicycle Survey showed that much of the city's potential urban cycling market prefers quiet streets or corridors with separation from motor traffic. Neighborhood Bikeways – lower-volume streets that parallel major arterials – satisfy the comfort principle successfully. However, some important destinations, including major shopping facilities and service centers, are served by major arterials like Cherry Street, which the survey indicated is a high-demand route. Here, complete street guidelines that include bicycle (and pedestrian) accommodations should provide enhanced comfort and safety to users when possible. Signage systems can also help guide users efficiently to their destinations by defining comfortable routes made up of different street segments.

Barriers. In many cases, reducing the dividing impact of barriers such as major highways and streets, can be the mostly effective way of improving connectivity. For example, Cherry Street, a desirable bicycle corridor, is also a major

barrier to comfortable north-south travel. Offset intersections in Downtown also pose challenges to people crossing Main Street.

The Highway 50 bypass will also present difficulties if significant destinations develop north of the highway. In other cases, existing trails cross busy streets, leading to concerns of parents about their children using the trail to get to school.

Regional Connectivity. Vermillion's potential network extends into the surrounding region. Beyond the immediate study area, this plan also considers potential destinations in the surrounding region that have proven popular with bicyclists, including Clay County Park, Burbank, the Missouri River Bridge to Nebraska, and the Interstate 29 interchange with the growing Coffee Cup Fuel Stop complex and Vermillion Information Center.

THE PROPOSED BICYCLE TRANSPORTATION NETWORK

Figure 3.7 illustrates the proposed bicycle transportation network for Vermillion and the surrounding region, based on the principles described previously in this chapter and possibilities for infrastructure development. These maps display the ultimate build-out by component type, and includes route designations that are used to describe infrastructure details. The network includes the following conceptual components:

Principal On-Street Bikeways. These streets and corridors make up the primary route grid using city streets. They are the "arterial" bikeways that link the parts of the Vermillion area together. They also complement the city's trails and connect neighborhoods and destinations to them. These routes use a variety of facility types, including quiet streets, multi-use shoulders, protected bike lanes, and in some cases sidepaths and short trail connections. Details of these individual routes are presented in Chapter Seven.

In the Vermillion network, many of the on-street routes have connections across town. This, plus moderate speeds and relatively low traffic loads (below 3,000 vehicles per day), are especially appropriate for neighborhood bikeway designation and treatment. Most of these facilities are local or collector streets with relatively low volumes that have good continuity and in many cases parallel higher order streets. They are far more comfortable for most cyclists and pedestrians than the busy corridors that they sometimes parallel. According to the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, base attributes for neighborhood bikeways (neighborhood bikeways) include:

- Average daily traffic below 3,000 vehicles per day (1,500 vpd desirable).
- Continuity similar to that of a normal local bicycle trip, typically 2-5 miles, although this varies according to the city. In Vermillion, most proposed bikeways cross the entire city.
- 85th percentile speeds of no more than 25 mph.

The principal bikeways are further categorized by the amount of change to existing sections that they require. These include streets that require 1) minor adaptation and 2) major lane revisions.

Neighborhood Bikeways with relatively minor adaptations. On these streets, pavement markings, special graphics, traffic calming devices, and wayfinding can make relatively low volume streets even more comfortable for a broad range of users. On higher volume segments, parking limitations and bike lanes may be considered. These Neighborhood Bikeways are also fundamental to the community pedestrian network, and should have continuous, barrier-free sidewalk access along at least one side of the street.

Some of the proposed on-street routes include new street segments that do not currently exist, but are logical street extensions of gap fillers that should occur with development. These include Clark Street between Norbeck and Crawford and Norbeck between Clark and Main. Others involve short segments of shared-use paths to maintain continuity.

Major Lane Revisions. These on-street routes propose substantial reallocation of road width to provide a level of user comfort and separation appropriate to their higher traffic volumes and operating speeds. These streets, including Cherry and Crawford, have adequate width to accommodate separated facilities like protected bike lanes.

Downtown Loop. The combination of head-in diagonal parking and offset intersections along Main Street creates conditions that many bicyclists find uncomfortable. While Main Street should continue to permit bicycling at the rider's discretion, the network envisions a circulator loop that serves all major downtown destinations and is enhanced by bicycle parking and other features. Intersections would also be redesigned to create safer travel across Main Street. Legs of this loop include National on the north, High/Austin on the west, Elm/Church on the east, and Kidder on the south.

Campus Circulator Route. This concept designates and adapts selected roads and paths both within the USD campus

and radiating from it to connect to the rest of the citywide network and major destinations of interest and necessity to students, such as Downtown, Walmart, and Hy-Vee. Route designations on-campus must be developed in cooperation with USD administration and staff.

Regional Recreational Routes. These on-road routes continue into the region beyond Vermillion's corporate limits, using low-volume county roads or highways with paved shoulders to connect to recreational destinations such as Clay County Park. Most of these routes are paved, but some section line gravel roads are also open to recreational use.

Neighborhood Connectors. These are very low traffic on-street routes that connect the principal network to specific neighborhoods. In most cases, they run parallel to other network facilities, but loop through adjacent residential neighborhoods.

Dual Use Promenade. This specialized facility would modify the wide sidewalk along the south side of Cherry Street through the USD campus, between Dakota and Plum, to provide separate tracks for bicycle and pedestrian use. This technique has been used at campuses including the University of Colorado and Washington University in Saint Louis.

Shared-Use Paths. Shared-use paths, providing fully separated facilities outside of street or road channels, are already popular in Vermillion and provide the insulation from motor vehicles that many bicyclists prefer. Vermillion, in common with many cities, currently has two types of separated shared-use paths:

- Off-road paths and trails, on their own right-of-way and substantially separated from roads, although they may follow roads for relatively short distances. The Vermillion River Trail is an example of such a facility.
- Sidepaths, paths built to full trail standards, but parallel to and within or adjacent to the right-of-way of streets and roads. The Highway 50 and Stanford Street Paths are examples of sidepaths. Sidepaths are most satisfactory when driveway and street interruptions are limited.

- The proposed network recommends key extensions of shared use paths along the Highway 50 bypass corridor, reconstruction of flood-damaged segments of the River Trail and its extension east to the Crawford Street Sidepath, and short but strategic segments along Cherry and Dakota Streets.

Perimeter Loop. A significant element of the completed network is the Perimeter Loop, providing a continuous route around the outside of the city. Existing segments follow Stanford and the SD 50 bypass from Main to Dakota; and the Vermillion River Trail (including the flood-damaged segment) from east of University to West and Dawson Road. Network segments to complete the Loop include a shared use path from Dakota to Crawford and Cherry; adaptation of Crawford as a bikeway to Crestview; a shared use path from Crawford to the current trailhead near University; and the rural system on the west edge of the city using low-traffic Dawson Road, SD-19 and SD-50 with paved shoulders (including a river crossing); and West Main or SD-50 with paved shoulders back to Stanford.

Figures 3.8 and 3.9 summarize the components of the recommended Vermillion network, keyed to Figure 3.7, the Network Plan. The summary identifies:

- The endpoints of each route or segment.
- The major destinations served.
- The highlights and purpose of each route.
- The general infrastructure types and approaches used for each component.

Figure 3.10 illustrates the application of specific infrastructure types for each route, which are then explained in the following discussion. The actual design concepts, details, and statements of probable cost for each route are then presented in Chapter Five.

FIGURE 3.7: Proposed Vermillion Bikeways Network

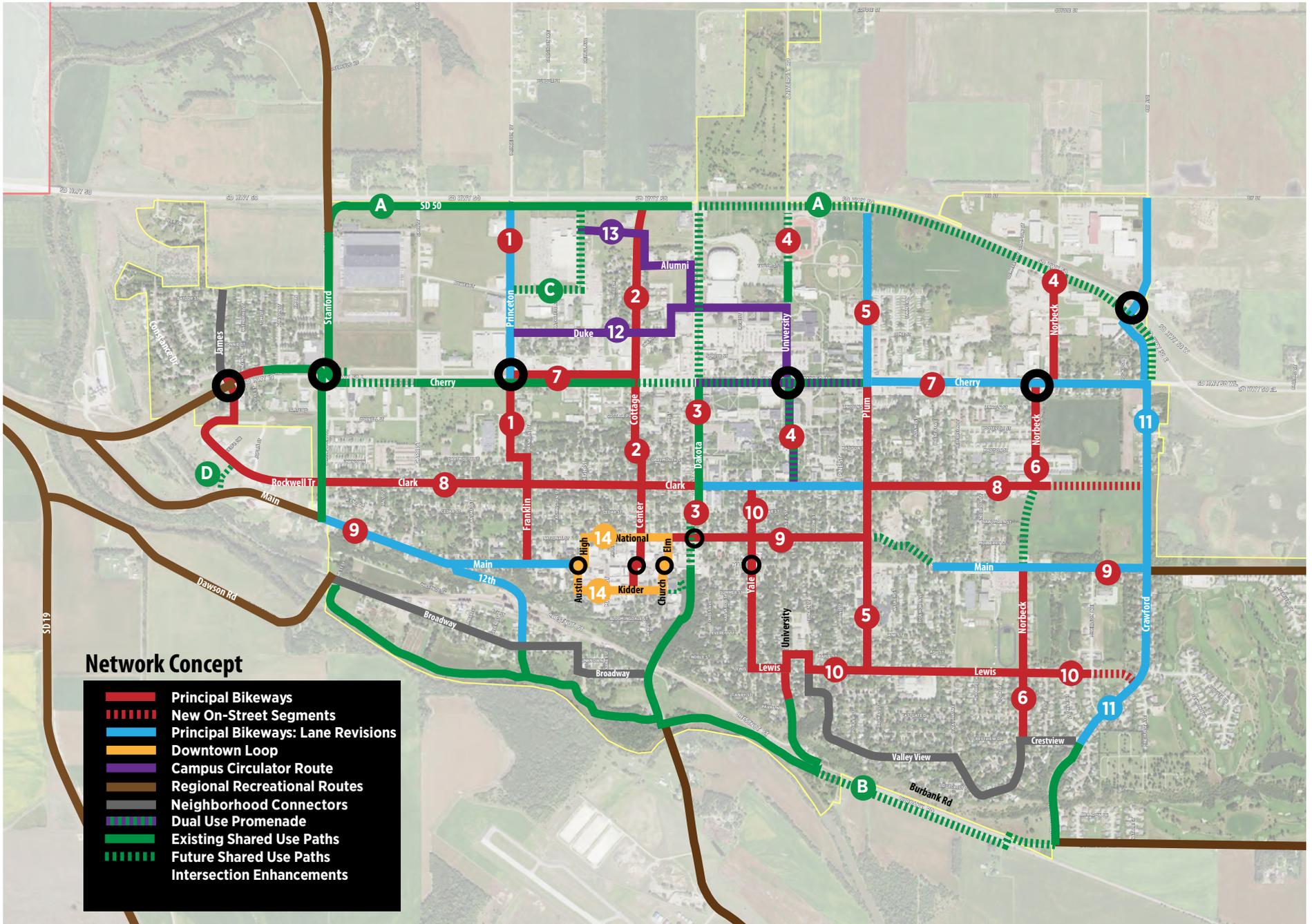


FIGURE 3.8: Summary of Network Routes

Map Line	Name	Endpoints and route	Major Destinations Served	Highlights	Infrastructure approach
1	Princeton/ Franklin	SD 50 Trail (N) to Main St (S)	Trail, Walmart, Hy-Vee, Lions Park, Middle School, County Courthouse	Major north-south route with access to major shopping destinations and middle school.	Bike lanes on Princeton segment, neighborhood bikeway on Princeton and Franklin south of Cherry, with jog at Dartmouth St. Enhanced intersection at Cherry Street signal.
2	Cottage/Center	SD 50 Trail (N) to Downtown at Kidder Street (S)	Trail, Walmart, Downtown center, City Hall, post office	Major north-south route paralleling Dakota Street and providing direct access to the center of downtown.	Neighborhood bikeway
3	Dakota Street Bikeway	SD 50 Trail (N) to Cotton Park (S)	USD, Downtown, Cotton Park and River Trail	Sidepath connection to SD 50; Gap filling path to connect wide path north of Cedar with sidepath to Cotton Park south of Main	Shared-use path segment linking to SD 50 Trail; In city crossing at Cedar from east to west side of street. Continues on east side to Main. Connects to Downtown Loop at National.
4	University Bikeway	Taylor (N) to Clark (S)	Dakota Dome, fields, art galleries, campus housing, Student Center, academic mall, National Music Museum	Main public axis through center of USD campus.	Sidepath connection from existing campus paths to SD 50. Dual use promenade on campus segment, existing east side sidepath and new bike lanes north of Cherry.
5	Plum	SD 50 (N) to Lewis St (S)	USD ballfields and housing, Cherry Street commercial corridor, Prentis Park, Sanford Vermillion Medical Center, St Agnes School	Destination rich north-south corridor with access to hospital and major community park	Neighborhood bikeway, with possibility of one-sided parking and standard bike lanes. Traffic calming techniques should be considered during all installations of neighborhood bikeways especially in higher volume segments. Intersection enhancements at Clark and Main.
6	Norbeck	SD 50 (N) to Crestview and Crawford Street sidepath (S)	High density housing areas, Cherry Street commercial corridor, Vermillion High, Crawford path and Old Vermillion district	North-south neighborhood link serving multifamily housing areas. Currently defined as a bikeway by shared lane markings. Continuity is broken between Clark and Main	Neighborhood bikeway with shared lane markings. Shared-use path between Clark and Main, aligned to parallel future street extension with development.
7	Cherry Bikeway	James (W) to Crawford (E)	Westside neighborhoods, Stanford Sidepath, Polaris, Barstow and Lions Park, Hy-Vee, USD campus, East Cherry commercial corridor, outer trail loop.	Main east-west community corridor, incorporating major commercial destinations and USD campus core.	West: Paved shoulders along roadway and shared use path on south side of the street. Existing shared use path is upgraded and extended west to Stanford. Campus Core: Dual-use promenade with defined pedestrian and bicycle tracks. East: Lane reallocation to 3-lane section, with two way turn lane and buffered bike lanes.

FIGURE 3.9: Summary of Network Routes

8	Clark	Cherry and Kennedy (W) to Crawford (E)	Westside neighborhoods, Stanford sidepath, Middle School, Barstow Park, Rachel L. Austin School, USD campus, National Music Museum, Prentis Park, Eastside multifamily housing	Main east-west neighborhood bikeway, with excellent connectivity, linking the campus to other city destinations and routes. Serves high density residential areas, connecting them to campus.	Neighborhood bikeway with bike lanes and one-sided parking in higher traffic segment between Dakota and Plum. Extension from Norbeck to Crawford with future development.
9	Main/National	Stanford (W) to Crawford (E)	Stanford Sidepath, County Courthouse, Downtown, Dakota Street Trail, Prentis Park, Medical Center, High School, Golf Course	Main east-west bikeway through city center, linking several civic destinations. Connects to Old Vermillion and Cotton Park and regional recreational routes, including a spur along using 12th Street to the original town.	Bike lanes on Main Street segments west of High and east of Prentis Park. Neighborhood bikeway along Downtown Loop and National between High and Prentis Park, with trail connection through park.
10	Yale/Lewis	Clark (N) to Crawford St (E)	USD, Jolley School, Southside neighborhoods, Crawford Sidepath	L-shaped route connecting USD with southern residential tier of the city	Neighborhood bikeway with enhanced crossing at Main
11	Crawford Rd	317th St (N) to Crestview (S)	Masaba and northside industries, developing westside neighborhoods, Bluff View Cemetery, River Trail via Burbank Road	Westside leg of peripheral trail loop, and connection to westside neighborhoods.	Protected two-way bike lane with one-sided parking from Cherry to Crestview, connecting with sidepath to the south. Shared use path north of Cherry, connecting with SD 50 paths. Enhanced crossing of SD 50 to industrial area.
12	Campus Circulator System				
	Duke Transverse	Princeton (W) to University (E)	Westside retail (Walmart/Hy-Vee), lodging, campus housing, welcome center	East-west connection from campus center and University axis to major off-campus centers for goods and services	Bike lanes on Duke from Princeton to Elm with one-side parking or neighborhood bikeway, shared route on Elm, shared-use path to University. Enhanced crossing at Dakota
	Alumni	Shriner at Walmart (W) to Duke and Dakota (E)	Walmart, Alumni House, DakotaDome	Connection from campus center and University axis to major off-campus centers for goods and services	Shared route on Shriner, standard bike lanes with one-side parking on Alumni, shared-use path on Dakota to Duke.
14	Downtown Loop	Circular route around Main Street core	All downtown destinations, public library	Bike circulator loop serving Main Street destinations while avoiding potential crash hazards on Main itself. Anticipates a bike hub (parking and services) on city parking lot at Kidder, bike parking and other enhancements along loop	Differs depending on geometry and parking constraints. In general, standard bike lanes adjacent to parallel parking, painted buffer behind head-in diagonal parking with shared lane markings in center of travel lane. Enhanced intersections at High/Austin and Elm/Church, integrated into streetscape plan.

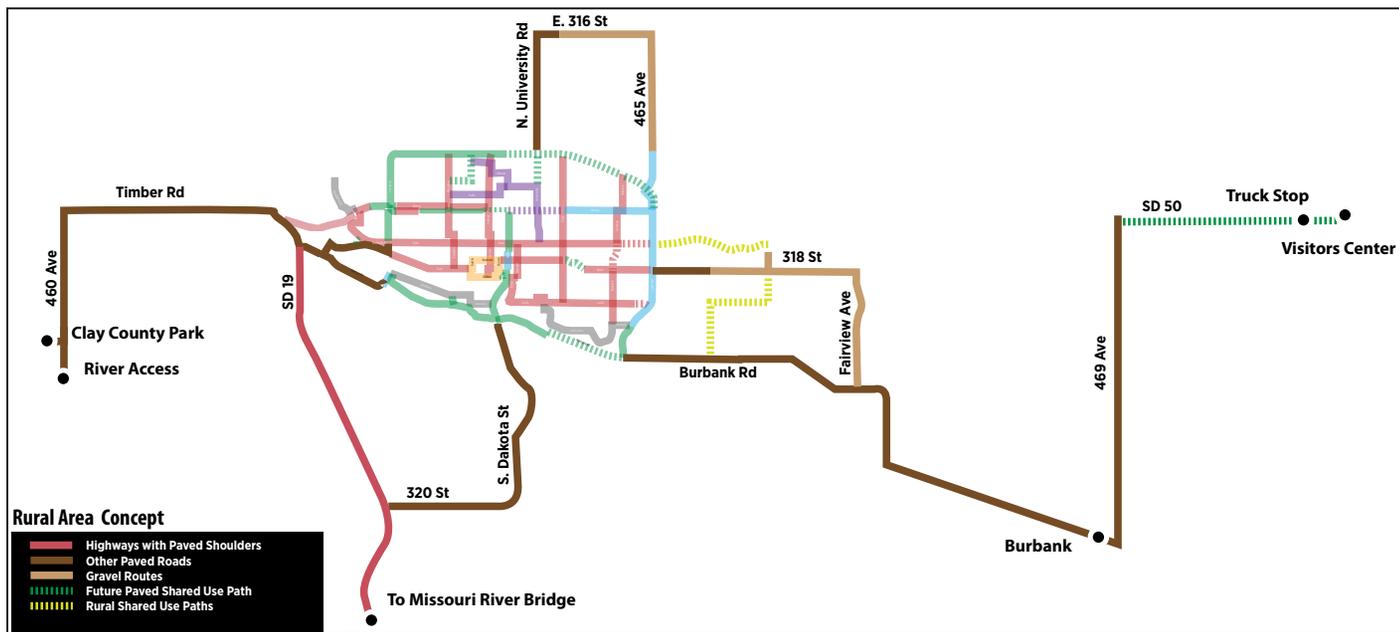
FIGURE 3.10: Summary of Network Routes

Map Line	Name	Endpoints And Route	Major Destinations Served	Highlights	Infrastructure Approach
A	Outer Loop Trail North Leg	Dakota (W) to Cherry and Crawford (E)	Polaris, USD athletic facilities and parking, westside neighborhoods	With Crawford Rd upgrades, completes peripheral loop.	Shared-use path on south side of SD 50. Total length: 1.5 miles
B	Outer Loop Trail South Leg Vermillion River Trail extension	Existing trail terminus on Burbank Rd east of University to Crawford Rd	Old Vermillion, Cotton Park, Vermillion River Trail	Element of outer loop, connecting Crawford and SD 50 segments to River Trail. Anticipates reconstruction of damaged River Trail to Broadway.	Shared-use path on south side of railroad track. Possible trailhead at city lift station. Crosses railroad at existing drive to lift station. Total length: 0.7 miles
C	Walmart Loop	SD 50 (N) to Princeton (W)	Walmart, Outer Loop Trail, other Princeton Ave retailing	Off-street distributor loop directing campus route on Shriner to major retail centers	Shared-use path along east buffer strip of Walmart and along Bower Street to Princeton. Total length: 0.4 miles
D	Main-Rockwell connector	Rockwell Trail (N) to Main (S)	New residential development	Short connection from new housing development to Main Street corridor	Shared-use path. Total length: 0.1 miles



Elements of the Perimeter Trail Loop. Above: Vermillion River Trail. Right: Sidepath segment along Stanford Street.

FIGURE 3.11: Rural Area Framework



RURAL FRAMEWORK

While bicycle transportation within the city limits of Vermillion is the focus of this plan, bicyclists travel through the broader region to specific destinations and for recreational purposes. Figure 3.11 above illustrates a framework of rural routes that serve developed areas or destinations, showing how they relate and extend the city network. These routes, which generally include paved roads and highways with and without shoulders and gravel roads generally do not require capital investment other than wayfinding signs. They include:

- A route along Timber Road and 460th Avenue to Clay County Park and its river access..
- A relatively flat route that completes a full outer loop, using Dawson Road, the SD 19 (with a crossing over the Vermillion River) of Main and both Main and Cherry Street to Stanford Street.
- Burbank Road to Burbank and continuing along 469th Avenue and SD 50 to the Coffee Cup Truck Stop and South

Dakota Visitor Center at Exit 26 on Interstate 29. This route proposes a two mile trail along SD 50.

- SD 19, to the Missouri River bridge to Nebraska and the Outlaw Trail Scenic Byway (Nebraska Highway 12).
- Loop routes including 320th Street and S. Dakota Street; University Road, 316th Street, and 465th Avenue that includes some gravel riding; and 318th Street (Main Street extended) and Fairview Avenue.
- A rural shared use path around The Bluffs Golf Course and paralleling East Main as a greenway incorporated into development east of Crawford Road.

BICYCLE FACILITY TYPES - OPTIONS

Table 3.12 summarizes the types of facilities included in the Vermillion system while Figure 3.13 applies these types to the Vermillion network. The following section provides a more complete description of the infrastructure treatments included in the recommended network. It describes these infrastructure types, their benefits, and potential design considerations.

Community members may use this chapter to understand the terminology and possibilities for bicycle facilities. City and DOT staff who plan and design transportation facilities may use this toolbox in conjunction with design manuals adopted by the City of Vermillion and the South Dakota Department of Transportation. Other vital sources of information that designers of specific facilities should consult include:

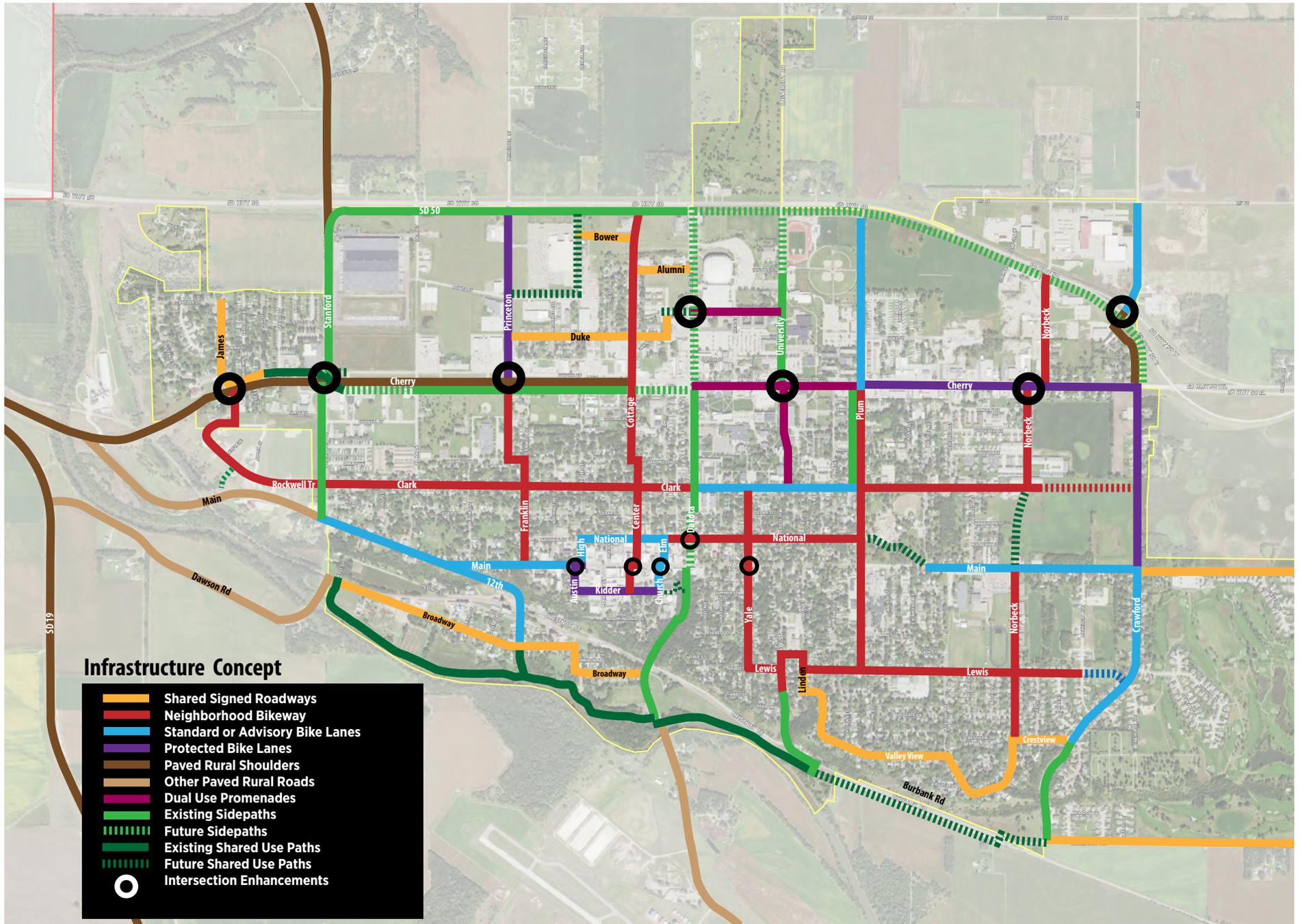
- Federal Highway Administration, The Manual for Uniform Traffic Control Devices, 2009 edition.
- American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities, 4th Edition, 2012 (in process of being updated)
- National Association of City Transportation Officials, Urban Bikeway Design Guide, 2nd Edition, 2014
- Federal Highway Administration, Small Town and Rural Multimodal Networks, 2016

Facility types will evolve over time. As the years go by, this chapter should be updated to reflect the latest experience of transportation professionals working for the City of Vermillion and its partners. Research by government agencies and professional organizations should also inform future updates.

TABLE 3.12: Facility Types in the Vermillion Network

	Context	Examples
Shared-Use Paths: Exclusive Right of Way	Trails or paths on right-of-way separated from roads. May follow roads for short distances. Paved within the Vermillion urban area	Vermillion River Trail
Shared Use Paths: Sidepaths	Trails or paths located on or adjacent to road or street right of ways.	Highway 50 Path, Stanford Street Sidepath
Dual Use Promenade	Joint pedestrian and bicycle use of a path, providing separate tracks for each mode. Typically wider than a standard shared use path.	Cherry Street between Plum and Dakota
Separated Bike Lanes	One- or two-way bike lane (or cycle track) within a street channel but separated from motor vehicle travel lanes by some form of physical barrier.	Downtown Loop
Buffered Bike Lanes	Directional bike lanes buffered from adjacent motor vehicle travel lanes or parked cars by buffer space, typically defined by paint.	Cherry, Crawford, Princeton
Standard Bike Lanes	Defined territory for bicycle travel distinct from motor vehicle travel lanes, typically defined by painted striping.	Princeton, Main, segments of Clark
Neighborhood Bikeway	Low volume streets with good continuity, with features designed to manage local traffic speeds and attract bicycle travel.	Center, Lewis, Clark
Shared Route (Shared Lane Markings)	Low volume streets defined as bike routes or connectors with infrastructure typically limited to signage and pavement markings	Broadway
Paved Shoulders	Hard-surfaced areas adjacent to and outside of normal travel lanes, typically on rural section streets, roads, and highways.	SD 19 to the Missouri River bridge, Main Street west of Vermillion
Advisory Bike Lanes	Suggested areas for bicycle travel, usually designated by dashed pavement markings, on low-volume streets where bike lanes are desirable but street width is inadequate for standard lanes.	

FIGURE 3.13: Facility Types Applied to the Vermillion Network





Well-marked crossings are important to improve safety of shared use sidepaths. They alert motorists in both directions to the presence of the path and tend to prevent motorists on intersecting streets from blocking the path by stopping on the crosswalk. (Clayton Road, Saint Louis County, MO)



Shared use paths can be developed along active railroads, but often require a fenced separation.



Shared use paths may be used in conjunction with bike lanes to provide alternatives for bicyclists of different capabilities.

SHARED-USE PATHS

Shared-use paths provide a shared space for bicycling, walking and other non-motorized uses. They offer a high-quality bicycling environment preferred by a wide range of people. Some shared-use path facilities provide designated lanes for bicycles and pedestrians, especially where there are higher volumes. Sometimes shared-use paths are outside of the street right-of-way, and often are sited along abandoned or active rail corridors, bodies of water, and parks.

DESIGN CONSIDERATIONS

- High separation from vehicles.
- Minimum width is eight feet with a two-foot clear zone on each side (two-way).
- Preferred width is 10 feet or greater with a two-foot clear zone on each side (two-way).
- Major road crossings may have signals, crossing beacons, refuge islands, or bridges and underpasses, where needed as determined through the Federal Highway Administration's (FHWA) Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations.
- Can provide connections along non-roadway corridors (e.g. rivers and railways).
- Preferably applied on medium to high-volume streets with an average daily traffic count of above 6,000 motor vehicles. Exceptions may be made for streets near K-12 schools, and locations where average operating speeds are greater than 30 mph.
- Unlike exclusive bicycle facilities, shared-use paths must be designed in accordance with applicable Americans with Disabilities Act requirements (typically the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way).



Dakota Street Sidepath, linking Downtown Vermillion with Cotton Park and the Vermillion River Trail.



Razorback Greenway in Fayetteville, Arkansas, an unusually well-designed facility that has become a regional transportation artery in Northwest Arkansas.

SEPARATED BICYCLE LANES

A separated bicycle lane, sometimes called a cycle track, is a bikeway facility that is physically separated from motor vehicle traffic with a vertical object. A separated bicycle lane may be constructed at street level, sidewalk level, or intermediate height. Separated bicycle lanes isolate bicyclists from motor vehicle and pedestrian traffic using a variety of methods, including on-street parking, landscaping, curbs, raised concrete medians, or flexible delineators (also known as bollards and flex posts). Separated bicycle lanes provide cyclists with a higher level of comfort compared to buffered or standard bicycle lanes and are typically used on arterial streets where higher motor vehicle speeds exist.

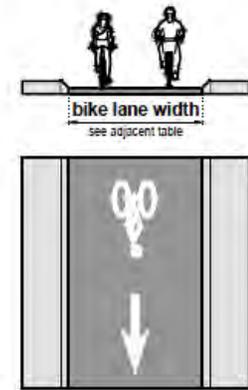
DESIGN CONSIDERATIONS

- Preferred width is 6.5 feet for a one-way facility, allowing for passing; 11 feet is preferred for a bi-directional facility.
- Minimum width is five feet for a one-way facility, and 10 feet for a bi-directional facility.
- Preferably applied on medium- to high-volume streets with an average daily traffic count of above 6,000 motor vehicles. Exceptions may be made for streets near K-12 schools, and locations where average operating speeds are greater than 30mph.
- Separated bicycle lanes require varying widths of buffer space between the bicycle lane and the adjacent lane. Small barriers such as flexible delineator posts or removable curbs can be separated with a minimum 2-foot buffer. In general, a 6-foot buffer is preferred for all separation methods.

Similar to shared-use paths, streets with separated bicycle lanes should have carefully designed intersections in order to function properly and ensure the safety of all users. Intersections with separated bicycle lanes may require adjustments to signal timing and phasing and/or modifications to pavement and curb sections.

The installation of separated bicycle lanes can create more challenging scenarios for street maintenance, particularly in winter. For bikeways under eight feet in width, it is advisable to acquire sidewalk maintenance vehicles that are narrower and can easily navigate the bicycle lanes. Several companies produce utility tractors with multiple attachments, which allow for greater versatility and year-round use. Specialty tractors around five feet in width can navigate narrower one-way separated bicycle lanes to complete sweeping and plowing maintenance.

Separated bicycle lanes should be maintained seasonally as necessary, which may include sweeping, plowing snow, or spreading sand and or salt. On wider, bi-directional separated bicycle lanes that are eight feet wide or greater, maintenance activities can generally be done with a light-duty pick-up truck, including snow plowing.



One-way separated bike lane using flexible delineators in Downtown Evanston, IL.

Peak Hour Directional Bicyclist Volume	Bike Lane Width (ft)	
	Preferable	Minimum*
<150	6.5	5
50-750	8	6.5
>750	10	8

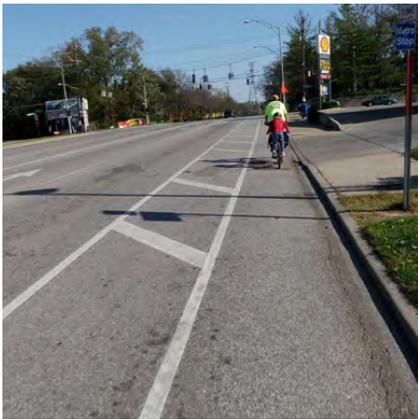
*Constrained width may be as low as 4 feet for short distances.



Two-way cycle track separated by vertical curb and parking from adjacent travel lanes (Broadway in Seattle, WA)



Buffered bike lane with on-street parking. The buffer separates the bike lane from the travel lane.



Buffered bike lane on an arterial street with no on-street parking.

Right: Transition from a buffered to a standard bike lane, a condition that may occur in the Vermillion network along Princeton. (Boulder, CO)

BUFFERED BIKE LANES

Buffered bike lanes enhance standard bike lanes with additional striped or buffered space between people biking and motor vehicles. A buffer can be incorporated to the right of the bicycle lane, protecting people biking from the door zone of parked vehicles or to the left of the bicycle lane, increasing lateral separation between bicycles and passing motorists. This application is most appropriate on streets with moderate motor vehicle volumes. Sometimes, right-of-way is limited and creating space for the buffer means narrowing or removing parking or space from other lanes. Similar to standard bicycle lanes, buffered bicycle lanes can be a low-cost retrofit as part of paving or restriping.

DESIGN CONSIDERATIONS

- Typically used on streets with moderate traffic volumes (1,500 to 6,000 vehicles per day) and speeds (20 to 30 mph).
- Typically used on streets with available width, but without high enough vehicle volumes and speeds to warrant physical separation with vertical objects.
- Minimum width is five feet (parking adjacent) to six feet (curb adjacent).
- Minimum buffer width is two feet.



Buffered bike lane with buffer separating bicycles and on-street parking. This arrangement uses parked cars to provide additional separation. (Armour Boulevard, Kansas City, MO)



Green paint is used to mark conflict zones as motor vehicles cross the bike and buffer to make right turns.

STANDARD BIKE LANES

Standard bicycle lanes provide a dedicated space for bicycling alongside motor vehicle traffic, using striping, signing, and pavement markings. They reduce the need for people riding bicycles and people driving cars to negotiate for space on a street. Bicycle lanes can be a low-cost option when adequate right-of-way is available, and often can be incorporated into street paving, sealcoating, and restriping projects.

DESIGN CONSIDERATIONS

- Bicycle lanes are separated from travel lanes by solid white lines.
- Typically used on streets with moderate traffic volumes (1,500 to 6,000 vehicles per day) and speeds (20 to 30 mph)
- Minimum width is five feet (parking adjacent) to six feet (curb adjacent)



Above: Enhanced standard bike lanes, using green paint to increase visibility, highlight the bike lane pavement marking, and define conflict zones and intersections. (North Avenue, Wauwatosa, WI)



Mini-traffic circles can be used to calm motor vehicle traffic on neighborhood greenways. (Berteau Avenue neighborhood bikeway, Chicago)



Distinctive street signs can mark Neighborhood Bikeway routes. (5th Street, Topeka, KS)



Clark Street in Vermillion

NEIGHBORHOOD BIKEWAYS

A neighborhood bikeway is typically suited for lower speed and volume streets. It can attract bicycle riders with pavement markings, signs, safer crossings of busy streets, adjustment of two-way stop controlled intersections to prioritize bike movements, and traffic calming (e.g. curb extensions, speed humps, miniature traffic circles, vehicle diverters). Neighborhood bikeways are intended to improve safety and comfort, and provide an alternative to higher speed roadways that are more intimidating for those with less experience or confidence bicycling.

DESIGN CONSIDERATIONS

- Used on lower traffic side streets (generally fewer than 1,500 vehicles per day), with speeds between 10 and 25 mph.
- No centerline striping and no impact to parking, except where needed to improve sight lines at intersections.
- At two-way stop controlled intersections, priority is generally given to the neighborhood bikeway. This may require an engineering study and City Council approval, and will likely require traffic calming on the neighborhood bikeway.
- Traffic calming should be used in conjunction with stop sign changes, to prevent neighborhood bikeways from attracting higher volumes of people driving.
- Major road crossings may have signals, crossing beacons, or refuge islands, where needed as determined through FHWA's Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, or other standards.
- Pavement markings typically include bicycle symbols in the center of the driving path of motorists. Large bicycle symbols (approximately 6' in width by 10' in height) may be placed once per block in each direction.
- Small bicycle symbols (approximately 2.5' in width) may be placed three times per block in each direction. These may or may not include chevrons.
- Identification signs are typically placed at each intersection, in place of or alongside street name signs.



SHARED LANE MARKINGS

Shared lane markings, also known as sharrows, are used as a low-cost awareness device on streets where bicycles and motor vehicles must take turns using the same travel lane. Shared lane markings help position bicyclists in the most appropriate location to ride within the travel lane, far enough away from the roadway edge or parked cars. They also provide a visual cue to motorists that bicyclists should be expected in the street. They are amongst the least comfortable bicycle facilities for majority of the public, particularly when placed on moderate- or high-volume streets, and should only be used on low-volume routes, or in locations where a short gap between other types of bicycle facilities needs to be bridged.

DESIGN CONSIDERATIONS

- Shared-lane markings should be placed at least 4 feet (on center) from the face of curb where on-street parking is prohibited, or 11 feet (on center) from the face of curb where on-street parking is allowed.
- Shared lane markings are not appropriate on streets with operating speeds greater than 25 mph, where motorists and bicyclists can safely and reasonably travel at the same speed.
- Shared lane markings should not be used for several blocks in a row, rather they should be used as a measure of last resort, where barriers prevent a bicycle lane from being developed over a short distance.
- The “Bicycles May Use Full Lane” sign (R4-11 in the MUTCD) is commonly used in conjunction with shared lane markings (Figure 9C-9 in the MUTCD).
- Shared lane markings should be epoxy or thermoplastic, for greater longevity and durability.



Green background behind a shared lane marking dramatically increases the symbol's visibility on the street. Image below shows green-backed shared lane marking and R4-11 sign.(Boulder, CO)



SD 19 between Vermillion and the Missouri River Bridge to Nebraska and West Main - paved shoulders on the Vermillion area network.

PAVED SHOULDERS

A paved shoulder may be used along low- to moderate-volume roads in suburban and rural areas with long distances between intersections and access points. A paved shoulder improves connections where sharing a travel lane would be inappropriate and a shared-use path has not yet been planned or constructed. Shoulders may be marked as bicycle lanes when five feet or greater in width. Shoulders' drawbacks, including frequent interruption by turn lanes or bypass lanes and ambiguous legal standing, as well as their location along busy roads, make them a higher stress experience for most bicycle riders.

DESIGN CONSIDERATIONS

- Preferred on roads with moderate traffic volumes (3,000 to 9,000 vehicles per day) or speeds (40 mph or less), although they may be used on roads of any volume or speed.
- Shared with pedestrians and slower moving tractors and buggies, and used for motor vehicle emergency pull-off.
- Minimum paved shoulder width is five feet (exclusive of rumble strips). Increasing the width is preferable if motor vehicle speeds exceed 40 mph, or if used by heavy trucks exceeds 10 percent of daily traffic.
- Where bicycle use is expected in a shoulder, the shoulder striping at intersections and driveways should transition to a dotted edge line to encourage motorists to yield to bicyclists, rather than tapering to the roadway edge.
- At right turn lanes, shoulders should transition to separated bicycle lanes, standard bicycle lanes, or shared-lane markings, depending upon motor vehicle volume and speed.
- White solid edge line markings may be eight inches or greater, or a buffer stripe may be added, to improve the comfort of bicyclists operating in the shoulder.



West Cherry Street

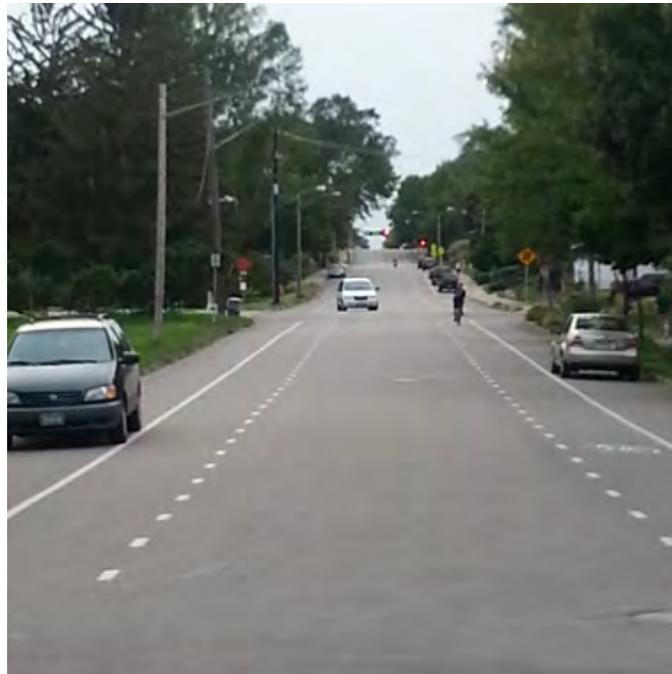
ADVISORY BICYCLE LANES

Advisory bicycle lanes, also known as suggestion lanes or dashed bicycle lanes, are typically applied on low- to moderate-volume and speed streets that are narrow and do not have enough space to accommodate standard bicycle lanes. Advisory bicycle lanes are similar to standard bicycle lanes, although because of the constrained space the centerlines on the roadways are removed to create one very wide lane that is shared between vehicles traveling in both directions. Streets with this facility type are marked to provide two separate standard width bicycle lanes on both sides of the road.

The dashed markings give bicyclists a dedicated space to ride, but are also intended to be available to motorists if space is needed to pass oncoming traffic and the bicycle lane is not being used by a bicyclist. Motorists yield to bicyclists in the advisory bicycle lane and wait to pass around the outside of bicyclists when there is no oncoming traffic.

DESIGN CONSIDERATIONS

- Typically used on streets with moderately low traffic volumes (1,500 to 3,000 vehicles per day) and speeds (20 to 25 mph), too busy to be a neighborhood bikeway.
- Minimum width is five feet (parking adjacent) to six feet (curb adjacent).
- Center bi-directional motor vehicle drive lane should be 16 to 18 feet wide.
- Advisory bicycle lanes have been developed on lower volume, lower speed roads as a more robust alternative to shared lane markings, providing more separation between bicyclists and automobile traffic. When advisory bicycle lanes are applied to roads with on-street parallel parking, the advisory bicycle lane is marked with a solid white line on the right (adjacent to the parked cars) and a dashed line on the left (adjacent to the drive lane).





GREEN COLORED PAVEMENT

Most motor vehicle crashes involving bicycles in urban areas occur at intersections. Good intersection design makes bicycling more comfortable, reduces conflicts with motor vehicles and pedestrians, and contributes to reduced crashes and injuries for all modes. Green colored pavement increases the visibility of bicyclists and provides a clear route for bicyclists through intersections. It also encourages turning motorists to yield to bicyclists, who have the right-of-way when passing straight through an intersection.

The use of green colored pavement is considered a traffic control device, the use of which is currently governed by FHWA Interim Approval IA-14.

DESIGN CONSIDERATIONS

- To the maximum extent possible, bikeways should be continuous through intersections. Dedicated bike lanes should be provided on all intersection approaches where space is available.
- At intersections with a dedicated right turn lane, bike lanes should be provided to the left of the right turn lane to minimize conflicts with motor vehicles.
- May also be used at high volume driveways.
- Corridor-wide intersection treatment can maintain consistency; however, spot treatments can be used to highlight conflict locations.
- Typically applied using ground-in or heated thermoplastic.
- Commonly used in conjunction with dotted lane extensions, with green colored pavement filling the area between the lane extensions (as shown in the figure above and on the following page)



BICYCLE SIGNALS

Bicycle signals can provide clearer direction to bicyclists crossing signalized intersections that they may enter an intersection. This is particularly important at locations where bicyclists may be provided an advance or exclusive phase. At locations (typically shared use path crossings) where cyclists are expected to follow pedestrian signals, under present law and timing practices, bicyclists may only “legally” enter the crosswalk during the solid WALK portion of the signal, but the solid WALK portion is significantly shorter than the entire WALK time. This often results in bicyclists disobeying the flashing DON’T WALK portion of the cycle which can lead to them being caught in the intersection during the change interval. Providing bicycle signals allows for a longer display of green as compared to the walk signal, which significantly improves compliance with traffic control.

DESIGN CONSIDERATIONS

- Bicycle-specific signal heads are similar to conventional signal heads, but instead of solid red, yellow, or green lights, they consist of an illuminated red, yellow, or green bicycle symbol.
- Bicycle signals operate as part of a phased system and facilitate movements of different legs of an intersection of roadways and/or shared-use paths.
- Bicycle signals recognize that bicyclists have different travel patterns than cars: they are likely to have slower travel speeds, may need to access different areas of the intersection, or have different movements through an intersection.
- Bicycle signals can help mitigate potential conflicts between bicyclists, motorists, and pedestrians that conventional red, yellow, green, or pedestrian signals may cause.
- Bicycle-specific signals can give protected (motor vehicles are stopped), leading (bicycles have a head start), or concurrent indications (motor vehicles and bicycles go at the same time).

- FHWA has currently given bicycle signals interim approval only for use where the bicycle movement is protected from any simultaneous motor vehicle movement at the same location. A request to experiment may be required where a permissive motor vehicle turning movement is allowed across a bikeway protected by a signal with a bicycle lens.
- Bicycle signals should typically be deployed in conjunction with bicycle detection or push buttons.



CROSSING BEACONS

Crossing beacons assist bicyclists (and pedestrians) with getting across busier streets. Motorists are encouraged to yield through the presence of flashing beacons, signs, and pavement markings. The three types of crossing beacons include hybrid (also known as HAWK signals), rectangular rapid flashing (also known as RRFB's), and warning (also known as yellow flashers).

DESIGN CONSIDERATIONS

- Hybrid beacons display solid red signal indications to drivers when activated, and are recommended for crossing higher speed and volume streets.
- Rectangular rapid flash beacons display yellow LED lights in two rectangular clusters, using a stutter-flash pattern like emergency vehicles, and are recommended for moderate speed and volume streets. The use and design of RRFB's is governed by FHWA's Interim Approval IA-21 .
- Warning beacons display flashing yellow signal indications, and are recommended for lower speed and volume streets.
- Beacons should be activated through active (i.e. push buttons) or passive (i.e. laser) actuation, and should only flash when being used when bicyclists or pedestrians are crossing.
- Lighting improvements should be made in conjunction with beacon installation, if existing lighting at the crossing location is insufficient.
- Hybrid beacons must meet a list of warranted conditions, set forth in the Manual on Uniform Traffic Control Devices.
- Criteria for installing rectangular rapid flash beacons may be developed by local agencies. For example, the Minnesota Department of Transportation has developed a technical memorandum which establishes speeds and volumes that warrant rectangular rapid flash beacons at pedestrian crossings.





Above: Hybrid beacon used in conjunction with a pedestrian/bicycle refuge median (Woodchuck Neighborhood bikeway, Wichita, KS)

A large, mature tree with a thick trunk and dense green foliage stands in the foreground on a well-maintained green lawn. In the background, a large, multi-story brick building with classical architectural features is visible. A paved walkway runs along the right side of the lawn. The scene is brightly lit, suggesting a sunny day.

4 Crossing Intersection Barriers



INTERSECTION CONCEPT NARRATIVES

Intersections in Vermillion are some of the most significant barriers to connectivity, creating challenges for bicyclists who must both navigate through them and cross them safely. This section presents diagrams of preliminary design recommendations for six of the network's most strategic intersections:

- Cherry and Stanford
- Cherry and Princeton
- Cherry and Dakota
- Cherry and Norbeck
- Dakota and National
- Main and Elm (and other Downtown offset intersections)

Intersections were chosen with input from residents and the project team. The recommendations are draft concepts for consideration during the early stages of planning and public review for each project. Enhancements are based upon the bicycle facility preferences chosen by Vermillion residents during the community engagement process for this Plan (see Chapter 2). Recommendations are also based on research, best practice, and local preference.



CHERRY STREET AND STANFORD STREET

This intersection is the crossroads of State Highway Business 50 (Cherry Street) and State Highway 19 (Stanford Street to the north and Cherry Street to the west). It is located on the west side of Vermillion, and is also the junction of existing shared-use paths along Stanford and the proposed Cherry Street Bikeway. The Stanford Street Sidepath and SD-50 are components of the future Perimeter Loop, and the Stanford Street facility transitions from the east side north of Cherry to the west side south of Cherry at this point. The intersection also includes a frontage road on the south side of Cherry Street, to the east of the intersection.

WHY THIS INTERSECTION WAS CHOSEN

Residents of the Westgate Mobile Home Village use this intersection to connect with the nearby convenience store and other Vermillion destinations to the east, including Barstow Park, the Middle School, and Austin Elementary. Shared-use paths along Cherry and Stanford Streets switch sides at this location, which requires 2-stage crossings for east-west and north-south bicycle traffic. There is also a gap in the existing shared use path on the south side of Cherry

Street to the east of the intersection, where bicyclists ride on the frontage road. Finally, the intersection is a key barrier along the Perimeter Loop and was mentioned frequently during the planning process as an especially challenging intersection to cross.

WHAT IT LOOKS LIKE TODAY?

The intersection is wide on all four approaches, with one lane in each direction, as well as center turn lanes and shoulder. Curb radii are large to accommodate turning semi-trucks. The east leg also includes a right turn lane. Stanford is stop controlled, but Cherry Street is not. Crosswalks are located on the west and south legs. The frontage road to the east of the intersection accommodates 2-way traffic, with a westbound “right lane, bicycles only” sign (although no lane markings are present). Along the frontage road, bicyclists and pedestrians use the street since there are no off-street paths or sidewalks.

WHAT IT COULD LOOK LIKE IN THE FUTURE?

- Shared-use path crosswalks can be defined at all four legs, to allow bicyclists a more direct and predictable route to each approach of the intersection. Crosswalks increase yielding behaviors by motorists.



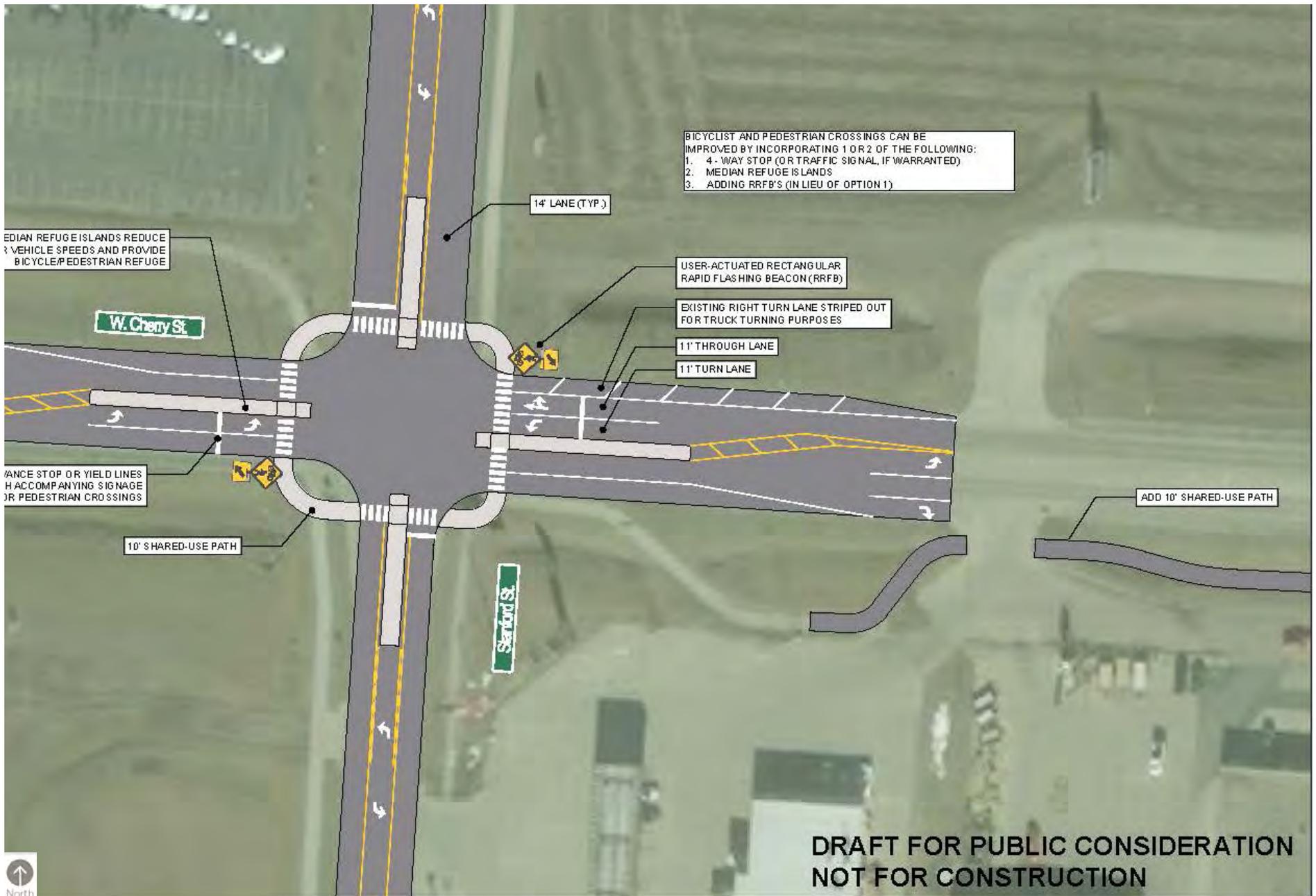


- Crossing islands may be added to each leg of the intersection, to allow a location for a bicyclist/pedestrian refuge and to reduce motor vehicle speeds.
- Each corner can have two clearly defined curb ramps, pointing either north-south or east-west, so that bicyclists are pointing in their direction of travel.
- In the absence of crossing islands, rectangular rapid flashing beacons may be added to make north-south movements across Cherry more safe and comfortable. As an alternative, the intersection may be converted to an all-way stop.
- The frontage road may be altered to raise bicyclist visibility in one of three ways:
 - » Stripe advisory bicycle lanes
 - » Construct a shared use path behind the north or south curb
 - » Convert the frontage road to one-way vehicle traffic, and install a 2-way separated shared use path at street level.



Stanford Street and sidepath north of Cherry Street

FIGURE 4.1: Concept for Cherry Street and Stanford Street Intersection



CHERRY STREET AND PRINCETON STREET

The intersection of Cherry Street (Business Highway SD-50) and Princeton Street is also located on the west side of Vermillion. The signalized intersection includes a shared use path along the south side of Cherry Street.

WHY THIS INTERSECTION WAS CHOSEN?

Princeton Street connects a residential neighborhood to the south with big box retailers to the north. Hy-Vee, Wal Mart, and Barstow Park are popular bicycling destinations, as noted by residents in the community engagement process. Connections between these destinations are not comfortable due to the absence of a north-south bicycle facility on Princeton.

WHAT IT LOOKS LIKE TODAY?

Each of the four approaches has one lane in each direction, as well as center turn lanes. In addition, Cherry Street includes shoulders, making north-south bicyclist movements more exposed to east-west traffic. The stoplight rests on green for east-west traffic, until it is triggered on Princeton by loop detectors for motorists or push buttons for pedestrians. Depending on the type of loop detector used at the intersection and how it's calibrated, it may not detect bicyclists at the intersection.

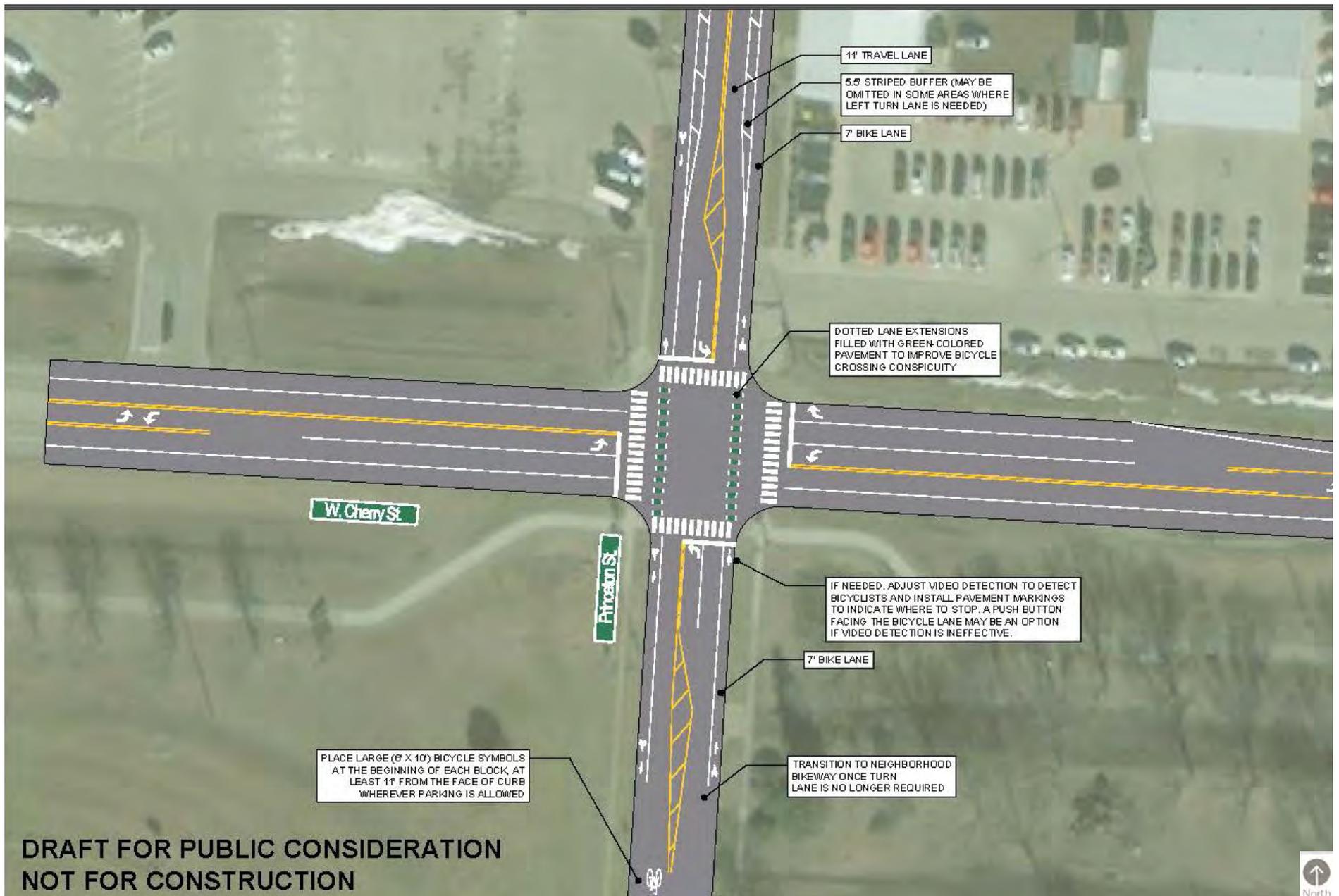


WHAT IT COULD LOOK LIKE IN THE FUTURE?

- At the intersection, travel lanes on the north and south legs can be narrowed to accommodate a 7' standard bicycle lane on each side of Princeton.
- Dotted lane crossings of the bicycle lanes may be striped across Cherry Street, filled with green colored pavement to improve bicycle conspicuity and improve yielding by turning vehicles.
- To the south of the intersection, Princeton may transition to a neighborhood bikeway, allowing on-street parking to remain adjacent to Barstow Park.
- To the north of the intersection, the center turn lane can be removed to allow for buffered bicycle lanes, improving the comfort of bicycling in an area dominated by retail and car-oriented businesses.
- The loop detectors at the signal may be adjusted to detect bicycles in the bike lane at the intersection. Pavement markings may be added to indicate where bicyclists should stop to trigger a signal activation. Should the loop detectors prove ineffective, push buttons on the curb facing bicyclists may be added.



FIGURE 4.2: Concept for Cherry Street and Princeton Street Intersection





CHERRY STREET AND DAKOTA STREET

The signalized Cherry and Dakota intersection, in the heart of Vermillion, is the city's busiest, and is a principal point of entry into the city and the USD campus.

WHY THIS INTERSECTION WAS CHOSEN?

Located at the northwest entrance to the University of South Dakota campus, the intersection of Cherry and Dakota is a problem spot for bicycling. With large numbers of turning motorists and pedestrians, bicyclists do not have predictable paths of travel. College housing units are located immediately to the northeast, northwest, and southwest of the intersection, making this a popular route of travel for



students bicycling to and from campus. A current shared use path on the south side of Cherry also ends at Cottage, leaving no options for eastbound bike traffic.

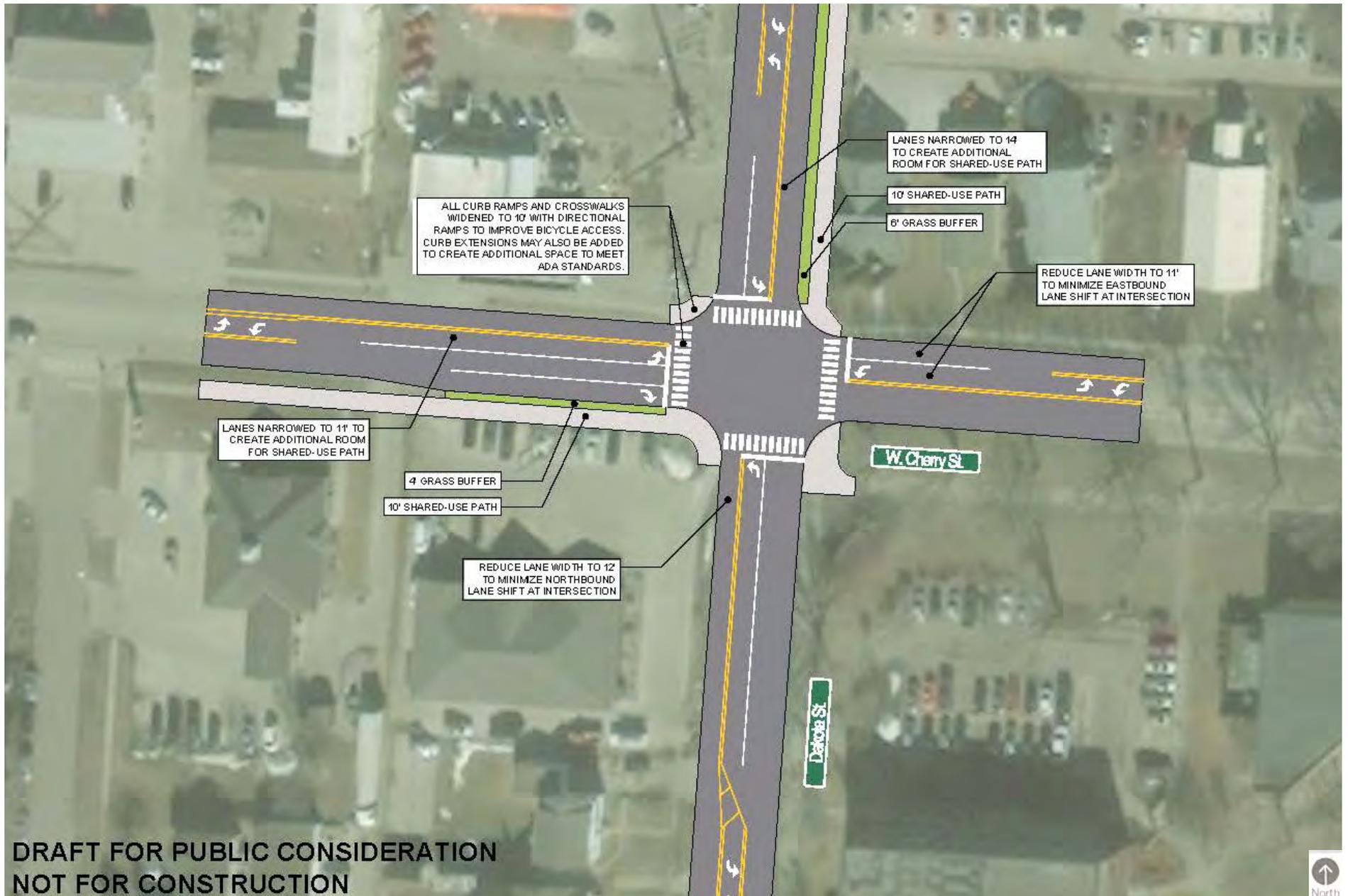
WHAT IT LOOKS LIKE TODAY?

Each of the four approaches has one lane in each direction, as well as center turn lanes. In addition, the west leg of Cherry Street has a right turn lane, and the north leg of Dakota has travel lanes wide enough to accommodate side-by-side vehicles. The stoplight rests on green for east-west traffic, until it is triggered on Dakota by loop detectors for motorists or push buttons for pedestrians. Two out of four legs include shared-use paths: one along the south side of Cherry Street to the east, and another along the east side of Dakota to the south.

WHAT IT COULD LOOK LIKE IN THE FUTURE?

- Travel lanes can be narrowed on all four legs of the intersection, to make space available for shared-use paths on the north and west legs.
- The existing sidewalk on the south side of Cherry Street, west of the intersection, may be widened to 10' with a 4' grass buffer. This change would close a 2-block bicycling gap along Cherry Street, between Dakota Avenue and Cottage Avenue.
- The existing sidewalk on the east side of Dakota Street, north of the intersection, may be widened to 10' with a 6' grass buffer. This path would improve accessibility between the USD campus and rental housing units along Dakota Street.
- All curb ramps and crosswalks may be widened to 10' to allow bicyclists to ride side-by-side with pedestrians. This will reduce the likelihood that bicyclists or pedestrians become caught in the crosswalk due to ramp bottlenecks. Curb extensions may also be added to meet current ADA accessibility standards.

FIGURE 4.3: Concept for Cherry Street and Dakota Street Intersection





CHERRY STREET AND NORBECK STREET

This intersection is located on the eastern section of State Highway Business 50 (Cherry Street), and includes offset north-south approaches with Norbeck Street.

WHY THIS INTERSECTION WAS CHOSEN?

Cherry Street between Plum Street and the eastern city limits was recently rebuilt as a 5-lane section, posing a barrier for bicyclists traveling along and across the highway. Many bicyclists already ride along Cherry Street between Crawford Street and points west. Norbeck Street has already been chosen as a bicycling route to the south, with shared lane markings installed. Because the future bicycle network includes Norbeck, crossing this offset intersection safely is an important network consideration.

WHAT IT LOOKS LIKE TODAY?

Cherry Street has two travel lanes in each direction and a center turn lane, with a 35 mph speed limit. ADT is about 9,000 vehicles per day, making the street a candidate for a lane reallocation, with a single through lane in each direction and two-way turn lane. Lane reductions or reassignments would need to occur with the DOT's approval, as well as public input. Norbeck Street to the north and south is a low-

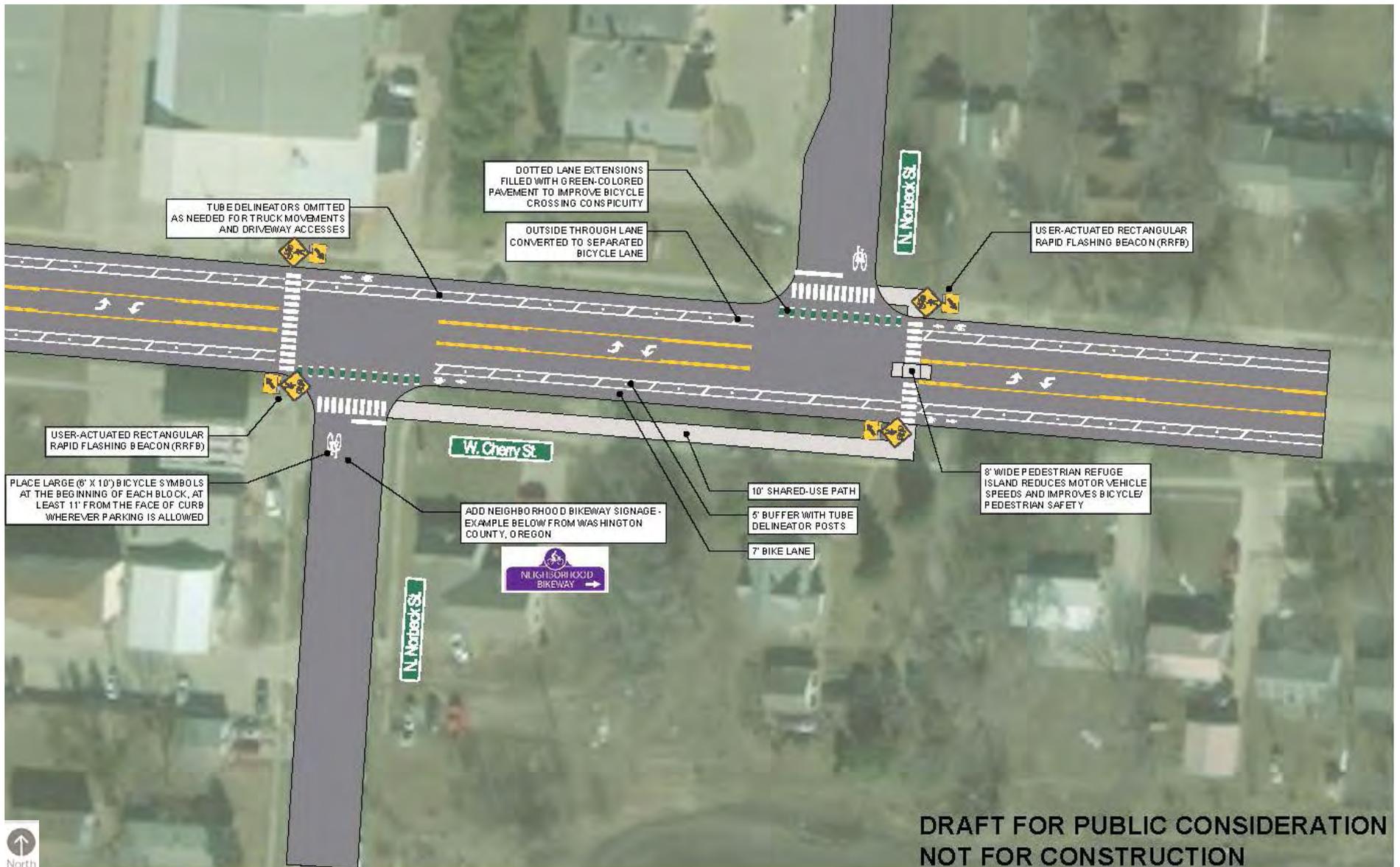


volume street with no center line painted, as well as a 25-mph posted speed limit on the south leg. A pedestrian crosswalk is marked across Cherry Street, on the west side of Norbeck's south leg. The south leg of Norbeck includes a southbound bicycle warning sign supplemented with a "Share the Road" message. A southbound shared lane marking is also painted on Norbeck, but it is placed so close to the curb that it is often covered by parked vehicles.

WHAT IT COULD LOOK LIKE IN THE FUTURE?

- The curbside travel lanes along Cherry Street can be converted to separated bicycle lanes, at the street level. The existing travel lanes may be converted to 7' bicycle lanes and 5' buffers, with tube delineator posts. This configuration is wide enough to be plowed in the winter by a pick-up truck. This approach could be piloted on an interim basis with construction cones and barricades, to observe changes in operation or safety prior to permanent implementation.
- East-west bicycle lanes at both legs of Norbeck Street can be striped through each intersection, and filled with green colored pavement to improve the visibility of bicyclists to turning motorists.
- Norbeck Street can be identified as a neighborhood bikeway, using signs on street name posts, as well as large bicycle symbols placed in the center of unmarked travel lanes.
- The existing sidewalk on the south side of Cherry Street between the north and south legs of Norbeck may be widened to a 10' shared-use path, to allow northbound bicyclists an opportunity to avoid bicycling in the street.
- The existing crosswalk across Cherry Street may be supplemented with rectangular rapid flash beacons, to improve the ability of southbound bicyclists to cross Cherry Street.
- A crosswalk, as well as a crossing island and/or rectangular rapid flash beacon, may be added across Cherry Street to the east of Norbeck's north leg, to improve the ability of northbound bicyclists to cross Cherry.

FIGURE 4.4: Concept for Cherry Street and Norbeck Street Intersection





NATIONAL STREET AND DAKOTA STREET

This near-downtown intersection includes Vermillion's main north-south thoroughfare, and National Street, part of the proposed Main/National east-west bikeway and directly connecting to the Downtown Loop.

WHY THIS INTERSECTION WAS CHOSEN?

National Street is a neighborhood bikeway alternative to Main Street and the north leg of the Downtown circulator loop. Despite National's important role in the proposed network, control is not present for north-south traffic on Dakota Street, making bicycle crossings a challenge. To draw bicyclists to National Street an attractive east-west bicycle route, safety improvements are needed at Dakota Street. This intersection also is an important part of the direct USD to Downtown route, connecting Vermillion's two highest bicycling demand locations.

WHAT IT LOOKS LIKE TODAY?

Dakota Street includes one travel lane in each direction with a center turn lane and a 25 mph speed limit. The traffic volume is approximately 4,000 vehicles per day. Parking is allowed only on the west side of the street, to the south of National.

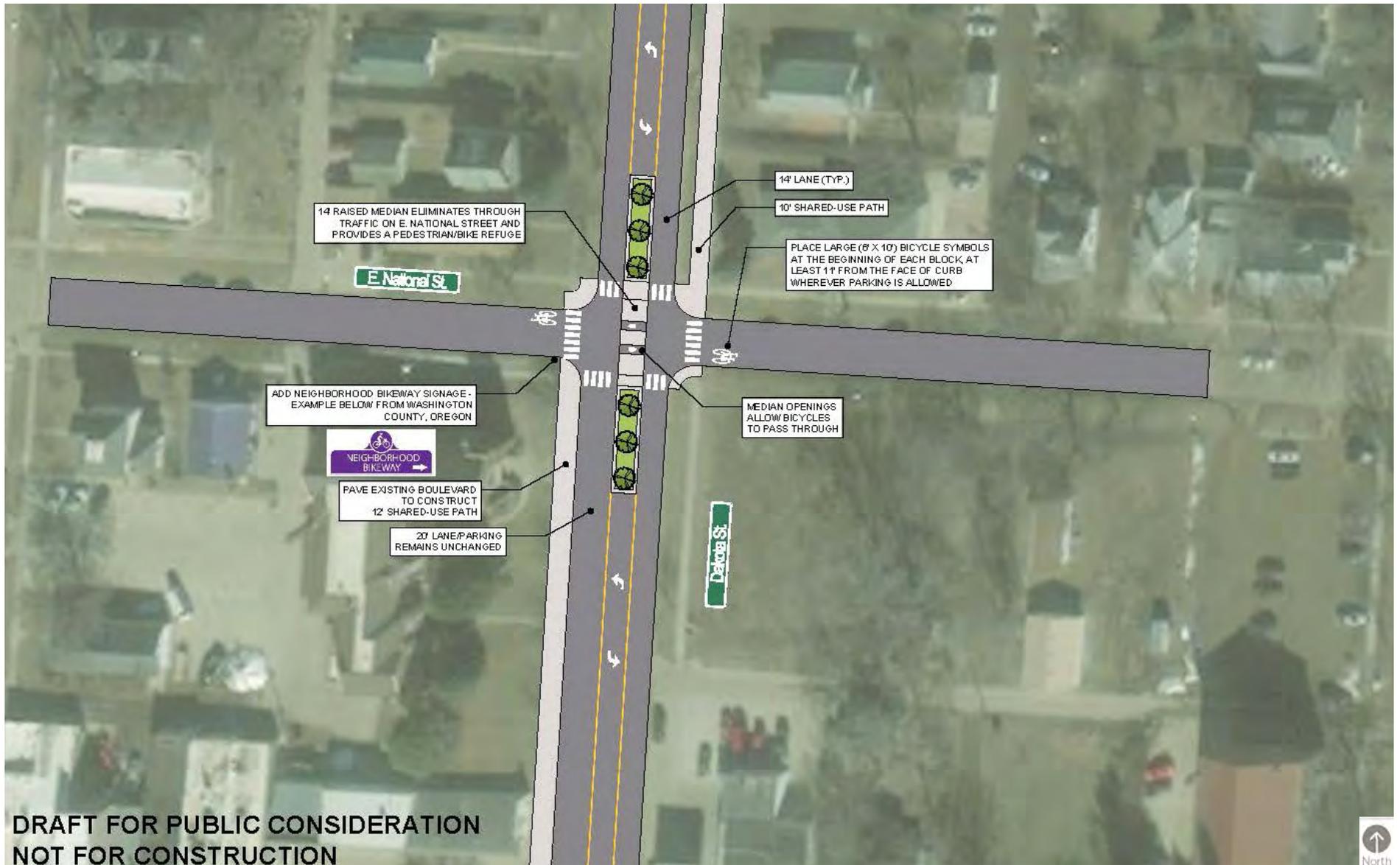


National Street is a low to moderate volume street with no center line painted. The traffic volume is 1,650 to the west of Dakota. Parking is allowed only on the north side of the street, to the east of Dakota. There are no bicycle facilities at this intersection, although it is one block north of the Dakota Street sidepath to Cotton Park and two blocks south of a campus path that begins at Clark.

WHAT IT COULD LOOK LIKE IN THE FUTURE?

- The center left turn lane on Dakota may be eliminated and replaced with a landscaped median and crossing islands for east-west bicyclists and pedestrians. This change would restrict motorists so that their only movements may be north-south on Dakota, and right turns on all other approaches. Most traffic on National west of Dakota is related to Downtown circulation, and through east-west traffic across Dakota is accommodated by Main and Cedar Streets. This alternative may be tested using a temporary pop-up demonstration.
- An alternative to a center median through the intersection may be crossing islands to the north and south of the east-west crosswalks. This alternative would allow all motorist movements to continue, and give bicyclists and pedestrians a refuge area (although less protected than the first alternative).
- An alternative to any center median may be rectangular rapid flash beacons. Push buttons would need to be installed along the National Street curbs facing the street, to facilitate bicyclists activating the beacons.
- National Street can be identified as a neighborhood bikeway, using signs on street name posts, as well as large bicycle symbols placed in the center of the unmarked lanes of vehicle travel.
- A 10' shared use path may be built along Dakota Street, connected existing paths to the south of Main and north of Clark. The transition between the east and west sides of Dakota can take place at the National Street crossing.

FIGURE 4.5: Concept for Dakota Street and National Street Intersection





MAIN STREET AND CHURCH/ELM STREET

This intersection is located within Vermillion's downtown, where a future north-south bicycle facility will cross Main Street at the offset intersection of Church and Elm Streets.

WHY THIS INTERSECTION WAS CHOSEN?

The network plan provides direct Downtown bicycle access with a circulator loop, avoiding the hazards created by conventional back-out diagonal parking. This loop uses Elm/Church and High/Austin as its north-south legs. However, then pattern of offset intersections in the district creates a number of conflict points for both pedestrians and bicyclists. Resolving this problem safely would create a better environment for all users, reduce traffic conflicts, and provide better linkages for downtown features both north and south of Main Street. Design changes can be incorporated into the city's planned Downtown streetscape project.

WHAT IT LOOKS LIKE TODAY

Main Street includes one travel lane in each direction, with pull-in angled parking on both sides. The speed limit is 20

mph, with a traffic volume of approximately 5,000 vehicles per day. Church and Elm Streets are lower volume with no center line painted. Parallel parking is allowed on both sides of each street. A crosswalk with curb extensions is located across Main Street to facilitate north-south pedestrian crossings, between Church and Elm Streets.

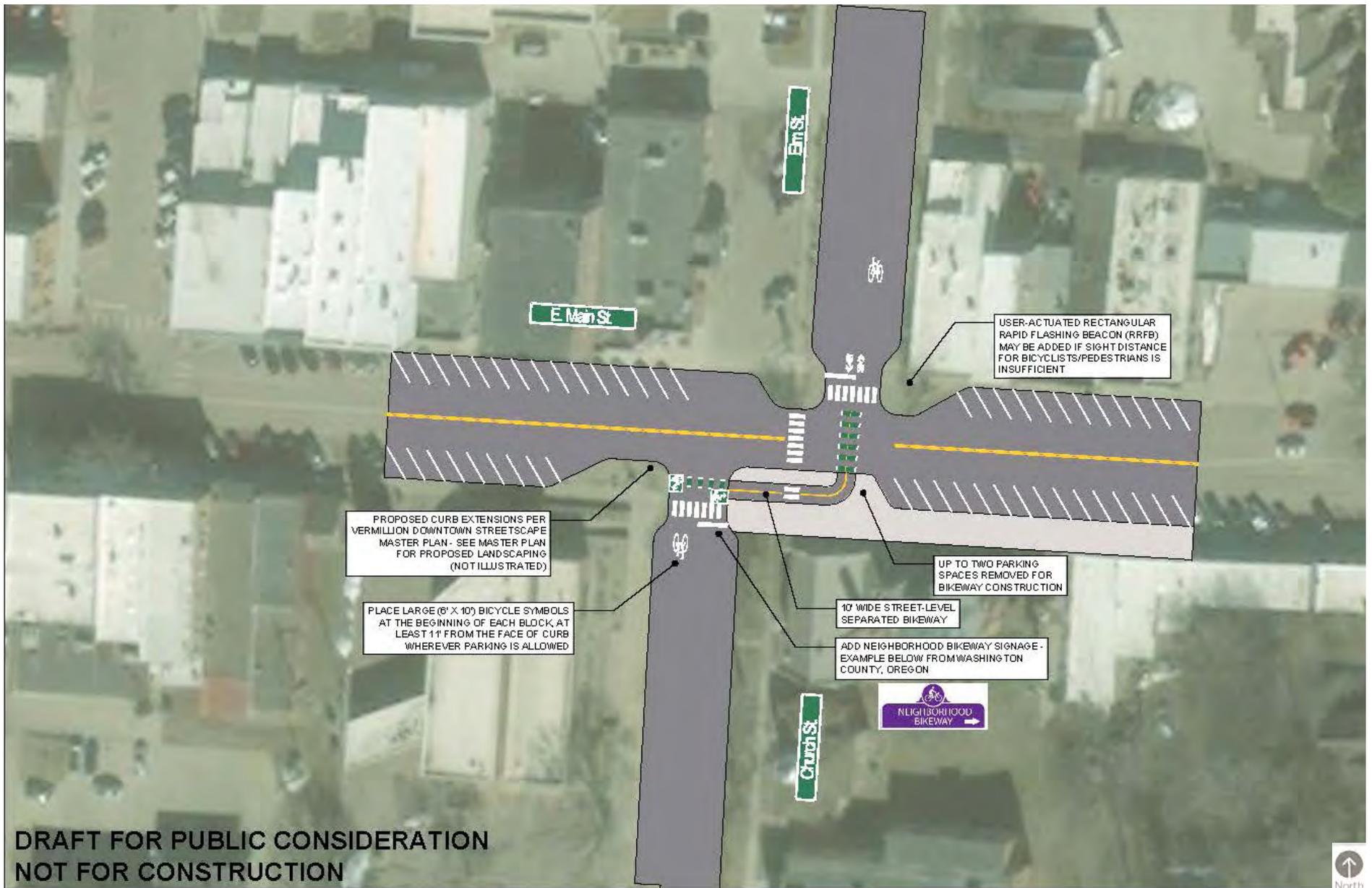
WHAT IT COULD LOOK LIKE IN THE FUTURE

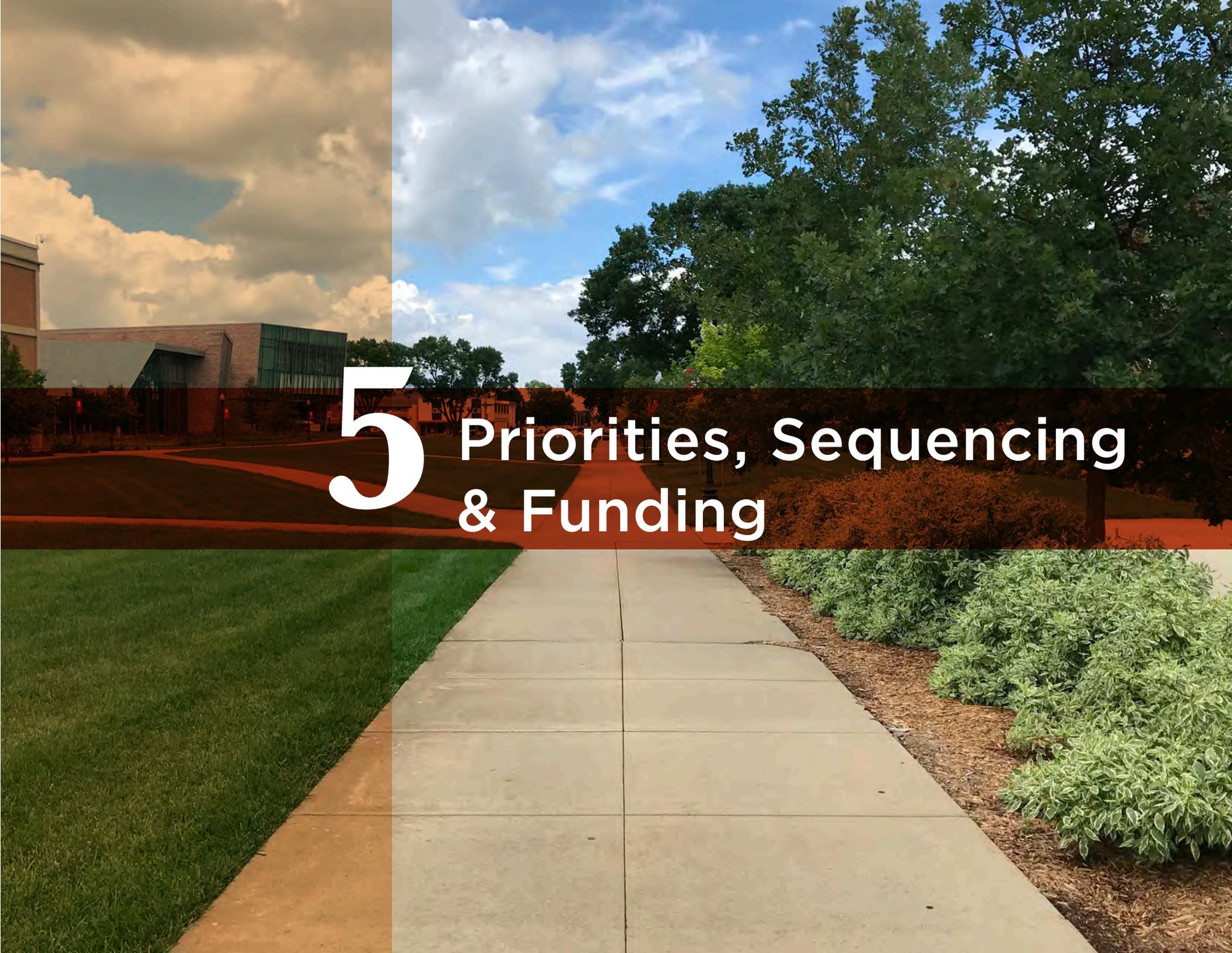
- A 10' wide street-level separated bikeway on the south side of Main Street, between Church and Elm Streets, would prevent bicyclists from weaving between Church and Elm Street in the middle of Main Street.
- Green colored pavement and turn boxes may guide bicyclists through the intersection.
- Church and Elm Streets can be identified as neighborhood bikeways, using signs on street name posts, as well as large bicycle symbols placed in the center of the unmarked lanes of vehicle travel.



Above: Proposed streetscape concept at Center Street intersection. Minor changes to this concept at High and Elm, at the edges of the district, will improve both bicycle and pedestrian crossings.

FIGURE 4.6: Concept for Church Street and Elm Street on East Main



The image is a collage of three photographs. The top-left photo shows a brick building with a large glass window under a dramatic, cloudy sunset sky. The top-right photo shows a long, straight path lined with tall, leafy green trees under a bright blue sky with scattered white clouds. The bottom photo shows a wide, light-colored concrete walkway running parallel to a green lawn on the left and a row of green bushes on the right. A dark red horizontal band is overlaid across the middle of the collage, containing the text.

5 Priorities, Sequencing & Funding



Above: Bicycle entrepreneurship. Photo courtesy of The Bean.

INTRODUCTION

The proposed bikeway network will be implemented in phases and will almost certainly evolve over time. The purpose of this chapter is to prioritize routes based on their role in the overall system, to establish appropriate sequencing for each part of the system, and then offer an opinion of probable cost for each piece.

ROUTE DETAILING

This chapter divides the network grid into north-south and east-west components. Each route displays a strip map that illustrates each street or pathway segment, key destinations along the way, and intersecting routes. These maps are divided into keyed segments, corresponding to key dividing points, milestones, or changes in infrastructure treatment.

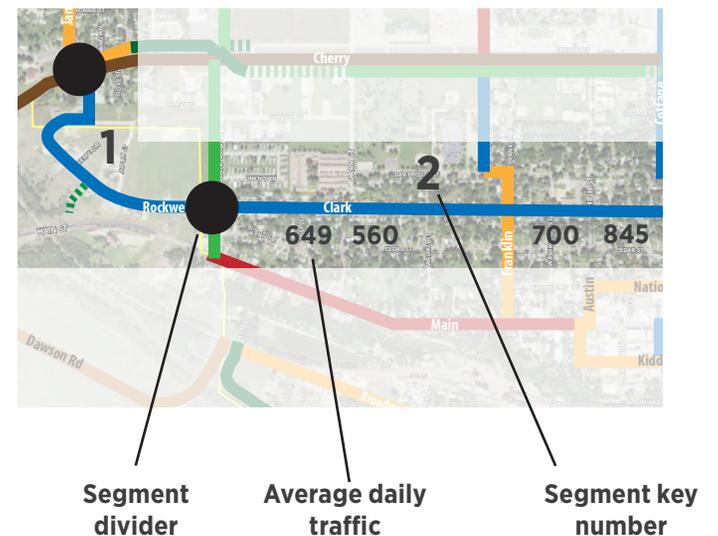
The number key for each segment corresponds to a row in the accompanying table.

The tables display:

- The endpoints and length of each segment.
- The nature of the existing facility. Information also includes number of lanes and approximate width of the street channel, aerial photography, and field measurements.

- Sidewalk coverage. Streets included in the active network should provide sidewalk continuity on at least one side.
- Recommended infrastructure. This presents the recommended infrastructure treatment and other ideas for adapting a segment for safer and more comfortable bicycle and pedestrian use. On-street treatments like marked routes and neighborhood bikeways typically use pavement markings and signage. In some cases, path or trail segments fill gaps in continuity.
- Planning level opinions of probable costs. While these are not based on detailed design, they give an idea of relative costs for planning purposes. Cost factors used for these estimates are shown in Figure 5.1. These costs include contingencies (25% with more complicated types of infrastructure); and design, engineering, testing, and other soft costs (25%), but do not include property acquisition, major drainage structures, or extraordinary grading expenses.

These recommendations should be refined further as individual projects are implemented. However, they provide a starting point for the more detailed design process, and provide guidance in determining priorities and costs of various improvements.



COST ESTIMATE RANGES FOR NEW PROJECTS

This section describes the estimated implementation costs and timeline for bikeway facilities on the Future Network Concept. These assumptions and unit cost rules guide the cost calculations for each proposed network element described in the subsequent tables.

The most prudent and cost-effective method for implementation is to seek out opportunities related to projects already programmed in the Vermillion CIP, as well as in the South Dakota DOT road construction program. These include overlay, chip sealing, road reconstruction, and traffic signal replacement projects. This strategy eliminates additional costs for bikeway project implementation such as pavement marking eradication, pavement removals, and pedestrian ramp replacements, since they are already included in the CIP project. As future street repair projects are added to these programs, bicycle projects should be coordinated to seek out further efficiencies. While this may produce some lack of continuity in the system, Vermillion's good street network and relatively low traffic provides opportunities for temporary workarounds and connections. Development of a comprehensive bikeway system is an incremental process, and may take a period of time to complete. Clear communication to the public on how plans will emerge over time will help explain this process as steady progress is made.

Planning-level cost estimates have been developed for each bikeway facility type. Per-mile cost estimates were developed conservatively – in some cases projects will cost less, especially when incorporated into a larger project. Note that updated engineering cost estimates will need to be developed for each project during detailed design.

A summary of the project types estimated are listed below. A more detailed description of the work included in each project type follows. Estimates generally include engineering and crew mobilization costs wherever applicable.

Shared-Use Paths: Concrete

Includes 10' wide concrete path with signage and intersection crossing/curb ramp improvements, along with drainage and landscaping.

Shared-Use Paths: Crushed Quartzite

Includes 10' wide crushed quartzite path with signage improvements, along with drainage and landscaping. Loose materials can meet ADA requirements for a firm, stable, and slip resistant surface if they are properly treated and maintained with binders, consolidants, compaction, and/or grid forms.

Separated Bicycle Lanes: Permanent Installation

Includes relocation of existing 5-foot concrete sidewalks with adjacent sidewalk-level, one-way, concrete bicycle paths. Requires grading, utility adjustment, and traffic control measures.

Separated Bicycle Lanes: Temporary Installation

Includes street-level, one-way bicycle lanes. Requires striping, signing, and flexible delineators.

Buffered Bicycle Lanes

Includes bicycle lane markings as noted with standard bicycle lanes, with the addition of a painted buffer between bicycle lanes and vehicle lanes.

Standard Bicycle Lanes

Includes epoxy bicycle lane markings in both directions with bicycle lane signs, along with green conflict markings at intersections.

Neighborhood Bikeways, with Traffic Calming

Includes the addition of large epoxy bike symbols with traffic-calming features. Per mile, includes two curb extensions, two miniature traffic circles, and four speed bumps. Traffic-calming features chosen during the design phase may significantly lower or increase the cost per mile.

Neighborhood Bikeways, without Traffic Calming

Includes the addition of large epoxy bike symbols with signs.

Shared Lane Markings

Includes three epoxy bicycle shared lane markings in each direction per standard city block, as well as signing.

Advisory Bicycle Lanes

Includes epoxy bicycle lane markings in both directions with bicycle lane signs, along with green conflict markings at intersections.

TABLE 5.1: Estimated Facility Costs

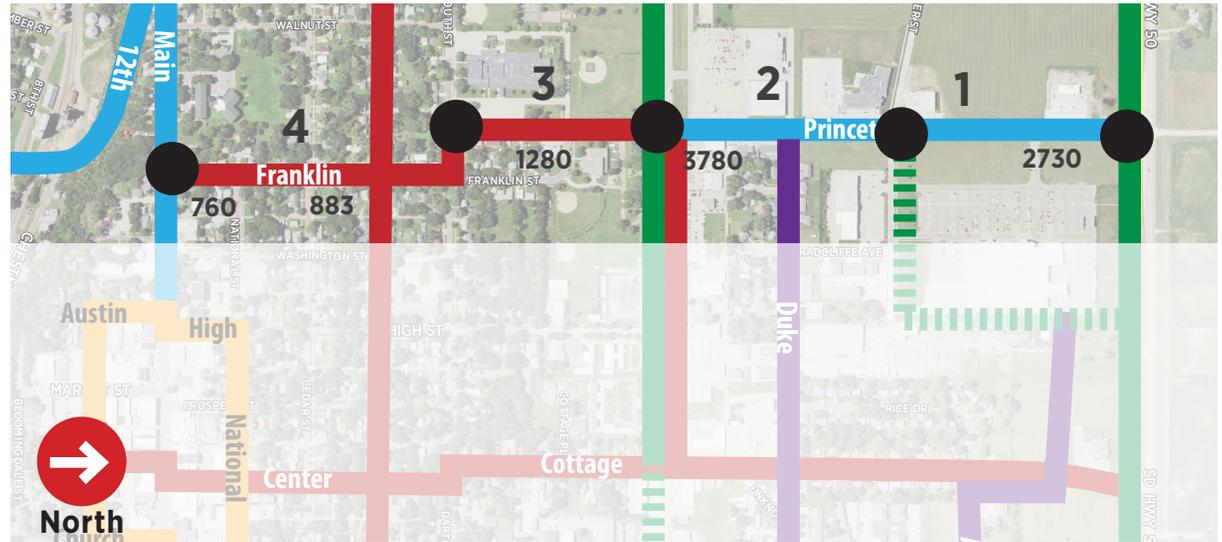
Project Type	Planning-Level Cost Estimate, per mile*
Shared-Use Paths: Concrete	\$500,000 - \$770,000
Shared-Use Paths: Crushed Quartzite	\$30,000 - \$50,000
Separated Bicycle Lanes: Permanent Installation	\$1,300,000 - \$1,950,000
Separated Bicycle Lanes: Temporary Installation	\$38,000 - \$58,000
Buffered Bicycle Lanes	\$33,000 - \$50,000
Standard Bicycle Lanes	\$27,000 - \$42,000
Neighborhood Bikeways, with Traffic Calming**	\$300,000 - \$450,000
Neighborhood Bikeways, without Traffic Calming	\$41,000 - \$53,000
Shared Lane Markings	\$22,000 - \$29,000
Advisory bicycle lanes	\$27,000 - \$37,000



NORTH - SOUTH

1

Franklin / Princeton Bikeway



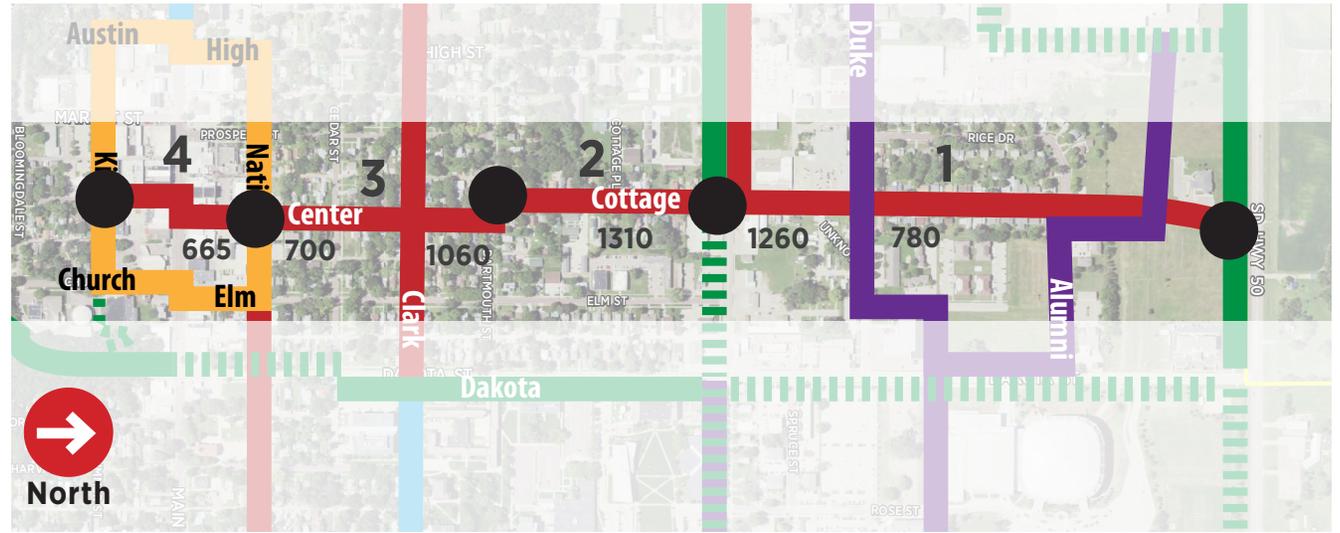
Segment Name: Franklin/Princeton

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Princeton, SD 50 to Bower	0.23	3-lane minor arterial (45')	Section modification to 2-lane with buffered bike lanes, with left-turn lane and standard bike lanes where left turns are required.	\$11,500
2	Princeton, Bower to Cherry	0.23	3-lane minor arterial (45')	Section modification to 2-lane with buffered bike lanes, with left-turn lane and standard bike lanes where left turns are required. See page 86 for further intersection details.	\$11,500
3	Princeton, Cherry to Dartmouth	0.10	2-lane minor arterial (40')	Neighborhood bikeway, jog on Dartmouth to Franklin	\$5,300
4	Franklin, Dartmouth to Main	0.30	2-lane minor arterial (32-40')	Neighborhood bikeway	\$15,900
Total		0.85			\$44,200

NORTH - SOUTH

2

Center / Cottage Bikeway



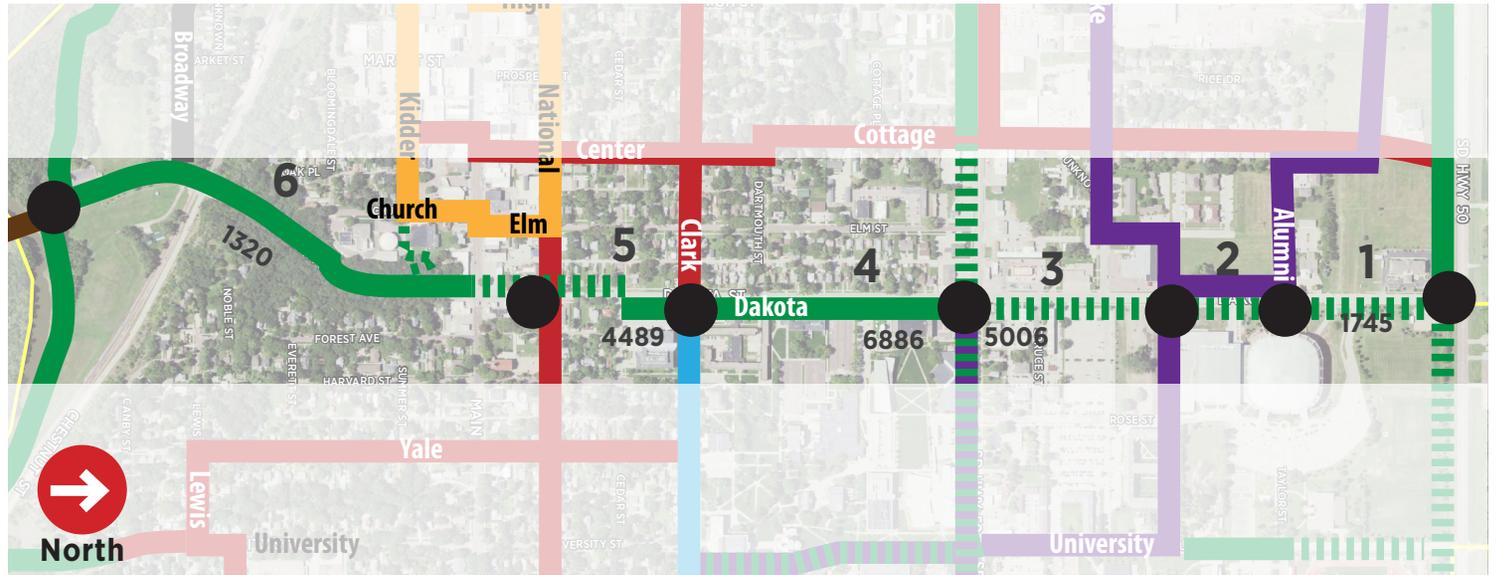
Segment Name: Cottage/Center

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Cottage, SD 50 to Cherry	0.35	2-lane local/major collector (40-45')	Neighborhood bikeway; striped shoulder from SD 50 to Alumni St	\$18,550
2	Cottage, Cherry to Dartmouth	0.37	2-lane major collector (27')	Neighborhood bikeway	\$19,610
3	Center, Dartmouth to National	0.23	2-lane major collector (30')	Neighborhood bikeway	\$12,190
4	Center/Court, National to Kidder	0.54	2-lane local (28')	Neighborhood bikeway with enhanced crossing at Main	\$28,620
Total		1.49			\$78,970

NORTH - SOUTH

3

Dakota Street Bikeway



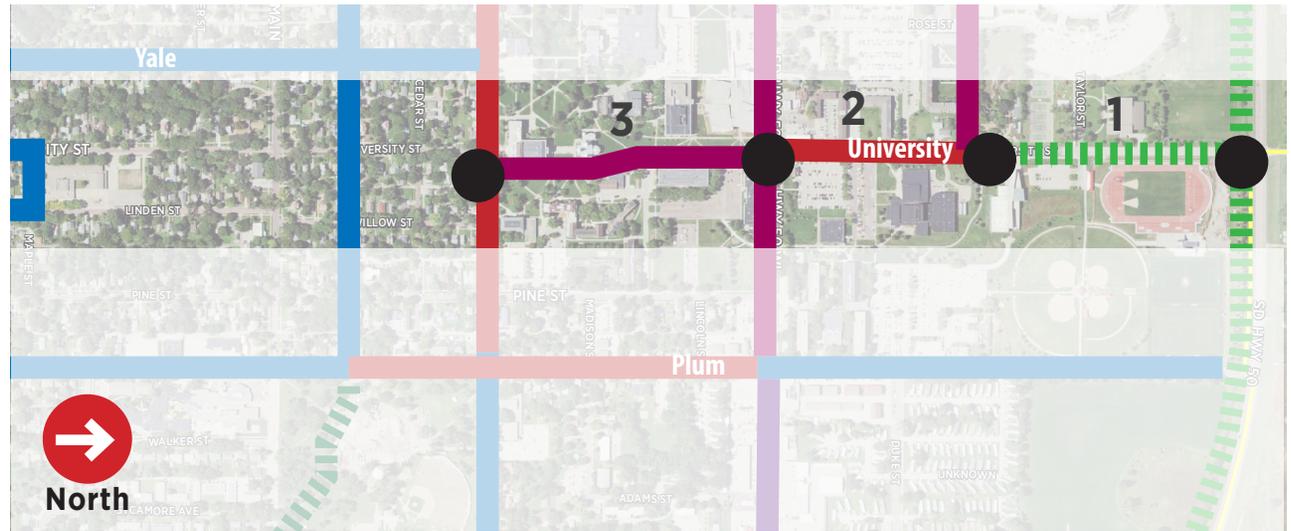
Segment Name: Dakota

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	SD 50 to Alumni	0.17	2-lane minor arterial (48')	Sidepath, on east side to match up with campus path. Consider pavement markings to stripe parking shoulders and define roadway as a three-lane section with center TWTL or painted median to manage speeds	\$103,700
2	Alumni to Dome Path	0.15	2-lane minor arterial (48')	Sidepath, requiring widening or sidewalk replacement to meet minimum width standard. Define street and drive crossings with continental markings	\$91,500
3	Dome Path to Cherry	0.15	2-lane minor arterial (48')	Sidepath, requiring widening or sidewalk replacement to meet minimum width standard. Define street and drive crossings with continental markings. See page 88 for intersection details.	\$91,500
3	Cherry to Clark	0.30	3-lane minor arterial (40')	Existing sidepath, with enhanced crossings at driveways	
4	Clark to Main	0.22	3-lane minor arterial (40')	Crossing to west side at Clark. New sidepath	\$134,200
5	Main to Cotton Park	0.46	3-lane minor arterial (36')	Existing sidepath. Spur path to Kidder Street and public library	
Total		1.45			\$420,900

NORTH - SOUTH

4

University Street Bikeway



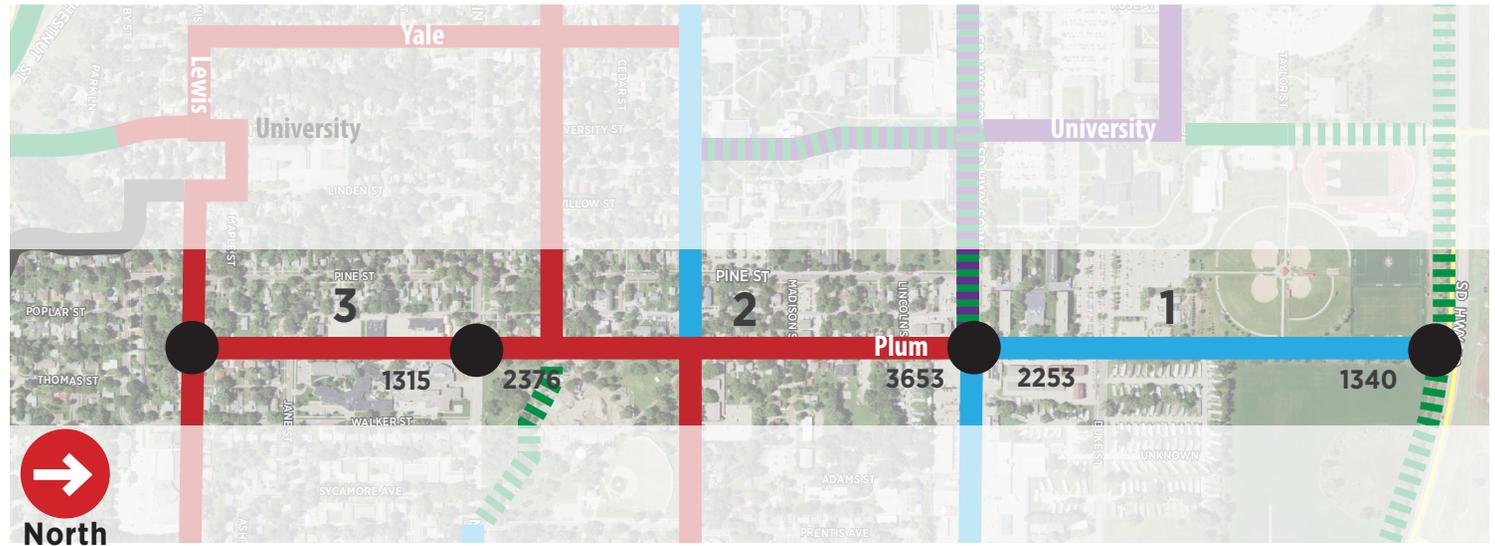
Segment Name: University

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	SD 50 to Taylor	0.17	2-lane local (42')	Sidepath to complement shared use of existing roadway	\$103,700
2	Taylor to Cherry	0.30	2-lane local (42')	Existing sidepath and continued use of existing roadway	
3	Cherry to Clark	0.30	12-foot campus path	Dual use promenade with widening south side campus walkway to accommodate adjacent but distinct tracks for pedestrians and bicycles	\$90,000
Total		0.77			\$193,700

NORTH - SOUTH

5

Plum Street Bikeway



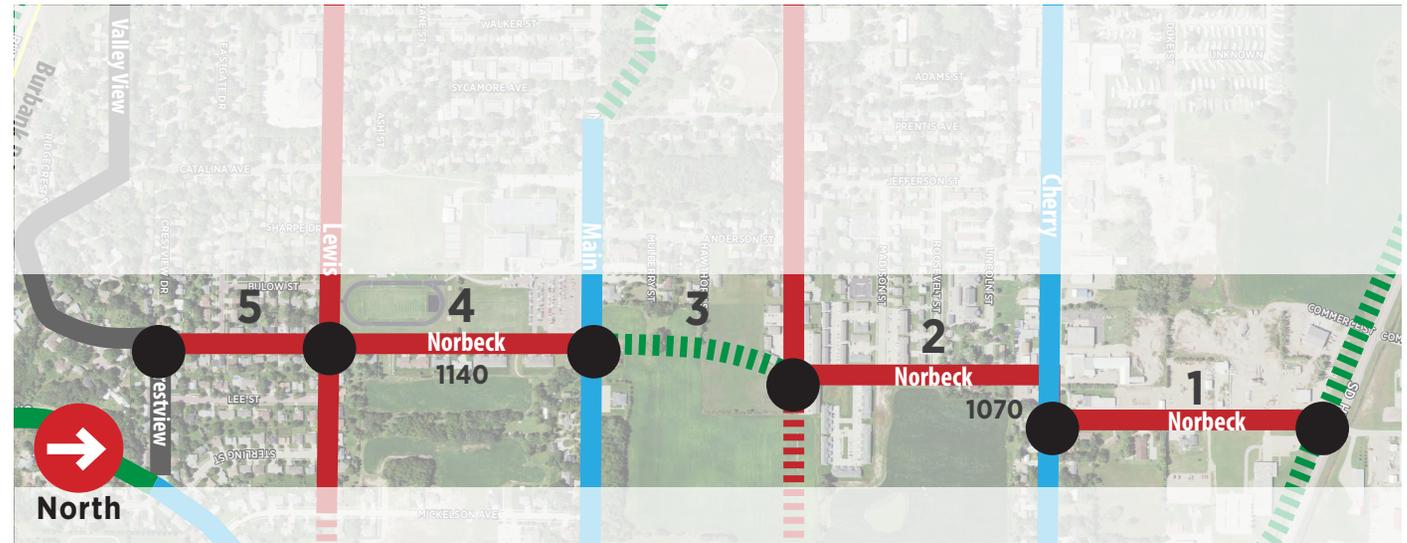
Segment Name: Plum

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	SD 50 to Cherry	0.50	2-lane minor arterial (48')	Standard bike lanes with one-sided parking	\$305,000
2	Cherry to Main	0.50	2-lane minor arterial (31')	Neighborhood bikeway; existing 8' sidewalk/sidepath on campus edge	\$26,500
3	Main to Lewis	0.30	2-lane minor arterial (31')	Neighborhood bikeway	\$15,900
Total		1.30			\$347,400

NORTH - SOUTH

6

Norbeck Street Bikeway



Segment Name: Norbeck

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	SD 50 to Cherry	0.30	2-lane local (30-36')	Neighborhood bikeway, with intersection jog at Cherry. See page 90 for intersection details.	\$15,900
2	Cherry to Clark	0.30	2-lane local (36')	Neighborhood bikeway	\$15,900
3	Clark to Main	0.23	No street	Interim path on alignment that accommodates future street. Neighborhood bikeway when street is developed	\$140,300
4	Main to Lewis	0.30	2-lane major collector (36')	Neighborhood bikeway	\$15,900
5	Lewis to Crestview	0.18	2-lane local (36')	Neighborhood bikeway	\$9,540
Total		1.31			\$197,540

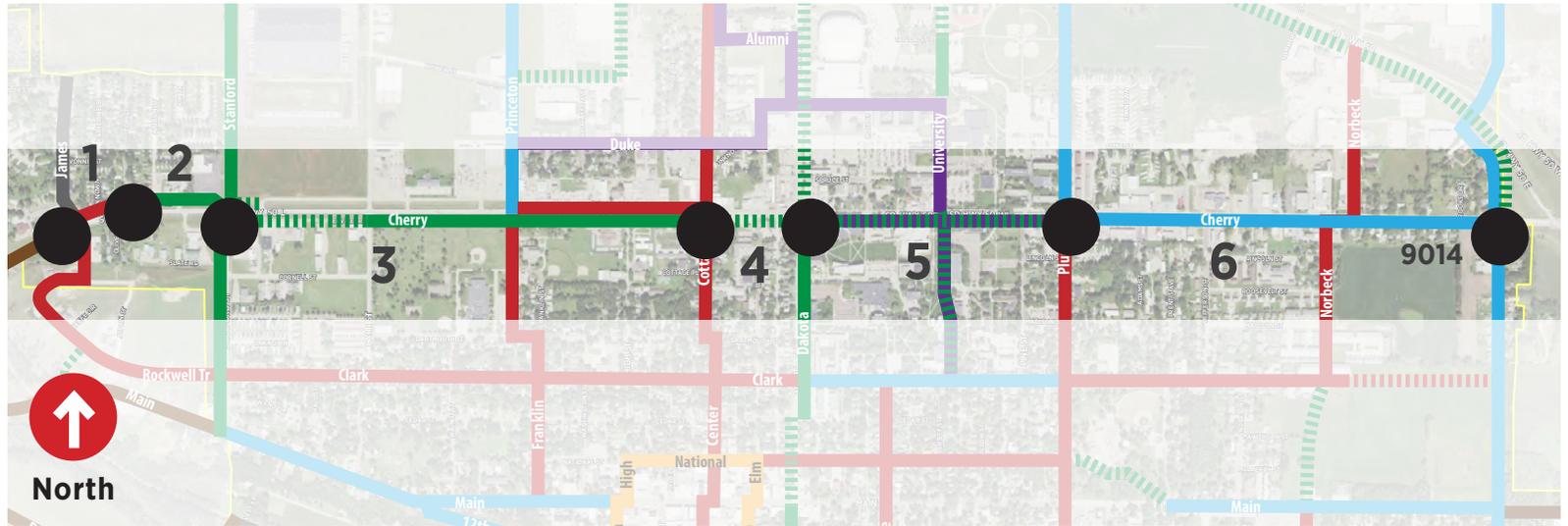
EAST - WEST



Cherry Street Bikeway



North



Segment Name: Cherry

Segment Key	Segment	Length (miles)	Existing Condition	Recommended Infrastructure	Probable Cost
1	James to Tom	0.1	2-lane frontage road (27')	Interim shared use, eventual north side sidepath	\$2,900
2	Tom to Stanford	0.17	Sidepath	Continued use of sidepath with redesign of Stanford St intersection, as described in Chapter 4. Paved shoulder on main roadway. See page 83 for intersection details.	
3	Stanford to Cottage	0.80	2-lane frontage road (27'), Stanford to Carr; sidepath east to Cottage	New 0.2 mi sidepath segment, Stanford to Carr, existing sidepath east to Cottage	\$122,000
4	Cottage to Dakota	0.15	3-lane arterial, 44'	Sidepath with narrowing of lanes and moving curb northward to provide adequate back-of-curb space	\$120,000
5	Dakota to Plum	0.47	2-lane divided arterial, 44' with wide sidewalks on both sides	Dual use promenade with widening south side campus walkway to accommodate adjacent but distinct tracks for pedestrians and bicycles	\$286,700
6	Plum to Crawford	0.75	5-lane arterial, 60'	Lane reallocation to 3 lanes with protected one-way bike lanes on both sides	\$37,500
Total		2.44			\$569,100

Cherry Street: Existing and proposed



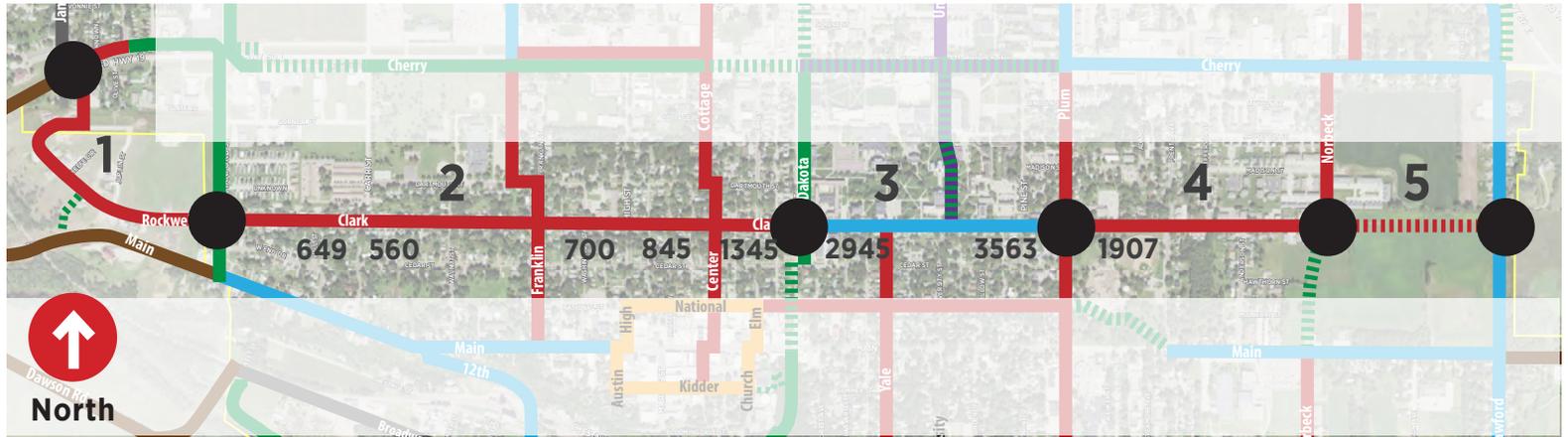
Cherry Street: Existing and proposed



EAST - WEST

8

Clark Bikeway

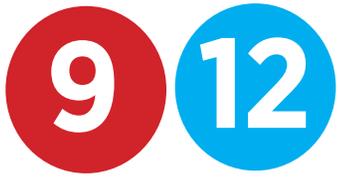


Segment Name: Clark

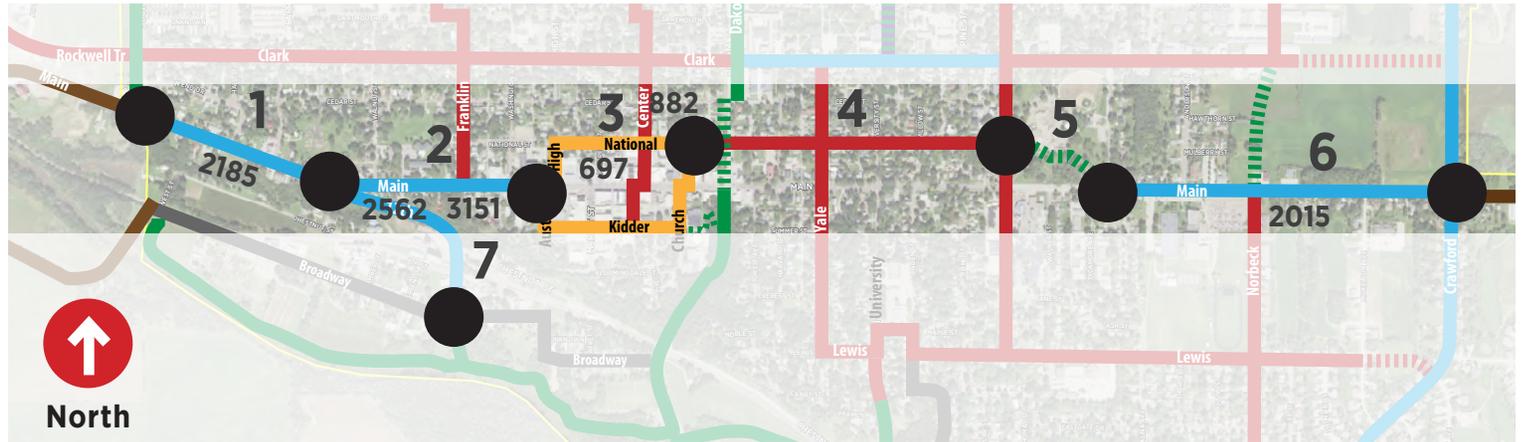
Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Kennedy/Rockwell. Cherry to Stanford	0.55	2-lane local (32')	Neighborhood bikeway	\$29,150
2	Stanford to Dakota	1.00	2-lane collector (37')	Neighborhood bikeway	\$127,100
3	Dakota to Plum	0.40	2-lane collector (33-36')	One-sided parking with standard bike lane; advisory bike lane on south side where width narrows	\$16,800
4	Plum to Norbeck	0.45	2-lane collector (37-45'), diagonal parking between Plum and Prentiss	Neighborhood bikeway; conversion to back-in diagonal parking between Plum and Prentiss for safer park loading and bicycle travel	\$23,850
5	Norbeck to Crawford	0.30	No existing street	Continuation of neighborhood bikeway with street extension. 37' width permits standard bike lane with 1-sided parking	\$15,900
Total		1.31			\$212,800



EAST - WEST



Main/National Bikeway

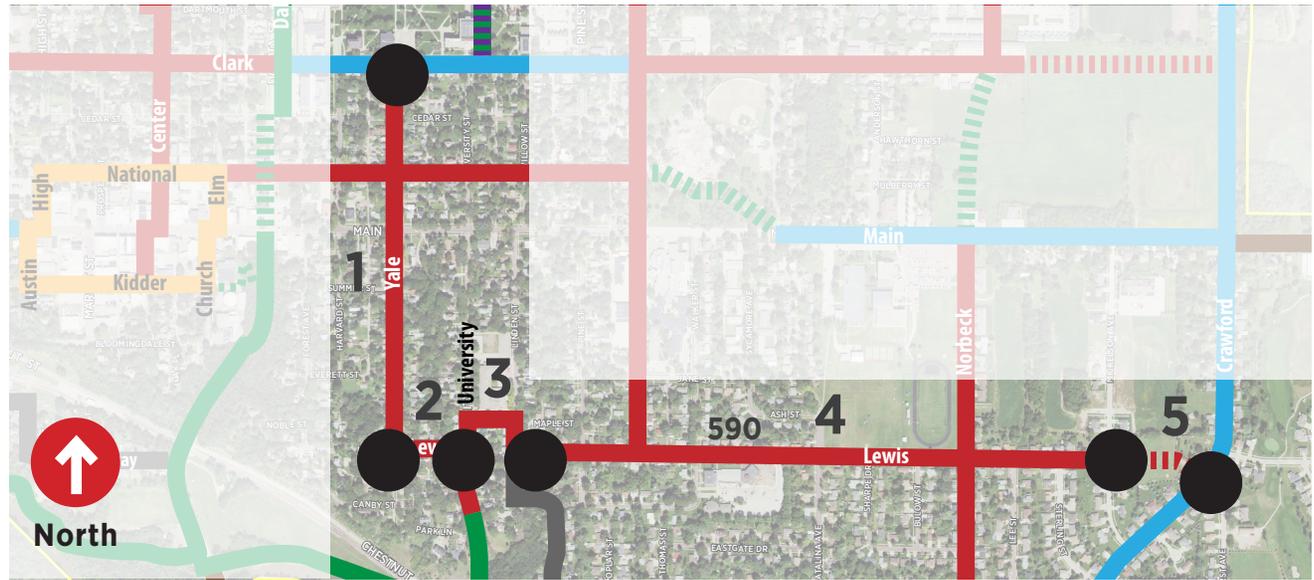


Segment Name: Main/National

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Main, Stanford to 12th St	0.35	2-lane minor arterial (48')	Standard bike lanes with 2-sided parking	\$14,700
2	Main, 12th to High	0.37	2-lane minor arterial (50-62'); diagonal parking between Washington and High	Standard bike lanes; enhanced shared lane marking on Washington to Prospect block behind diagonal parking; stripe a buffer area behind parking stalls.	\$15,540
4	National, Elm to Plum	0.54	2-lane local (28')	Neighborhood bikeway with enhanced crossing at Dakota. See page 92 for intersection details.	\$28,620
5	Prentis Park, Plum to Prentis	0.20	Park	Upgraded shared-use path through edge of park	\$122,000
6	Main, Prentis to Crawford	0.60	2-lane minor arterial (40-45')	Standard bike lanes with 1-side parking	\$25,200
7	12th, Main to Broadway	0.34	2-lane collector (31')	Standard bike lanes, at a minimum single bike lane in uphill (northbound) direction with shared lane marking in southbound lane	\$14,280
Total		2.63			\$220,340

10

Lewis / Yale Bikeway

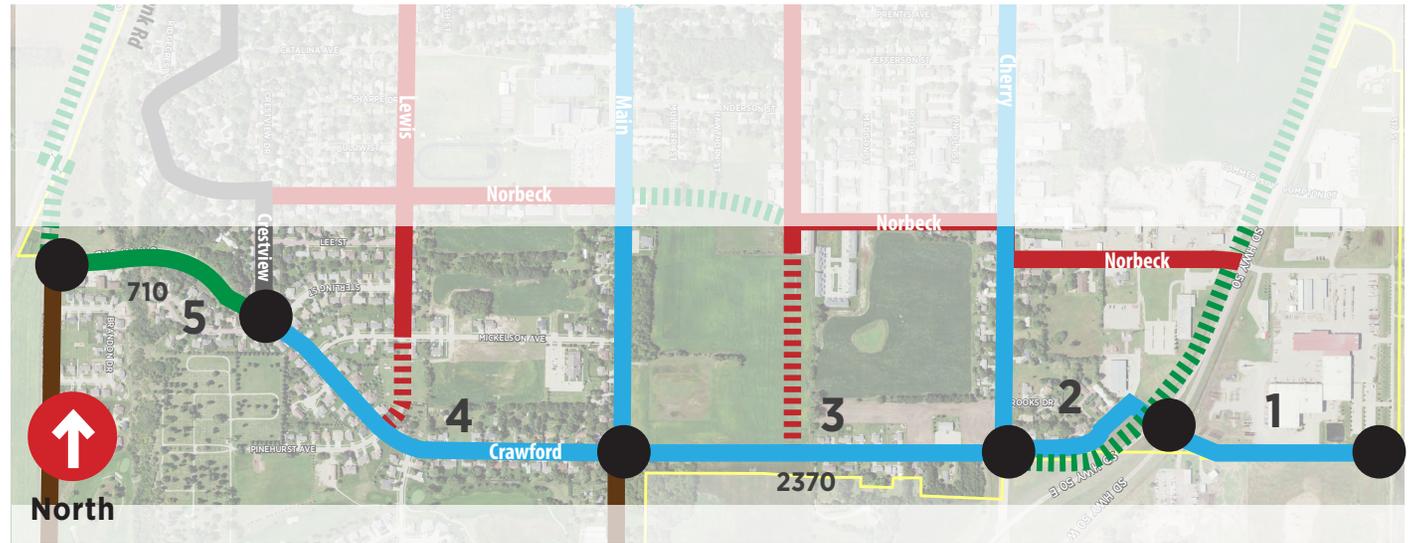


Segment Name: Lewis/Yale

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Yale, Clark to Lewis	0.50	2-lane local (28')	Neighborhood bikeway with enhanced crossing at Main	\$26,500
2	Lewis, Clark to University	0.10	2-lane local (32')	Neighborhood bikeway	\$5,300
3	University/Maple/Linden	0.13	University: 2-lane major collector (32'); Maple/Linden, 2-lane local (32')	Neighborhood bikeway jog at discontinuity at Lewis	\$6,890
4	Lewis, Linden to Mickelson	0.45	2-lane local (collector adjacent to high school) (28'-40')	Neighborhood bikeway	\$23,850
5	Mickelson Ave, Lewis to Crawford	0.30	2-lane local (32')	Neighborhood bikeway; future through connection of Lewis directly to Pinehurst and Crawford	\$15,900
Total		1.48			\$78,440

11

Crawford Street Bikeway



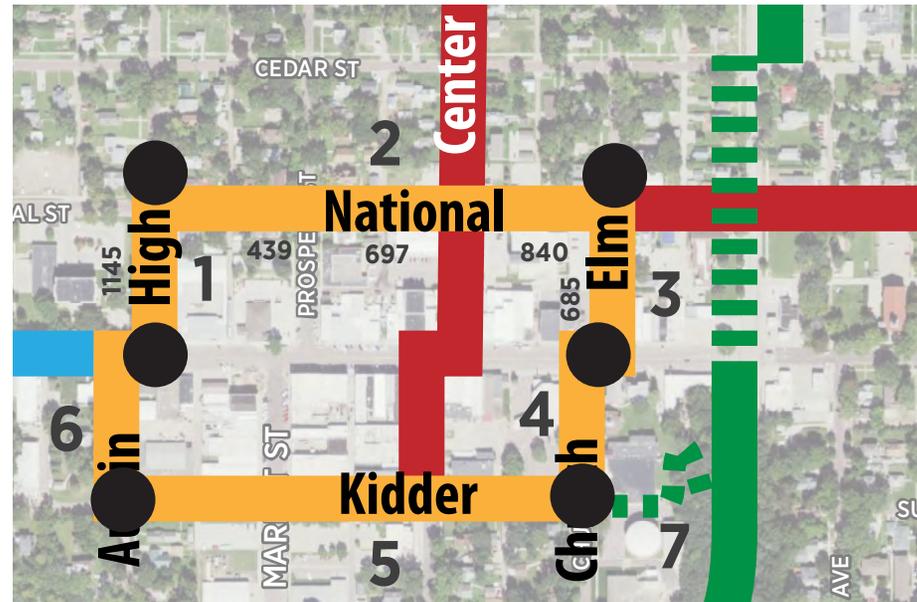
Segment Name: Crawford

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	317th St to SD 50	0.31	2-lane local (44')	Standard bike lanes; motorist caution signs and marked bicycle crossing of SD 50	\$13,020
2	SD 50 to Cherry	0.24	2-lane local with hard surfaced shoulders (24')	Existing paved shoulders	\$-
3	Cherry to Main	0.50	2-lane minor arterial (44')	One-side parking with buffered bike lane on one side, standard 6' bike lane on opposite side and 11-foot travel lanes; option of no on-street parking with buffered bike lanes on both sides	\$25,000
4	Main to Crestview	0.54	2-lane minor arterial (40')	One-side parking with standard bike lane	\$22,680
5	Crestview to Burbank Rd	0.31	2-lane minor arterial (28') with shared-use sidepath	Existing sidepath with transition markings at Crestview between bike lane and sidepath sections	\$-
Total		1.90			\$60,700

CIRCULATOR



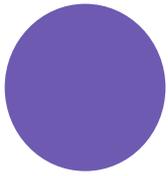
Downtown Circulator



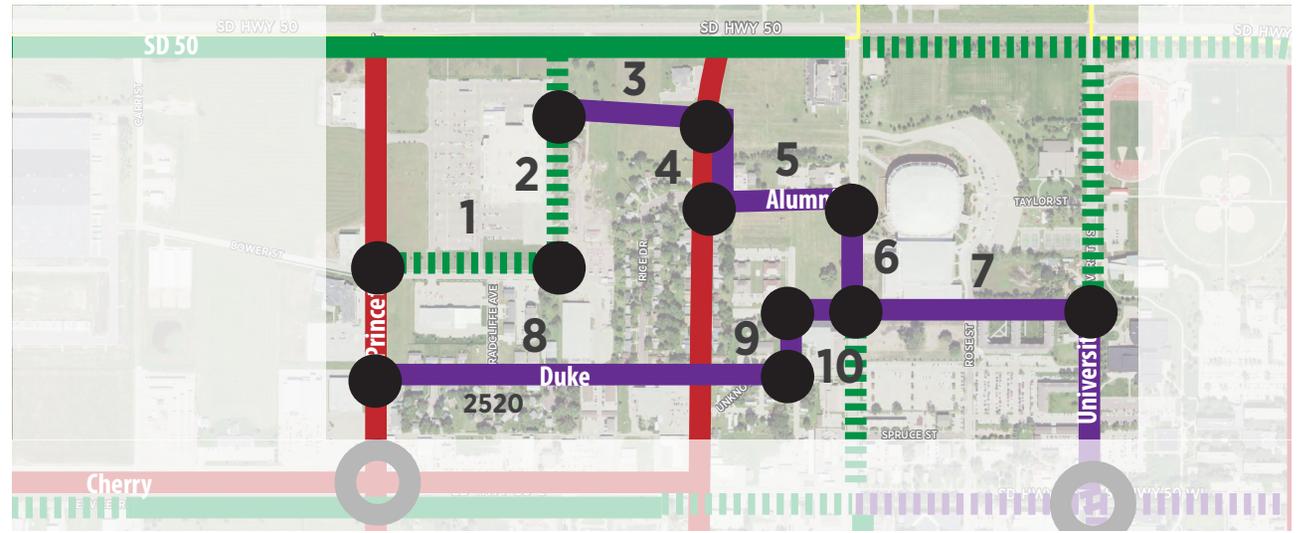
Segment Name: Downtown Circulator Loop

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	High, Main to National	0.07	2-lane major collector (40')	Advisory bike lane	\$2,940
2	National, High to Elm	0.23	2-lane local (40')	One-side parking with standard bike lanes	\$9,660
3	Elm, National to Main	0.07	2-lane local (48')	Standard bike lanes, modified intersection at Main using design on page --	\$2,940
4	Church, Main to Kidder	0.07	2-lane local (46' on north half, 32' on south half of block)	Standard bike lanes, removing on-street parking on south half of block	\$2,940
5	Kidder, Church to Austin	0.23	2-lane local (60' with parking cut-outs)	2-way protected bike lane (cycle track) on south side, maintaining north side diagonal and south side parallel parking. Bike hub with parking and fix-it station proposed on city parking lot at Kidder and Market	\$11,500
6	Austin, Kidder to Main	0.07	2-lane local (54'), diagonal parking on east side.	2-way protected bike lane probably on west side, either removing west side parallel parking or converting diagonal to parallel parking on east; transitional intersection redesign at Main Street	\$3,500
7	Path to Cotton Park Sidepath	0.12	Open space	8' paved path	\$73,200
Total		0.86			\$106,680

CIRCULATOR



Campus Connector



Segment Name: Campus Connector

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Bower, Princeton to Walmart buffer	0.19	2-lane local (33')	Shared use path. Interim use of shared lane markings	\$115,900
2	Walmart buffer area, Bower to Shriner	0.17	Landscaped buffer parallel to Walmart service drive	Shared use path with cooperation of Walmart	\$103,700
3	Shriner, Walmart site to Cottage	0.17	2-lane local (33')	Shared roadway with shared lane markings/ bike route identification	\$4,930
4	Cottage, Shriner to Alumni	0.08	2-lane local (45')	Striped shoulders, included in Center/Cottage Bikeway	\$2,320
5	Alumni, Cottage to Dakota	0.17	2-lane local (36')	Shared roadway with shared lane markings/ bike route identification	\$4,930
6	Dakota, Alumni to campus path south of DakotaDome	0.11	2-lane minor arterial (48')	Shared use sidepath included in Dakota Bikeway, enhanced bicycle crossing of Dakota at Alumni	\$3,300
7	Campus Paths, Dakota to University	0.25	Existing 10-13' paths	Use existing paths with crosswalk markings of Rose St	\$-
8	Duke, Princeton to Elm	0.43	2-lane major collector (36')	Shared roadway with shared lane markings/ bike route identification	\$12,470
9	Elm, Duke to Prairie Inn lot line	0.07	2-lane local (40')	Shared roadway with shared lane markings/ bike route identification	\$2,030
10	Prairie Inn	0.07	Undeveloped site, Elm to Dakota	Shared use path with enhanced crossing markings of Dakota, connecting with campus paths	\$42,700

Total

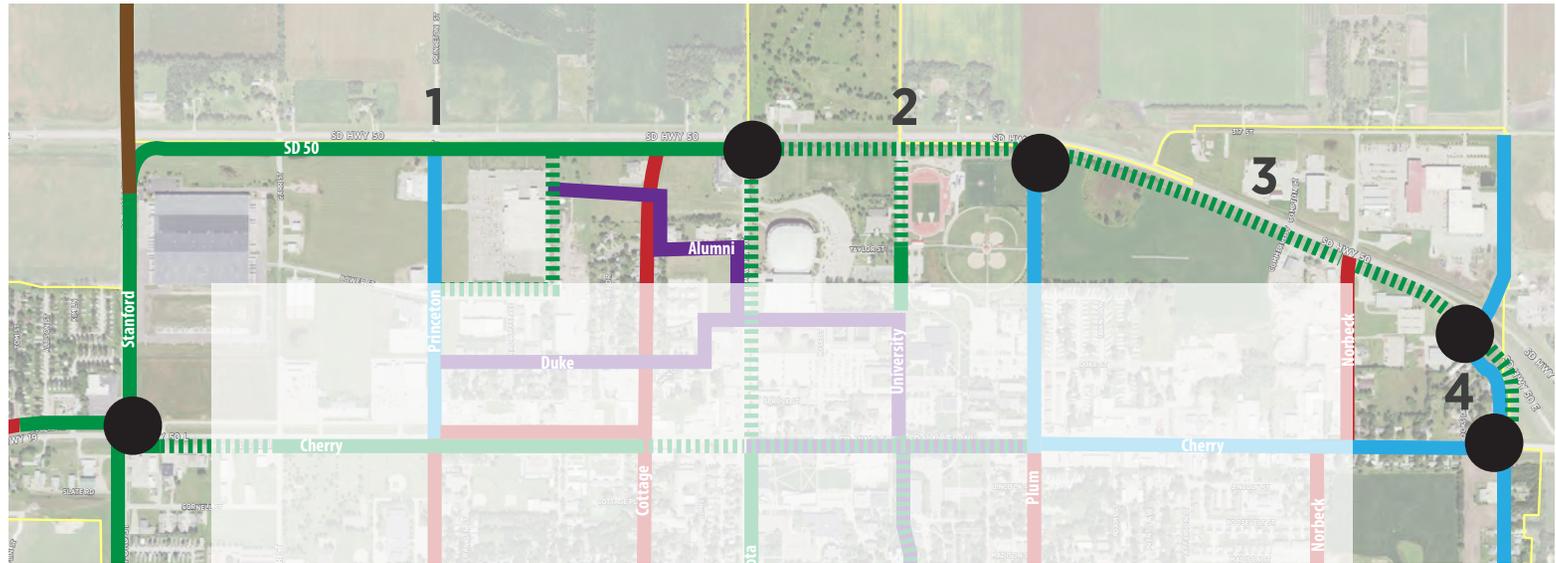
1.71

\$292,280

TRAIL LOOP



Perimeter Loop:
North Leg

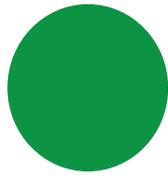


Segment Name: Trail Loop: North Leg

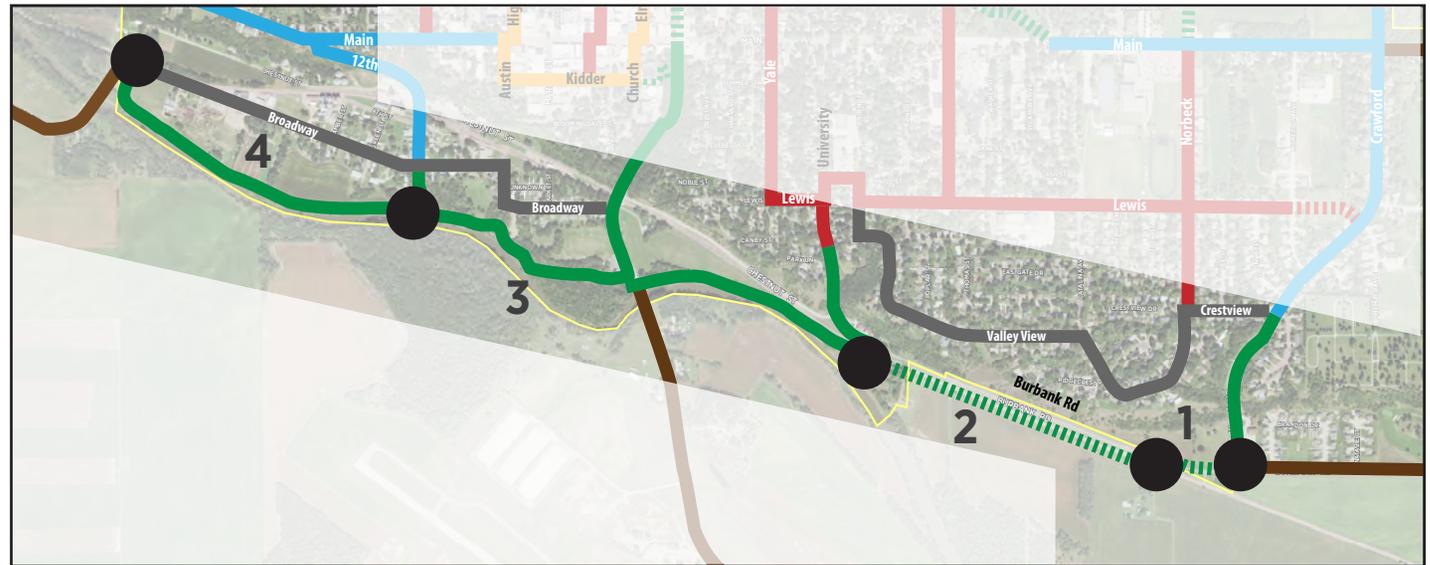
Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Cherry to Dakota	1.42	Existing Shared Use Sidepath	Enhanced crossings and motorist caution signs at Carr, Princeton, Cottage and Dakota.	\$-
2	Dakota to Plum	0.47	Open area adjacent to SD 50	Shared use path. Best alignment would be on USD property south of drainageway. Enhanced crossings and motorist caution signs at University and Plum.	\$286,700
3	Plum to Crawford	0.90	Open area adjacent to SD 50	Shared use path. Best alignment would be on property south of drainageway. Path should be routed around wetlands area east of Plum. Enhanced crossings and motorist caution signs at Norbeck and Crawford, with transitions to Crawford Rd bike lanes.	\$549,000
4	Crawford to Cherry	0.21	Open area adjacent to Crawford	Shared use path along the east esdge of Crawford. Well-marked intersection at Cherry with transitions to Crawford bikeway, continuing path loop to the south, and Cherry Street protected bike lanes.	\$128,100
Total		3.00			\$963,800



TRAIL LOOP



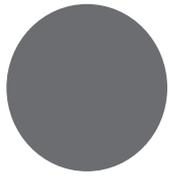
Perimeter Loop: South Leg



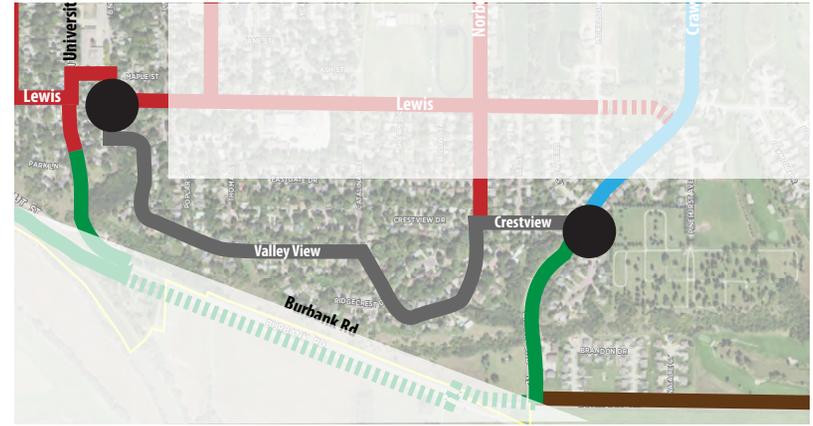
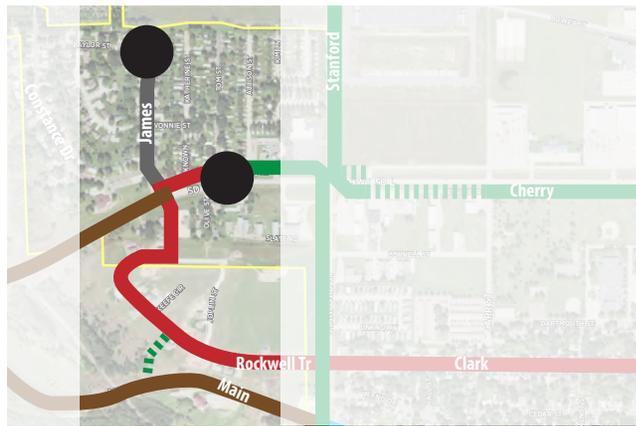
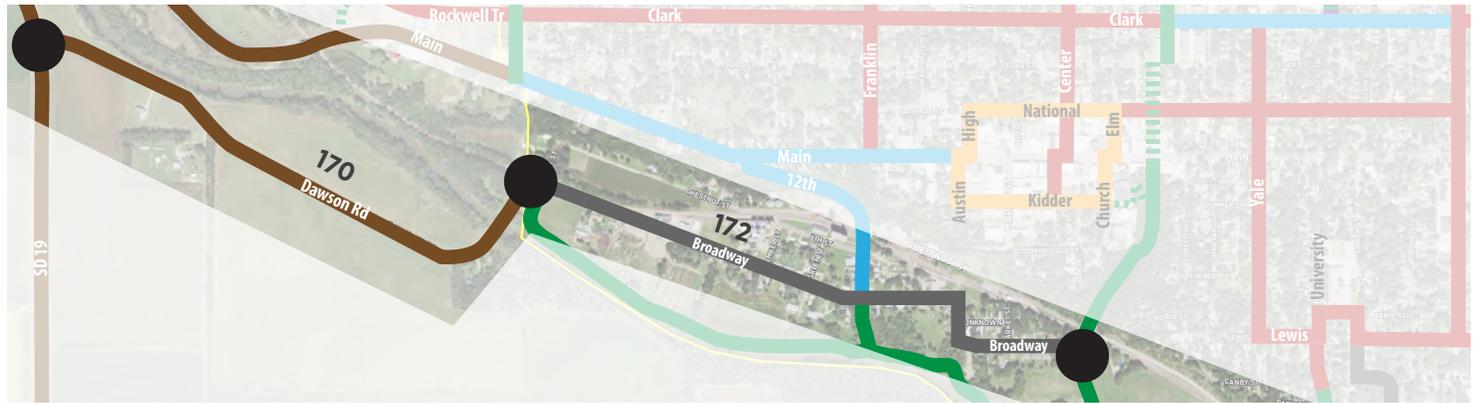
Segment Name: Trail Loop: South Leg

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	Crawford to Access Drive	0.13	Open land	Shared use path on north side of Burbank Road, changing to south side at access drive. Enhanced pavement markings with motorist advisory signs at transition point. Possible upgrade to RRFBs.	\$79,300
2	Access drive to city lift station.	0.54	Agricultural land adjacent to railroad	Shared use path. Trailhead and parking at lift station site	\$329,400
3	Lift Station to 12th Street	1.00	Existing shared use path	No necessary changes	\$-
Total		2.32			\$408,700





Neighborhood Connectors



Segment Name: Trail Loop: North Leg

Segment Key	Segment	Length (miles)	Existing Condition (Width)	Recommended Infrastructure	Probable Cost
1	South/Old Town. Broadway/Austin, West to Dakota Ave	0.96	2-lane local (36')	Shared roadway with identification signs	\$27,840
2	Dawson Road, SD 14 to Broadway	0.94	2-lane local (36')	Shared roadway with identification signs	\$27,260
3	Northwest. James and Cherry Frontage Road, Baylor to Tom	0.34	2-lane local (36')	Shared roadway with identification signs	\$9,860
4	Southeast. Linden/Valley View/Cresview, Maple to Crawford	1.11	2-lane local (28')	Shared roadway with identification signs amd shared lane markings	\$32,190
Total		3.35			\$97,150

PRIORITY CRITERIA AND UNIT COSTS

The proposed Vermillion area bikeways network will be implemented in phases, and will evolve over time. However, this plan establishes both a basic phase that guides activity during the next ten years, and an ultimate network that emerges logically from that foundation. The sequencing of phases and specific trails and routes proposed here follows these criteria and principles:

Response to demands. In every phase, high priority routes should address existing demand patterns, and serve destinations that are valuable to users and appropriate endpoints for bicycle transportation. The survey results summarized in Chapter 2 provide valuable information on the importance of various destinations.

Route integrity. High priority routes and projects should provide continuity between valid endpoints such as destinations and trails. When developed incrementally, routes should not leave users at loose ends.

Extensions of existing facilities. Projects that make use of and extend the reach of key existing facilities that need attention.

Gaps. Small projects that fill gaps in current facilities can be especially useful at early stages of the system's development.

Opportunities. The implementation sequence should take advantage of street projects, resurfacing and street rehabilitation projects, and other infrastructure projects

Safety enhancement. High priority projects should increase safety and reduce user discomfort for people of all ages.

Demographic equity. Projects should provide bicycle and pedestrian access to underserved populations and connect people and households without access to a motor vehicle to destinations important to their lives and livelihood.

Service to key destinations. These include parks, schools, the library, and similar destinations.

Relative ease of development. It is important that the a useful system be established relatively quickly and at comparatively low cost. Developability helps determine

priorities. The initial system should serve major destinations and provide good connectivity while minimizing large scale projects.

Clearly economics and available resources are extremely important and facilities that meet user demands and preferences are frequently relatively expensive because they require a greater degree of separation from motor vehicles. Table 5.1 identifies typical costs per mile for the different types of on-street facilities anticipated for the Vermillion network. The subsequent detailed route tables apply these cost factors to the individual on-street components of the active network.

SEQUENCING

The sequencing concept uses these guiding criteria to identify a basic network that would provide a high level of service to Vermillion even if no further progress were made. The sequence design divided into a basic on-street and gap path network, and an ultimate network that provides comprehensive coverage of the city. It also considers the peripheral Trail Loop as a distinct project because it is likely to use dedicated funds for its specific construction. The Basic Network implemented over ten years translates into a proposed investment of about \$1.5 million, or slightly under \$150,000 annually in 2018 dollars. The Trail Loop completed over the same period costs about \$1.77 million, or about \$177,000 annually over a ten-year period. Clearly implementation depends on availability of funding and some large projects or overall efforts could receive federal and state funds that could advance certain projects. This implementation sequence represents a suggested scenario that may change over time.

THE BASIC SYSTEM

While the City and the user community will help to determine the order of projects within each phase, the system must start to emerge with some specific routes and route segments. This basic system is the foundation of the ultimate network, and should provide maximum impact, link all parts of the city, and serve proven destinations and traffic patterns. It features the following key elements:

- Completion of three major east-west corridors: Cherry Street, including East Cherry, viewed as one of the leading concentrations of campus- and community-oriented destinations; Clark Street; and Main/National, serving Downtown Vermillion.
- A southside neighborhood Bikeway via Lewis Street, serving neighborhoods south of Main and the high school to both the center of the city and the USD campus.
- Major north-south routes, serving schools and key destinations, including Princeton/Franklin; Cottage/Center; and Plum.
- A major gap filling shared use path along Dakota between Clark and Main.
- The Downtown circulator loop, to be coordinating with a programmed downtown revitalization and streetscape program.
- A direct and much requested route between USD and Downtown using Cherry, Dakota and Yale; and National.
- A direct bikeway link from USD west to Walmart and Hy-Vee.

While considered separately, a complete trail loop is also an integral part of the basic system. This includes:

- Completion of the north leg between Dakota and Crawford.
- Filling the gap on the south leg between Crawford and the current trail terminus and proposed trailhead at the city lift station near University.
- Repair of the damaged trail between 12th Street and Broadway.
- The trail loop is connected to the citywide network by existing sidepaths along Crawford and University; a new climbing bike lane on 12th Street; and Dawson Road to shouldered routes and an existing river bridge along SD 19 and the SD 50 Cherry Street business route.

The basic system also includes several key intersection improvement projects:

- Cherry and Stanford (SD 19 and SD 50 business route)'.
 - Cherry and Princeton.
 - Dakota and National.
 - Yale and Main

LATER PHASE

Phase 2 expands the on-street transportation improvements of the basic system and upgrades some existing routes. It includes:

- Extension of the basic system to the Trail Loop along Dakota and University.
- Upgrading of wide sidewalks within the USD campus to dual purpose promenades with separate pedestrian and bikeway tracks. These projects could be accelerated if included in a USD capital program.
- Extensions of the system into parts of the city that are likely to develop within the next ten years.
- Improvement of the Campus Collector system west of Dakota and around major commercial development in the west Cherry and Princeton areas.
- Extension of the Vermillion network into future industrial job centers north of the SD 50 bypass loop.

Significant barrier improvement projects primarily address intersections associated with these later phase extensions. These include:

- Crawford and SD 50.
- Rockwell and Cherry.

OPINION OF PROBABLE COST

Tables 5.2 and 5.3 on the following pages summarize planning level opinions of probable construction cost for the Vermillion area bikeway network. These calculations and concepts provide decision-makers with information that can evaluate and sequence segments of the network in relation to available resources and specific future projects that most appropriately meet community needs.

TABLE 5.2: Probable Costs by Phase for Network Lines

Routes	Opinion of Probable Cost			
	Total	Basic Phase	Later Phase	Perimeter Loop
On-Street Network				
1 - Franklin/Princeton	\$44,200	\$44,200		
2 - Center/Cottage	\$78,870	\$78,970		
3 - Dakota	\$420,900	\$225,700	\$195,200	
4 - University	\$193,700	\$103,700	\$90,000	
5 - Plum	\$63,400	\$42,400	\$21,000	
6 - Norbeck	\$197,540	\$57,240	\$140,300	
7 - Cherry	\$569,100	\$282,400	\$286,700	
8 - Clark	\$212,800	\$167,750	\$45,050	
9 - Main/National	\$220,340	\$98,340	\$122,00	
10 - Lewis/Yale	\$78,440	\$78,440		
11 - Crawford	\$60,700	\$60,700		
Downtown Loop	\$106,680	\$106,680		
Campus Circulator	\$292,280	\$57,200	\$235,080	
Connectors: South	\$27,840	\$27,840		
Connectors: Dawson	\$27,260	\$27,260		
Connectors: Northwest	\$9,860	\$9,860		
Connectors: South	\$32,190		\$32,190	
Outer Loop: North				\$963,800
Outer Loop: South				\$805,200
TOTAL	\$4,405,200	\$1,468,680	\$1,167,520	\$1,769,000

TABLE 5.3: Probable Costs by Phase for Intersections

Intersections	Opinion of Probable Cost*
	Basic Phase
Cherry - Stanford	\$640,000
Cherry - Princeton	\$38,000
Cherry - Dakota	\$190,000
Cherry - Norbeck	\$140,000
National-Dakota	\$200,000

TOTAL

* Estimates are for construction expenses only and do not include engineering fees

FIGURE 5.1: Basic Bikeway Network

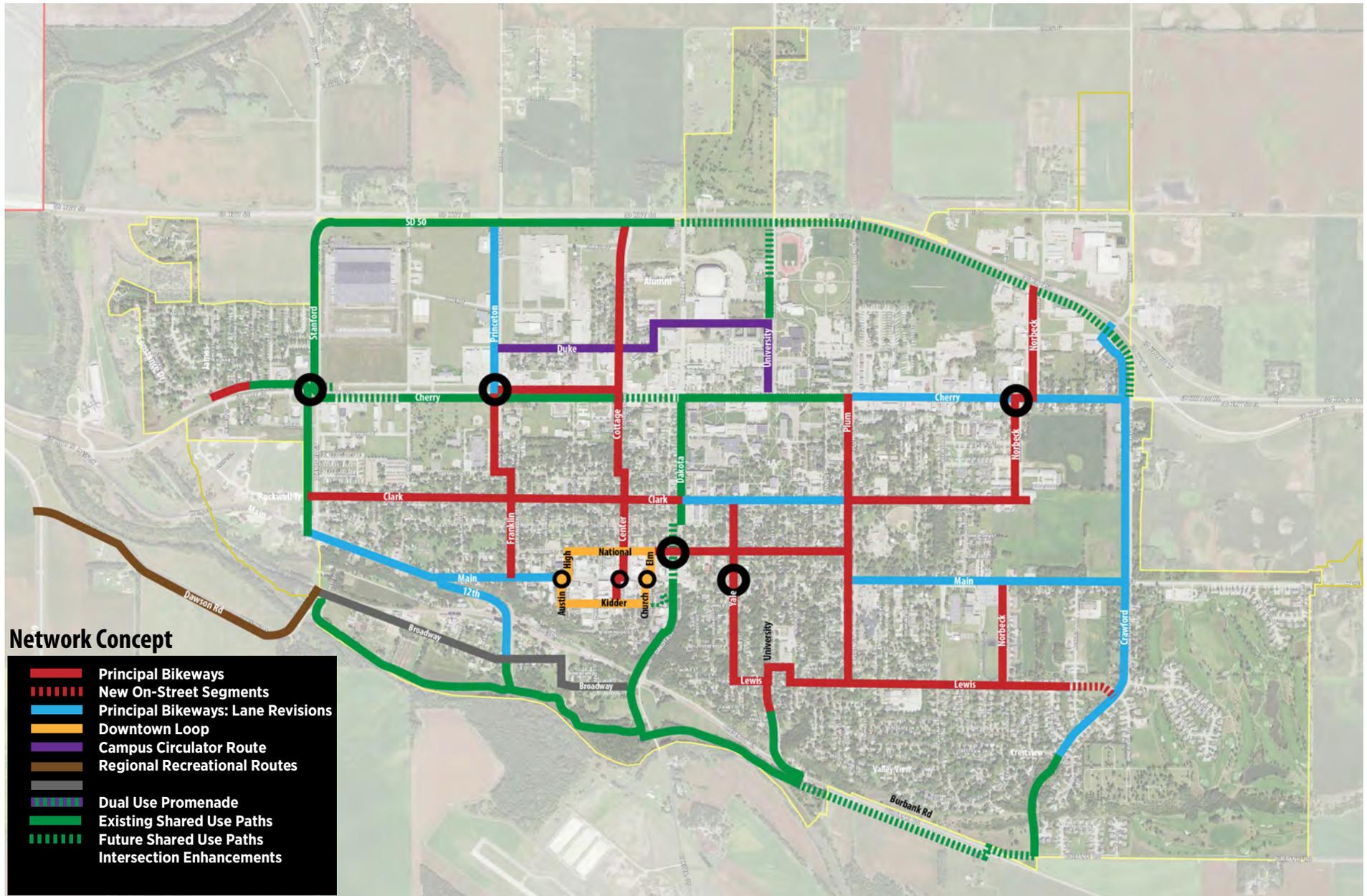


FIGURE 5.2: Later Phase Bikeway Network

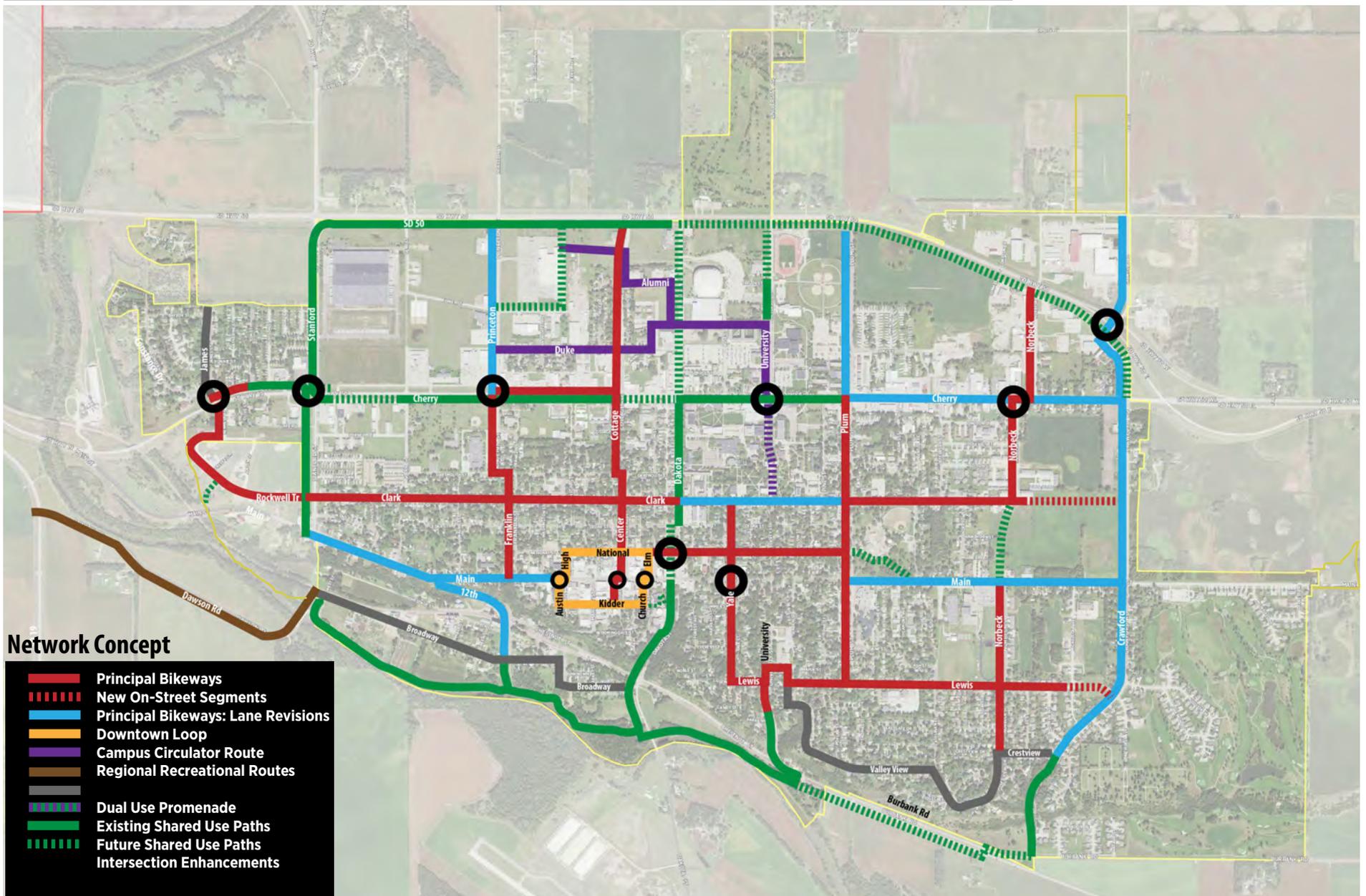
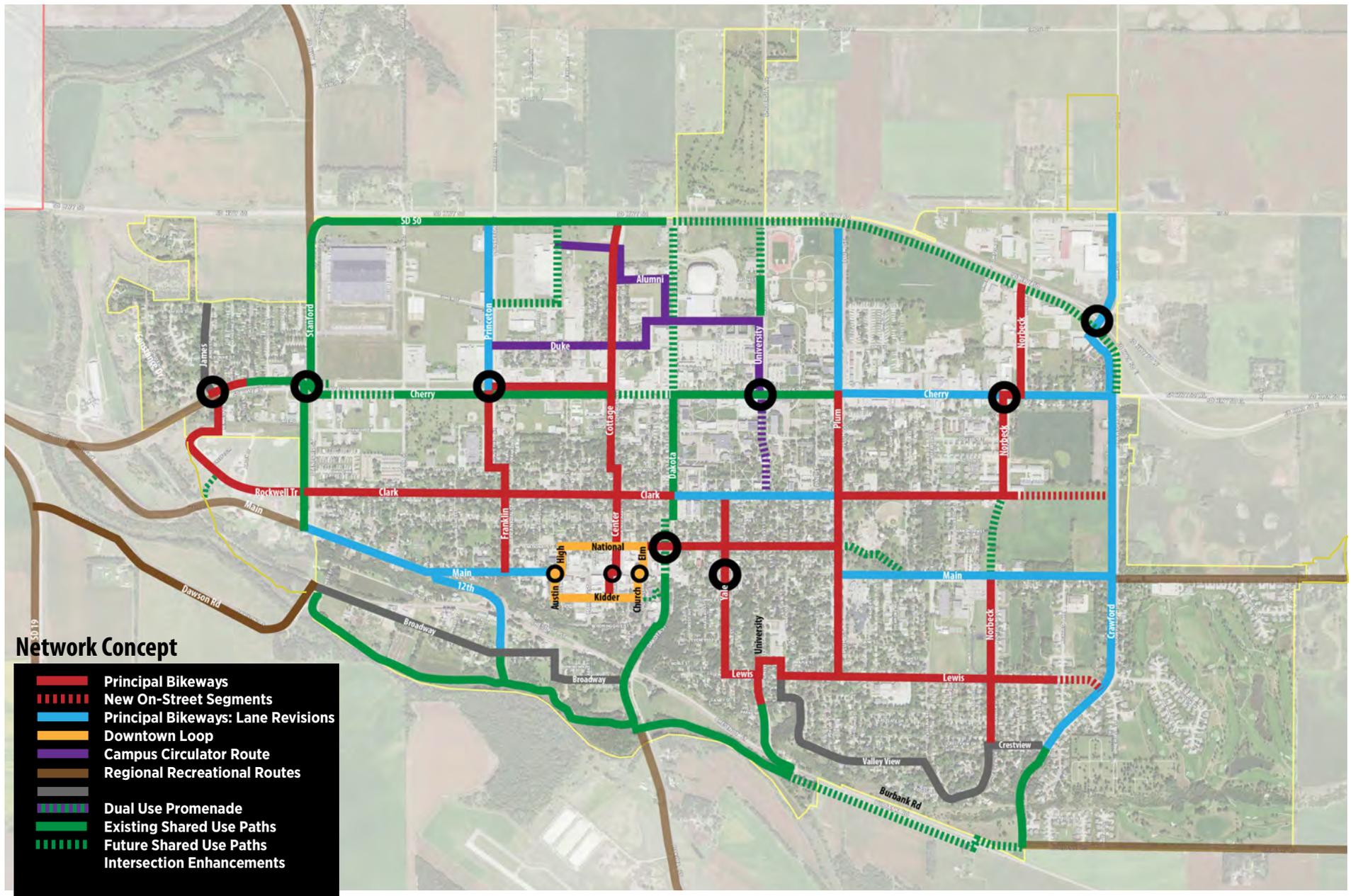


FIGURE 5.3: Bikeway Network at Full Build-Out



FUNDING

The City of Vermillion should develop a diverse approach to funding projects on the future bicycle network. Funding for the implementation of the network is likely to come from a variety of sources, and these are likely to vary by project and year. The Rails to Trails Conservancy publishes an exhaustive list of funding sources for bicycle projects, including federal, state, local, and private.¹ Several sources recommended specifically for Vermillion include the following.

CITY OPERATING BUDGET

The operating budget of the City of Vermillion is already a source of funding for bicycle programs and infrastructure. For example, staff in the Parks, Engineering, and Streets Departments design, build, and maintain the existing bicycle network. Funding for the Police Department also has a direct impact on bicycle rodeos, patrol, and enforcement. Each year, the City should consider how the current annual operating budget impacts bicycling, with an eye toward incremental and practical improvements for the future.

CAPITAL IMPROVEMENT PLAN

The City has already funded the shared-use path network through the Capital Improvement Plan (CIP), and to continue improving bicycling in Vermillion, the City should continue to dedicate funding to projects that enhance bicycling. The CIP includes a list of projects, costs, and the year of funding. For bicycling there are two major areas in the current 2018 – 2022 CIP:

- The Parks & Recreation Department currently has allocated \$250,000 for Phase 2 of bike path repair on the Vermillion River Trail, between 12th Street and West Street, in 2019.
- The Street Department budget includes chip sealing, overlay, surfacing, and road reconstruction projects, many with state funding. Funding may be available within the existing budget to implement bikeway improvements. The most efficient and cost-effective way to implement improvements is typically through existing projects.

The operating budget of the Vermillion School District may affect the amount of instruction students receive about bicycling. For example, physical education programs can provide the resources for a bicycling curriculum. The facilities budget may also allow for bicycle parking installation.

UNIVERSITY OF SOUTH DAKOTA

Several funding sources may be available through the University of South Dakota (USD). These could be leveraged to help fund bicycle infrastructure in Vermillion, particularly routes near or on the campus of USD. University funding sources may include alumni donations, capital improvements, or operating funds. USD's bike share program launched in 2017 after it received a grant from the Student Government Association's Green Initiative Fund.

CLAY COUNTY

The City of Vermillion and Clay County can be strong partners in creating a bicycle-friendly community. There are many opportunities for coordination and partnership in planning, funding, and implementation of bicycling infrastructure and initiatives. Although Clay County does not own or operate any roadways within Vermillion's City Limits, County roadways





exist leading up to the edge of the city. The Vermillion Area Multi-Modal Transportation Plan, adopted in 2012, was a joint planning effort by the City of Vermillion and Clay County to improve the connectivity of the bicycling network. The County and City would be ideal partners to jointly apply for grant opportunities of federal programs.

SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION

The City of Vermillion and the South Dakota Department of Transportation (DOT) can also be strong partners in creating a bicycle-friendly community. The DOT owns and operates State Highways 19 and 50, including State Business Highway 50 along Cherry Street. Federal Transportation Alternatives Program funding set aside for State of South Dakota projects can be used along these roads (see Federal Grants section below). The DOT has a policy of funding shared-use path maintenance during roadway maintenance (including ADA curb ramps) when the bicycle facility is located within its right-of-way. The DOT also provides funding to the City of

Vermillion for construction of certain local streets, which may include bicycle facilities.

SOUTH DAKOTA DEPARTMENT OF HEALTH

Two funding opportunities are made available by the South Dakota Department of Health on an annual basis with the goal of encouraging physical activity. The first is the Active Transportation Assessment Collaboration, which is a technical assistance program offered to communities by South Dakota State University landscape architect and city planning students, during their spring semester. The second is a Steps to Wellness Workplace grant, which funds projects that address environment and policy changes at worksites.²

FEDERAL GRANTS

Bicycle infrastructure and programming are eligible for some federal grant programs. The US Department of Transportation publishes an exhaustive list of bicycle-related improvements which are eligible for various sources of federal funding.³ The City should seek and apply for these funds, but should consider them only as a partial funding source because grants are generally competitive and limited. Yet federal funding sources can finance large infrastructure projects that the City of Vermillion may not be able to afford otherwise, so these sources are important to the implementation of the Plan.

Federal funding often requires a supply of matching funds from local agencies, typically 20% of the project's total cost. One source of federal funding is the Transportation Alternatives Program (TAP), administered by the South Dakota DOT. TAP grants fund specific activities that enhance the "intermodal" transportation system and provide safe alternative transportation options. Safe Routes to School projects are also funded through TAP. Letters of intent are due annually in July, and applications must be submitted by September. According to the most recent application guide, approximately \$5.3 million is available annually in South Dakota:

- "Roughly \$2.1 million is available through a competitive grant process administered by the South Dakota Department of Transportation (SDDOT) Office of Project Development."

- “Each individual grant may be approved for a maximum of \$400,000 in Federal funds, although SDDOT may approve a larger amount for phased projects. The minimum grant for infrastructure projects is \$50,000. There is no minimum for non-infrastructure projects.”⁴

The remaining \$3.2 million in the TAP program is earmarked for State of South Dakota projects. In 2015, the City of Vermillion applied to TAP for reconstructing downtown sidewalks but was denied funding.

The Recreation Trails Program (RTP) is another source of federal funding for bicycle projects, administered through the South Dakota Game, Fish, and Parks Department. Municipal agencies, counties, school districts, and state education institutes are eligible for grants typically in the range of \$40,000 to \$60,000. RTP funds may be used for new construction, land or easement acquisition, educational projects, maintenance, equipment, and trailhead facilities.⁵ Past grants have gone to municipalities including Aberdeen, Britton, Crooks, Hot Springs, Pierre, Sturgis, Webster, and Worthing. Vermillion received RTP funding for the Riverfront Trail in 2008 through an earmark, with some funding still remaining.

PEOPLE FOR BIKES

People for Bikes is a charitable foundation sponsored by the bicycle industry. The organization runs a community grant program, funding projects such as shared-use paths, mountain bike trails, bicycle parking, and Open Streets events. Grants of \$10,000 are awarded, and must be matched with local funding of at least 50%. Grant cycles occur one to two times annually.⁶

DONATIONS AND CHARITABLE CONTRIBUTIONS

In other communities of a similar size, donations have contributed funding to bicycle-related projects and programs. The South Dakota Community Foundation is an example of a potential donor, which has already given funds to the Vermillion Area Farmer’s Market.

A likely strategy is to launch a community giving campaign to match other funds for the construction and maintenance

of Vermillion’s Riverfront Trail. Businesses, organizations, foundations, and individuals could be recognized along a future segment of path, through plaques and donor recognition boards.

REFERENCES

1. <https://www.railstotrails.org/build-trails/trail-building-toolbox/funding/acquisition-funding/>
2. <http://healthysd.gov/fundingopportunities/?tag>
3. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/funding/funding_opportunities.cfm
4. <http://www.sddot.com/services/transalt/SDDOTTAPSummaryandApplicationGuide.pdf>
5. <https://gfp.sd.gov/userdocs/docs/rtp-manual.pdf>
6. <https://peopleforbikes.org/grant-guidelines/>
7. Minnesota Local Road Research Board
8. <https://www.threeriversparks.org/page/west-mississippi-river-regional-trail-master-plan>



A photograph of a concrete path leading through a wooded area. The path is made of several slabs of concrete and is flanked by green grass and bushes. The trees are dense and green, with sunlight filtering through the leaves. A semi-transparent orange banner is overlaid across the middle of the image, containing the text "6 Support Facilities".

6 Support Facilities



Razorback Greenway Trailhead,
Fayetteville, AR

SUPPORT FACILITIES

The planning of bicycle networks begins with definition of routes, which in the proposed Vermillion system will consist of a combination of multi-use paths on right-of-ways both separated from and adjacent to streets, a variety of on-street bicycle routes that share the space between curb lines with motor vehicles; and sidewalks for pedestrian use.

Much of the network passes through the city, and private or public establishments provide support features for users, typically food, drink, bathrooms, and support or shelter in emergencies. However, parts of the proposed Vermillion network are relatively remote or lack public places or businesses that routinely serve support functions. Well-placed support facilities can fill these needs and increase the comfort level of people using the trail and active transportation network.

Support facilities enhance the experience of using an active transportation network. They can help orient users and provide milestones and events along a trail. This report identifies criteria, locations, and features of support facilities related to the current state of the network plan.

TYPES OF TRAILHEADS AND NODES

Based on both function and facilities, the Vermillion network may have three levels of support facilities which will be referred to as major trailheads, minor trailheads, and nodes.

Major Trailheads. Major trailheads provide essential access to the shared-use path system and include information and amenities for trail user comfort. Trailheads that serve local and regional individuals who arrive by car or bike may have a variety of features.

Minor Trailheads. Minor trailheads provide strategic points of access to the shared-use path system. They typically serve local users. While major trailheads are likely to be accessed by car and are transfer points from car to bike or pedestrian travel, users are more likely to walk or bike to minor trailheads. In addition to marking entrances to the system, minor trailheads should provide users with information and some amenities, but have a much more limited facility program than major trailheads.

Nodes. Nodes are generally focused to people already using a trail, and may suggest points of interest or limited amenities to be used along the way. They also might provide useful features that can address contingencies or improve the experience.

LOCATION CRITERIA AND FEATURES

Due to their different functions, each of the three support facility types has different location criteria and menus of features.

MAJOR TRAILHEADS

In Vermillion, major trailheads will function largely as interchanges, where people arrive by car and become pedestrians or bicyclists. They will also tend to use these entry points for recreational purposes.

Criteria for Major Trailheads:

- Direct adjacency to a major trail. A location that will require some level of on-street cycling or walking will not be a successful major trailhead.
- Good access and visibility from a principal street or road. With urban trails, clear access routes are more important than with rural trails.
- Possible location at or near the ends of major trails. This tends to place major trailheads on the periphery of the city.
- From a practical point of view, sites that provide adequate space to accommodate the facility program without requiring land acquisition. Examples are parks, school sites, and other public lands.
- Reasonable access to major community facilities, including retailers and food service.
- Presence of existing features or facilities that serve multiple uses, such as substantial parking areas.

Major Trailheads may include the following facilities:

- Motor vehicle parking, including accessible parking spaces.
- Bicycle parking, such as a sufficient number of inverted U's or hitching post designs. Guidelines for bike parking will be provided later in the plan.

- Wayfinding kiosks and signage, with orientation and interpretive information.
- Drinking water fountains.
- Screened portable toilets if facilities are not provided elsewhere on site.
- Shelters, benches, tables, trash receptacles, and similar site furniture.
- Emergency telephone.
- Scenic viewpoints or overlooks if relevant to the site.
- Interpretive information if applicable
- Fix-it station, installations that have secured tire pumps and tools for light repairs. Many of these features are included in parks, and a trailhead location and trail extension that can use existing facility clusters is very desirable.



Trailhead on the Prairie Spirit Trail, Princeton, KS

MINOR TRAILHEADS

Minor trailheads will be primary points of entrance by local users. Thus, location criteria and the facilities menu will adjust accordingly.

Criteria for Minor Trailheads:

- As with major trailheads, direct adjacency to a major trail. A location that will require some level of on-street cycling or walking should be avoided.
- Location in a park (including a neighborhood park), school site, or other public space. Other potential locations include the intersection of a trail and a principal on-street route.
- Availability of at least a few parking spaces (desirable but not mandatory).
- Reasonable spacing to permit access and exiting from the trail. Given the city's size and configuration, a reasonable spacing of minor trailheads would be about one mile apart.
- Nearby commercial convenience services are desirable.

Minor trailheads may include the following facilities:

- A small parking area if available in an adjacent use.
- Bicycle parking for a small number of bicycles, such as two inverted U's, hitching posts, or other space efficient designs.
- Wayfinding signage, with orientation and interpretive information.
- Bench and trash receptacle.
- Interpretive information if applicable
- Fix-it station for light repairs.

NODES

Nodes are points along the trail, generally placed for the comfort and convenience of trail users, or to emphasize a special destination or feature. As a result, they need not be placed at street intersections or other access points.

However, spacing along trails becomes a much more important factor than it is for trailheads. Possible locations for nodes include:

- Sites of special interest, such as historic sites, locally important destinations, or scenic or environmentally important features.
- Changes in trail direction or places where special guidance to the user is required.
- Junctions between trails or between trails and a major on-street route.
- Shade trees, green spaces, or other locations that can add quality to the trail experience.
- Nodes should be placed to ensure a typical distance of one mile between support services or guidance. Trailheads and publicly-available convenience services can fill the same function as a node and may have an effect on their location.

Facilities for a node may include:

- Bicycle parking.
- Wayfinding and interpretive signage or kiosks.
- Bench and trash receptacle.
- Fix-it stations at key locations.

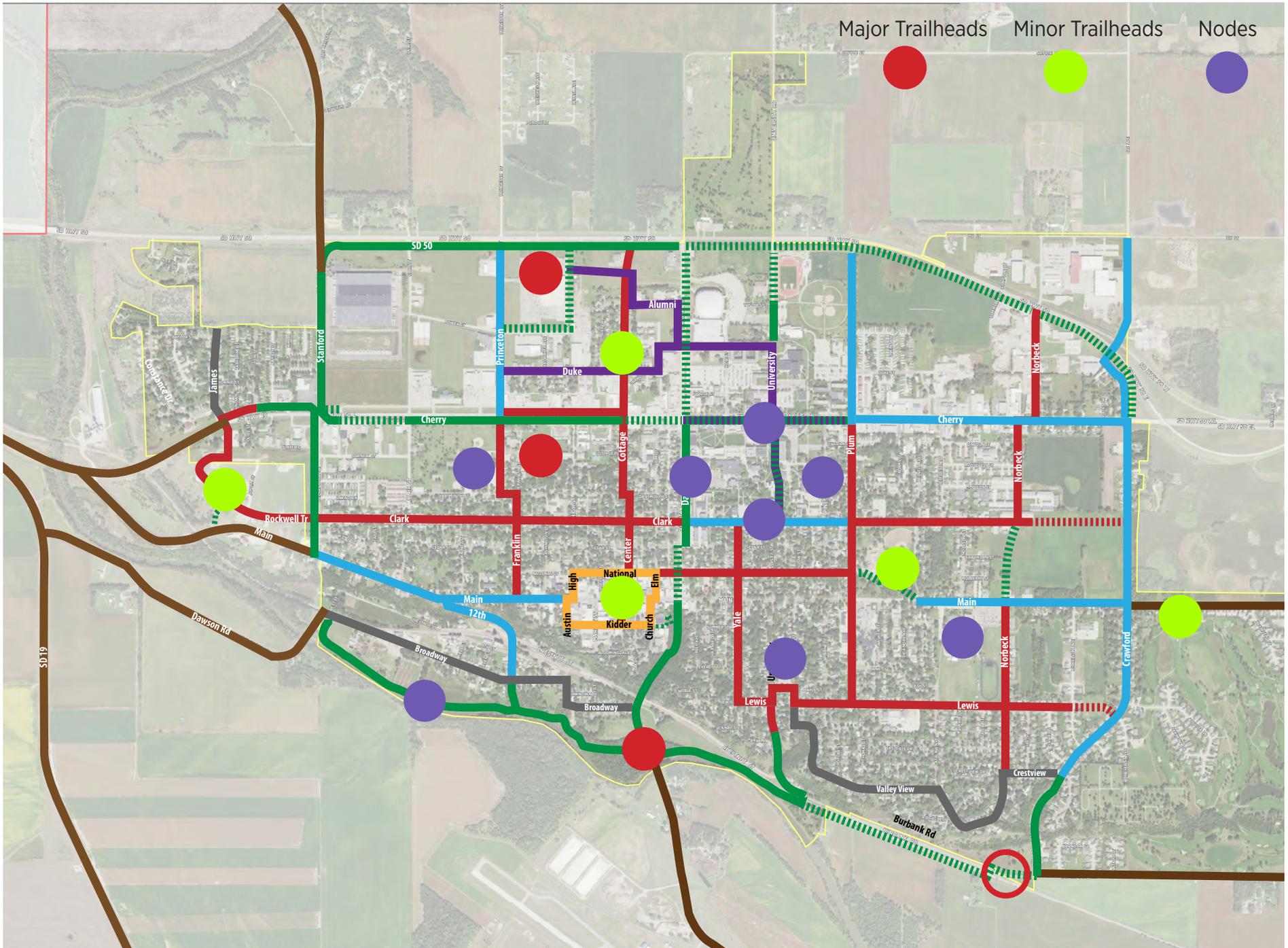
Proposed locations:

- The table on the following page presents potential trailhead and node locations, based on the current and future development of the Vermillion network.

TABLE 6.1: Possible Support Facility Locations

	Support Facility Type	Location	Network Segment	Current site resources and needs	Other comments
	Major Trailhead	Cotton Park	Riverfront Trail and Dakota Street Access	Parking, Shelters, Picnic Areas, Lighting, Trash Receptacles, Interpretative Signage, Restroom	Role would increase with the completion of the City Trail Loop, the repair of the riverfront trail, and the extension of the riverfront trail to Crawford.
	Major Trailhead	Wal Mart	City Loop Trail (progress to date)	Parking, Lighting, Wal Mart as a service amenity	A plaza space with shade, orientation signage, and benches would reinforce this area as a place to access the City Loop Trail. An extension of the trail to the Wal Mart parking lot would be needed for this to function as an effective major trailhead.
	Major Trailhead	Barstow Park	Cherry Street Shared Use Path	Parking, Restrooms, Shelter, Benches and Tables, Playground Amenities	Lighting would be desirable in addition to strong bicycle infrastructure along Carr Street.
	Minor Trailhead	Bliss Point (Location TBA)	Stanford Street Shared Use Path, City Trail Loop (progress to date)	None	Subject to property availability, could function as a minor trailhead in western Vermillion.
	Minor Trailhead	Rotary Park	Cottage Street Neighborhood bikeway, Proximity to City Trail Loop (progress to date)	City Owned, benches, shade, playground equipment, on-street parking.	Orientation signage recommended to connect visitors to the bicycle network. On-street wayfinding recommended to increase use of the trailhead. Recommended addition of bicycle amenities.
	Minor Trailhead	Prentiss Park	National Street Neighborhood bikeway	City Owned, central community feature at the heart of the bicycle network; playground, monument with interpretative signage, waterpark, ballfields, parking (on-street and off-street).	Recommend additions of bicycle amenities. Potential trailhead at 'old drop-off.'
	Minor Trailhead	Golf Course	Crawford Road Trail; City Loop Trail (progress to date)	Privately Owned, well located at the edge of city limits, adjacent to the regional trail start, paved parking lot.	With improved vehicular wayfinding, this could be a primary trailhead
	Minor Trailhead	Downtown Bike Hub	Downtown Circulator Route	City Owned, high concentration of bicycle users, trip origins, and trip destinations.	Recommend including bike parking, fix-it station, lighting, and orientation signage including a system map.
	Minor Trailhead	Burbank Lift Station	Riverfront Trail (Extension) and Burbank Road (Proposed Trail Extension to Crawford Street)	City Owned, Lift Station, Small Gravel Parking Area	Proposed upon completion of trail extension connecting the Riverfront Trail and Crawford Road
	Node	Schools	Important nodes along the on-street network.	Various	The role of each school varies as a trailhead or node. As a major destination for many bicyclists, Vermillion's schools should be positioned as intentional "stops" on the bicycle network.
	Node	USD Campus Quadrants	Important nodes at the center of the bicycle network. Segments include: the Cherry Street Promenade, Dakota Street, and the Clark Street Neighborhood bikeway	High concentration of bicycle users, trip origins, and trip destinations. Immediate access to high volume pedestrian and bicycle paths.	Potentially positioned as four orientation points with one in each quadrant of the USD campus (Cherry Street, Pine Street, Dakota Street, and Clark Street). Each point could include orientation signage and/or a system map, a fix it station, bike share station, etc.
	Node	Vermillion River - Trail End	Riverfront trail	Overlook, trail access	Interim trailhead as an overlook while the riverfront trail is reconstructed.

FIGURE 6.1: Possible Support Facilities



POINTS OF INTEREST

The proposed network plan was designed to serve major destinations and points of interest in the community through trails, on-street principal routes, and shorter connectors. Thus, the active transportation network serves schools at all levels, most parks, the library, many substantial commercial areas, and major employment destinations.

The network also is designed to extend to new growth areas and currently-planned park and open space projects. Thus, future projects serve areas identified for new development in the future land use plans and identifies proposed collector streets through these areas, which should be designed to accommodate all modes comfortably.

However, one area of concern not fully considered are historically and/or architecturally significant points of interest. The National Register of Historic Places provides an excellent inventory of these resources, some of which are distinctive. The network, or at least its wayfinding system to be developed later in this planning process and part of the supporting facilities program described in this paper, should direct users to these features, all of which help tell the story of Vermillion and the region. The table below lists the study area's National Register listings and whether they are served by the network.

TABLE 6.2: National Register of Historic Places in the Study Areas

Historic Name	Location	On-Route (Y/N/Proximity)
Downtown Vermillion Historic District	Downtown	Yes
Forest Avenue Historic District	Forest, South of Main	1 block west, 1 block east
Bluff Historic District	South of Downtown	1 block south
University Historic District	South of Campus	Yes
Vermillion City's Andrew Carnegie Library	Downtown	Yes
Gunderson House	24 S. Harvard	1 block west
Linden House	509 Linden	1 block east
South Dakota DOT Bridge No. 14-130-176	465th Ave, North of Vermillion	No
South Dakota DOT Bridge No. 14-133-170	Near 465th Ave, North of Vermillion	No
South Dakota DOT Bridge No. 14-088-170	On 314th Street, NW of Vermillion	No
Old Armory	Downtown	Yes
First Methodist Episcopal Church	Dakota and Main	Yes
Bluff View Cemetery Chapel	Pinehurst Ave	1 block east
Yusten House	Highway 19, North of Vermillion	Yes, on Regional Route
Colton House	402 S. University	Yes
Austin-Whittemore House	15 Austin Ave	Yes
Old Main	USD Campus	
Spirit Mound	Highway 19, North of Vermillion	Yes, on Regional Route
Inman House	415 E. Main	Yes
Rice Farm	NW of Vermillion	No
First Baptist Church of Vermillion	101 E. Main	Yes
Wiley, E. H., House	104 Court	Yes
Clay County Courthouse	211 W. Main	Yes
First National Bank Building of Vermillion	1 E. Main	Yes
St. Agnes Catholic Church	202 Washington	Yes
City Hall	25 Center St.	Yes

WAYFINDING

Most Vermillion residents are familiar with navigating the street network when traveling by foot or in a motor vehicle. However, the network of bicycle-friendly routes can be “invisible”, both to new visitors and to lifelong residents, without a dedicated wayfinding system. Bicycle wayfinding helps knit together a planned bicycle network with signs that help with navigation, safety, and encouragement. Improving navigation is important for promoting the use of preferred bicycle routes and encouraging bicycling on designated corridors.

Wayfinding contributes to safety by providing a visual cue for drivers that bicyclists should be expected on streets, increasing driver awareness of bicyclists. Wayfinding for bicyclists can also assist emergency officials attempting to locate an injured bicyclist, particularly on trails. Wayfinding also encourages more bicycling by providing a higher level of comfort and confidence for people choosing to travel by bicycle.

According to the guiding principle of “integrity” for this plan, wayfinding signs should keep users informed and oriented at all points and avoid ambiguities that cause users to feel lost or require them to carry unnecessary support materials. Signs should be clear, simple, consistent, and readable, and should be consistent with the Manual on Uniform Traffic Control Devices (MUTCD).

SIGNS

Street name signs are already located at every street-to-street intersection within Vermillion and provide wayfinding for drivers and pedestrians. Bicyclists can also refer to these signs as reference points, and they can be enhanced to serve the additional purpose of directing bicyclists towards the designated routes of the bicycle-friendly network. Small bicyclist and pedestrian logos can be added to standard street name signs on the routes comprising the Vermillion bicycle network. Through this low-cost wayfinding plan,



bicyclists will be able to easily find their way along the network, and drivers will be aware that they are likely to share the space with bicyclists. All intersections of multiple shared use pathways and where those pathways connect to the street network should include dedicated street name signs to allow for a seamless transition from those facilities into the Vermillion street network.

The following recommendations outline the types and placement of wayfinding signage for the proposed bicycle network in Vermillion.

Add bicycle logo to street name signs on streets containing on-road and/or parallel bicycle facilities.

All street name signs on streets with on-street bicycle facilities, and those with a shared-use sidepath or promenade running parallel to the roadway, should have a bicycle symbol added before the street name. These types of facilities will not receive separate names, but rather will be referred to by the name of the street they parallel. Signs may be placed on overhead mast arms (single-sided), or on stop signs or other posts (double-sided), as appropriate for the given intersection.

D3-1 (MOD). Signage for street with on-street bicycle facility or parallel sidepath



Facility Types:

SIGNED, MARKED ROUTE

STANDARD BIKE LANE

PROTECTED BIKE LANE

PAVED RURAL SHOULDER

OTHER PAVED RURAL ROAD

DUAL USE PROMENADE

EXISTING SIDEPATH

FUTURE SIDEPATH



Sign assembly for intersection of street with on-street bicycle facility and street with parallel sidepath



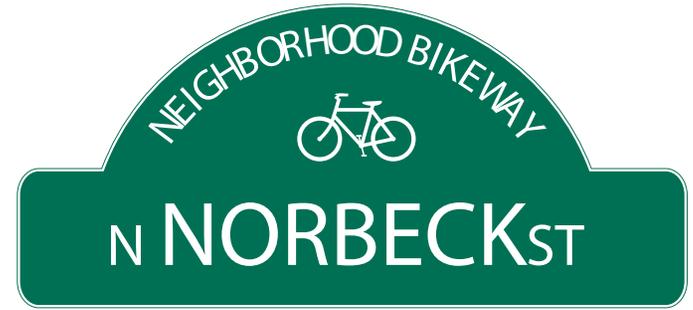


Sign assembly for intersection of street with on-street bicycle facility and street with parallel sidepath

Add “Neighborhood Bikeway” logo to street name signs on streets designated as Neighborhood Bikeways.

All street name signs on streets designated as Neighborhood Bikeways should have a bicycle symbol and the text “Neighborhood Bikeway” added to the sign. These can be contained in a semi-circular extension at the top of the sign. Signs may be placed on overhead mast arms (single-sided), or on stop signs or other posts (double-sided), as appropriate for the given intersection.

D3-1 (MOD). Signage for streets designated as Neighborhood Bikeways

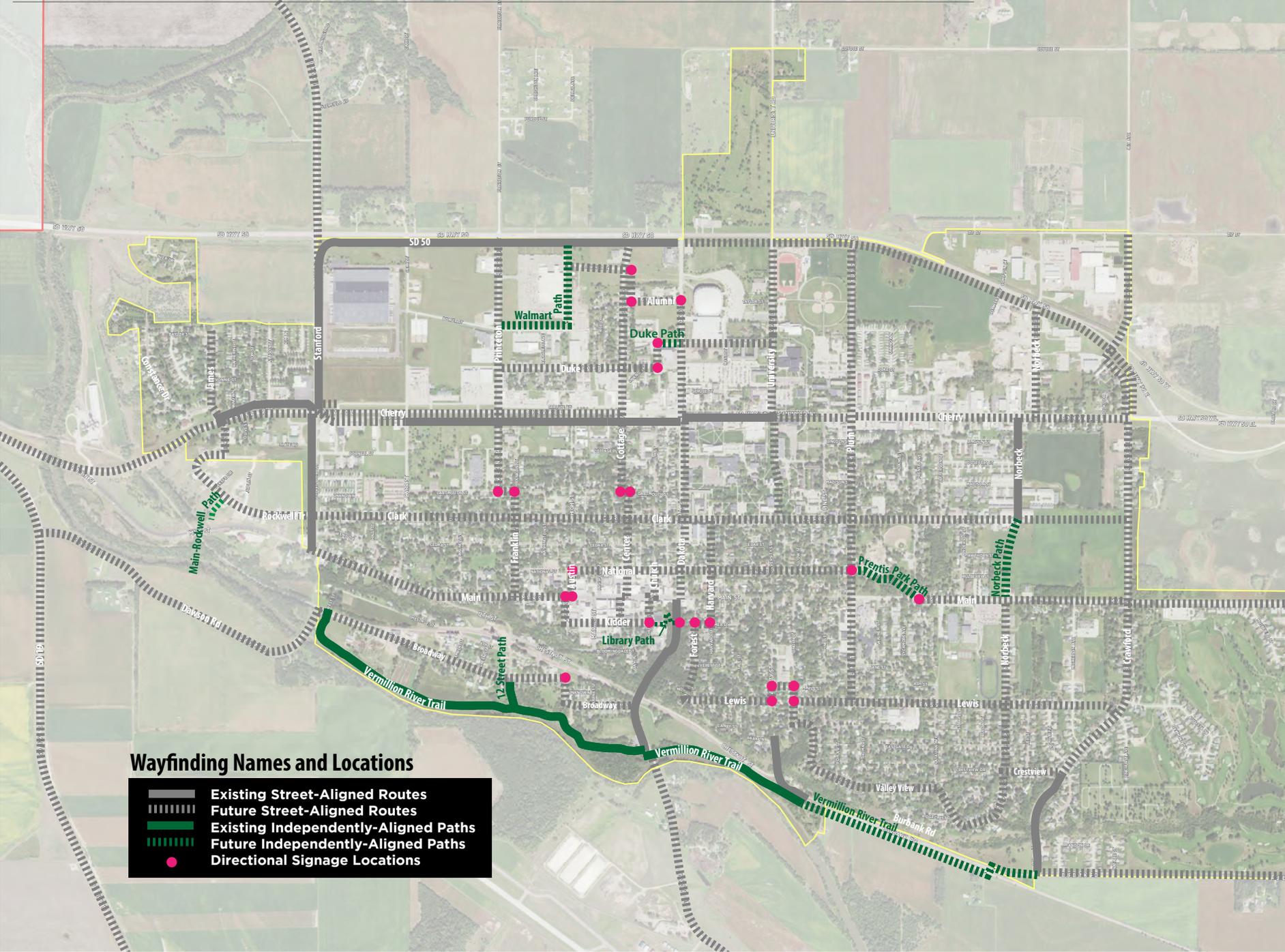


Facility Types:

NEIGHBORHOOD BIKEWAY



FIGURE 6.2: Wayfinding Map





Sign assembly for intersection of independently aligned shared-use path with street

Use double-sided street name sign assemblies to identify independently aligned shared-use paths.

The Vermillion bicycle network contains several shared-use paths that do not parallel the street network. Each of these paths and segments should be formally named (see Figure 6). Then, all path-to-path and path-to-street intersections should receive street name signs for the intersecting routes, visible by drivers and bicyclists on both routes. A bicycle and pedestrian logo should be placed before the name of the path. The suffix PATH or TRAIL should be printed in all capital letters. The text “No Motorized Vehicles” should be placed after the street name over a white background. Signs should be placed on a double-sided street name sign assembly post with two perpendicular signs, and may be paired with stop or yield signs as appropriate.

D3-1 (MOD). Signage for independently aligned shared-use path



Facility Types:

EXISTING SHARED-USE PATH

FUTURE SHARED-USE PATH



Wayfinding assembly in Boulder bikeway system identifies the type of facility and the destinations that it serves

Place directional signage with path name and arrow where on-street or parallel bicycle routes transition off course.

In several locations, the planned bicycle network follows the street network, but then turns to follow an alternate street or independently aligned path (for example, crossing from Main St. to National St. by way of the Prentis Park Path). In these instances, additional directional signage is needed to help bicyclists find and remain on the preferred route. A sign containing a bicycle symbol, with the words “Bike Route” placed below, along with an auxiliary directional arrow sign pointing in the direction of the route, should be placed at each of these locations. Signs should be placed together, with the arrow sign located below the bike route sign, on a street name assembly post, perpendicular to the direction of oncoming bicycle travel.

Locations (See Figure 4.6):

- Cottage and Shriner
- Cottage and Alumni
- Alumni and N Dakota
- Duke and Elm
- Elm and Duke Path
- Cottage and Dartmouth
- Dartmouth and Center
- Franklin and Dartmouth
- Dartmouth and Princeton
- Main and Prentis Park Path (both ends)
- Main and Austin
- Austin and National
- Kidder and Library Connector (at Church)
- Library Connector and N Dakota
- Forest and Everett
- Everett and Harvard
- Lewis and S University
- S University and Maple
- Maple and Linden
- Linden and Lewis
- Broadway and Austin

D11-1c and M6-1. Directional signage to indicate turns in the bicycle network



Left: The bike route identification sign should include a specific destination on or at the end of the route and may be stacked with wayfinders that direct people to other destinations off the specific route.



Directional sign assembly for intersection where bike route turns or jogs off main road

Place street name signage on bridges and overpasses over shared-use paths.

When shared-use paths intersect the street network at a separated grade (a bridge or underpass), street name signage should be placed on the bridge or underpass to indicate the name of the intersecting street. This allows trail users to orient themselves to the street network even while on a separated facility.

Symbolize National Bike Routes 36 and 55 using standardized USBR signage.

The City of Vermillion lies on the potential routes of United States Bike Routes (USBR) 36 and 55. The USBR System is a plan for a national network of 50,000 miles of designated routes, with 13,000 miles already approved in 26 states. Routes 36 and 55 have not yet been established, but the potential routes could go through Vermillion. To be designated as an official USBR, the proposed route must be submitted to the American Association of State Highway and Transportation Officials (AASHTO), which, upon approval, will assign an official number. Routes may follow existing bicycle routes, trails, and roads. State Departments of Transportation

(DOTs) are responsible for designating, supporting, and overseeing USBRs in their state; the South Dakota DOT does not plan to designate USBRs within the state until a neighboring state has developed one up to the South Dakota border.

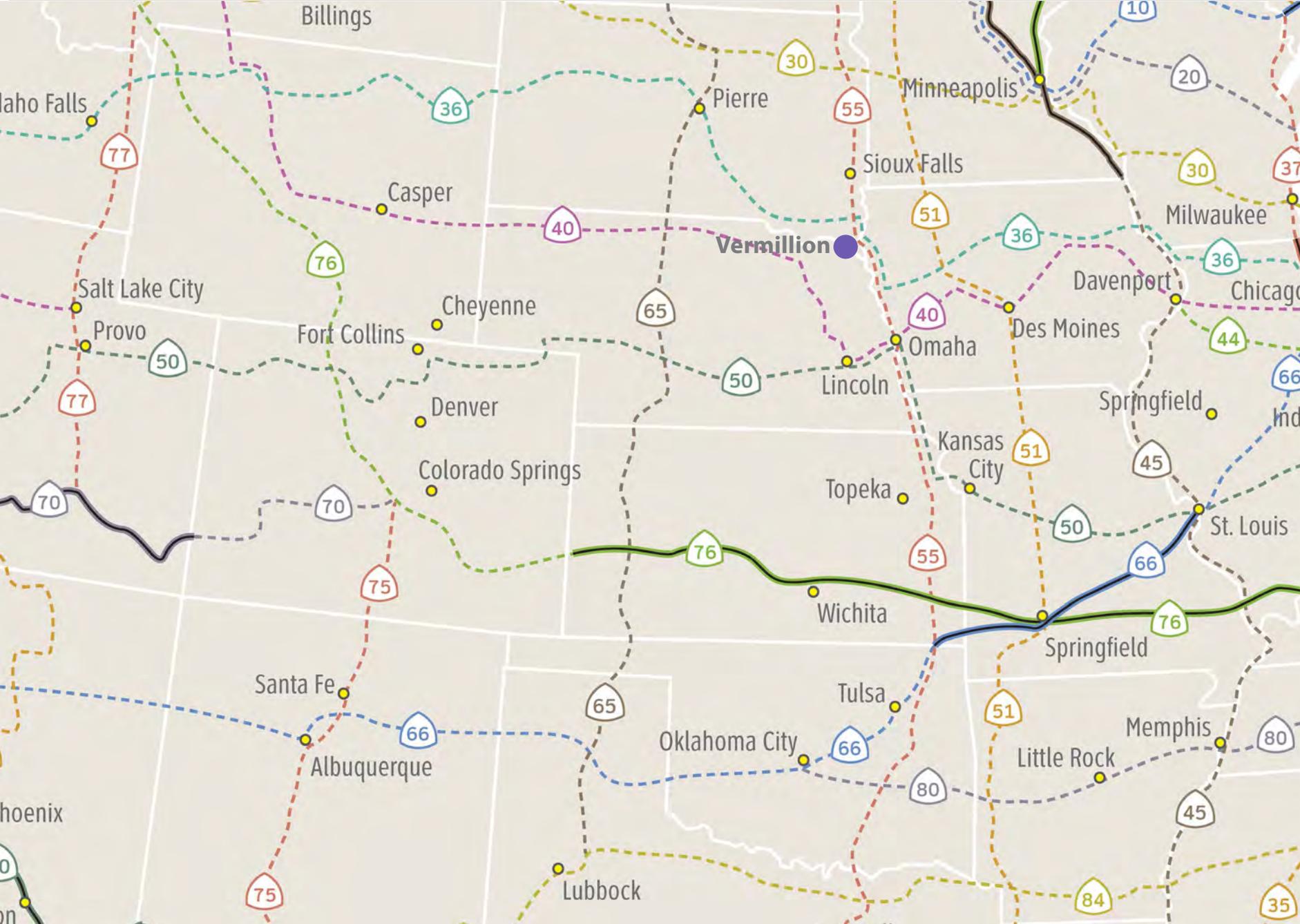
The National Committee on Uniform Traffic Control Devices of the Federal Highway Administration (FHWA) has approved a signage design for USBRs, sign M1-9. This signage, indicating the number of the route, should be placed along the designated route, in addition to the local bicycle route signage described above. Additional guidance for designating and signing a USBR is provided by the Adventure Bicycling Association, or in the NCHRP 20-07 Task 350 Report, entitled “U.S. Bicycle Route Signing Final Report.”



M1-9. FHWA-approved signage for US Bicycle Routes



FIGURE 6.3: USBR 36 and 50 are proposed search corridors, approximately 50 miles wide, within which a route may be developed. The proposed routes could run through Vermillion. (Source: Adventure Cycling Association)



7

Support Programs





SUPPORT PROGRAMS

In addition to the infrastructure changes recommended in previous chapters of this plan, policy and programmatic strategies and actions will play an influential role in the future of bicycling in Vermillion. The proposed network would significantly increase active transportation, but there are other opportunities for bicycling in Vermillion. These policy actions can maintain and encourage active transportation, and pursuing them now will ensure a strong policy framework as the proposed network is constructed. Strategies are numbered in order of priority, as determined through the public engagement process (to be completed after community engagement in late August). Certain actions may take effect immediately while others depend upon the successful implementation of this plan. Partners identified to carry out each strategy are listed in Table 7.1.



TABLE 7.1: Support Systems Actions

Action	Responsible Parties
Apply to the Bicycle Friendly Community and Bicycle Friendly University programs	City of Vermillion, USD
Create a bicycle and pedestrian advisory committee	City of Vermillion
Create a campaign to get USD students to use their bicycles	USD
Create and distribute a print and online bicycle facility network map	City of Vermillion
Create or participate in a bicycle count program	City of Vermillion
Create, print, publish, and distribute pocket-sized law cards	City of Vermillion, SDDOT
Designate an official City Bicycle Program Manager/Coordinator	City of Vermillion
Develop bicycle-related curriculum at all schools	Vermillion Public Schools
Develop educational materials for the public about how to use new bikeway facilities	City of Vermillion, SDDOT
Employ temporary demonstrations to promote and pilot new bicycle infrastructure	City of Vermillion, SDDOT
Expand USD's bicycle share program	USD, City of Vermillion
Find champions to submit Bicycle Friendly Business applications for local organizations	Sanford Health
Incorporate bicycling into USD student orientation	USD
Increase the number of bicycle-related events	City of Vermillion, Recycle 605, USD
Increase the number of buses with racks	Support for People with Disabilities/Vermillion Public Transit
Initiate a City-led bicycle parking program	City of Vermillion
Offer bicycle skills and adventure classes	Vermillion Parks & Recreation, USD
Phase in bicycle-related enforcement with warnings, then citations	Vermillion Police Department, USD Police Department
Review and update existing South Dakota statutes	SDDOT, City of Vermillion
Train law enforcement officers on bicycle-related traffic laws	City of Vermillion Police Department, USD Police Department

APPLY TO THE BICYCLE FRIENDLY COMMUNITY AND BICYCLE FRIENDLY UNIVERSITY PROGRAMS

(CITY OF VERMILLION, USD)

The League of American Bicyclists launched the Bicycle Friendly Community program in 1995 to recognize local governments with a vision and commitment to a better, bikeable community. The League has processed over 1,500 community applications, and there are currently 450 recognized Bicycle Friendly Communities and over 100 Honorable Mention communities across the country.

The Cities of Brookings and Sioux Falls are already Bicycle Friendly Communities in South Dakota. Black Hills State University in the City of Spearfish is a Bicycle Friendly University.

Attaining Bicycle Friendly Community status confers many benefits on recipients. It recognizes past efforts and helps communities get funding and build support for future projects. It may increase bicycle tourism, boosting economic development. The steps taken to become a Bicycle Friendly Community often result in improved public health, reduced traffic congestion, improved air quality, and improved quality of life.



CREATE A BICYCLE AND PEDESTRIAN ADVISORY COMMITTEE

(CITY OF VERMILLION)

Bicycle and pedestrian advisory committees are appointed by elected officials and may include city staff, citizens, advocates, business owners, and other stakeholders. They are responsible for providing input to decision makers on active transportation projects, programs, and policies. Bicycle and pedestrian advisory committees allow for transparency and public input during project development and can act as a focal point for community discussion of active transportation-related issues. They can also convene major stakeholders, such as universities, large employers, and public agencies, around one table to discuss common interests.

CREATE A CAMPAIGN TO GET USD STUDENTS TO USE THEIR BICYCLES

(USD)

While the USD bike share does encourage students to ride bicycles, many students still rely on private vehicles and do not consider bicycling as a convenient mode of travel. Often, first year students bring bicycles to campus and rarely use them, which clutters campus bike racks and creates additional work for university and city staff.

Group rides can be used to show students that bicycling is a fun, safe, viable option. Nature rides, art and history rides, food tours, and other organized events would encourage students to use more active modes of travel, including their own bicycles or the bike share program.

CREATE AND DISTRIBUTE A PRINT AND ONLINE BICYCLE FACILITY NETWORK MAP

(CITY OF VERMILLION)

A bicycle facility network map should be developed to promote existing, new, and proposed bikeways within the City of Vermillion and its environs. The map could include information on facility type, route distance, bicycle parking locations, bicycle friendly business locations, popular bicycle and pedestrian destinations, road conditions, and level of comfort, highlighting low-stress neighborhood bikeway routes. Maps should be made of durable, waterproof material, and include education on how to ride safely (e.g. use lights at night, follow all traffic laws, etc.). The map should also be available online and be updated regularly as the bikeway network expands.

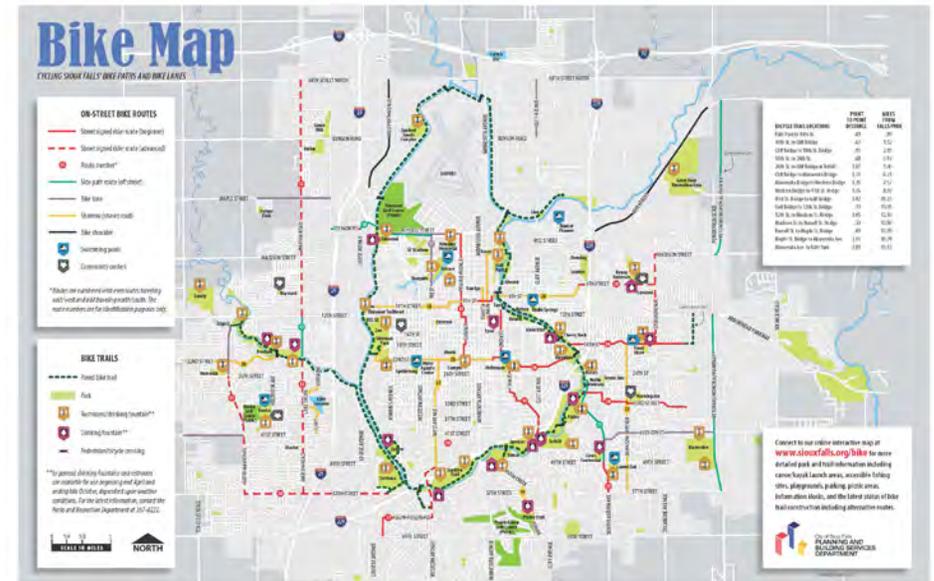
CREATE OR PARTICIPATE IN A BICYCLE COUNT PROGRAM

(CITY OF VERMILLION)

The National Bicycle and Pedestrian Documentation Project provides a consistent model of data collection and analysis to evaluate network usage. It occurs twice a year, in the Spring and Fall, although communities are encouraged to conduct counts at any time. Local government agencies coordinate the effort and recruit volunteers. This recommendation should be implemented as soon as possible to obtain baseline data before the proposed bikeway network and associated support systems are implemented. Nearby communities such as Sioux Falls conduct their own regular trail counts and use the data to set priorities for improvements and maintenance.



Sioux Falls, SD bike map



Counting bicyclists for the National Bicycle and Pedestrian Documentation Project
(Source: City of Minneapolis)

CREATE, PRINT, PUBLISH, AND DISTRIBUTE POCKET-SIZED LAW CARDS

(CITY OF VERMILLION, SDDOT)

Many communities around the country provide pocket-sized law cards about the rules of the road: one side may be focused on laws for bicyclists, and the other side on laws for motorists (demonstrating that safety is a two-way street). Including a small card in a city-wide mailer, such as with utility bills or newsletters, is an effective way to reach many people.

The Washington Bikes advocacy group publishes a bicycle law pocket reference (Source: Washington Bikes)



DESIGNATE AN OFFICIAL CITY BICYCLE PROGRAM MANAGER/COORDINATOR

(CITY OF VERMILLION)

The Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, required states to have a bicycle and pedestrian coordinator or program manager on staff. Many local governments followed suit, and bicycling staff are now common in cities and counties. Bicycling program managers institutionalize the consideration of bicycling accommodations and coordinate efforts across various agencies and departments. A study by the League of American Bicyclists shows that cities with more bicycle and pedestrian staff have higher levels of active commuting and attain a higher Bicycle Friendly Community status than those with few or no staff. This proven return on investment is a strong incentive for cities to dedicate staff to a coordinated active transportation program.

Responsibilities of a bicycle program manager/coordinator include:

- Developing and implementing educational programs
- Coordinating city-sponsored biking events
- Pursuing and securing funding opportunities
- Working with various departments to ensure coordination of bicycle-related policies and facilities
- Communicating with the public in-person and online
- Collaborating with partner community organizations and agencies
- Implementing the adopted Vermillion Bicycle Master Plan

DEVELOP BICYCLE-RELATED CURRICULUM AT ALL SCHOOLS

(VERMILLION PUBLIC SCHOOLS)

Education on how to walk and ride safely can be incorporated into grade school curricula through a variety of means, including Safe Routes to School programming, physical education, and visits and demonstrations from law enforcement officers and active transportation advocates. Other state DOTs offer Safe Routes to School lesson plans designed for specific age groups that are incorporated into regular classroom curricula, and nearby Brookings has a robust physical education bicycling curriculum for grades 4 through 12. There is currently no Safe Routes to School program in Vermillion; the City could request a similar program or create one in consultation with industry experts.

Safe Routes to School lesson plan (Source: Ohio Department of Transportation)

DEVELOP EDUCATIONAL MATERIALS FOR THE PUBLIC ABOUT HOW TO USE NEW BIKEWAY FACILITIES

(CITY OF VERMILLION, SDDOT)

Some of the proposed bicycle facilities in this plan may be unfamiliar to Vermillion residents. Advisory bicycle lanes, for example, are an experimental treatment that require approval from the Federal Highway Administration before installation. Developing educational materials about how to use these new facilities can reduce safety hazards from improper use. The City could distribute these materials at city offices, community centers, libraries, and other community gathering places, and offer demonstration rides once new facilities are installed.

Bike Hays information brochure, published after implementation of bikeway network

EMPLOY TEMPORARY DEMONSTRATIONS TO PROMOTE AND PILOT NEW BICYCLE INFRASTRUCTURE

(CITY OF VERMILLION. SDDOT)

Many communities have recently recognized the value of demonstration projects (also known as tactical urbanism) in promoting and implementing bicycle plans. Roadway design projects are sometimes met with resistance from the public, often stemming from uncertainty over the safety of a proposed design. Temporary demonstrations can allow people to test out a new type of facility, such as separated bicycle lanes. They also allow users to test a street design, simultaneously giving design engineers the opportunity to identify unforeseen issues and make adjustments before construction. Small-scale, short-term, and low-cost demonstration projects are installed to show how new bicycle facilities are meant to be used before investing in permanent infrastructure changes. Using chalk, spray paint, planters, cones, and other inexpensive materials, communities can create temporary installations such as separated bicycle lanes and neighborhood bikeways. Community buy-in and support for permanent changes is generated when residents can use these new facilities and understand their value.

This temporary separated bicycle lane uses cones and plants to separate riders from traffic



EXPAND USD'S BICYCLE SHARE PROGRAM

(USD, CITY OF VERMILLION)

The University of South Dakota launched a bike share program in the spring of 2017, with 12 bicycles available for rent on the Vermillion campus. The student-initiated program rents bicycles daily and averages ten to 15 checkouts per day. Students must check out the bicycles from the Muenster University Center with a student ID number and a signed liability waiver and return them during open hours.

The university-based bike share program could be expanded both on-campus and to include the City of Vermillion. An expanded bike share would allow students to access off-campus destinations more easily and integrate them into the surrounding community. Likewise, community residents could use the bike share to attend on-campus events. Some college towns have a campus-based bike share and a separate off-campus program that do not interface, which limits connectivity and deters users from traveling by bike. Vermillion could avoid this challenge by operating a comprehensive, citywide program that includes USD.

Due to the greater service area and more potential users, the program structure would likely need to be automated so that bicycles could be checked out and returned at any time. A bike share feasibility study could determine the appropriate program structure for Vermillion (e.g. station-based or dockless), calculate demand, system size and station density, and explore funding sources to guide the City during program development.



FIND CHAMPIONS TO SUBMIT BICYCLE FRIENDLY BUSINESS APPLICATIONS FOR LOCAL ORGANIZATIONS

(SANFORD HEALTH)

Businesses can encourage their employees to bike to work by providing secure bicycle parking, lockers, showers, changing rooms, implementing incentive programs, and offering safety classes through local partnerships.

The League of American Bicyclists has a national program that recognizes these efforts and designates bike friendly businesses (BFB). The program promotes bicycling to:

- Attract and retain the best workers
- Increase quality of life for employees
- Foster a sense of community in the workplace
- Reduce healthcare costs
- Create a more alert and productive workforce
- Reduce absenteeism
- Showcase a commitment to sustainability
- Cut transportation spending

Strategies for becoming a BFB include:

- Offering the Bicycle Commuter Tax Benefit or other cash incentives
- Ensuring rides home during inclement weather or emergencies through a Guaranteed Ride Home Program
- Organizing participation in community bicycling events such as the Mayor's Bike Ride, or national events such as Bike to Work Day or the National Bike Challenge
- Making showers, changing facilities, and lockers available
- Providing shared bikes that staff can use for errands and recreational outings
- Implementing secure and convenient bike parking for employees and guests, as well as bicycle repair stands

- Connecting employees from home to the workplace through low-stress bikeways
- Educating employees about bicycle routes and safety through newsletters and hiring packets
- Encouraging employees who drive to work to safely operate around bicyclists, including ways to reduce distracted driving
- Appointing an employee to coordinate bike events and facilities
- Collecting internal data on commuting habits and barriers that exist for employees to bike more

There are six Bicycle Friendly Businesses in South Dakota, most of which are in Sioux Falls. Vermillion businesses could significantly increase the state's Bicycle Friendly Report Card by joining the program. The City of Vermillion and Sanford Health could lead by example, by applying to this program as a Bicycle Friendly Business.

Left: Bicycle Friendly Business program award (Source: League of American Bicyclists)

Right: The Bean Coffee Shop, which uses a mobile bike station to sell coffee around the community, would be an ideal candidate for the Bicycle Friendly Business program (Source: The Bean)



INCORPORATE BICYCLING INTO USD STUDENT ORIENTATION

(USD)

Safety awareness and education campaigns have been employed on many university campuses to increase students' bicycling knowledge and confidence. In addition to social media, printed materials and other advertising, some universities offer group rides to show students proper (and legal) riding etiquette, as well as workshops on bicycle law, fitness, and other aspects of active transportation.

INCREASE THE NUMBER OF BICYCLE-RELATED EVENTS

(CITY OF VERMILLION, RECYCLE 605, USD)

Bicycle-related events are a great way to build momentum and increase excitement for bicycling in Vermillion. Bicycle-related events can be anything from small-scale to city-wide events, and from a few hours to an entire month. There are many different types of events that can be used to promote bicycling as a valid means of transportation. Certain events, such as bicycle rodeos (which the Vermillion Police Department already does), are targeted towards a younger audience, while other events encourage the general population to get on their bicycles. Hundreds of cities host events every May during National Bike Month and Bike to Work Day, including group rides, concerts, contests, and other celebrations of bicycling as a means of commuting. Monthly neighborhood rides, Mayor's rides, Critical/Courteous Mass rides, open streets events, and bicycle themed art shows, festivals, rallies, and happy hours are other common event types to promote bicycling. Recycle 605 is a bicycle cooperative that repairs abandoned bicycles and redistributes them to those needing transportation and financial help. They host multiple rides throughout the year and would be a strong partner for planning bicycle-related events.

Bicycle-related events are not limited to the warmer months. A growing number are happening in the winter, as communities recognize the benefits of winter bicycling. Winter bicycle event examples include holiday light rides, fat tire bike races, winter bike to work day, and winter bike festivals. These events embrace cold weather, strive to get more people riding bikes, and create positive energy about bicycling.

Mayor's Ride in Brookings, SD (Source: City of Brookings)



INCREASE THE NUMBER OF BUSES WITH RACKS

(SUPPORT FOR PEOPLE WITH DISABILITIES/
VERMILLION PUBLIC TRANSIT)

The Vermillion Public Transit system operates five buses and two vans providing nearly 400 different customers with more than 5,000 rides per month. Currently, one bus has a bike rack. Equipping the remaining four buses with bike racks increases mobility for riders. It gives riders more flexibility on how they travel.

INITIATE A CITY-LED BICYCLE PARKING PROGRAM

(CITY OF VERMILLION)

During the public involvement process, residents identified Downtown Vermillion as priority location for increased bicycle parking. Access to Downtown Vermillion could be improved with additional bicycle parking. Investing in bike racks, bike corrals, and other bike parking solutions is a low-cost, high-visibility strategy to encourage more bicycling. The City could offer incentives to business owners for installing bicycle parking, such as cost sharing for capital expenses. At schools, libraries, community centers, and other civic uses, the City could offer to cover 100 percent of the cost.

While Downtown Vermillion should be a focal point for increasing bicycle parking based on stakeholder feedback, other areas of need were identified as well. New or improved bicycle parking is needed at Barstow Park, Prentis Park, the National Music Museum, Sanford School of Medicine, the Vermillion Driver Exam Station, the Hy-Vee super market, and the Walmart Super Center.

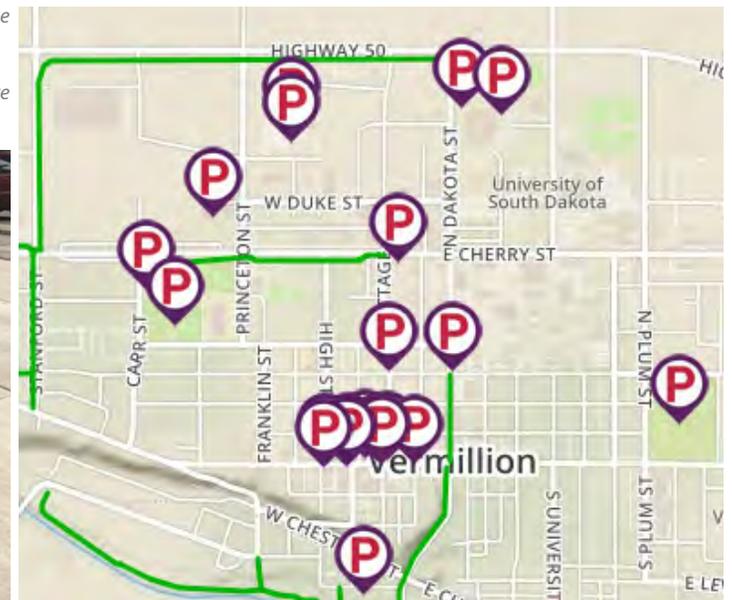
Bus-mounted bike rack (Source: Vermillion Public Transit)



Below: Dayton, Ohio has specially branded bike racks throughout Downtown



Right: Stakeholder feedback identified areas where bicycle parking is needed throughout the City



OFFER BICYCLE SKILLS AND ADVENTURE CLASSES

(VERMILLION PARKS & RECREATION, USD)

Many people need simple training on how to ride a bicycle safely, as well as how to perform common maintenance repairs on bicycle tires, brakes, and chains. Combining skills and maintenance training with outdoor adventures will draw in a wider variety of participants. Classes could be organized through Vermillion Parks & Recreation and community partners, such as USD.

PHASE IN BICYCLE-RELATED ENFORCEMENT WITH WARNINGS, THEN CITATIONS

(CITY OF VERMILLION POLICE DEPARTMENT, USD POLICE DEPARTMENT)

During the early phases of an enforcement program, after bicyclists and motorists have received educational information, it is important to publicize that for a period police will give warnings, and then citations. This gives bicyclists and motorists fair time to understand bicycle-related laws, but also to understand their seriousness for safety. Pocket-sized law cards should be distributed with each warning or citation.

Smart Cycling (Source: League of American Bicyclists)



REVIEW AND UPDATE EXISTING SOUTH DAKOTA STATUTES

(SDDOT, CITY OF VERMILLION)

Existing laws may be outdated, so they need to be updated to clearly define what traffic behavior is legal and illegal. For example, rules governing bicycle lanes are not defined in South Dakota statutes. In its recent review of South Dakota State University's Bicycle Friendly University application, the League of American Bicyclists recommended the following changes for their community:

- Implement specific penalties for motorists who fail to yield to a bicyclist when turning
- Make it illegal to park or drive in a standard bicycle lane (except when turning at an intersection)
- Implement penalties for motor vehicle users who open a driver side door into the path of a bicyclist
- Specifically protect all vulnerable road users
- Make it illegal to harass a bicyclist

The same recommendations could be adopted by the City of Vermillion.

TRAIN LAW ENFORCEMENT OFFICERS ON BICYCLE-RELATED TRAFFIC LAWS

(CITY OF VERMILLION POLICE DEPARTMENT, USD POLICE DEPARTMENT)

The Vermillion Police Department already has a bike patrol program with several mounted officers; however, all law enforcement officers must understand the regulations that govern bicyclists, know how to enforce them, and apply them equitably to ensure public safety for all road users. A good relationship between law enforcement and bicyclists is essential to create a safe and inviting environment for riding. Police officers should be aware of the rights and responsibilities of bicyclists, and cadet academies should incorporate active transportation education into their training.

The National Highway Traffic Safety Administration offers a two-hour video course on enforcing bicycle-related laws on the road. This training should be led by someone in the Police Department who also serves as a liaison to the bicycling community, so that consistent messages reach both officers and the public.



Biking Rules. Excerpts from a street code to promote responsible urban cycling, developed by New York City's Transportation Alternatives advocacy organization.



Classroom and field trainings can familiarize officers with bicycle-related issues (Source: Meridia Interactive Solutions)



8 Maintenance & Policies



MAINTENANCE POLICIES

Maintenance is a crucial component of well-functioning bikeway networks. In addition to the system-wide maintenance approaches discussed in this section, individual projects should include a maintenance plan that details costs, including personnel and equipment needed to maintain any new facilities that are part of the proposed plan. The City's timely response to any maintenance issues will encourage more people to ride and boost confidence in the bikeway network.

Maintenance best practices included in this section include the following activities:

- Concrete pavement preservation
- Snow and ice control (including prioritized routes)
- Drainage design
- Vegetation management
- ADA requirements
- Signs
- Pavement markings
- Public communication and reporting
- Coordination/responsibilities between agencies
- Traffic signals
- Surface repair and street sweeping

For each category, one or more strategies are suggested to sustain Vermillion's existing maintenance program as the bikeway network expands. Strategies are summarized in Table 8.1.

Maintenance activities for shared use paths and separated bicycle lanes are described separately from other bicycle facilities, due to their unique nature.

TABLE 8.1: Maintenance Strategies

Facility Type	Maintenance Activity	Strategy
Shared Use Path	Concrete pavement preservation	Develop and implement a comprehensive pavement management system for Vermillion’s off-street bikeway network.
	Snow and Ice Control (Including Prioritized Routes)	Design shared-use paths to accommodate existing maintenance vehicles.
		Identify a priority network of off-street bikeways for snow clearance.
	Drainage Design	Clear debris from all drainage devices to keep drainage features functioning as intended and minimize trail erosion and environmental damage
		Check and repair any damage to trails due to drainage issues.
	Sweeping	Implement a routine sweeping schedule to clear shared-use paths of debris.
		Provide trail etiquette guidance and trash receptacles to reduce the need for sweeping.
	Vegetation Management	Implement a routine vegetation management schedule to ensure user safety.
		Trim or remove diseased and hazardous trees along trails. Preserve and protect vegetation that is colorful and varied, screens adjacent land uses, provides wildlife habitats, and contains prairie, wetland and woodland remnants.
	ADA Requirements	Conduct walk and bike audits to assess accessibility of new, proposed, and existing shared-use paths.
Ensure that ADA compliance is incorporated into the design process for new facilities.		
Signs	Repair or replace damaged or missing signs as soon as possible.	
Public Communication and Reporting	Develop a snow removal policy for shared-use paths.	
	Maintain active and up-to-date social media accounts to communicate directly with the public about bikeway maintenance issues.	
Coordination/ Responsibilities Between Agencies	Coordinate with utility companies to ensure that they follow maintenance standards in public rights-of-way.	
Separated Bicycle Lanes	Flexible Delineators and Other Vertical Separators	Replace damaged flexible delineators in a timely manner.
		Consider maintenance operations in flexible delineator material and spacing.
	Snow and Ice Control	Implement a proactive deicing program for priority bikeways prior to major weather events.
		Design separated bicycle lanes to accommodate existing maintenance vehicles.
Drainage Design	Install drainage grates and manhole covers outside of bikeways whenever possible.	
Other Bicycle Facilities	Pavement Markings	Perform routine inspection of pavement markings and replace as needed.
	Snow and Ice Control	Upgrade proposed bikeways for priority snow removal, from the third priority to second priority networks.
	Traffic Signals	Adopt a user-focused, responsive approach to signal maintenance.
	Surface Repair and Street Sweeping	Implement a sweeping schedule that prioritizes high-volume routes.

SHARED-USE PATHS

Shared-use paths, providing fully separated facilities outside of street or road channels, are already popular in Vermillion and provide the separation from motor vehicles that many bicyclists prefer. Maintaining these facilities is a complex and ongoing task. However, well-kept shared-use paths and trails strengthen community confidence in the active transportation network and encourage use. This section provides recommendations and strategies to keep Vermillion's existing and proposed shared-use path facilities in a state of good repair.

CONCRETE PAVEMENT PRESERVATION

A consistent pavement inspection and maintenance schedule is one of the most effective ways to ensure user safety on shared-use paths and trails. Regular and preventive maintenance can also extend the service life of a facility, ensure user safety, and reduce long-term expenses by delaying or eliminating the need for costly rehabilitation projects.

All of Vermillion's existing shared-use paths are concrete,



Heaving pavement and horizontal cracking create hazards for bicyclists.

which makes them less vulnerable to common maintenance issues that occur with asphalt, such as pavement raveling, pop-ups, and cracking. While it is costlier on the front end, concrete is also more durable than asphalt and has a longer lifespan.

Several factors influence pavement preservation:

Pavement thickness – In cold weather climates that experience freeze-thaw cycles, such as Vermillion, a six-inch thickness is preferred.¹ Concrete paths should be sufficiently thick to support the weight of maintenance vehicles (see Snow and Ice Control).

Subgrade – The type of soil underlying a shared-use path plays a significant role in the pavement's durability. Subgrades that provide stability and good drainage can increase pavement lifespan. While design guidance varies based on soil type and condition, general best practices² are listed below:

- Subgrade should be a uniform material compacted to a minimum 98% standard Proctor density.
- Provide 100 – 150 millimeters (4 – 6 inches) of free-draining granular material under surface for base material.
- Minimum compaction of 95 % standard Proctor density for concrete.

Control and Expansion Joints – Control and expansion joints minimize and contain cracking in concrete surfaces. Control joints allow shrinkage to occur during drying and should be spaced a maximum distance of 24 to 30 times the thickness of the concrete. Expansion joints should be placed next to rigid structures, such as poles, and at either end of curved path sections.³ Saw cut joints are preferred over tooled joints, because they are smoother for bicyclists and people using mobility devices.

Many short- and mid-term maintenance techniques are used for pavement preservation. These include patching, crack sealing, grinding and cutting, and tree root barriers. Long-term maintenance options are required for trails with severely degraded surfaces or those at the end of their service life,

which may need major rehabilitation to ensure continued use.

Removal and Replacement – When subgrade failure of the original trail occurs, complete removal and replacement is the only viable option for rehabilitation. Removal and replacement allows base and subgrade layers to be fully repaired. Recycling existing pavement can reduce replacement costs. For minor repairs, patching spalls and grinding panel edges or slab-jacking to remove vertical discontinuities from faulted panels are the preferred treatments.

Strategy: Develop and implement a comprehensive pavement management system for Vermillion’s off-street bikeway network.

A pavement management system should evaluate four trail characteristics: roughness (ride), surface distress (condition), surface skid characteristics, and structure (pavement strength and deflection). A rating system can be used to score each characteristic. Based on the resulting score, recommended actions may range from “no maintenance required” to “routine maintenance” or even “reconstruction.”⁴ Data from the pavement management system can inform maintenance decisions, in conjunction with other considerations, such as trail user volumes.

Installing a root barrier



SNOW AND ICE CONTROL (INCLUDING PRIORITIZED ROUTES)

Winter maintenance of bikeways and its related efforts, such as equipment, geometric design, priority routes, public communication, and sweeping, are the most challenging and discussed aspects of bikeway maintenance. Many communities are adjusting their maintenance programs to meet the recent increase in winter bicycling.

Strategy: Design shared-use paths to accommodate existing maintenance vehicles.

Most cities already use pickup truck-mounted plows to clear smaller roadways and parking lots. Cities can save on capital expenses by designing bicycle facilities to accommodate these vehicles.

Small pickup trucks or small tractors can be outfitted with brooms, perforated plows, and salting and wetting devices to clear shared-use paths.

Strategy: Identify a priority network of off-street bikeways for snow clearance.

Shared-use paths are the interstate highways of the active transportation network: they are limited access, allowing only non-motorized modes of travel; they enable fast and convenient travel over long distances; and they are often

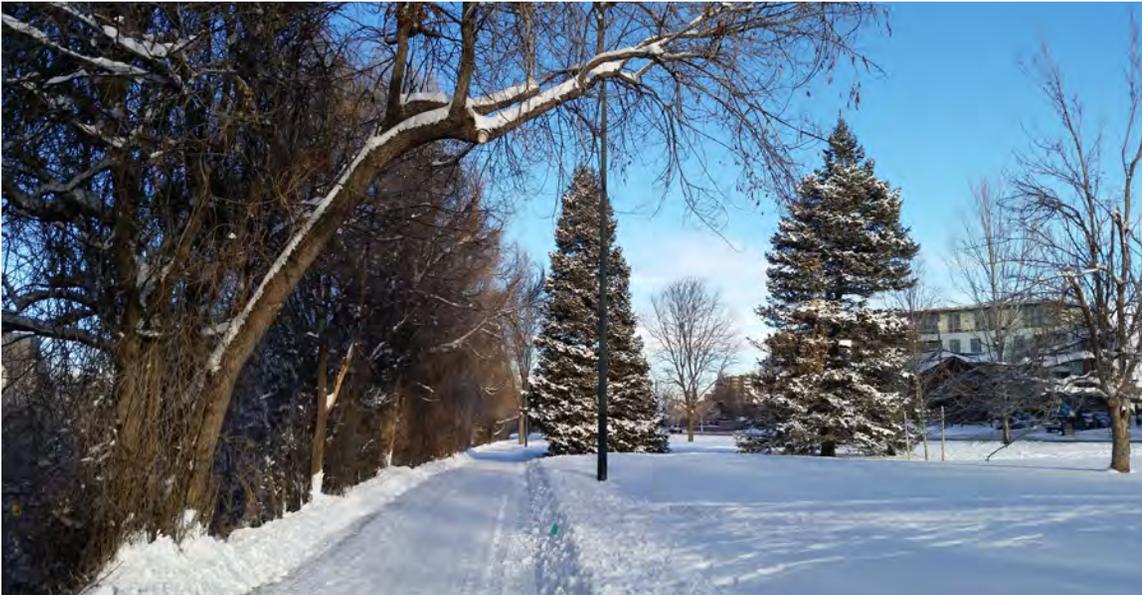
A pickup truck plowing a shared use path



the preferred route for many users. After winter weather events, clearing these facilities should be a priority, just as the Interstate Highway System is for motorized travel.

Data collected during plan development on user patterns (see Figure 2.10, Interactive Map Survey Results: "Routes I Currently Ride"), as well as future ridership data, can inform which routes should receive priority for snow clearance. Facilities that carry the highest number of bicyclists should have the highest priority. These routes should also be first for de-icing before winter weather events. To make the public aware of priority routes, designated facilities could be signed as such and identified in City-produced cycling literature and on the City web site. This priority network would be distinct from the proposed on-street bikeways included in the City's existing emergency snow routes (see Snow and Ice Control in Other Bicycle Facilities).

Plowed trail after snowfall



DRAINAGE DESIGN

Proper maintenance of drainage appurtenances is important to maintain a smooth riding surface and prolong pavement life. A well-draining bikeway will also prevent hydroplaning or areas of ponding that are prone to freezing.⁵ Drainage issues on shared-use paths are often most costly to repair. However, drainage maintenance saves money long-term by preventing more costly water damage and washouts.

Drainage grates should be placed outside of bikeways whenever possible. If drainage grates are located on or near a bikeway, they should have narrow openings that are perpendicular to the riding surface.

Strategy: Clear debris from all drainage devices to keep drainage features functioning as intended and minimize trail erosion and environmental damage.⁶

Clearing may need to be done on a routine basis as well as after storms and at specific times of the year, such as in the fall during and after leaf drop.

Strategy: Check and repair any damage to trails due to drainage issues.

Pooling water can accelerate surface and structural distress of a shared-use path, especially during freeze/thaw cycles. Drainage issues that cause pooling water should be remedied and any resulting damage should be repaired.

SWEEPING

Keeping shared-use paths clear of debris, trash, and other materials improves safety for users and maintains facility aesthetics. Sweeping can be included as part of ongoing and routine maintenance activities, such as mowing and trimming. Trails that parallel nearby roads (sidepaths) should be swept in conjunction with road cleaning schedules, as road debris can frequently land on the adjacent sidepath.

Strategy: Implement a routine sweeping schedule to clear shared-use paths of debris.

Removing trash, glass, gravel, branches, and other debris from shared-use paths should be included as part of ongoing maintenance activities. Frequent sweeping and debris removal reduces the risk of accident and injury for facility users and improves aesthetics.

Strategy: Provide trail etiquette guidance and trash receptacles to reduce the need for sweeping.

Posting etiquette rules on littering and encouraging trail users to pick up trash can help maintain a clean and attractive facility. Providing trash receptacles at trailheads and rest stops and emptying them regularly can also reduce the need for sweeping.

*Routine sweeping keeps the riding surface clear
(Source City of Brooklyn Center, MN)*



VEGETATION MANAGEMENT

When conducting vegetation management, agencies should understand the important role that vegetation plays in facility character as well as user experience. Routine trimming, mowing, and pruning of vegetation can contribute to trail aesthetics and user safety, but an overly aggressive approach can degrade the natural features that attract users in the first place.

If new vegetation is being planted, it should be carefully located and maintained to prevent blocking the trail or sight distances.⁷ Dense brush or thickets alongside the trail should be avoided.⁸ Native species should be preserved and maintained as much as possible. These considerations vary depending on the location and character of the facility. For example, a low-impact management approach should be used for vegetation along the Vermillion River Trail to maintain its seclusion from adjacent land uses and preserve its natural features. In contrast, the shared-use path along between Stanford and Dakota Streets travels through a developed corridor; regular mowing along this facility would be more appropriate.

Clear zones on either side of the trail prevent vegetation from encroaching onto the riding surface



Strategy: Implement a routine vegetation management schedule to ensure user safety.

Mowing, trimming, and sweeping should be performed on a regular basis to keep sight lines clear and shared-use paths free from obstructions. Noxious weeds and invasive species can also be monitored and managed during routine vegetation maintenance. The City should also be prepared to respond to specific complaints of low-hanging branches or downed trees as needed.

Strategy: Trim or remove diseased and hazardous trees along trails.

While some experts caution that over-trimming of vegetation can detract from the natural features of the trail, reducing aesthetic appeal,⁹ sometimes tree removal is the only viable option. Trees that are diseased, threaten the safety of trail users, and/or obstruct continuous travel on a shared-use path (i.e. interfere with sight distances, clearance, or lighting) should be removed. All other trees, including dead or fallen trees, should remain undisturbed to preserve natural aesthetics; they should be trimmed as needed for the safety of trail users.

Strategy: Preserve and protect vegetation that is colorful and varied, screens adjacent land uses, provides wildlife habitats, and contains prairie, wetland and woodland remnants.

The natural features surrounding a shared-use path or trail are often its greatest asset in terms of attracting users and generating trail activity. Vegetation maintenance should preserve natural landscapes and scenic views to highlight these features. At the same time, vegetation can be used to screen the trail from adjacent land uses, where appropriate (for example, a neighborhood shared-use path may not need to be screened from nearby houses).

ADA REQUIREMENTS

Shared-use path design must accommodate pedestrians and bicyclists and must therefore abide by the accessibility requirements of the Americans with Disabilities Act (ADA).¹⁰ Typically, paved shared-use paths will almost always meet or exceed ADA if built to accepted transportation standards.¹¹ However, maintenance is required under ADA to keep shared-use paths in compliance.¹² Further, the United States Access Board's Public Rights-of-Way Accessibility Guidelines (PROWAG) require that public rights-of-way be brought up to current standards whenever they are altered.

Common maintenance issues that lead to ADA noncompliance include cracked pavement, spalled areas, settled areas that trap water, tree-root damage, and vegetation overgrowth.¹³

Other maintenance-related ADA issues include:

- Keeping pedestrian surfaces free of obstacles, such as trash receptacles, utility poles, etc.
- Maintaining the trails original width by filling ruts and holes and removing debris and overgrowth.
- Wetting, reshaping, and recompacting crushed stone paths, so that a firm and stable surface is maintained.
- Removing snow in a timely manner to maintain shared-use path accessibility and avoid liability. The Federal Highway Administration has issued guidance that pedestrian routes must be open and usable throughout the year, with only isolated or temporary interruptions. Snow removal is also required on pedestrian facilities which have been constructed with federal funds.¹⁴
- When maintenance or construction activities impede a pedestrian pathway, alternate routes are required to accommodate pedestrian traffic.¹⁵

Strategy: Conduct walk and bike audits to assess accessibility of new, proposed, and existing shared-use paths.

Planners, engineers, and other city staff can gain valuable insight by inviting users with disabilities on walk and bike

audits. Experiencing a facility from the perspective of an individual with hearing, vision, or other physical impairments can lead to better designs for future facilities and solutions for existing problems. Advocacy groups such as the local AARP chapter should be invited to attend audits.

Strategy: Ensure that ADA compliance is incorporated into the design process for new facilities.

Making sure that proposed facilities meet or exceed ADA standards will reduce the risk of future problems and protect the city from liability. ADA compliance should also be considered for reconstruction and rehabilitation projects.

SIGNS

Signs serve several purposes. First and foremost, they convey information: distance and direction to popular destinations, warnings about hazardous conditions, and general information, such as trail names and maps. Signs can also be used to brand a facility with a look and feel that highlights important or special attributes of the community.

By design, signs are highly visible and can leave trail users with a positive impression. Well-maintained signs convey a sense of pride and exhibit community investment in active transportation infrastructure, while poorly-maintained signs may contribute to a diminished visitor experience, encourage vandalism, or lack of respect for the facility (e.g. littering).

Strategy: Repair or replace damaged or missing signs as soon as possible.

If a sign is reported damaged or missing, a maintenance crew should be dispatched to repair or replace the sign. Chronically damaged or missing signs degrade user experience, making the facility more difficult to navigate for visitors and less enjoyable for all users. This policy should also apply to on-street bikeways.

PUBLIC COMMUNICATION AND REPORTING

Most agencies use a variety of media to communicate with the public. Traditional press releases and PSAs, television, radio, and print news outlets, as well as social media are all useful tools in conveying local government's priorities and

accountability when it comes to maintaining the bikeway network.

Strategy: Develop a snow removal policy for shared-use paths.

Many cities have performance measures and goals in place for snow clearance on their bikeway networks. Policies include time-sensitive targets, such as clearing priority shared-use paths within 24 hours of snowfall, or de-icing the off-street network in advance of winter weather.

Strategy: Maintain active and up-to-date social media accounts to communicate directly with the public about bikeway maintenance issues.

Direct communication with the public allows local governments to control the message and promote their maintenance efforts. The City already provides reliable, timely, and regular updates via social media on many issues, from street maintenance to special events. @CityVermillion has over 500 followers and the City's Facebook page has over 1,400 followers and 1,500 likes, indicating that many Vermillion residents view the City's social media platforms as a trustworthy source of news. Adding updates about bikeway *Damaged signs are visually unappealing and make the facility more difficult to navigate*



maintenance to the City's already active Twitter account will keep the public informed about repairs, plowing, sweeping, and other maintenance activities.

COORDINATION/RESPONSIBILITIES BETWEEN AGENCIES

Confusion over which entity and which level of government (local or state) are responsible for the maintenance of shared-use paths exists in many jurisdictions. Frequently there is no documentation showing who is responsible for maintenance of existing facilities, which can prolong unsafe conditions for trail users. Coordination between the government agencies is an important element of effective maintenance programs.

Intergovernmental agreements (IGAs) are used to codify the roles and responsibilities of each agency regarding ongoing maintenance. For example, a local government may agree to conduct plowing, mowing, and other maintenance activities on trails in its jurisdiction that were built by the state DOT. Generally, DOTs defer maintenance for shared-use paths and other off-street bicycle facilities to local municipalities.¹⁶ Clarifying who is responsible for maintenance costs and operations ensures that maintenance problems are resolved in a timely manner.

Ideally, one agency should be responsible for the length of an individual shared-use path or trail.¹⁷ Trails managed by a single entity are more likely to have a consistent level of winter maintenance that users come to expect. For this reason, shared-use paths that run adjacent to private properties and are in the public right-of-way should be maintained by the City of Vermillion. However, this would require a change to current city policy, which currently requires property owners to clear shared-use paths like sidewalks. The trade off for a higher level of service would affect the city's maintenance budget, which would need to be increased. Additionally, the City pays three-eighths of the cost of surface repair of shared-use paths adjacent to private properties, leaving the remaining five-eighths to property owners. This fraction of responsibility derives from the average width of a sidewalk, which is five feet, compared to the average width of a shared-use path, which is eight feet.

Strategy: Coordinate with utility companies to ensure that they follow maintenance standards in public rights-of-way.

While the city-operated Vermillion Light & Power company provides electric services to Vermillion residents, other utility companies, such as internet and cellular providers, also operate in the area. If utilities are located underneath, above, or adjacent to a shared-use path or trail, utility work may interfere with trail use. Utility companies that damage bicycle facilities should be required to repair them immediately to a specified standard. In addition, utility companies should be made aware of and abide by the maintenance practices adopted by the City.

COST ESTIMATES FOR MAINTENANCE OF SHARED-USE PATHS

Whenever shared-use paths are placed into service, maintenance funding is needed. This is often not considered and maintenance is absorbed within existing staff resources and operating budgets. A lack of maintenance can then result in higher long-term costs, with premature replacements required due to a lack of regular maintenance.

For shared-use paths, the primary maintenance need is pavement preservation. Over the life cycle of a shared-use path, there are different strategies for pavement preservation, and lower-cost preventative maintenance or rehabilitation may defer more costly reconstruction.⁷ Preventative maintenance includes strategies such as patching, grinding, concrete raising, and panel replacement. Keeping consistent records of pavement conditions of shared-use paths helps to track past shared-use path maintenance and predict future needs.

Another typical maintenance cost of shared-use paths is plowing in winter. The per-mile cost estimate for plowing an 8' wide shared-use path is \$25 to \$250 per snow event, based on Twin-Cities-area municipal snow removal costs. The wide disparity in costs depends upon how agencies staff and equip for trail snow removal. The low range is using existing forces and equipment, typically after other roadway snow removal tasks are complete. The high range is for dedicated bikeway snow removal staff positions, with specialized equipment

solely for trail snow removal.

Three Rivers Park District in Hennepin County, MN, which maintains regional shared-use paths in suburban Minneapolis, recently calculated the following costs (2018 dollars) for routine maintenance of a planned 20-mile shared use path corridor:³⁰

- \$5,777 per mile, per year for mowing, vegetation control, trash pickup, trail sweeping, erosion repair, sign replacement, striping, asphalt patching, and seal coating.
- \$100,000 one-time cost for additional maintenance equipment, including additional vehicle, mower, trailer, utility cart, pull behind blower, and miscellaneous hand and power tools.

SEPARATED BICYCLE LANES

In recent years, the use of separated bicycle lanes has risen across the country. Separated bicycle lanes provide bicyclists with a higher level of comfort compared to buffered or standard bicycle lanes and are typically used on arterial streets where higher motor vehicle speeds exist. Because of their more complex design, special maintenance considerations should be considered for separated bicycle lanes.

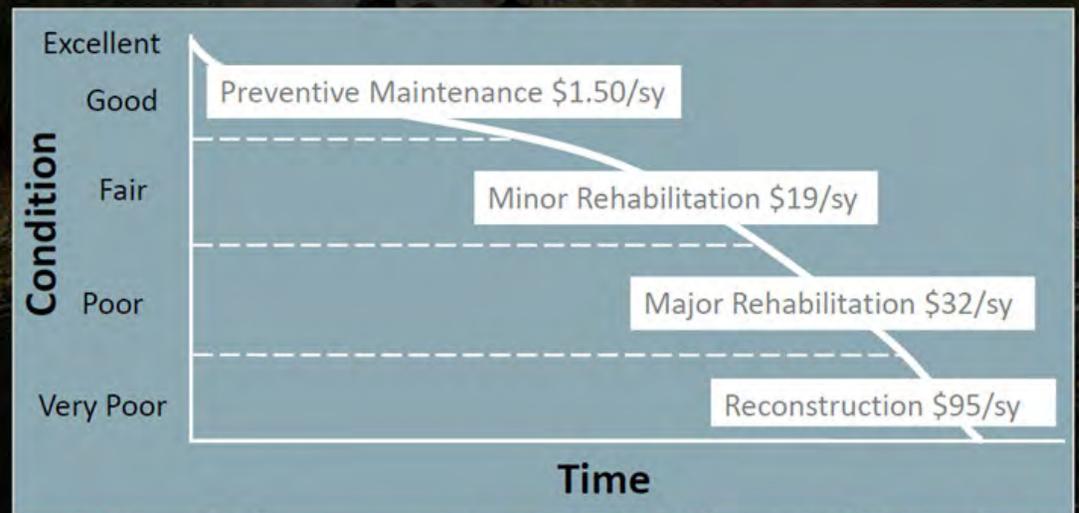
FLEXIBLE DELINEATORS AND OTHER VERTICAL SEPARATORS

One of the most common forms of separation between bicyclists and vehicles on separated bicycle lanes is flexible delineators. Flexible delineators are plastic posts, typically three to four feet in height, which are secured to the pavement and provide a visual delineation between travel lanes and bike lanes. They are a relatively cost-effective, easy, and quick tool for designing protected bike lanes. However, they also present considerable challenges for winter maintenance, particularly with plowing equipment. Flexible delineators are easily displaced when struck by a snow plow and some become brittle in cold weather and are prone to cracking. Downed delineators also create hazardous situations for bicycle riders, because their bases remain in place.



Trail Pavement Management

Pay Now or Pay More Later



Source: LRRB

Most cities that use flexible delineators replace a significant number of them annually (25% or more).¹⁸ They should be placed in a manner that does not interfere with snow plowing and may be removed in constrained situations to facilitate snow clearance. In some cities, the posts also need to be removed and reinstalled year-round for sweepers.

Rigid bollards are a costlier alternative to flexible delineators, but they provide more protection for bicyclists from adjacent motorized traffic. While material and installation costs are higher, rigid bollards are more durable and typically require less maintenance than flexible delineators. However, bollards can make snow removal difficult for maintenance equipment.

If Vermillion chooses to use flexible delineators or other vertical separators for the proposed separated bicycle lanes in this plan, several strategies should be considered.

Strategy: Replace damaged flexible delineators in a timely manner.

Damaged flexible delineators give the impression of an unmaintained facility and can create hazardous conditions for users. Performance goals should be established to replace damaged equipment within a certain time (e.g. 72 hours) after it is reported.



Strategy: Consider maintenance operations in flexible delineator material and spacing.

Some delineators use a mounting system that screws into the pavement and can be easily removed, while other delineators have a more permanent attachment. If delineators need to be removed regularly for maintenance operations, the first option may be preferable.

Flexible delineators in Montréal are spaced at intervals of 32 to 50 feet, which is wider spacing than in most cities.¹⁹ This wide spacing makes it easier for specialty equipment to clear snow that is in the buffer zone, allowing weaving between delineators.

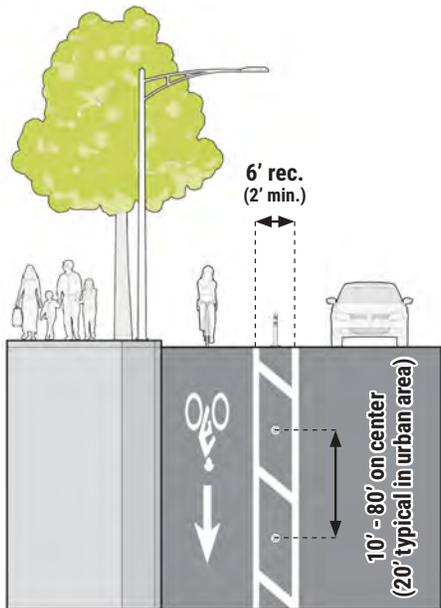
SNOW AND ICE CONTROL

With the growth of separated bicycle lanes in recent years, the issue of winter maintenance has been brought to the fore. Whereas traditional on-street bike lanes could be cleared using large plow trucks along with the rest of the roadway, separated bicycle lanes almost universally require smaller vehicles.

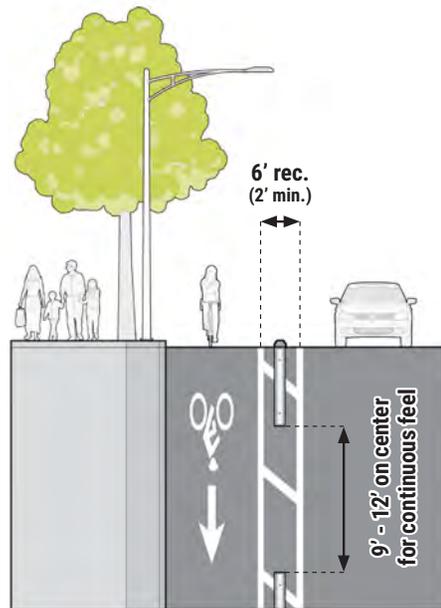
Separated bicycle lanes should be designed and constructed to facilitate year-round maintenance. If roadway width allows, facilities should be made wide enough to accommodate existing street sweeping and snow clearing vehicles. For



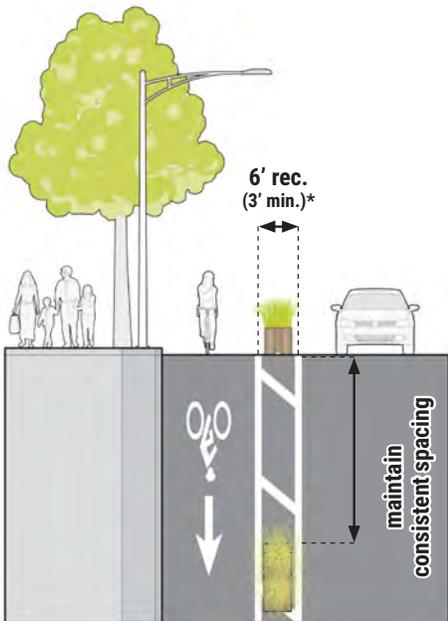
Flexible delineators can use a variety of materials, mounting mechanisms, and spacing configurations



Flexible Delineator Posts

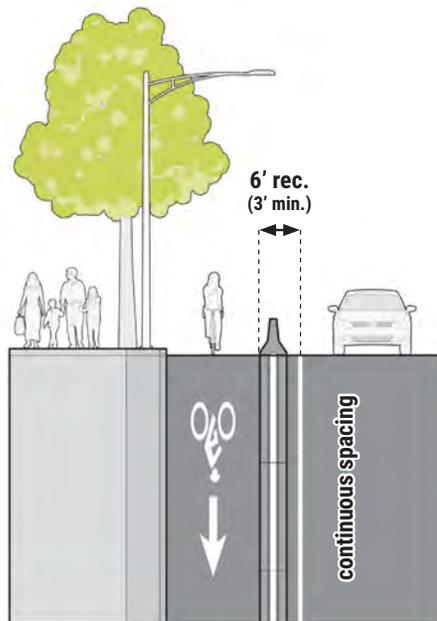


Parking Stops

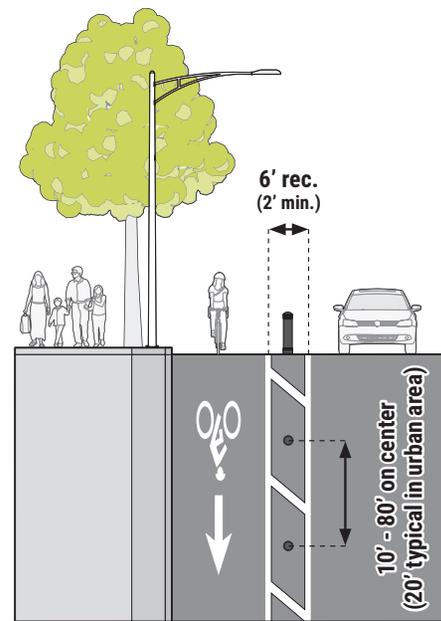


Planter Boxes

* Buffer may need to be wider when adjacent



Concrete Barriers



Rigid Bollards

winter maintenance it is especially important to have proper drainage to prevent ice formation during freeze/thaw conditions and after plowing. Deicing strategies will depend on the configuration of the separated bike lane and the type of pavement used. Deicers can be applied prior to snow fall and again while clearing to help prevent ice formation. Alternatively, beet juice/brine has been used in some cities as a deicer on streets and bicycle facilities to reduce environmental impacts associated with salt.

Strategy: Implement a proactive deicing program for priority bikeways prior to major weather events.

Proactive de-icing is a best practice for bikeway networks in cold climates.²⁰ This method requires less material and plowing than reactive deicing, which is applied after snow events. DOT's report using one third the amount of deicing material for proactive programs as compared to reactive ones.

Strategy: Design separated bicycle lanes to accommodate existing maintenance vehicles.

Most cities already use pickup truck-mounted plows to clear smaller roadways and parking lots. Cities can save on capital expenses by designing bicycle facilities to accommodate these vehicles, rather than purchasing specialized equipment that can navigate the constrained spaces common in some

separated bikeways. The City of Vermillion already uses pickup trucks to clear shared-use paths; the same vehicles could be used to plow separated bicycle lanes.

DRAINAGE DESIGN

Separated bicycle lanes can be designed to allow water to drain freely from the street and eliminate standing water whether at the sidewalk or street level. Depending on the type of project, simple changes to drainage infrastructure or complex overhauls during full depth reconstruction projects can accommodate separated bicycle lanes through a variety of methods. Where separated bicycle lanes are installed as a retrofit on recently reconstructed streets, such as this plan's recommendation for Cherry Street, it may be infeasible to alter existing drainage design. Instead, regular sweeping, plowing, and debris removal can keep drains clear and maintain a safe riding surface.

Strategy: Install drainage grates and manhole covers outside of bikeways whenever possible.

When drainage grates are located in or near a bikeway, they should have narrow openings and be placed perpendicular to the riding surface.

Various maintenance vehicles can be used to plow separated bicycle lanes (Right photo source: District Department of Transportation)



OTHER BICYCLE FACILITY TYPES

In addition to shared-use paths and separated bicycle lanes, several other facility types are recommended in this plan as part of Vermillion's proposed bikeway network. Compared to shared-use paths and separated bicycle lanes, a simpler maintenance approach may suffice for less separated facilities, such as buffered bicycle lanes, standard bicycle lanes, neighborhood bikeways, shared lane markings, paved shoulders, and advisory bicycle lanes.

PAVEMENT MARKINGS

Agencies use a variety of different materials for marking bikeways, including paint (water- or oil-based), epoxy, thermoplastic, and preformed marking tape. Often these materials are divided into two categories: nondurable (paint) and durable (all other marking materials). Agencies weigh several factors when determining which marking material to use including cost, durability, retroreflectivity, and friction coefficient (slipperiness), if the material can be applied using existing agency labor and equipment, and remarking limitations and processes.²¹

Paint (or latex) markings are generally less durable than other pavement marking materials, but they are also much cheaper to install. One major disadvantage of latex paint is its sensitivity to temperature. Precautions must be taken to protect stored material from freezing and extreme heat. During application, latex paint is very sensitive to high humidity, which can drastically increase drying time.

Epoxy paint is longer lasting than latex pavement markings but is also more expensive. Epoxy markings use a mixture of two bonding components. Its application requires specialized equipment to assure proper blending of the two components and successful application of the markings.

Preformed thermoplastic is a durable pavement marking system where thermoplastic symbols and legends are supplied in their final form and shape. Typically, the marking is supplied in large pieces, which are put together like a giant puzzle. Preformed thermoplastic pavement marking material combines the convenience of preformed markings with the performance qualities of hot applied thermoplastic. This

heavy-duty grade pavement marking material is ideal for high traffic areas where maximum wear and tear is present. Thermoplastic pavement markings are more expensive than painted markings.

Preformed polymer tape is the most durable pavement marking material, but also costs more than any other material. The tape consists of pigments, resins, and reflective materials (glass beads or reflective elements) and comes ready to use with or without adhesives. Additional adhesive (primer) can be applied to the pavement to enhance the bond. This material can be used for lane lines, legends, symbols, and transverse markings.

The appropriate material for pavement markings depends on the type of facility. Generally, facilities that are subject to significant wear and tear from motor vehicles require a strong and durable material, such as thermoplastic. However, because thermoplastic has a raised profile, it is easily damaged by snowplows. Some agencies recess thermoplastic to decrease the likelihood of snowplow damage, but this is expensive. Generally, thermoplastic is used for on-street facilities due to its longevity, while less durable, paint-based materials (latex or epoxy) are used for facilities with non-motorized travel only.

Pavement markings should be determined by consulting the NACTO Urban Bikeway Design Guide, the latest edition of the MUTCD, and the AASHTO Guide for the Development of Bicycle Facilities. Bicycle lane symbols can be placed to promote the correct direction of travel and discourage wrong-way riding, while indicating to pedestrians the intended use of the facility.

Strategy: Perform routine inspection of pavement markings and replace as needed.

On-street bikeways are subject to more wear and tear than shared-use paths. Frequent inspection of pavement markings should be conducted and degraded markings should be replaced as needed.

SNOW AND ICE CONTROL

While shared-use paths and separated bicycle lanes require specialized plowing equipment, all the bicycle facilities that fall under “Other Bicycle Facility Types” are on-street and not separated from motorized traffic by physical barriers. As such, standard snow plows used to clear city streets can also clear these facilities every time snow accumulates. Maintenance crews should make every effort to clear the entire facility to the curb whenever possible, which may require several passes to achieve on wider streets.

Strategy: Upgrade proposed bikeways for priority snow removal, from the third priority to second priority networks.

Under the City of Vermillion’s existing snow and ice removal policy, emergency snow routes are plowed and de-iced before other roads. These routes are primarily collector streets and include Crawford Road, Cherry, Plum, Princeton, Franklin, and Main Streets. This plan recommends on-street bikeways on these roadways, overlaying a significant portion of the proposed bikeway network on existing emergency snow routes. As such, on-street bicycle facilities on these routes would receive priority for plowing and deicing.

A second tier of streets receives second priority after emergency snow routes, with plowing taking place between midnight and 6am. As a result, proposed bikeways on National Street, Clark Street, and University Street will receive second priority after they are installed.

Several proposed on-street bikeways are located on streets that receive third priority after snowfalls. These includes streets such as Princeton, Norbeck, Duke, Lewis, and sections of Clark and Plum Streets. These streets should be upgraded to the second priority network as bikeways are designated, to ensure a functioning and safe bikeway network year-round and boost user confidence in the system (see Figure 7.2 on the following page).

TRAFFIC SIGNALS

Generally, the published guidance for bikeway signal maintenance practices is like that for standard traffic signals and overhead lighting, such as replacing broken bulbs and responding to power outages. Regarding detection, actuation, and timing, signals should be calibrated and adjusted as needed based on industry best practices and user feedback.

Paint



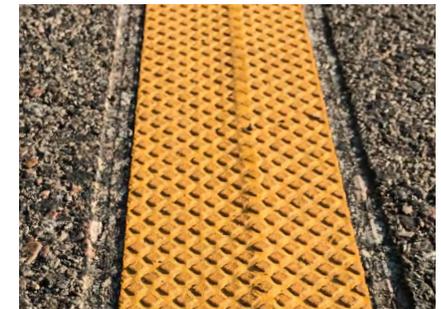
Epoxy Paint



Thermoplastic



Preformed Tape



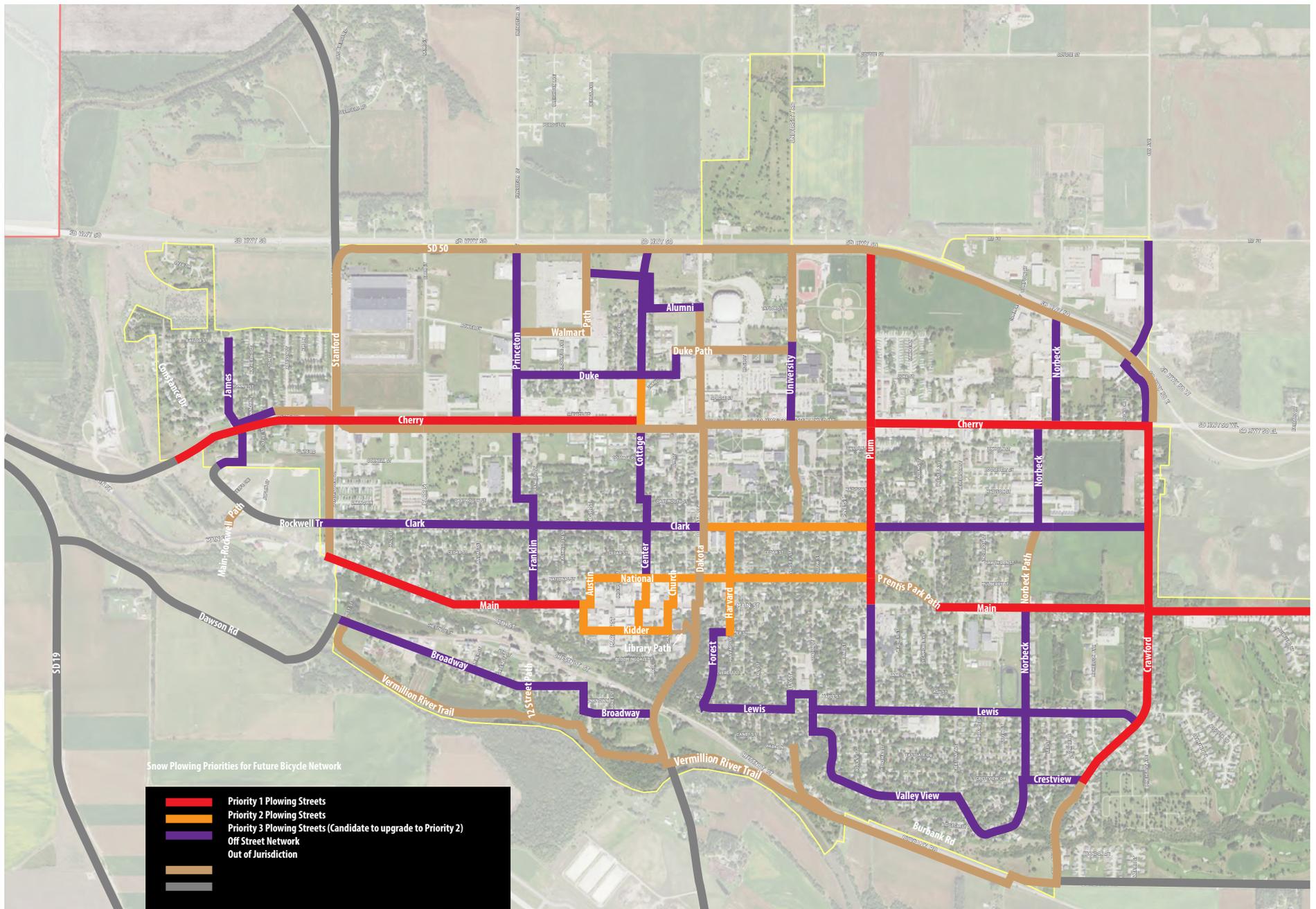
A bicycle signal head on a two-way separated bike lane



An actuated signal pavement marking (Source: NACTO)



FIGURE 8.1: The future bikeway concept, as it relates to snow priority control



Strategy: Adopt a user-focused, responsive approach to signal maintenance.

Poorly timed or unresponsive signals can cause delays for bicyclists and create hazardous conditions. At intersections with recorded bicycle crashes or complaints from users, traffic engineers should review the existing signal timing and determine if it is contributing to the problem. For example, short clearance intervals, uncalibrated bicycle actuated signals, and signal sequencing timed for motorized traffic rather than bicycles can all contribute to a poor user experience. Providing a platform to collect user feedback is an important component of this approach. The City could use its active social media accounts to receive community feedback or dedicate a webpage to the topic.

SURFACE REPAIR AND STREET SWEEPING

Keeping bikeways clear of debris is a simple and cost-effective way to encourage use and build user confidence in the bikeway network. Proper maintenance is an important factor in people's facility and route choice²²: if bicyclists frequently encounter gravel, glass, trash, or other debris on a

bikeway, they are less likely to use it.

Strategy: Implement a sweeping schedule that prioritizes high-volume routes.

Vermillion sweeps streets monthly, with weekly passes along the Downtown and Cherry Street business districts. Sweeping is recommended at the same frequency of established street sweeping programs, with a potential for more frequent sweeping on heavily-used bicycle routes to meet the higher likelihood of bicyclists falling on slippery surfaces.

Maintenance crews can also use street sweeping as an opportunity to check for cracks and other irregularities in the riding surface. Recording the location of needed repairs and dispatching crews to patch and seal is a proactive approach to maintaining a safe and comfortable riding surface.



REFERENCES

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26. <http://www.sddot.com/services/transalt/SDDOTTAPSummaryandApplicationGuide.pdf>
27. <https://gfp.sd.gov/userdocs/docs/rtp-manual.pdf>
28. <https://peopleforbikes.org/grant-guidelines/>
29. Minnesota Local Road Research Board
30. <https://www.threeriversparks.org/page/west-mississippi-river-regional-trail-master-plan>

A large, white, serif capital letter 'A' is centered on a dark red horizontal band that spans the width of the image. The background of the entire image is a photograph of a paved path leading through a dense forest of green trees.

Appendix

APPENDIX A: RECOMMENDATIONS FOR REGULATIONS AND STREET/HIGHWAY DESIGN DETAILS

Existing regulations (including city ordinances and state statutes) and street and highway design details for the City of Vermillion and South Dakota Department of Transportation (SDDOT) affect the bicycle friendliness of the community. The project team sought out elements of each that could be amended to improve Vermillion’s bicycling environment.

City of Vermillion Code of Ordinances

The project team reviewed the Vermillion Code of Ordinances. Recommendations vary from bicycle parking requirements and the design speed of new streets, to shared use path design and maintenance.

Current Ordinance	Recommended Change and Justification
<p>Vermillion Ordinance 96.12 (a) <i>Removal of snow and ice; duty of person in charge.</i> Every person in control of any building or lot of land within the city fronting or abutting on a paved sidewalk, whether as the owner, tenant, occupant, lessee, or otherwise, shall remove and clear away, or cause to be removed and cleared away, snow and ice from the sidewalk in front of or abutting on the building or lot of land within 24 hours after any fall of snow or freezing rain. When freezing rain has resulted in frozen ice upon the sidewalk making it impossible to remove, the person in charge shall sprinkle or spread some suitable material upon the sidewalk to prevent the sidewalk from being slippery and dangerous to pedestrian travel.</p>	<p><i>Shared use paths should be considered public facilities for maintenance rather than the responsibility of the adjacent property owner.</i></p> <p>Modify to clarify that winter maintenance of shared use paths and separated bicycle lanes in the Bicycle Master Plan are the responsibility of the City, not property owners or tenants. The greater width of shared use paths is a barrier to residents who clear sidewalks with shovels. Additionally, the likelihood of the shared use path being cleared by 100% of property owners, in a consistent manner (including at corners) is low, which is a deterrent to bicycling in winter. Most municipalities in the United States require property owners to clear sidewalks, but the majority take responsibility for clearing shared use paths. This change would have an impact on the Street or Park Department’s budget.</p>
<p>Vermillion Ordinance 96.50 through 96.54 <i>Construction of Sidewalks</i> § 96.50 SUPERVISION. The building, construction, and/or repair of all sidewalks within the streets of the city shall be done under the direct supervision of the Street Superintendent and/or the City Engineer. The construction of all sidewalks shall be according to lines and grades furnished by the City Engineer. § 96.51 SPECIFICATIONS. The construction of all sidewalks, whether to be done by direct contract with the city or by contract with the abutting property owner, shall be done in accordance with specifications for sidewalks on file in the office of the City Engineer. The Street Superintendent shall have full power to condemn work and/or material not in accordance with the requirements of the specifications. § 96.52 WIDTH.</p>	<p><i>Shared use paths are not currently defined in Vermillion’s Ordinance. They should be added to the list of public facilities including design specifications.</i></p> <p>Add shared use paths and relevant information to this section:</p> <ul style="list-style-type: none"> • Minimum shared use path width is 10’ • Thickness of shared use paths is 6” • Shared use paths are built alongside streets, and are not subject to the 75% occupancy rule <p>Adding information about shared use paths will reduce confusion for developers about what is required for sidewalks versus shared use paths.</p>

<p>New sidewalks constructed where a sidewalk did not previously exist shall be 5 feet in width. Repair or replacement of existing sidewalk sections totaling less than 75% of the abutting street frontage along a property may be constructed to instead match the existing sidewalk width of the property. If sidewalks adjacent thereto are of different widths, then the City Engineer shall determine the width thereof. It is further provided that on Main Street, between Forest Avenue and High Street; on Center Street, between Main Street and National Street; on Court Street between Main Street and Kidder Street; on Market Street between Main Street and Bloomingdale Street; on Prospect Street from Main Street to first Alley; and on the north side of Kidder Street between Court Street and Market Street, sidewalks hereafter constructed shall extend in width from the lot line to the curb line.</p> <p>§ 96.53 THICKNESS. All the sidewalks shall be constructed of concrete at least 4 inches thick. Sidewalks crossing any driveway approach shall be constructed of concrete at least 5 inches thick.</p> <p>§ 96.54 NEW SIDEWALK CONSTRUCTION REQUIRED. (A) Owner installation of sidewalks. Whenever a city block is developed along 75% or more of a street frontage, property owners along the street frontage must install sidewalks in compliance with the Vermillion Code of Ordinances. Property owners will have 60 days after being notified by code enforcement officials to install the sidewalks. Code enforcement officials may set a time frame greater than 60 days if, in their judgment, circumstances exist justifying such extension. Failure by property owners to comply with sidewalk installation requirements herein will render each noncomplying property as a public nuisance, abatement of which will proceed pursuant to § 90.20 of the Vermillion Code of Ordinances. (B) Sidewalk installation as building permit requirement. Sidewalk installation will be required to be included as part of any building permit for the erection, construction, reconstruction, conversion, enlargement, or extension of any building or structure, in any portion, within the city from and after November 19, 2009, regardless of the amount of city block street frontage development. (C) Exceptions. The City Engineer may grant exceptions to the installation of sidewalks in situations such as height, area, topography, setback, yard, or parking conditions will cause unwarranted hardship, which constitutes an unreasonable deprivation of use.</p>	
<p>Vermillion Ordinance 154.02.1 (4) Conceptual plans regarding plat development. Conceptual plans will be required of all major plats. Depending on size and planned development, a conceptual plan may also be required by the City Engineer in concurrence with a minor plat or replat. A conceptual plan shall depict the concept of the proposed development. The plan shall show the general layout of streets/roads, street improvements, parks, trails, open spaces, sewerage, water systems, and any other utilities. A conceptual storm drainage study shall also be</p>	<p><i>The Vermillion Ordinance provides guidance to land owners on elements to include or consider in their development plans. This guidance should be expanded to include "bikeways" to reference the menu of bicycle infrastructure types.</i></p>

submitted as per the storm drainage design criteria or as required by the City Engineer. The conceptual plan shall be reviewed and approved by the City Engineer prior to the development being allowed to continue.

Modify to refer to bikeways instead of trails, so that developers incorporate bikeway requirements from the Bicycle Master Plan. A reference to bikeways will cover not only trails (also referred to as shared use paths), but other bikeway types such as separated bicycle lanes, standard bicycle lanes, and neighborhood bikeways.

Vermillion Ordinance 154.08.1 (4) Street/road plans regarding plat development.
The street/road plan shall show the proposed street alignments along with curb and gutter and sidewalks. The centerline shall be stationed at critical locations. The curb and gutter shall be stationed and offset based on the stationing used on the centerline. Elevations shall also be included for the curb and gutter at critical locations (i.e. intersections crest and sag vertical curves). Along with the plan view of the street or road, plans shall also depict the centerline profile along with the curb and gutter flow line profile at intersections and at crest and sag vertical curves. Existing and proposed centerline elevations shall be included on the plan sheets.

The Vermillion Ordinance required plat development to illustrate street designs. The requirement should include "bikeways" to reinforce this as important.

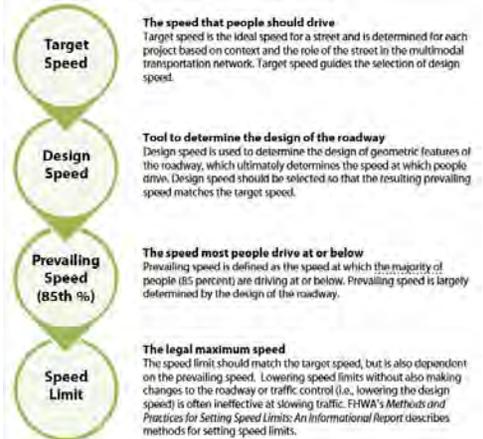
Modify to refer to include bikeways, so that developers incorporate recommendations from the Bicycle Master Plan.

Vermillion Ordinance 154.11.1 (D) Design Standards.

Design speeds should correlate with the intentional speed of a street relative to its function and context.

DESIGN ELEMENTS	ARTERIALS	COLLECTORS	LOCAL	FRONTAGE ROAD	PRIVATE ROAD EASEMENT	CUL-DE-SAC	ALLEY
RIGHT-OF-WAY (FT)	80-100	80	66-80	50	50-100	66-80 (SEE NOTE 1 & 2)	20
DESIGN SPEED (MPH)	50	50	25	25	25	25	25
PARKING ALLOWED	NONE	SEE NOTE 1	SEE NOTE 1	SEE NOTE 1	SEE NOTE 1	SEE NOTE 1	NONE

Modify design speeds for arterials and collectors to match the legal maximum posted speed. High speeds in urban areas with bicycle and pedestrian activity decrease the likelihood that road users, especially people bicycling, will survive or avoid serious injuries in a crash (see images below). This change would require public education about the safety benefits of narrower travel lanes.



	<p style="text-align: center;">PEDESTRIAN FATALITY & SERIOUS INJURY RISK</p> <p style="text-align: center;">18% 50% 77%</p> <p style="text-align: center;">- 20 MPH 30 MPH 40 MPH +</p> <p style="text-align: center;">CONE OF VISION</p> <p style="font-size: small; text-align: center;">As motor vehicle speeds increase, the risk of serious injury or fatality for a pedestrian also increases (AARP Impact Speed and a Pedestrian's Risk of Severe Injury or Death 2011, p. 1). Also, motorist visual field and peripheral vision is reduced at higher speeds.</p>																																						
<p>Vermillion Ordinance 155.072 (B) Required off-street parking spaces.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; font-size: small;">Uses and Structures</th> <th style="text-align: center; font-size: small;">Minimum Parking Requirements</th> </tr> </thead> <tbody> <tr> <td>Rooming and boarding houses, sororities and fraternities</td> <td>1 parking space for each 200 square feet of floor area. In calculating the required parking spaces, these uses may be permitted to include off-street parking available on a different lot, or zoning lot, than the use served, subject to approval of the use through the conditional use permit process. Parking spaces may not count towards more than one use</td> </tr> <tr> <td>Bowling alleys</td> <td>4 spaces per lane</td> </tr> <tr> <td>Church or temple</td> <td>1 space for each 4 seats in main seating area</td> </tr> <tr> <td>Private club or lodge</td> <td>1 parking space for each 300 square feet of floor area</td> </tr> <tr> <td>High school</td> <td>4 spaces for each classroom or office room, plus 1 for each 150 square feet of seating area in any auditorium or gymnasium or cafeteria intended to be used as an auditorium</td> </tr> <tr> <td>Elementary school</td> <td>2 spaces for each classroom or office room, plus 1 for each 150 square feet of seating area in any auditorium or gymnasium or cafeteria intended to be used as an auditorium</td> </tr> <tr> <td>Eating and drinking places</td> <td>1 space for each 300 square feet of gross floor area</td> </tr> <tr> <td>Hospitals</td> <td>1 space for each bed</td> </tr> <tr> <td>Nursing, convalescent and rest homes</td> <td>1 space for each 3 beds</td> </tr> <tr> <td>Auditoriums, theaters and places of public assembly</td> <td>1 space for each 4 seats of design capacity</td> </tr> <tr> <td>Hotels and motels</td> <td>1 space for each 2 rental rooms</td> </tr> <tr> <td>Funeral homes</td> <td>1 space for each 4 seats in the chapel</td> </tr> <tr> <td>Retail sales establishments</td> <td>1 space for each 300 square feet of floor area</td> </tr> <tr> <td>Medical and dental clinics</td> <td>1 space for each 2 staff members and full-time employees, plus 1 space for each 600 square feet of gross floor area</td> </tr> <tr> <td>Manufactured home parks</td> <td>2 spaces for each</td> </tr> <tr> <td>Industrial uses</td> <td>1 space for each 2 employees on the maximum working shift</td> </tr> <tr> <td>Service establishments</td> <td>1 space for each 300 square feet of floor area</td> </tr> <tr> <td>Wholesale and distribution establishments</td> <td>1 space for each 2 employees on the maximum working shift</td> </tr> </tbody> </table>	Uses and Structures	Minimum Parking Requirements	Rooming and boarding houses, sororities and fraternities	1 parking space for each 200 square feet of floor area. 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This should be expanded to include bicycle parking and should consider offsetting the amount of vehicle parking required if compliant bicycle parking is included.</i></p> <p>Modify to include minimum bike parking requirements. Include methods for reducing minimum motor vehicle parking requirements with indoor, outdoor, and covered bike parking. See Association of Pedestrian and Bicycle Professionals Bicycle Parking Guidelines, 2nd Edition (2010). Minimum bike parking requirements make bicycle parking at destinations more convenient, providing places for bicycle riders to park when they arrive. Minimum automobile parking requirements sometimes unnecessarily create parking spaces at destinations where bicycling and walking are more prevalent modes of transportation. Allowing developers to substitute bicycle parking for automobile parking acknowledges that a one size fits all approach does not always work, particularly in university and downtown settings.</p>
Uses and Structures	Minimum Parking Requirements																																						
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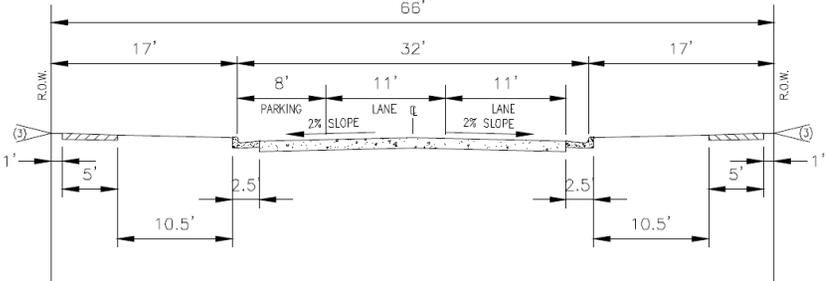
State of South Dakota Statutes

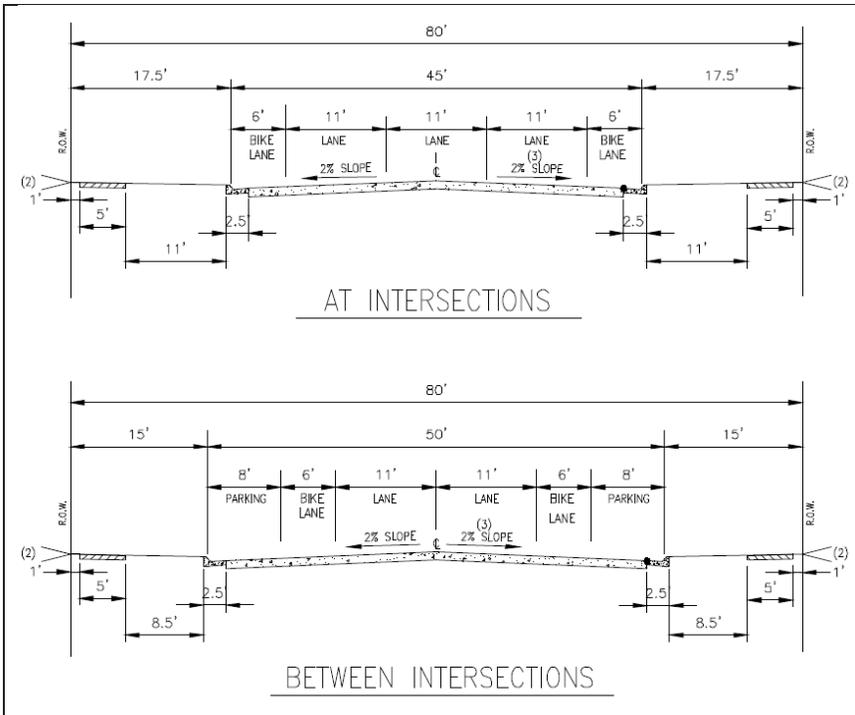
The State of South Dakota’s Statutes were reviewed. The absence of definition for shared use paths leads to confusion about the rules for bicyclists on shared use paths (as opposed to sidewalks), as well as municipal versus property owner responsibility for maintenance.

Current Statute	Recommended Change and Justification
<p>South Dakota Statute 32-20B-2 Duty for bicyclists to stop on sidewalks or crosswalks. A person operating a bicycle upon and along a sidewalk, or across a roadway upon and along a crosswalk, shall have all the rights and duties applicable to a pedestrian under the same circumstances, except as provided in Statute 32-20B-3, and except that bicyclists must stop before entering a crosswalk or highway from a sidewalk or sidewalk area.</p>	<p><i>Clarify the appropriate behavior of bicyclists and pedestrians on shared use paths in South Dakota.</i></p> <p>Shared use paths, often incorrectly equated with sidewalks, are designed to carry high amounts of bicycle traffic. This facility type is not currently defined in state statute. The Manual on Uniform Traffic Control Devices (MUTCD) allows right-of-way between a shared use path and street to be determined through an engineering study, but this statute as currently worded suggests that bicyclists must stop at a street intersection on a shared use path, even if directed otherwise by traffic control devices (i.e. yield signs, stoplights, or a stop-controlled street). Statutes should be amended to define shared use paths, and give deference to engineering studies which determine the appropriate right-of-way based on data and standardized traffic control devices. Requiring bicyclists to stop at every intersection, in conflict with posted traffic control devices (such as yield signs and stoplights), is confusing and may lead to unpredictable or unsafe behavior.</p>
<p>South Dakota Chapter 9-46 Sidewalk Improvements.</p> <p>9-46-1 Width and material of sidewalks prescribed by ordinance. 9-46-2 Liability of adjoining property owner for failure to keep sidewalks in repair. 9-46-3 Notice to adjoining property owners to construct or repair sidewalk. 9-46-4 Municipal construction or repair on failure by adjoining owner. 9-46-5 Assessment of sidewalk costs against abutting property. 9-46-6 Filing of assessment roll for sidewalk construction or repair – Costs covered by assessment. 9-46-7 Division of sidewalk assessment into annual installments – Notice of filing and hearing on assessment roll. 9-46-8 Amendment and approval or rejection of assessment roll – Certification to county officers and collection of assessments. 9-46-9 General assessment law applicable to sidewalk improvements. 9-46-11 Mailboxes on or adjacent to curbs or sidewalks.</p>	<p><i>South Dakota DOT specifies the design, process, and construction process for the installation of sidewalks. The section could be expanded to include shared use paths.</i></p> <p>Modify to clarify that each municipality may define the width and materials of shared use paths (intended for bicycle and pedestrian traffic), and that each municipality may or may not choose to prescribe liability for repairs on adjacent property owners.</p>

City of Vermillion Street Design Details

The Vermillion Engineering Department’s Street Design Details were reviewed. Items of interest primarily focused on the facility widths and cross slopes of standard bicycle lanes, shared use paths, and travel lanes, which vary depending upon the amount of traffic on a given street type. Widths and cross slopes influence the safety of bicyclists, primarily through the speeds of motorists and surface hazards such as steep gutters and pooling water.

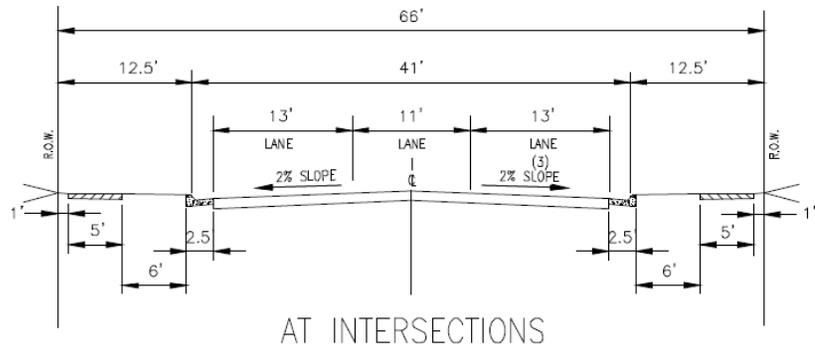
Current Vermillion Street Design Detail	Recommended Change and Justification
<p>Width of Local Residential Streets</p> 	<p><i>The width of local residential streets should be narrowed to contribute to lower operating speeds, resulting in a safer environment for all users, including bicyclists.</i></p> <p>Reduce travel lane widths from 11’ to 10’, based on national research and guidance from the Minnesota DOT’s Performance-Based Practical Design (2018, pp. 25 – 26). The AASHTO Green Book (2011, pp. 4-7 – 4-8) allows 10-foot travel lanes in low speed environments (45 miles per hour or less). This change would require public education about the safety benefits of narrower travel lanes.</p>
<p>Bicycle Facility Type on Higher Volume Streets</p>	<p><i>On-street bicycle lanes should be constructed so that longitudinal joints are not placed in the middle of bicycle lanes. On streets with higher traffic volumes and speeds, separated bicycle lanes are recommended.</i></p> <p>Separated bicycle lanes are preferred over standard bicycle lanes on streets with greater than 6,000 motor vehicles per day, or speeds above 25 mph. NACTO’s Designing for All Ages and Abilities also recommends separated bicycle lanes on streets with multiple lanes per direction.</p>



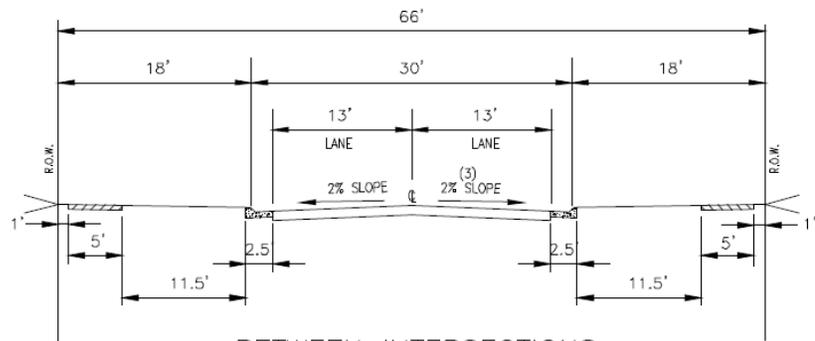
Width of Travel Lanes

The width of travel lanes on higher volume and speed streets should be narrowed to contribute to lower operating speeds, resulting in a safer environment for all users, including bicyclists.

Reduce travel lane widths from 13' and 11', to 11' and 10', respectively, based on national research and guidance from the Minnesota DOT's [Performance-Based Practical Design](#) (2018, pp. 25 – 26). The AASHTO Green Book (2011, pp. 4-7 – 4-8) allows 10-foot travel lanes in low speed environments (45 miles per hour or less). According to [NCHRP Report 783](#), using narrower lanes on urban and suburban arterials can provide space for incorporation of other features that are

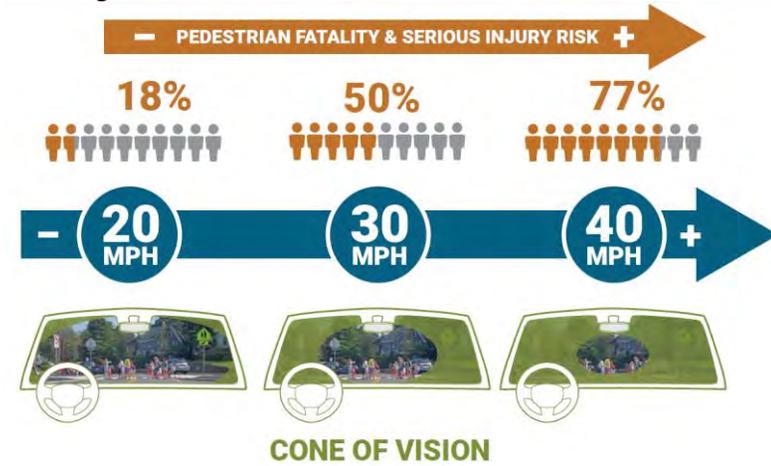


AT INTERSECTIONS



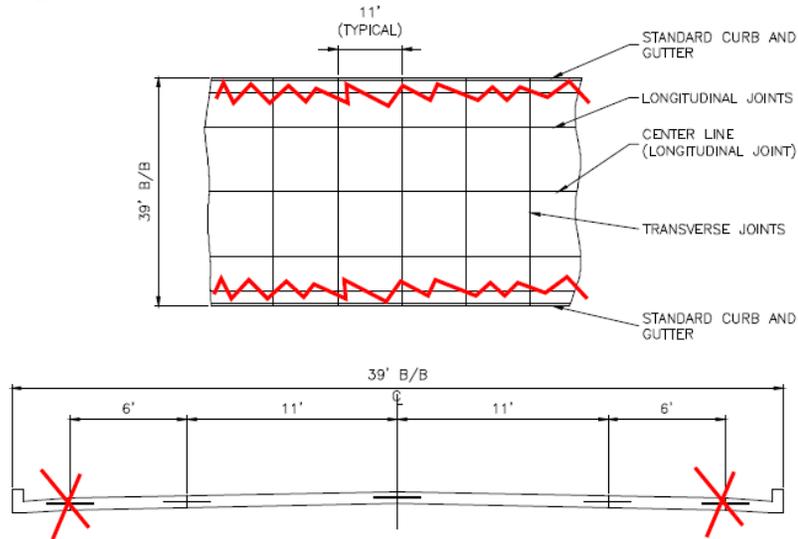
BETWEEN INTERSECTIONS

positive for operations and safety including medians, turn lanes, bicycle lanes, parking lanes, and shorter pedestrian crossings.”



As motor vehicle speeds increase, the risk of serious injury or fatality for a pedestrian also increases (AARP Impact Speed and a Pedestrian's Risk of Severe Injury or Death 2011, p. 1). Also, motorist visual field and peripheral vision is reduced at higher speeds.

Longitudinal Joints



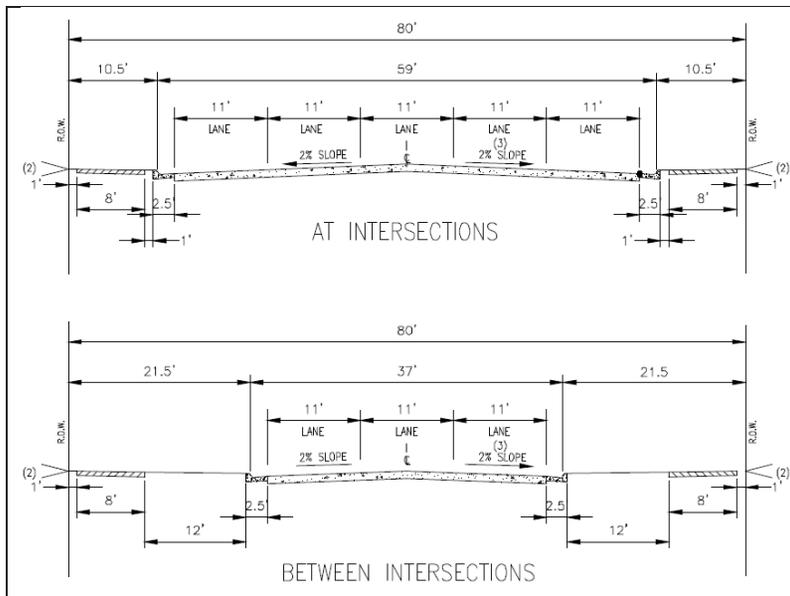
On-street bicycle lanes should be constructed so that longitudinal joints are not placed in the middle of bicycle lanes.

Longitudinal joints in the middle of bicycle lanes can pose a danger to bicyclists, especially those using narrow-width tires. Gutters should be constructed integrally with concrete pavement, so that longitudinal joints are placed between bicycle lanes and motor vehicle lanes. An example of a community that uses a [bicycle-friendly gutter standard plate](#) is Minneapolis. If the gutter area is constructed with a 5.5% to 6% cross slope, the gutter should not be included in the width of the bicycle lane. 4' is the minimum preferred bicycle lane width next to a curb (and steep gutter), with 5' to 7' preferred.

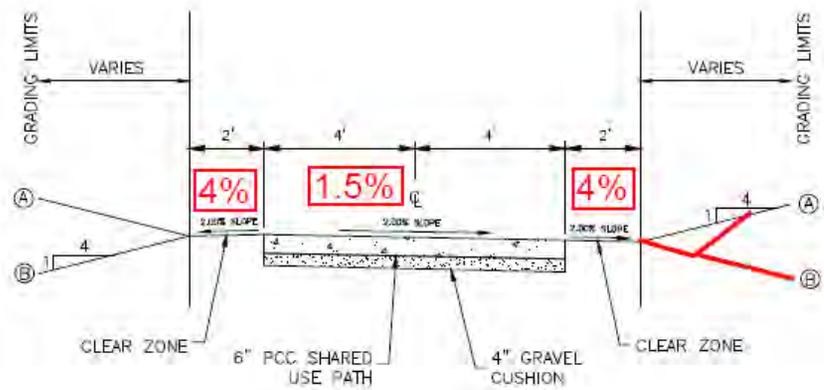
Width of Shared Use Paths

Minimum recommended widths for shared use path are 10' instead of 8', to allow bicyclists and pedestrians comfortable passing width.

Path width should be determined based on the number and types of users, and the difference in speeds. A minimum path width of 10' is recommended, although 8' may be used where volumes are low, physical constraints are present, or one user type is expected to predominate. 11' to 14' is recommended where higher uses are anticipated. Use the [FHWA Shared Use Path Level of Service Calculator](#) to determine width based on volumes and user type.



Cross Slopes and Drainage Design on Shared Use Paths



Cross slopes on shared use paths should meet current ADA standards. To ensure proper drainage, shared use path design should be similar to roadways.

Decrease cross slopes on shared use paths from 2% to 1.5%, to allow for construction tolerance. 2% is the maximum cross slope allowed by current ADA standards. Shared use paths can experience icing issues with poor drainage, with windrows melting and refreezing across the traveled way. Treat shared use paths like roadways by designing shoulders at 4% cross slopes, and adding a "V" ditch in cut sections.

SDDOT Road Design Manual

The Bicycle and Shared Use Facilities section of Chapter 16 of the SDDOT’s Design Manual was reviewed. Items for recommended change in this manual focused on the menu of bicycle facilities available. The manual, which was adopted in the late 2000’s, lists shared use paths, standard bicycle lanes, and wide outside lanes as potential bicycle facility types. Bicycle facilities are rapidly developing in the United States, with a recent focus on designing for all ages and abilities, rather than for bicyclists who ride mixed with motor vehicle traffic. Recommendations incorporate the latest guidance and research regarding safety and user preferences.

Current South Dakota Road Design	Recommended Change and Justification
<p>Wide Outside Lanes as Bicycle Facilities <u>Shared Roadway</u>: Any roadway upon which a bicycle lane is not designated and which may be legally used by bicycles regardless of whether such facility is designated as a shared roadway. In urban locations an additional 3’ should be added to the outside lane (not including the gutter width). In locations with lower speeds and reduced traffic volumes a shared lane marking and/or signage may be used. Justification should be included in the projects scope if additional width is not provided.</p>	<p><i>Wide outside lanes should no longer recommended as a bicycle facility type in urban areas, since they increase speeds of motor vehicles and do not attract a wide array of users.</i></p> <p>Wide outside lanes encourage higher motor vehicle speeds, reducing comfort and safety for bicyclists. In the past, wide outside lanes were provided to allow motorists to pass bicyclists without encroaching in the adjacent lane.</p> <p>Research has found motorists do not recognize this additional space is intended for bicyclists. NACTO’s Designing for All Ages and Abilities provides justification for appealing to a wider audience, and recommends facility types with broader appeal.</p>
<p>Width of Standard Bicycle Lanes <u>Bicycle Lane</u>: A portion of a roadway that has been designated by striping, signing, and/or pavement markings for the preferential or exclusive use of bicyclists. In an urban setting, this may be a 3-foot shoulder developed between the travel lane and the gutter, not including the gutter width. An additional two feet should be provided if adjacent to parking and space allows, in some cases marking this buffer may be applicable.</p>	<p><i>4 feet should be the absolute minimum width for standard bicycle lanes, with no longitudinal joints in the middle. Strong consideration should be given to adopting a 5-foot minimum width.</i></p> <p>The minimum operating width for bicyclists is 3.5’, so the minimum recommended width for bicycle lanes is 4’ next to curbs (5’ to 7’ is desirable), and 5’ adjacent to parking (6’ to 7’ is desirable). Wider bicycle lanes are preferable where parking turnover is high, on roads with more than 5 percent heavy vehicles, and where it is desirable for bicyclists to travel side-by-side or pass other bicyclists. The space should be a smooth surface clear of joints.</p>

	<p>Longitudinal joints in the middle of bicycle lanes can pose a danger to bicyclists, especially those using narrow-width tires. Gutters should be constructed integrally with concrete pavement, so that longitudinal joints are placed between bicycle lanes and motor vehicle lanes.</p>
<p>Separated Bicycle Lanes as a Facility Type</p>	<p><i>Separated bicycle lanes, which were not in wide use 10 years ago when the DOT's design manual was last updated, should be added as a new facility type.</i></p> <p>Most bicyclists prefer to ride on separated bicycle lanes, as illustrated in recent visual preference surveys taken in Vermillion and Brookings. Guidance on separated bicycle lanes has been published in documents such as FHWA's Achieving Multimodal Networks, FHWA's Small Town and Rural Design Guide, NACTO's Urban Bikeway Design Guide. Depending on the context, separated bicycle lanes may be designed for one-way or two-way operation, and may be constructed at street, sidewalk, or intermediate level. Separation may be achieved with vertical elements such as medians, flexible delineator posts, parked vehicles, or elevation changes between the bicycle lane and road.</p>
<p>Shared Use Paths as Alternatives to On-Road Bikeways <u>Shared Use Path</u>: A shared use path is physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Most shared use paths are designed for two-way travel and are a supplemental network to on-road bicycle facilities and should not be used an alternate for an on-road bikeway. Shared use paths may be used by bicycles, pedestrians, skaters and</p>	<p><i>Shared use paths should be encouraged as alternatives to on-road bikeways, since they have broad appeal to a wide array of bicyclists.</i></p> <p>Shared use paths provide a bicycle facility separate from motor vehicle traffic. In higher speed and traffic volume locations, most bicyclists and motorists prefer separation.</p>

other non-motorized users. A side path is a type of shared use path that runs adjacent to the roadway and should only be used when other shared use path options are not available. Vertical clearance to obstructions shall be 100 inches minimum and 120 inches desired.

Conflict points at intersections on shared use paths can be made conspicuous to improve safety.

