Technical Report for the Provo Bicycle Master Plan

Prepared for:

provo

MOUNTAINLAND ASSOCIATION OF GOVERNMENTS

Prepared by:

alta PLANNING + DESIGN

September 2013

This page left intentionally blank

Table of Contents

Table of Contents

Table of Contents

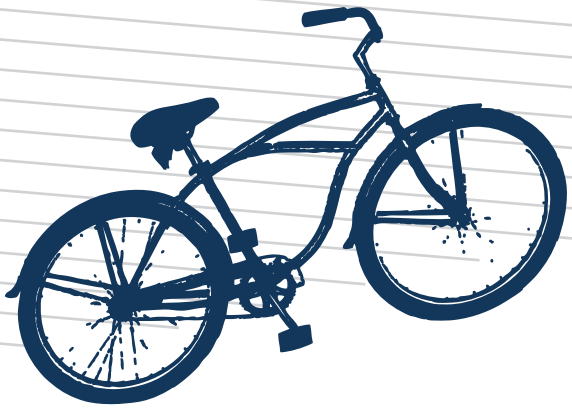
Table of Contents

Table of Contents

List of Figures

List of Tables

List of Tables

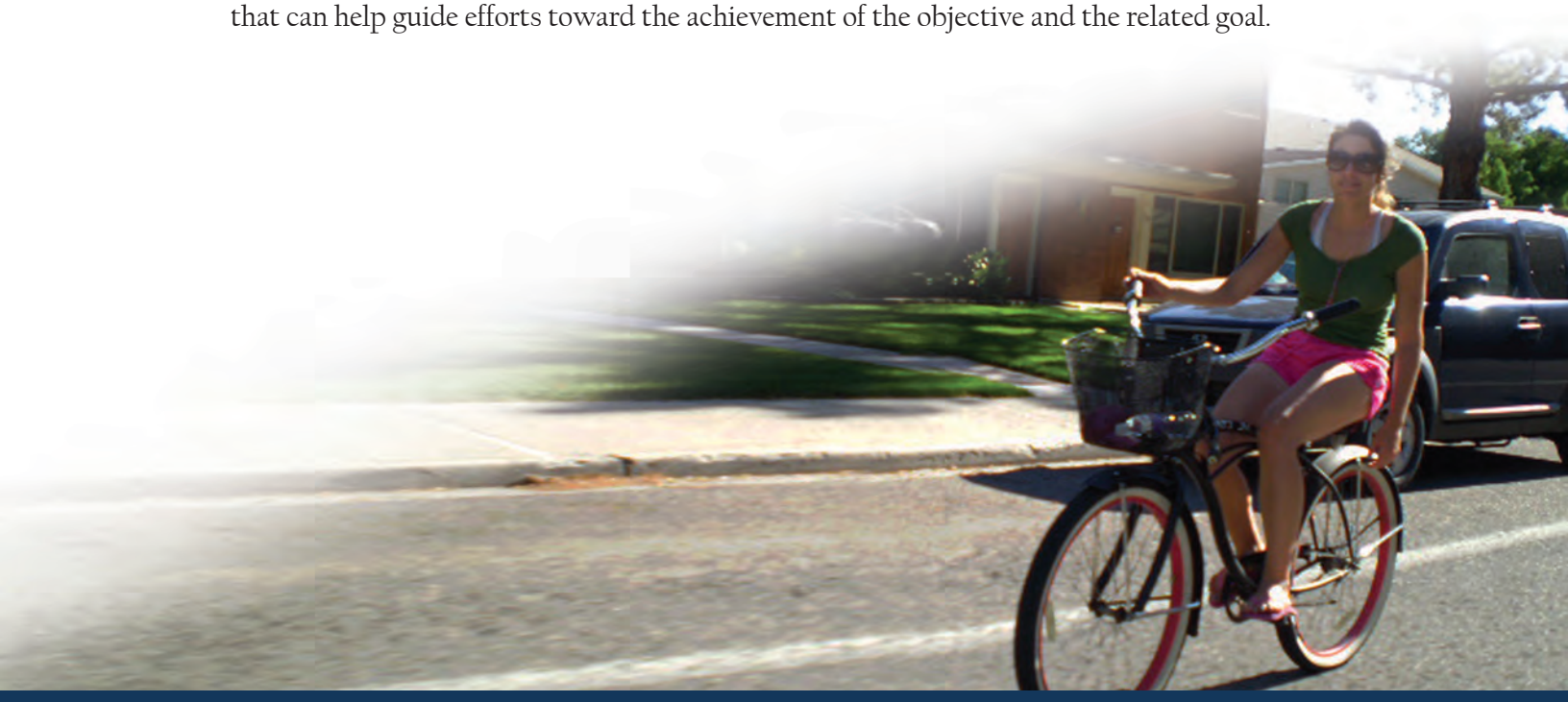


1 Vision, Goals, & Objectives

The Vision, Goals, and Objectives of the Provo City Bicycle Master Plan will guide the development and implementation of bicycle facilities in Provo for years to come. Goals and objectives direct the way public improvements are made, where resources are allocated, how programs are operated, and how city priorities are determined. This section lays out a framework for how to increase bicycling in Provo.

1.1 Vision Statement

A vision statement outlines what a city wants to be. It concentrates on the future and is a source of inspiration. Goals help guide the city towards fulfilling that vision and relate to both existing and newly launched efforts by Provo. Objectives are more specific statements within each goal that define how each goal will be achieved. They are measurable and allow tracking of progress toward achieving the goals and overall vision. Each objective has a number of implementation measures that can help guide efforts toward the achievement of the objective and the related goal.



« Connecting people who walk and bicycle to UTA's FrontRunner and bus services is part of Goal #8

The Steering Committee that helped guide this master plan established the following vision for bicycling in Provo:

"Provo City will create strong families, vibrant neighborhoods, and a healthy community through the promotion and accommodation of bicycling as a vital means of everyday transportation and recreation."

1.2 Goals & Objectives

Based on input from the Steering Committee, the following eight categories of goals were established for bicycling in Provo:

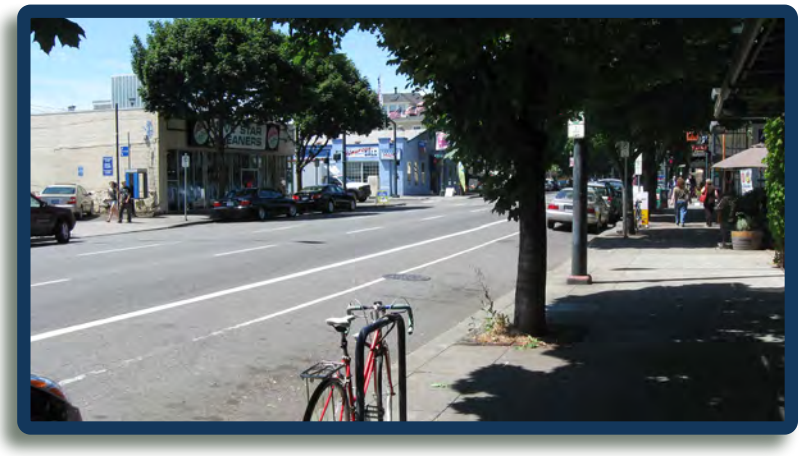
1. Complete Streets
2. Implementation
3. Bikeway Network
4. Maintenance
5. Safety
6. Education and Encouragement
7. Evaluation
8. Bike-Transit Integration

This section describes each of these goal categories and supplies specific objectives to support each goal. These goals and objectives support the overall vision and describe the most important aspects of Provo's priorities and attitudes towards bicycling. Summaries of each goal, their purposes, and the objectives that support them are given in the following subsections.

1.2.1 Complete Streets

Complete Streets is an ethos that encourages consideration of all road users when modifying or constructing roads. The genesis of Complete Streets can be traced back to the perception that pedestrians, bicyclists, and transit users should be more fully accommodated in the road design process. Complete Streets principles are typically incorporated at the municipal level through the adoption of policy and ordinance language. The following goal and objectives address how Provo can achieve the bicycle component of Complete Streets.

Purpose: Accommodate bicyclists within the public right-of-way.
Objectives
1A. Consider every road in Provo where bicyclists are legally permitted as a road that bicyclists will use.
1B. Coordinate Livable Streets traffic volume requirements with the development of residential bike routes/bike boulevards.
1C. Require all Capital Improvement Projects to include relevant recommended facilities as contained in the bicycle master plan.
1D. Provide a bicycle network that is safe and attractive for all users, particularly people who would like to ride more but do not feel comfortable with the infrastructure currently available.
1E. Evaluate streets for recommended on-street bike facilities so that they may be implemented when street resurfacing and restriping projects are scheduled.
1F. Incentivize or require private development projects to include bicycle facilities identified in this master plan.



» Complete streets welcome all types of users

« The Provo River Parkway is used for both transportation and recreation

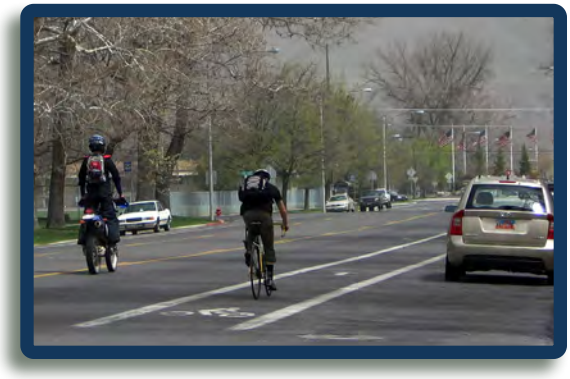
1.2.2 Implementation

Implementing the recommendations outlined in the bicycle master plan will help Provo address the needs of its residents.

Purpose: Equip city staff/stakeholders with the necessary tools to implement the bicycle master plan.	
Objectives	
2A.	Thoroughly vet the recommendations in the bicycle master plan with the Project Steering Committee and relevant funding agencies so that the plan can be implemented as efficiently as possible.
2B.	Utilize the bicycle master plan Steering Committee throughout bikeway* implementation to ensure citywide support and harmony with other department plans, policies, and goals.
2C.	Maintain open dialog with Provo residents, advocacy groups, and other public groups at every stage of the bicycle master plan implementation.
2D.	Analyze previously-planned bikeways for feasibility and value in the overall network.
2E.	Prioritize proposed projects for construction and funding.
2F.	Engage with elected officials at major milestones of bicycle master plan implementation to remind them of the importance of bicycles in Provo's transportation network.
2G.	Coordinate bikeway projects with the Utah Department of Transportation (UDOT) and the Utah Transit Authority (UTA) to help with planning and funding of bikeways.

* The term "bikeway" refers to any type of designated bicycle facility. Shared-use paths, bike lanes, and cycle tracks are just a few examples of bikeways. "Bikeway" and "bicycle facility" are synonymous.

» Goal #3 focuses on developing a complete bicycle network of facilities that serve multiple types of people, not just "serious" bicyclists



1.2.3 Bikeway Network

A complete bikeway network provides a variety of bikeway types, accommodating bicyclists of varying skills and abilities, and connects them with destinations throughout the city.

Purpose: Provide a complete bikeway network throughout the city of Provo.	
Objectives	
3A.	Implement a continuous network of bikeways that serves all bicycle user groups, including both recreational and utilitarian riders*.
3B.	Bridge network gaps between the adjacent communities of Orem and Springville.
3C.	Work with UDOT to coordinate desired bikeways on State roadways.
3D.	Prioritize future bikeway projects that connect to existing bicycle facilities.
3E.	Identify and construct a safe, attractive, and viable north-south bikeway.
3F.	Prioritize bikeway projects with connectivity to downtown, parks/recreation sites, BYU, and other major trip generators.
3G.	Adopt and adhere to existing and future design guidelines and standards established by the National Association of Cities and Towns (NACTO) Urban Bikeway Design Guide, American Association of State Highway Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities, and the Manual of Uniform Traffic Control Devices (MUTCD).

* A utilitarian bicycle rider is someone who uses a bicycle to accomplish a transportation-oriented purpose such as commuting to work, going to school, or shopping.

« Bike facilities must be kept clean of debris, weeds, and snow (pictured here is a buffered bike lane in Salt Lake City)

1.2.4 Maintenance

Well-maintained bikeways promote active use and enhance bicyclists' safety and overall experience.

Purpose: Keep bicycle and trail facilities clean, safe, and accessible.	
Objectives	
4A.	Maintain existing and future bicycle facilities to a high standard in accordance with guidelines established in this plan.
4B.	Incorporate bicycle network repair and maintenance needs into the regular roadway maintenance schedule as appropriate, paying particular attention to sweeping and pothole repair on priority bicycle facilities.
4C.	Establish weed management program to target spread of Puncturevine (primarily on shared-use paths) for the purpose of reducing tire punctures.
4D.	Address bicyclist safety during construction and maintenance activities.
4E.	Identify safe, convenient, and accessible routes for bicyclists through construction zones.
4F.	Provide a simple way for citizens to report maintenance issues that impact bicyclist safety and for the city to respond appropriately.
4G.	Implement an on-going citywide bikeway maintenance strategy.
4H.	Develop and update actual maintenance costs for existing bikeways to help the City budget for its future bikeway network.
4I.	Consider future maintenance requirements when making choices for new facilities so that they are as easy as possible to maintain and minimize maintenance resource needs.

1.2.5 Safety

Bicyclists, motorists, and other road users should be considerate and operate their respective vehicles in a safe manner.

Purpose: Make Provo a safe and enjoyable place to ride a bicycle.	
Objectives	
5A.	Reduce the number of crashes involving bicyclists with pedestrians and with motor vehicles while increasing overall levels of bicycling and walking.
5B.	Design facilities that encourage bicyclists to travel at safe speeds when the facility is shared with other user types or intersects with pedestrians and other users.
5C.	Transition bicycle facilities through intersections according to current standards.
5D.	Provide well-marked, visible roadway crossings for shared-use path facilities and clarify expected behavior for motorists, bicyclists, and pedestrians.

» Education courses encourage more people to bicycle and to do so in a safe manner

1.2.6 Education & Encouragement

Many cities around the nation are finding that robust efforts in road user education and encouragement are just as effective at increasing bicycle use as construction of new facilities.

Purpose: Implement comprehensive education and encouragement programs targeted at all populations in the City.	
Objectives	
6A.	Educate the general public about bicycle safety issues and encourage non-motorized transportation with programs that target pedestrians, bicyclists, and motorists.
6B.	Install signage along local and regional bikeways to assist with wayfinding, increase motorists' awareness of bicyclists, and encourage more people to ride bicycles.
6C.	Support Safe Routes to School (SRTS) programs and other efforts, including educational and incentive programs to encourage more students to bicycle or walk to school, through a partnership with the school districts and other interested parties.
6D.	Promote bicycling through events sponsored by Provo City.
6E.	Encourage large employers, schools, UTA intermodal stations, and other activity centers to provide secure bicycle storage facilities and promote their efforts.
6F.	Encourage new commercial building projects to provide bicycle parking, showers, changing facilities, and lockers for employee use.
6G.	Partner with other interested groups across the State to update the driver's license exam to include the latest bicycle markings and signs, and to ensure that bicycle-related exam questions are used.
6H.	Create a downloadable and printable City bikeways map and make it available at logical locations throughout the City.
6J.	Make a link on the City website to the Provo Bicycle Committee's* website so that interested citizens can obtain current bicycling information.

* The Provo Bicycle Committee is a citizen group that promotes bicycle riding by working with the City government and holding events.

1.2.7 Evaluation

Tracking implementation of the bicycle master plan recommendations allows the City to be accountable to its stakeholders and identify strategies that are working or may need to be changed.

Purpose: Monitor implementation of the Provo City Bicycle Master Plan and conditions relating to bicycling in Provo.	
Objectives	
7A.	Track the success of the bicycle master plan as a percent completed of the total recommended bikeway system.
7B.	Create a regular bicycle count system in order to establish a baseline understanding of bicycle ridership for use in future evaluations.
7C.	Determine bicycle crash rates from available data.
7D.	Complete Bicycle Friendly Community application. Achieve Silver-level status by 2015 and Gold-level status by 2020.*

*For more information on these programs, visit www.bikeleague.org/programs

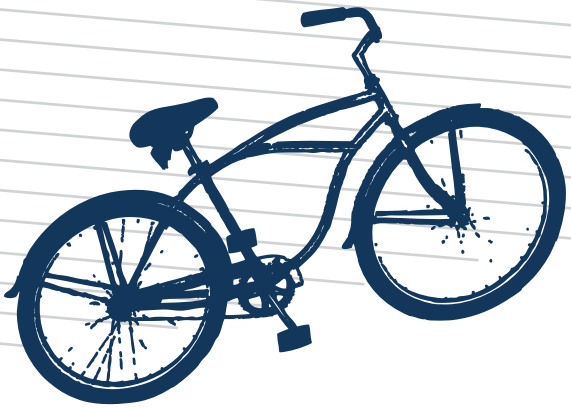
» Evaluation of bikeway implementation strategies and user habits is an important part of ongoing efforts in Provo

1.2.8 Bike-Transit Integration

Connecting bikeways with transit facilities helps to reduce traffic congestion and promote both bicycling and transit use.

Purpose: Improve multi-modal transportation by coordinating bicycle projects with existing and future transit plans.	
Objectives	
8A.	Provide access and bicycle support facilities to transit by connecting bikeways to transit stops and intermodal centers.
8B.	Support UTA in accommodating bicycles on all transit vehicles including FrontRunner commuter rail and Bus Rapid Transit (BRT) buses.
8C.	Provide secure end-of-trip facilities (bike parking, etc.) at intermodal centers.
8D.	Partner with UTA and BYU when developing educational and outreach programs.
8E.	Integrate bicycle parking into new bus shelters.

« Bike racks on transit vehicles are a key way to integrate bicycling with transit



2 Summary of Existing Plans

This section summarizes the major planning documents that shape the physical and policy environment for Provo City as it relates to bicycling. The following documents are reviewed in this section:

- UDOT Guidelines for Bicycle and Pedestrian Accommodations
- UDOT Roadway Design Manual of Instruction
- UDOT Pedestrian and Bicycle Guide
- UDOT Bicycle Priority Routes Project
- Utah Traffic Controls for School Zones Manual
- Mountainland Association of Governments (MAG) Bicycle and Pedestrian Planning
- MAG Non-Motorized Trail Standards
- Provo City General Plan
- Provo Master Transportation Plan
- Provo-Orem BRT Plans
- Provo City Vision 2030
- Proposed Improvements to City Bicycle Network

« UDOT's Guidelines for Bicycle and Pedestrian Accommodations

2.1 UDOT Guidelines for Bike & Pedestrian Accommodations

UDOT has outlined bicycle and pedestrian accommodation guidelines to promote safety and mobility of bicyclists and pedestrians in roadway projects. The guidelines are as follows:

2.1.1 Freeways & Limited Access Highways

Bicycle and pedestrian accommodations are not required on urban area freeways where cycling and walking are prohibited. Where bicyclists are permitted on rural freeways, special attention should be given to rumble strip application and shoulders. For a listing of locations on state routes where bicyclists are prohibited, visit www.udot.utah.gov/walkingandbiking and select "Online Maps".

2.1.2 Urban & Rural Arterials

Utah State Code defines bicycles as vehicles. Every effort should be made to include bicycle and pedestrian accommodations in all new construction and reconstruction projects on the state system. The specific level of accommodation will vary by project and should be determined by the Project Team in conjunction with the UDOT Bicycle and Pedestrian Coordinator. The guidelines were created in response to UDOT Policy 07-117: Routine Accommodations for Bicyclists and Pedestrians, which was adopted in May 2006. The text of this policy reads as follows:

"An accommodation is defined as any facility, design feature, operational change, or maintenance activity that improves the environment in which bicyclists and pedestrians travel. Examples of such accommodations include the provision of bike lanes, sidewalks, signs, and the addition of paved shoulders. Bicycling and walking are successfully accommodated when travel by these modes is efficient and safe for the public. The level of accommodation should be considered on a project-by-project basis."

A checklist is included as part of the guideline document to facilitate a discussion between the project team members and to determine the level of accommodation for bicyclists and pedestrians in a roadway project.

2.2 UDOT Roadway Design Manual of Instruction

UDOT encourages multi-modal transportation options on roadway facilities. Bicycle and pedestrian planning and design guidelines outlined in Section 9 are based on AASHTO standards. Checklists are provided for bicycle and pedestrian facilities in general, as well as for the Concept, Environmental, and Scoping Phases of a project.

2.2.1 Bicycle Facilities

UDOT encourages the use of the Bicycle Compatibility Index (BCI) to evaluate roadways for bicycle compatibility. They also specify that urban state highways should have an 8-foot-wide minimum shoulder.

2.3 UDOT Pedestrian & Bicycle Guide

The Pedestrian and Bicycle Guide was created to provide UDOT staff and interested citizens resources for improving walking and bicycling conditions in Utah. The guide addresses design, maintenance, funding, education, and the UDOT project development process. It is a valuable resource and reference for any Utah city or county planning bicycle and/or pedestrian facilities.

2.4 UDOT Bicycle Priority Routes Project

In response to increased demand for bicycle facilities statewide, UDOT formed a planning team to prepare a statewide Bicycle Priority Routes analysis.

2.4.1 Public Involvement Element

The public involvement portion of this analysis began in September 2008 and included 13 open houses held throughout the state. The open houses offered general information about the project, sketches showing how bikes could be accommodated on state roads, a map showing existing conditions, and the selection criteria UDOT would use to prioritize bicycle route improvements. Public comments were received in a number of ways including comment sheet submissions, notes written on maps, and email comment submissions.

Of the 13 open houses, the closest one to Provo was held in Orem. 59 people attended the Orem open house September 2008. According to UDOT's geographic tracking of comments, attendees at Orem's open house represented several communities in Utah Valley.

2.4.2 Priority Routes

In Provo three Level 1 (highest) priority projects were identified. Table 2-1 outlines these projects. UDOT makes mention in these project documents that funding has not been secured for the identified priority improvements and encourages public agencies to make the improvements as opportunities arise.

« UDOT's Bicycle and Pedestrian Guide

Table 2-1: Bicycle Priority Routes Projects

Street	Improvement
SR-114 (Geneva Road): 820 North to Orem boundary	Widen shoulders and/or restripe. Bike lanes are desired, but wide shoulders would be acceptable.
US-89 (State Street): 1100 South to Springville boundary	Widen shoulders (note: portions of this improvement have been completed since 2009).
Utah Lake Trail: end of current trail north to Orem boundary	New 10' wide shared use path.

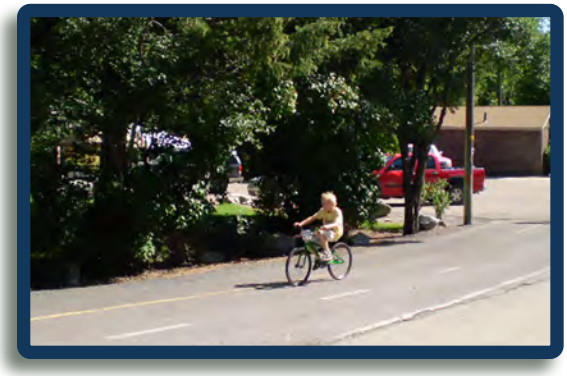
2.5 Utah Traffic Controls for School Zones Manual

UDOT created this manual to ensure consistency and set specific standards for all Utah school crossing zones. All jurisdictions in Utah are required by code to use the manual.

2.6 MAG Bicycle & Pedestrian Planning

MAG is responsible for preparing and approving a TIP for the Utah County region annually. The TIP is a compilation of projects sponsored by municipalities, the county, UDOT, UTA, and others utilizing various Federal, State, and local funding sources.

In May 2011, the MAG 2040 Metropolitan Transportation Plan (2040 MTP) was adopted, which includes a discussion on bicycle and pedestrian improvements regionally, including Provo. Generally, the 2040 MTP provides guidance on maintaining and enhancing the regional transportation system for urbanized Utah County. The 2040 MTP includes a section on bicycle and pedestrian improvements that indicates that funding is a major barrier to fully constructing a trail network that provides for connectivity between cities and destinations in the urbanized area of Utah County. Stated goals of the regional bicycle and pedestrian network are the reduction of vehicle trips and mitigation of traffic congestion. The 2040 MTP identifies a network that connects population and employment centers to each other based upon projected densities



» The Provo River Parkway is a City and regional trail that has benefitted from MAG funding

through planning year 2040. A map is provided within the 2040 MTP that shows where the paved trails, bike routes (which includes bike lanes, wide shoulders, and signed routes), crushed stone trails, and priority planned trails are planned at the regional level, including existing trails to show connectivity. This map is shown in **Figure 2-1**.

The 2040 MTP further states that design considerations should cover connectivity, safe roadway crossings, traffic calming techniques, street, street furniture, and other pedestrian-scaled amenities. MAG's staff utilizes the Bicycle Compatibility Index (BCI) model to analyze all roadway projects within the 2040 MTP. The output of the model indicates a Level-of-Service (LOS) ranging from "A" to "F". A LOS of "C" indicates that a roadway is comfortable for the average adult bicyclist. Based on an LOS of "C", MAG has identified that bike lanes or wide shoulders should be included in planned projects unless law or engineering judgment precludes such inclusion.

Regionally, approximately $16M is needed annually to fund a bicycle and pedestrian network. While this level is not currently available at MAG, efforts are being made to combine bicycle and pedestrian efforts with roadway projects that will eventually create a network over time. Most of the bicycle and pedestrian projects at the regional level are made up of local city projects with the Utah Valley Trails Committee helping to identify gaps and determine which regional facilities will help provide the most connectivity.

2.7 MAG Non-motorized Trail Standards

The standards presented in this document are based on recommendations from the AASHTO Guide for the Development of Bicycle Facilities (1999), the MUTCD (2003), and other sources. Section B sets definitions of various facility types. Most notably, it discusses the nature of shared-use paths as follows:

"Proper design will accommodate two-way use, with infrequent interruptions by driveways or roadway crossings. Long sections of trail without road crossings or driveways are most desirable. At a bare minimum, 1320 feet (1/4 mile) between such interruptions should be planned and maintained throughout.

"Trails should not be located along roadsides where sidewalks are normally provided. Typically, sidewalks are not good candidates for use as trails, since they tend to be too narrow to accommodate multiple uses and are too

15

frequently interrupted. Where good trail design is not possible due to frequent interruptions or lack of suitable separation from roadways, a combination of bicycle lanes and sidewalks may be more appropriate."

Section C governs design and construction standards and provides standards beyond what is available in the AASHTO Guide for the Development of Bicycle Facilities. Shared-use paths should be 10 feet wide (8 feet minimum) and conform to recommended surface thicknesses and subgrade requirements. Recommendations are also made for bridge structures, signage, grades, and corner radii. Finally, the standards require all new construction and alterations to comply with ADA laws.

2.8 Provo City General Plan

2.8.1 Chapter Eight – Transportation & Circulation

In the Bike Paths section, the General Plan identifies the importance of two bike paths to the Provo Bikeway System: the Provo River Parkway and The College Connector Trail. These off-street bikeways are the "backbone" of Provo's bikeway network. The Plan also calls for the development of future on-street facilities to enhance safety and improve connectivity between on- and off-street bikeways.

The Intermodal Transit Station is identified as one of the premier destinations for future bikeway development. Chapter 8 also sets a goal for the City to be designated by the League of American Bicyclists as a Gold-level Bicycle Friendly Community.

2.9 Provo Master Transportation Plan

The Provo Master Transportation Plan (MTP) addresses bicycle transportation in several sections of the plan, which are described below.

« Provo River Parkway south of Columbia Lane

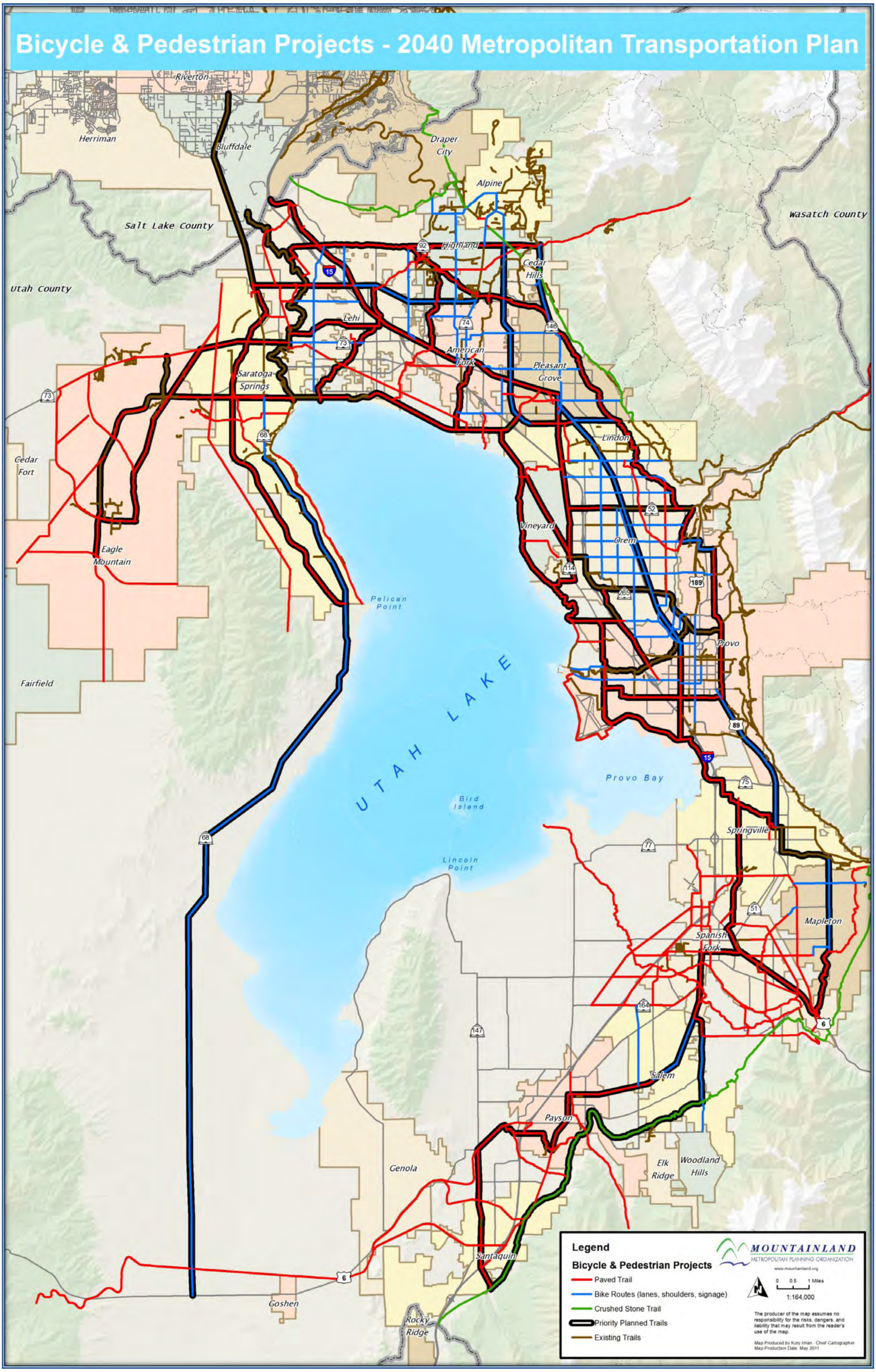


Figure 2-1: Bicycle & Pedestrian Projects – 2040 MAG Transportation Plan

2.9.1 Livable Streets

The first part that relates to bicyclists in Provo is the Livable Streets section. In this section, the desired maximum traffic volume for residential streets is defined as 1,800 vehicles a day. Under this designation, residential streets that meet the Livable Streets standards would also work well as residential bike routes, neighborhood greenways, or bicycle boulevards.

The Livable Streets Standards Policy Statements in the MTP mostly focus on livability as a measure of traffic volume or land use along a specific corridor with little mention of addressing the needs of alternate users of the road.

2.9.2 Traffic Mitigation Strategies

In the public involvement portion of the MTP a joint City Council and Planning Commission meeting was held wherein meeting participants ranked and scored various strategies for traffic mitigation. Strategies included instituting transit corridors, reducing land densities, instituting parking pricing, and building wider streets. Included in the ten strategies was the concept to "develop and improve bike and pedestrian paths". Of the 10 choices, bike and pedestrian paths ranked the 4th highest, indicating a moderate level of support for bicycle facilities in Provo.

2.9.3 Transportation Demand Management (TDM) Strategies

The MTP outlines various TDM strategies to maximize transportation efficiency in Provo and decrease single occupant vehicle use. The Provo TDM policy strategies include:

- Provo City will encourage TDM measures, such as a student shuttle system, van and car pools, alternative work hours, transit service improvements, and the construction of pedestrian and bicycle facilities and amenities.

The MTP identifies four different classes of bike facilities in Provo:

- Class I routes – completely separate (from roads) rights-of-way designated for exclusive use of bicycles (often referred to as a bike path or bike trail).
- Class II routes – paths that are part of the street right-of-way but are separated by a physical barrier such as a guardrail or landscaped median (commonly known as a cycle track or protected bike lane).
- Class III routes – paths designated by a painted stripe or curb within the street right of way (commonly known as bicycle lanes).
- Class IV routes – have no lane designation with bicyclists using the outside portion of the lane or shoulder (commonly known as bike routes).

The MTP includes a few examples of TDM measures that promote bicycling:

- Bike lockers and changing facilities/showers
- Secure bike parking near entrances to work

2.9.4 Traffic Calming

Provo City is committed to improving the quality of life in residential neighborhoods by calming traffic. The City will use measures such as bulb-outs and roundabouts to calm traffic and discourage cut-through traffic. When implemented with a bicycle network in mind, traffic calming measures can be critical building blocks of residential bicycle routes and can provide a more comfortable riding environment for less confident bicyclists. A grid pattern street system such as Provo's is advantageous for bicyclists because it distributes traffic to a variety of streets rather than just a handful of collectors and arterials. Grid networks also provide multiple alternatives from which to choose when implementing bikeways.

The MTP promotes the adoption of a residential traffic calming goal that would:

- Promote safe and pleasant conditions for residents, motorists, bicyclists, pedestrians, and transit riders on residential streets
- Promote and support the use of transportation alternatives to the single occupant vehicle

These goals and others clearly support the development of a complete bikeway system, utilizing off-street and on-street facilities. In addition to existing streets and development the MTP also calls for traffic calming treatments to be included in new residential developments.

2.10 Provo-Orem BRT Plans

The Provo-Orem Bus Rapid Transit (BRT) System is a joint project of UDOT, UTA, and MAG. This project will link the two communities with a BRT line that aims to decrease single occupancy vehicle use and congestion, increase the convenience of travel between Provo and Orem, and improve overall traffic flow in the region. According to planning documents, the BRT system hopes to improve accessibility for bicyclists across I-15 and identifies several components to be developed as a part of the BRT implementation. These components are described in the subsections below.

« Provo's Master Transportation Plan contains various elements related to bicycling

2.10.1 800 South Interchange and Access to UVU

A bike lane is planned for the interchange at 800 South, which would provide improved access between eastern and western neighborhoods as well as improve cyclist safety by providing an alternative to crossing I-15 on University Parkway.

2.10.2 BRT Vehicles

All UTA buses currently include exterior bicycle racks on the front of the vehicles. As part of the proposed project, UTA plans to explore the feasibility of including bicycle storage areas within BRT vehicles, which would reduce boarding and alighting times. This would help improve mobility within the project study area by providing more convenient multi-modal transportation options.

2.10.3 Street Modification

Some of the existing bicycle facilities will be adjusted to accommodate the construction of the BRT project. Affected bicycle facilities will be relocated by the BRT Project onto adjacent streets. The Environmental Assessment for the BRT line lists two impacts to existing and planned bicycle facilities:

700 North Bike Lane

The existing 8-foot bike lane along 700 North would be reduced to 4 feet.

900 East Bike Route

If an exclusive BRT lane is constructed on 900 East in the future, the existing 2-foot shoulder will need to be removed. Therefore, no additional space would be available for a bike lane.

2.11 Provo City Vision 2030

In March 2010, Provo City formed a 10-member steering committee responsible for providing guidance on what the City should be like by the year 2030. The purpose of this process and document is to provide long-term direction to municipal decision-making. Section 12 of this document provides direction on Transportation and Mobility.

The Transportation and Mobility section contains the following goals that relate to the advancement of bicycling as a more substantial travel choice:

- Goal 1: Promote the use of transit and alternative modes of transportation.
- Goal 2: Augment the multi-modal transportation opportunities in Provo.
- Goal 3: Modify current street standards to promote flexible street widths in residential areas.
- Goal 5: Promote easier navigation with appropriate signage throughout the city.

2.12 Proposed Improvements to City Bicycle Network

BYU students in conjunction with a consulting firm analyzed several recommendations for new bikeway facilities that have been proposed in the past by the Provo Bicycle Committee. This analysis included the extents, benefits, and physical conditions of the proposed bicycle network. The findings of this report focus on rider experience and usefulness of the overall route as a potentially implementable bikeway in the overall Provo City bike network. To gauge and qualify rider experience, two performance criteria were developed for the routes – connectivity and travel time. "Connectivity" refers to how well a particular bikeway would connect to the rest of the bikeway network and important community destinations. Potential routes included multiple north-south corridors and one east-west corridor.

North-South Corridors

- Freedom Blvd
- 100 West
- University Avenue
- 700 East
- 900 East

East-West Corridor

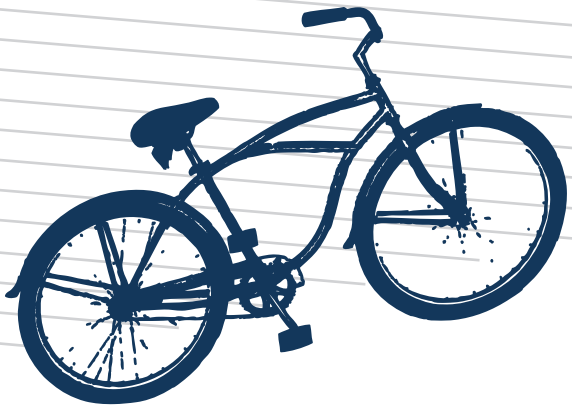
- 500 North

The study examined proposed routes for travel time and connectivity in relation to major trip generating destinations within Provo. These destinations included:

- University Parkway
- Downtown portions of Center Street
- Future Intermodal Transit Station
- BYU Campus
- Provo Recreation Center

Findings of this report conclude that there are three ideal bike routes in various parts of the city:

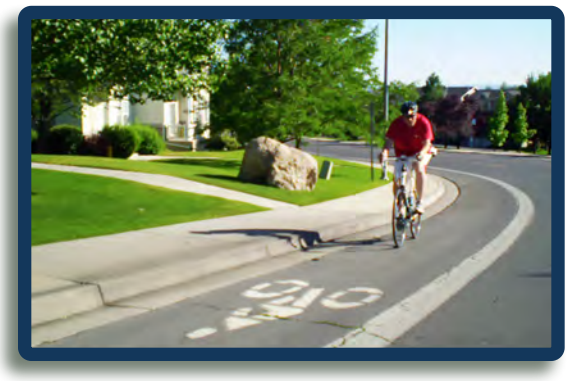
1. University Avenue
    a. Add bike lanes north of 700 North as soon as possible
    b. Add bike lanes south of 700 North in conjunction with BRT construction
        i. Possibly develop Freedom Boulevard as an alternative to the southern section of University Avenue
2. 700 East
    a. Add bike lanes in conjunction with road reconstruction
3. 500 North
    a. Add bike lanes between 500 West and 700 East



3 Summary of Existing Conditions

The backbones of Provo's off-street bicycle network are the Provo River Parkway and the College Connector Trail. Over the past decade, Provo has also been steadily growing its on-street bikeway network. This has been accomplished primarily by installing new bike lanes in conjunction with road surfacing projects and new construction. This chapter summarizes Provo's current bicycle infrastructure and is divided into the following sections:

- Setting
- Existing Bicycle Facilities
- Bicycle Crash Analysis
- Transit Connections
- Opportunities
- Constraints



« Bike lanes such as this one on Seven Peaks Blvd are an important part of Provo's existing bikeway network

3.1 Setting

Provo is the third largest city in Utah and is located approximately 40 miles south of Salt Lake City. It is located at the base of the Wasatch Mountains in Utah County, bordered by Orem to the north, Springville to the south, Utah Lake to the west, and Uinta-Wasatch-Cache National Forest to the east. Provo has a total area of 41.8 square miles with a mixed topography that supports bicycling.

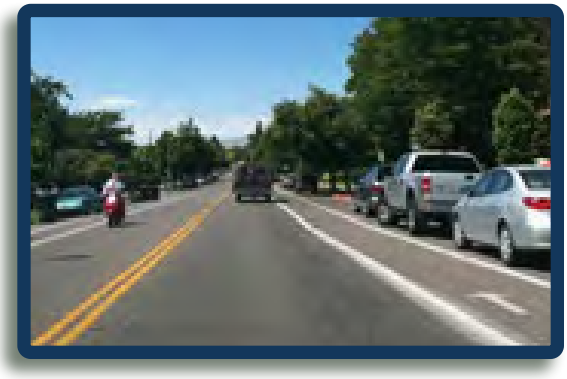
According to the 2010 census, Provo's population is approximately 112,000 people. Provo is the seat of Utah County and the principal city of the Provo-Orem metropolitan area. Utah County has a population topping 519,000 people. The median age in Provo is 24.8 and 21.3% of the population is under the age of 18.

Provo's population is largely influenced by two major universities. Brigham Young University is one of the largest private universities in the United States with an active daytime student enrollment near 33,000 in 2011. Nearby Orem hosts Utah Valley University and its more than 28,000 students. BYU and UVU account for a significant percent of the area's population. They combine for at least 61,000 students and an additional 20,000 faculty and staff.

Several leading software and technology companies are located in the Provo/Orem area including Novell, Symantec, Adobe, Corel, Micron Technology, Ameritech Library Services, and Convergys. Significant employment in Provo is also provided by Nestle Frozen Foods, NuSkin Enterprises, and Intermountain Healthcare.

The Utah Valley Convention Center is a 21,000 sq. ft. exhibition hall and 18,000 sq. ft. ballroom that opened in 2012 in downtown Provo. The center hosts NuSkin's annual convention and other large-scale events that bring temporary population influx to downtown.

Provo contains a variety of land uses with several main streets serving as the major commercial/industrial corridors. Like many of Utah's communities, Provo's street system was built upon the common grid. As such, it provides various parallel routes for bicyclists and motorists. The majority of Provo's land is developed, with limited room for new development east of I-15. Much of the future development and growth will likely be urban in-fill and redevelopment. Because



» The 800 North bike lanes connect western Provo with the BYU campus area

Provo is relatively built out and constrained by natural boundaries to the west and east, it does not face the ever-expanding boundaries and increased commuting distances between residential and commercial developments that other growing communities are grappling with. The challenge lies instead with providing a balanced transportation network that meets the needs of all residents and connects their homes to where they want to travel.

The topography and built environment in Provo generally support bicycling. Most of Provo is relatively flat with gentle increases in elevation approaching the BYU campus and more significant elevation increases in the foothill areas along the east edge of the city. The existing conditions in Provo provide a solid foundation on which to build future on-street bikeways.

3.2 Existing Bicycle Facilities

Provo's existing bicycle network consists of shared-use paths, sidepaths, and bike lanes. Figures 3-1 through 3-3 graphically depict these bikeway types. Table 3-1 summarizes Provo's existing bikeway mileage based on facility type. Figure 3-4 displays these facilities on a map. There are many miles of unpaved trails (primarily in the foothills) but those are not shown on the map because this master plan focuses on the urban area of Provo and its transportation-oriented bikeway system.

Table 3-1: Existing Bikeways

Facility Type	Mileage
Shared-Use Path	12.4
Sidepath	3.4
Bike Lane	21.5

« The Provo River Parkway Trail (pictured above along University Avenue) is the City's preeminent example of a shared-use path

Figure 3-1: Shared-Use Path

Figure 3-2: Sidepath

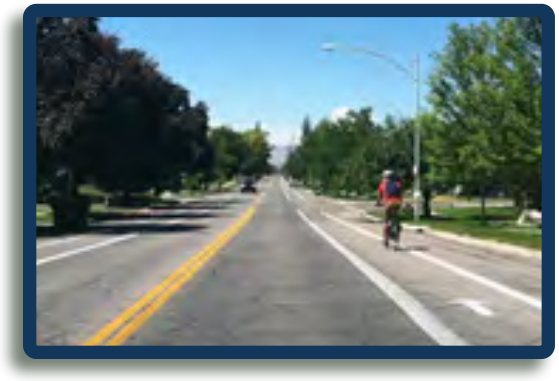
Figure 3-3: Bike Lane

3.2.1 Shared-Use Paths

Shared-use paths are paved facilities separated from motor vehicles. They provide space for bicyclists, pedestrians, and other non-motorized forms of transportation. Shared-use paths are typically located in rights-of-way (such as canals, streams, and utility corridors) that are independent of roads.

The Provo River Parkway is the main example of shared-use paths in Provo. It is a 15-mile paved facility between Vivian Park in Provo Canyon and Utah Lake. The trail varies in width from 8 to 16 feet wide. Most of the trail follows the Provo River with grade-separated crossings of major roads. However, a few sections – principally along University Avenue between 2230 North and 3700 North – are adjacent to surface streets and are classified as sidepaths (see Section 3.2.2). The Provo

» The College Connector Trail provides a link between the BYU campus, shopping areas, and student housing



« The 700 North bike lanes connect the eastern bench of Provo to University Avenue

River Parkway is relatively flat. This topography makes the trail popular with families since small children can ride the trail. There are 10 trailheads along the Provo portion of the parkway.

3.2.2 Sidepaths

Sidepaths are similar to shared-use paths but have a few key traits that make them different. Sidepaths are located within or immediately adjacent to roadways. They typically cross more streets at-grade and have more driveway and intersection crossings than shared-use paths. Caution must be exercised when planning and building sidepaths because they may encourage people to ride bicycles at moderate-to-high speeds through driveways and intersections where drivers are not expecting to encounter them.

The College Connector is the longest and most visible sidepath in Provo. It was developed to link Brigham Young University to Utah Valley University in Orem. This path, in combination with other bike lanes and shared-use path segments, also connects Provo's Rock Canyon to Orem's Lake Park. Some long stretches of this path are free of driveway and intersection crossings, which allows it to function more like a shared-use path at times.

3.2.3 Bike Lanes

A bike lane is a portion of the roadway designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists. Bike lanes create a visual separation between bicycle and automobile facilities, thereby increasing bicyclists' comfort and confidence. Bike lanes are typically used on major through streets with average daily traffic (ADT) counts of 3,000 or higher and should be one-way facilities (on each side of the streets) that carry bicycle traffic in the same direction as motor vehicle traffic.

Provo City has many miles of marked bike lanes. Generally, they are placed adjacent to parking lanes. Where parking is not highly utilized many bicyclists may ride in the parking lane to achieve a greater separation from vehicle traffic. Provo has some bike lanes with rumble strips incorporated into the wide outside stripe. This practice is typically only found on higher speed rural highways in most of the nation and could be hazardous to urban bicyclists particularly where they are placed on curves.

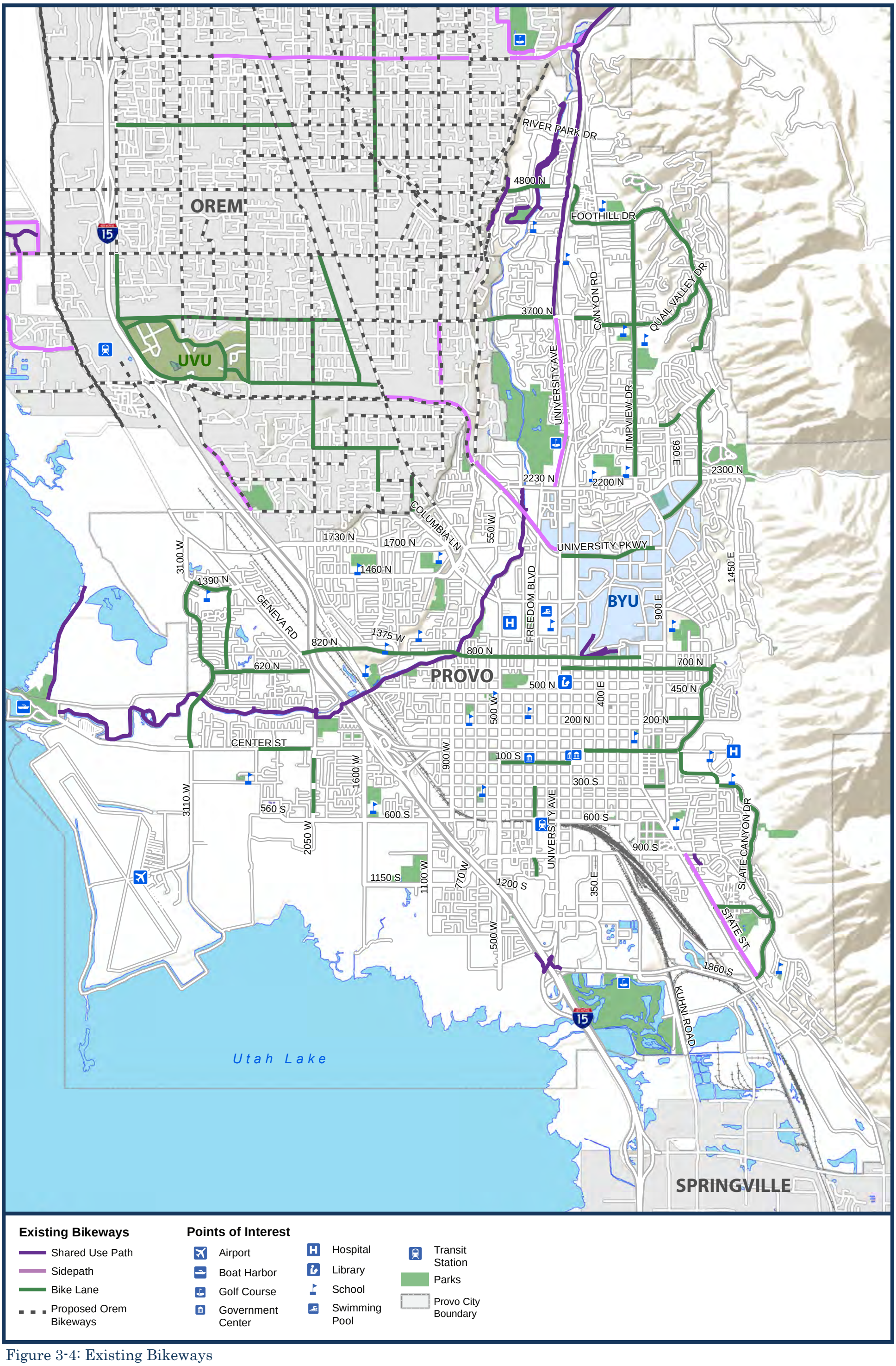


Figure 3-4: Existing Bikeways

3.3 Bicycle Crash Analysis

Bicycle crash statistics for the 2008-2011 period were obtained from the Provo Police Department to analyze trends and highlight areas that exhibit high numbers of bicycle-related crashes. Figure 3-5 shows the results for the central part of the City where most crashes occur. The size of the circles and the numbers inside them correspond to numbers of crashes at specific locations.

The following trends are evident from looking at the crash map:

- A large majority of crashes occur at or near intersections.
- Areas around the perimeter of BYU (particularly on the west side of campus) experience the most crashes.
- The University Avenue and Bulldog Boulevard corridors are particularly noticeable hotspots for bicycle crashes.
- Aside from the BYU campus perimeter, the other noticeable hotspot is 2230 North between Freedom Boulevard and University Avenue.

Care should be taken with drawing definitive conclusions about crash causation based on this cursory analysis. However, the data do highlight locations in the City that merit a closer look for possible improvements. The following traits are common among the hotspot corridors:

- They are locations where significant bicycle demand exists.
  - In the case of University Avenue and Bulldog Boulevard, they are funnels for students traveling to and from BYU and Provo High School.
  - The 2230 North hotspot is a short missing link in the Provo River Parkway system where trail users must ride on a narrow sidewalk right next to traffic in order to transition from the northern part of the parkway to the southern part.
- They are locations without designated bikeway accommodations, which may lead to situations where people on bicycles behave in unpredictable ways.

It should be noted that bicycle-related crashes are routinely underreported, particularly those that did not require police or emergency personnel to respond to the scene of the crash. Nevertheless, there are enough data points from documented crashes to paint a broad picture of locations in Provo where bicyclist safety is a concern.

3.4 Transit Connections

Provo City's transit service is provided by UTA. Existing services include standard bus routes and FrontRunner commuter rail. BRT is being planned for the future. Route maps and timetables for all UTA services can be found at www.rideuta.com.

3.4.1 Bus Service

Provo City's transit service is provided by UTA. UTA has 12 bus routes that serve Provo, connecting to various parts of the Provo-Salt Lake region. Most bus service intervals range between 30-

60 minutes, but the local Utah Valley-TRAX Connector (Route 811) and Provo-Orem Shuttle (Route 830) run every 15 minutes for large parts of the day. Many of the routes connect to Provo's FrontRunner station. Bicycle racks that accommodate two bicycles are available on all UTA routes aside from Ski Service and Paratransit service routes.

3.4.2 Bus Rapid Transit

UTA will also be implementing a BRT line between Provo and Orem serving the Provo and Orem FrontRunner stations, downtown Provo, BYU, and UVU. The BRT line has the potential to change the way the overall transportation network functions between Provo and Orem. Figure 3-6 shows the proposed BRT route and station locations. There are 13 planned BRT stations within Provo City's limits. Once the BRT line is operational, buses will likely run every 5 minutes.

3.4.3 FrontRunner Commuter Rail

FrontRunner is a commuter (heavy rail) train operated by UTA. This service presently operates between Pleasant View (north of Ogden) and Provo with future extensions south of Provo possible. Travel time between Provo and Salt Lake City is approximately one hour. Initial ridership projections for the Provo-Salt Lake City portion of FrontRunner (which opened in December 2012) were estimated at 7,500 people per day.

The Provo FrontRunner station is located at approximately 650 South between Freedom Boulevard and University Avenue. This station will likely be an epicenter of new bicycle traffic in Provo. Commuter rail facilities are complemented by bicycle facilities because they allow people to extend the reach of their non-motorized trips over longer distances. FrontRunner trains have room for 12 bicycles in a designated bicycle car as well as additional space in the normal passenger cars. Convenient bicycle access to the Provo FrontRunner station will be an important component of Provo's bicycling future.

« FrontRunner began service from Provo to Pleasant View (north of Ogden) in December 2012

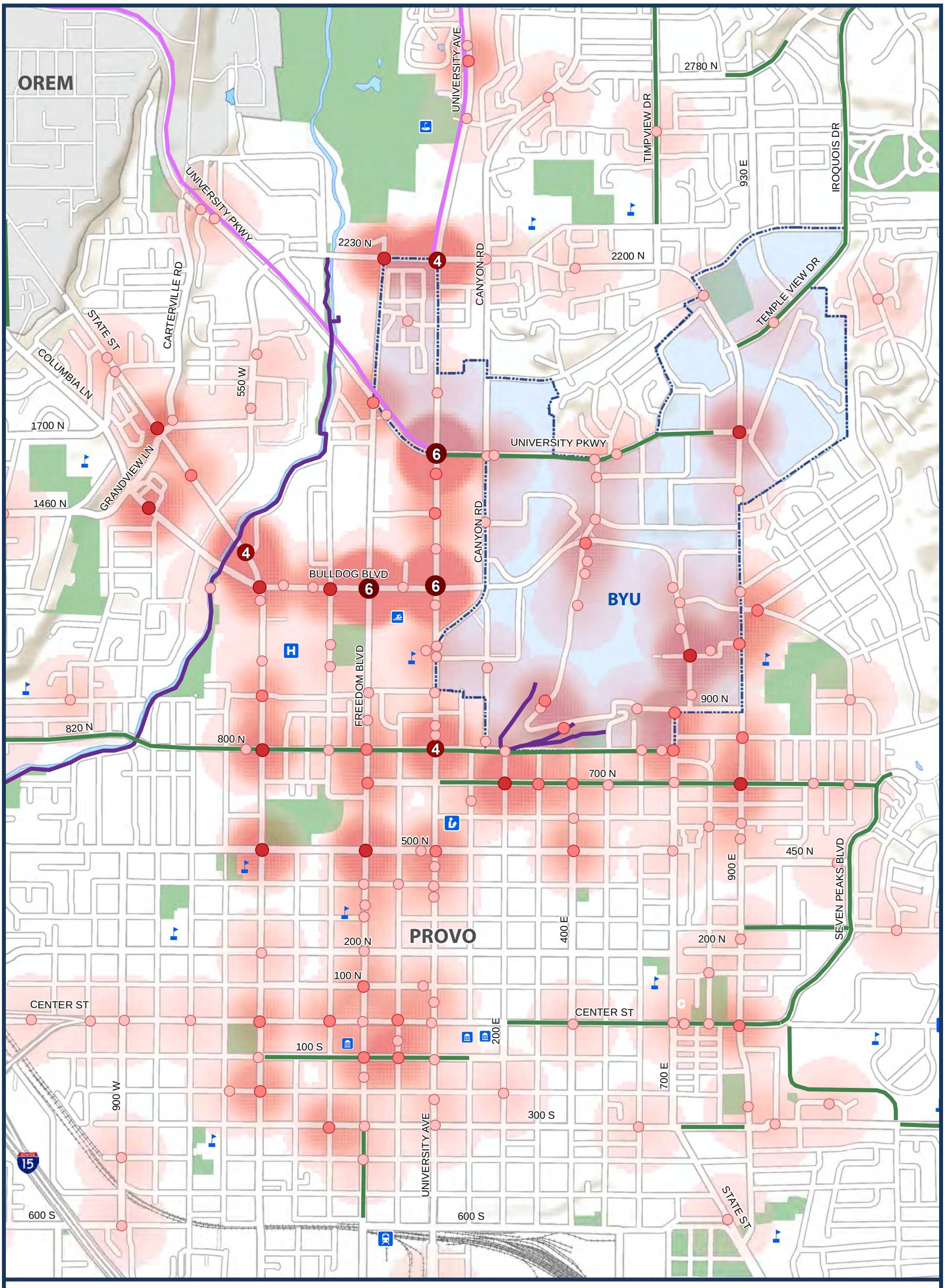


Figure 3-5: Bicycle Crash Analysis

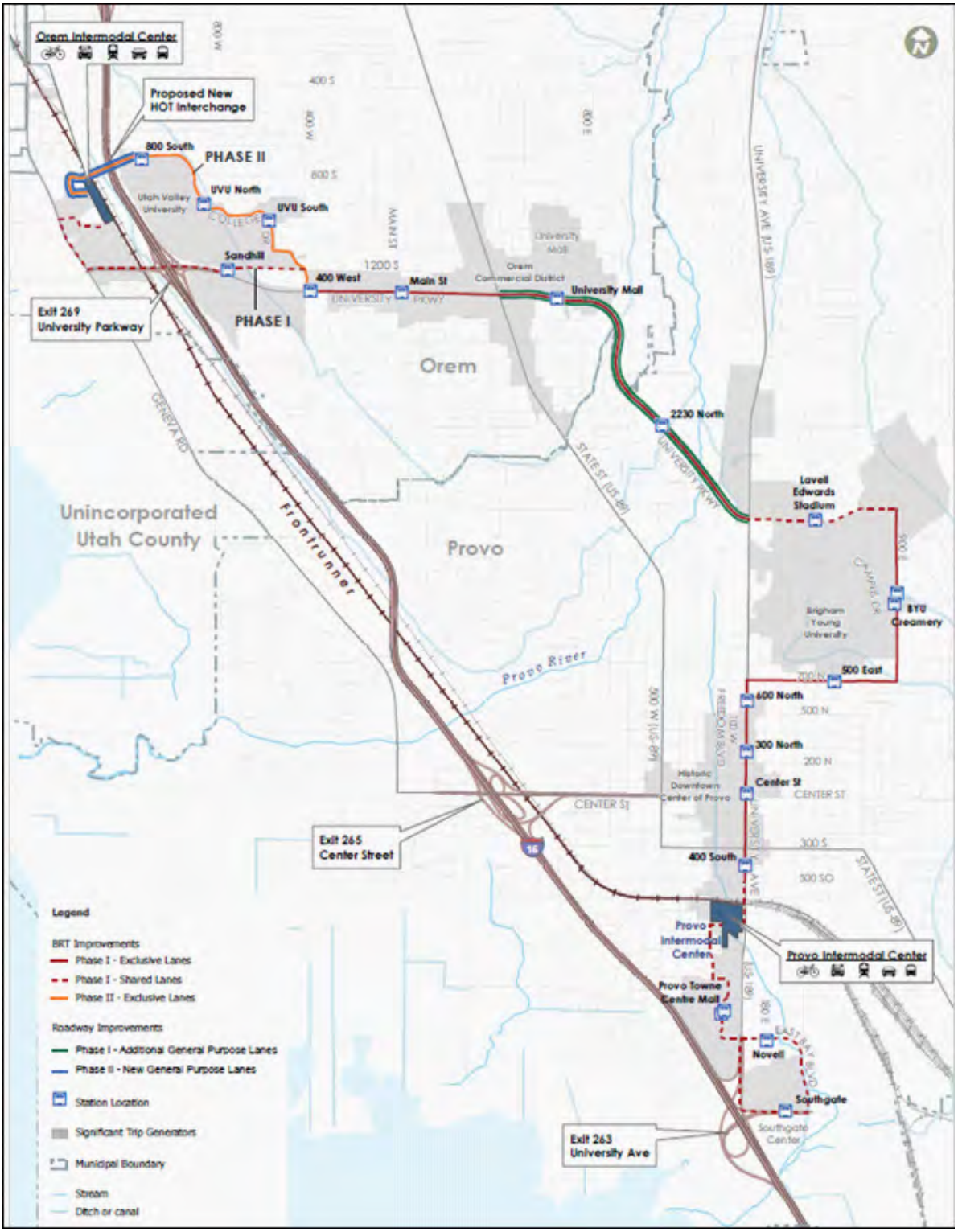


Figure 3-6: Proposed BRT Route Map

3.5 Opportunities

3.5.1 2010 General Plan Proposed Network

In 2010 the Provo Bicycle Committee helped move forward a new bicycle facilities plan that is now included in Provo's General Plan. The plan aims for the City to reach gold-level Bicycle Friendly Community status and to quadruple the inventory of on-street bike lanes from approximately 21 to nearly 80 miles. Facility recommendations include shared-use paths, sidepaths, and bike lanes. Table 3-2 lists the mileage of the proposed bikeways in these three categories.

Table 3-2: General Plan Proposed Bicycle Network Mileage

Bikeway Type	Mileage
Shared-Use Paths & Sidepaths	73
Bike Lanes	59

These proposed facilities were carefully considered during the master plan process to determine their feasibility, quality, and whether or not they should remain as recommended facilities in the Provo City Bicycle Master Plan.

3.5.2 Roads

Roadways in Provo City are classified by street sections as outlined in the Master Transportation Plan. Street sections provide basic parameters on street layout, including direction on width for lanes, medians, sidewalks, planters, curb, and gutter. The current street sections for Provo City include layouts for the following types of streets:

- 120' section
- 84' section
- 72' section (4-lane with median)
- 72' section (4-lane, wide outside lane, no median)
- 3-lane collector street
- Local Street (38' ROW)
- Local Street (32' ROW)

These street designations correspond with target ADTs. At present the street sections do not have standard designations for streets with bike lanes, shared lane markings, or shared roadways although bike lanes are currently found on many streets. Under current design standards some of the existing street sections could include on-street bicycle facilities with slight reallocations of road space. Examining on-street bikeway feasibility was an integral part of the Provo Bicycle Master Plan.

3.5.3 On-Street Parking

The allocation of vehicle parking on the public right-of-way can play a significant role in the provision and condition of on-street bikeways. In some instances, on-street parking may be hazardous to bicyclists depending on the design and parking turnover rate. In other instances, it may be determined that on-street parking is under-utilized and could be removed in order to provide bicycle facilities. Sometimes parking can actually be beneficial to bicyclists by helping to slow vehicles speeds.

Provo has varying types and designs of on-street parking. In residential areas, on-street parking is often parallel to the curb and unmarked. On higher volume local streets and collectors, on-street parking can be designated by a white stripe. On some streets on-street parallel parking may present a hazard to bicyclists who ride too close to doors of parked cars. "Dooring" occurs when a driver opens a parked car door into the path of a bicyclist, resulting in a crash.

Bicyclists can avoid being doored by riding outside of the door zone. This can sometimes be difficult on roads with narrow lanes that do not provide adequate room for a car to pass a bicyclist safely. It can also be daunting for less-confident or experienced bicyclists to ride a safe distance from parked cars.

Another form of on-street parking found in Provo City is diagonal parking. Diagonal parking is common in commercial areas (e.g. Center Street) due to its ease of use when entering and exiting. While dooring is not a potential hazard with diagonal parking, this type of parking does present other hazards to bicyclists. Traditional "front-in" angled parking results in difficulty for drivers to see oncoming bicyclists while reversing. The limited rear-view perspective can result in collisions when bicyclists and motorists are not cautious in these areas. Many cities are now using "back-in" angled parking, which provides improved visibility for drivers, curb-side loading of the vehicle's trunk, and easier maneuvering relative to parallel parking.

3.5.4 Expansion of Shared-Use Path Network

Provo's shared-use paths are a significant amenity to bicyclists. These paths are highly desired because they provide separation from motor vehicle traffic, making them a more comfortable place to ride for many bicyclists. Shared-use paths also provide a superior riding experience for longer trips because they frequently have grade-separated crossings that allow bicyclists and other path users to travel with minimal delays or influence by vehicular traffic on the surrounding road network.

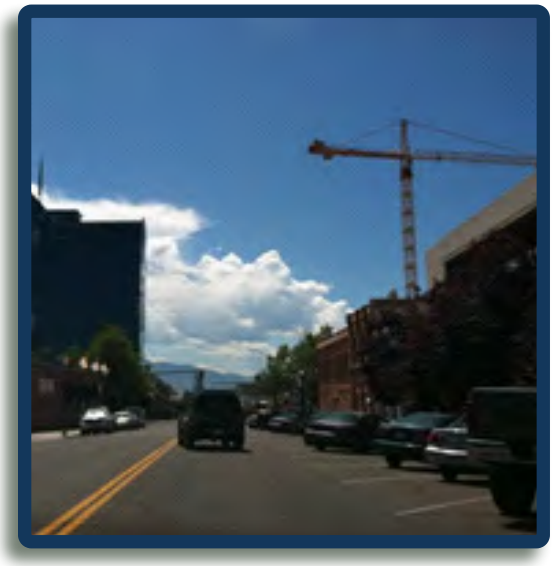
Opportunities to expand existing trails or develop new trails can be limited, especially for cities like Provo where there is limited land available for new development. Despite these limitations, there are opportunities for the expansion of shared-use paths in Provo and the improvement of existing pathways. Potential opportunities include shared-use paths along the Union Pacific rail line that runs parallel with I-15.

Adding bicycle facilities to active rail corridors is often referred to as "Rails with Trails" (RWT). RWT describes any shared-use path or trail located in or directly adjacent to an active railroad corridor. There are over 60 RWTs presently active in the United States totaling more than 240 miles in 30 states. RWTs are located adjacent to active rail lines ranging from a few slow-moving short-haul freight trains weekly to high-frequency passenger trains traveling as fast as 140 mph. In addition to the existing paths, dozens of additional RWTs are proposed or planned. While most are located on public lands leased to private railroads, many are on privately-owned railroad property. A local example of a trail that was developed within a historic rail right-of-way is the Provo River Parkway in Provo Canyon. In cases where a rail corridor is no longer active, these corridors can be converted into a shared-use path.

Another opportunity for expanding the shared-use path network is the shoreline area of Utah Lake. Lakes, rivers, and other bodies of water often make for natural places to travel by bike. These paths receive heavy use due to their scenic qualities as well as uninterrupted rights-of-way. At present, there is a paved shared-use path going north from Utah Lake State Park along the shore area for nearly a mile. Shared-use paths are also planned along the lake wetland areas as part of the Westside Connector and Northwest Connector projects, which would essentially trace the outside perimeter of the Utah Lake wetlands between the I-15/University Avenue interchange and Geneva Road in west Provo.

3.5.5 Canal Corridors

Canal corridors often make for good shared-use paths because they provide cut-through opportunities not offered by the roadway network and are almost always constructed along gentle grades. The canals in Provo offer north-south connection opportunities, which could provide



On-street diagonal parking on 100 West

On-street parallel parking on Freedom Boulevard (200 West) at approximately 800 South

» Bike racks are available on FrontRunner for passengers that want to bring a bicycle on board but do not want to stand with it during the ride

valuable additions to the city's off-street path network. Several of the canals run between Orem and Provo. If bikeways were developed along these canals, they could provide good bikeway connections between the communities. In many cases, however, there is little right-of-way next to the canals and pathway development would require piping of the canal with the path placed on top, which can be very expensive.

3.5.6 Transit

Bus Rapid Transit

The Provo-Orem BRT line will likely be operational within a few years. This project will provide residents of Provo-Orem with a frequent and fast transit option between and within the two communities. It has the potential to significantly improve traffic flow between Provo and Orem by providing a convenient alternative to cars. The BRT system will have multiple stations within Provo City, terminating at the Provo FrontRunner station. BRT buses will be equipped with front racks and BRT stations may also include bike racks for individuals who prefer to leave their bike at the station. The BRT will greatly increase the convenience of multi-modal commuting, making bicycling a more viable transportation option.

Frontrunner Station/Intermodal Hub

The recently-opened FrontRunner commuter rail line is a large benefit for bicyclists because it allows them to bring bikes on board and lengthen the effective distance that they are able to travel comfortably. Integrating bicycle storage accommodations (particularly long-term secure storage) into the Provo FrontRunner station would further enhance Provo's transit system utility for bicyclists.

Creating high-quality bikeways to connect the station with the rest of Provo is also important. This was a major focus of the route recommendations presented in Chapter 5.

3.5.7 Development

Provo has limited developable land. However, the City has an opportunity to ensure that bicycle facilities are included in the design of future roadways and reconstruction of existing streets. Land

redevelopment provides opportunities for implementing recommendations in this master plan. Building approvals provide an opportunity to incorporate the bike parking recommendations found in Chapter 6.

3.6 Constraints

This section discusses the types of barriers that Provo faces in its attempt to become more bicycle friendly.

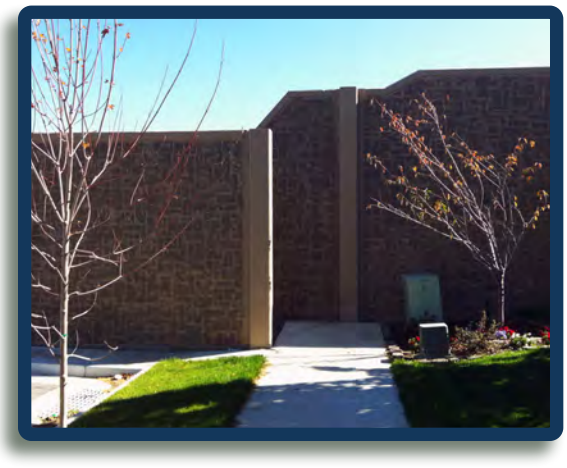
3.6.1 Physical Barriers

This type of barrier is identified as a physical impediment to travel, such as a freeway where crossings can only occur at interchanges and limited grade-separated locations. I-15 is the most obvious example of a physical barrier in Provo because there are only a few bike-friendly ways to cross it. The Provo River is also somewhat of a physical barrier, but crossing are much more plentiful compared to I-15.

3.6.2 Facility Barriers

Facility barriers are those that (through their design or physical constraints) restrict, prohibit, or discourage active use. Facility barriers can take many forms. Barriers can be gaps in a facility (where a bikeway ends suddenly), or actual facilities that do not provide optimal riding conditions. Bike lanes that provide little to no buffer between on-street parking place bicyclists in danger of being doored when a motorists opens a door into a bike lane. This situation could be classified as a facility barrier.

Lack of maintenance can also lead to unusable facilities or undesirable conditions. Shared-use paths and bike lanes frequently collect snow or road debris, making them hazardous to use.



« Limited-access highways such as this one are common physical barriers for people who walk and bicycle

3.6.3 Situational Barriers

This type of roadway occurs where roadway widths, travel speeds, or other roadway characteristics make bicycle travel difficult, uncomfortable, or unsafe regardless of the provision of bike lanes or wide shoulders. 900 East is a good example of a situational barrier in Provo.

3.6.4 Gaps

Gaps typically exist where physical or other constraints impede bikeway network development. Typical gap constraints include narrow bridges on existing roadways (such as the University Avenue viaduct) and large intersections where bike lanes are dropped on the approaches in order to accommodate turn lanes. Traffic mobility standards, economic development strategies, and other policy decisions may also lead to gaps in a bikeway network. For instance, a community's strong desire for on-street parking or increased vehicle capacity may hinder efforts to install continuous bike lanes along a major street. Figure 3-7 presents a theoretical diagram illustrating different kinds of bikeway gaps.

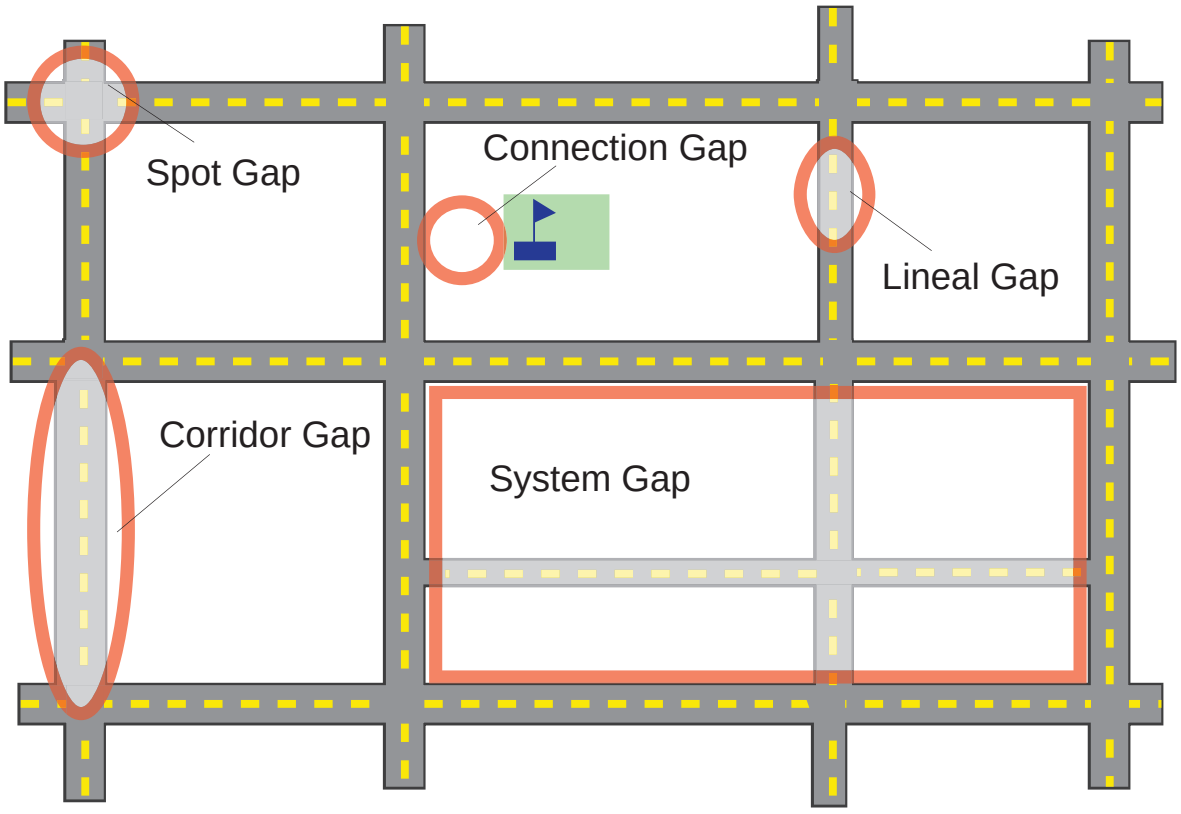


Figure 3-7: Bikeway Gap Types

Bikeway gaps are significant constraints in Provo. However, this also means that there is a tremendous opportunity to fix the gaps. Gaps exist in various forms ranging from short missing links on specific street or path corridors to larger geographic areas with few or no bicycle facilities at all. Gaps can then be organized based on length and other characteristics as described in the subsections that follow.

Spot gaps

Spot gaps refer to point-specific locations lacking dedicated bicycle facilities or other treatments to accommodate safe and comfortable bicycle travel. They primarily include intersections and other conflict areas posing challenges for people riding bicycles. Examples include bike lanes on a major street "dropping" to make way for right turn lanes at an intersection or a lack of intersection crossing treatments for bicyclists on a route or path as they approach a major street. Figure 3-8 shows an example of a spot gap. Another example is 4800 North between Edgewood Drive and University Avenue.

Figure 3-8: Spot Gap Example

Connection gaps

Connection gaps are missing segments (1/4 mile long or less) on a clearly defined and otherwise well-connected bikeway. Major barriers standing between bicycle destinations and clearly defined routes also represent connection gaps. Examples include:

- Bike lanes on a major street "dropping" for several blocks to make way for on-street parking
- A discontinuous off-street path
- A freeway standing between a major bicycle route and a school.

Figure 3-9 shows an example of a connection gap.

Figure 3-9: Connection Gap Example

Lineal gaps

Lineal gaps are similar to connection gaps but are longer – typically half-mile to one-mile long. Figure 3-10 shows an example of a lineal gap.

Figure 3-10: Lineal Gap Example

Corridor gaps

Corridor gaps are missing links longer than one mile. These gaps will sometimes encompass an entire street corridor where bicycle facilities are desired but do not currently exist. Figure 3-11 shows an examples of a corridor gap.

Figure 3-11: Corridor Gap Example

System gaps

Larger geographic areas (e.g. a neighborhood or business district) where few or no bikeways exist would be identified as system gaps. Figure 3-12 identifies one of the system gaps in the Provo City bikeway network.

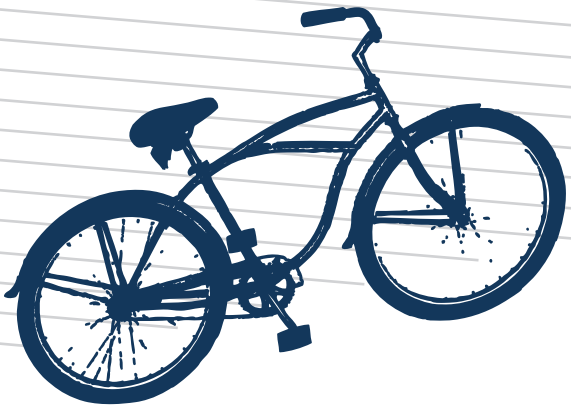
Figure 3-12: System Gap Example

3.6.5 Insufficient Road Widths

Along some Provo roads the existing width may not be sufficient to accommodate a bikeway in addition to the other desired uses of road space. This occurs in two distinct scenarios. The first is where the existing width is narrow, such as Carterville Road. The second situation occurs where roadways are wide but are currently striped to the curb with vehicle lanes or parking and the political willpower does not exist to remove either of those uses. In both cases, property acquisition either through sale or easement dedication may be needed to provide the necessary width for establishing a bikeway.

3.6.6 Snow Removal Practices

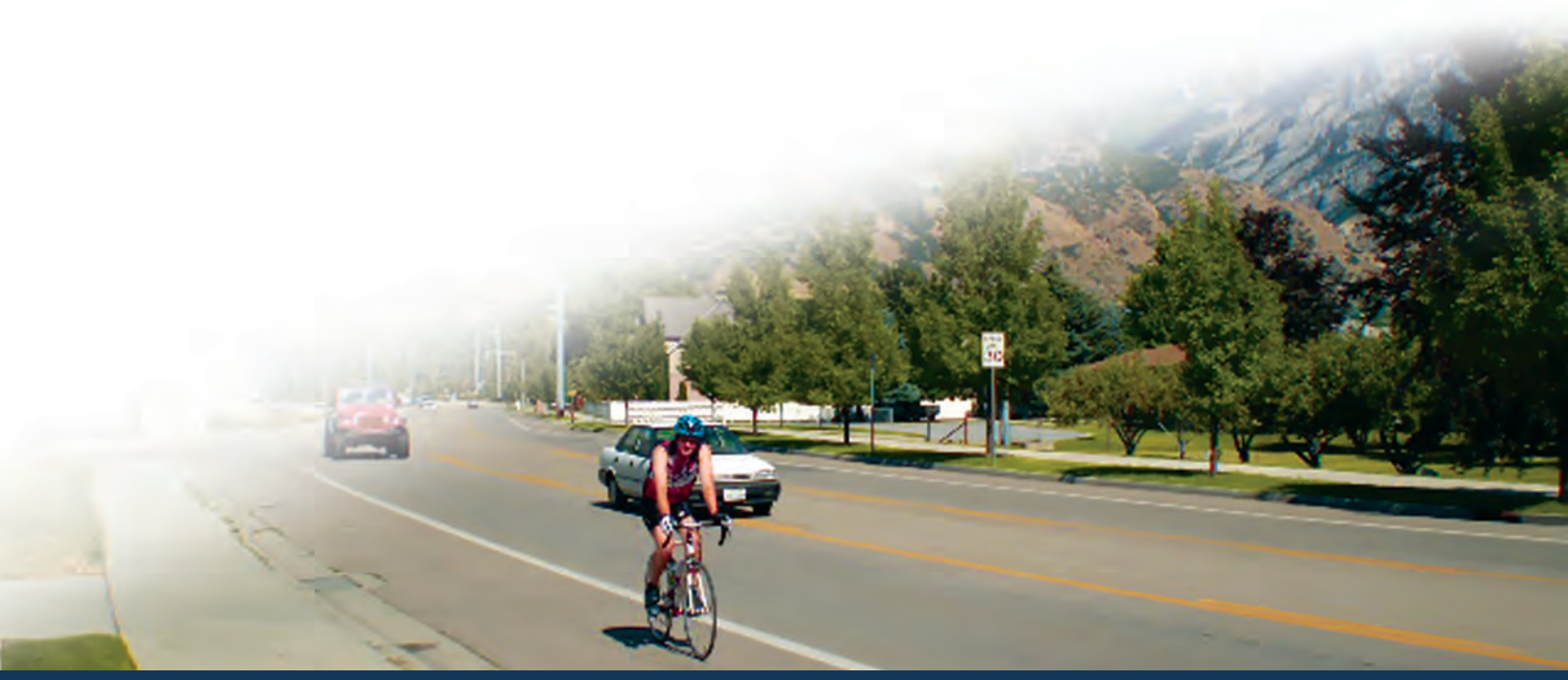
Winter brings colder temperatures and ice accumulation. Both of these factors can affect the decision to bicycle for transportation or recreation in the winter. While ice accumulation will always remain a barrier to bicycling, improved maintenance and enforcement practices can minimize the impact to those wishing to bicycle year-round in Provo.

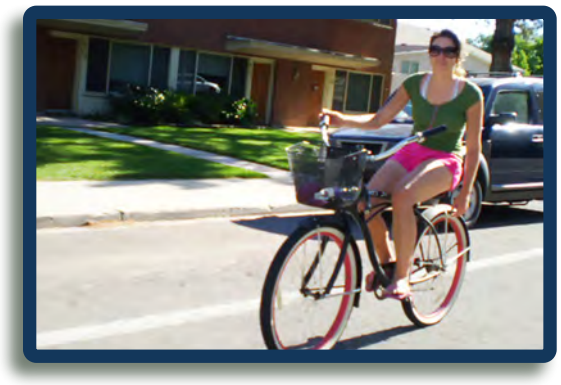


4 Needs Analysis

The information in this chapter summarizes the process used to solicit input from the public, work with a steering committee to guide development of the master plan, and develop a model to estimate the demand and benefits of bicycling in Provo. The chapter is organized into the following sections:

- Needs and Types of Bicyclists
- Steering Committee
- Public Workshops
- Project Website and Online Survey
- Boulder (CO) Bicycle Tour
- Demand and Benefits Analysis





« Different types of bicyclists have varying needs, expectations, and abilities

4.1 Needs & Types of Bicyclists

Similar to motor vehicles, bicyclists and their bicycles come in a variety of sizes and configurations. This variation ranges from the type of bicycle a bicyclist chooses to ride (e.g. a conventional bicycle, a recumbent bicycle, or a tricycle) to the behavioral characteristics and comfort level of the bicyclist. Bicyclists by nature are much more sensitive to poor facility design, construction, and maintenance than motor vehicle drivers. Bicyclists are more exposed to the elements and prone to physical injury due to the lack of protection of the bicycle compared to the automobile.

Bicyclist skill level also leads to a dramatic variance in expected speeds and behavior. Several systems of bicyclist classification are currently in use within the bicycle planning and engineering professions. These classifications can be helpful in understanding the characteristics and infrastructure preferences of different bicyclists. However, it should be noted that these classifications may change in type or proportion over time as infrastructure and culture evolve. Sometimes an instructional course can instantly change a less confident bicyclist to one that can comfortably and safely share the roadway with vehicular traffic. Bicycle infrastructure should be planned and designed to accommodate as many user types as possible with separate or parallel facilities considered to provide a comfortable experience for the greatest number of bicyclists.

The 1999 AASHTO Guide for the Development of Bicycle Facilities identifies bicyclists as being "Advanced or Experienced", "Basic or Less Confident" or "Children". These AASHTO classifications have been the standard for at least 15 years and have been found to be helpful when assessing people who currently bicycle. However, these classifications do not accurately describe all types of bicyclists, nor do they account for the population as a whole, especially potential bicyclists who are interested in riding but may not feel existing facilities are safe enough. Beginning in the Pacific Northwest in 2004, and then supported by data collected nationally after 2006, alternative categories have been developed to address the attitudes of Americans towards bicycling. Figure 4-1 illustrates the different viewpoints and their respective proportions.

» Different types of bicyclists have varying needs, expectations, and abilities

Figure 4-1: Bicyclist Types by Overall Population

Less than 2% of Americans comprise a group of bicyclists who are **"Strong & Fearless"**. These bicyclists typically ride anywhere on any roadway regardless of roadway conditions or weather. They can ride faster than other user groups, prefer direct routes and will typically choose roadway connections – even if shared with vehicles – over separate bicycle facilities such as bicycle paths.

"Enthused & Confident" bicyclists encompass 10-13% of people. They are mostly comfortable riding on all types of bicycle facilities, usually prefer low traffic streets or shared-use pathways when available, and may deviate from a more direct route in favor of a preferred facility type. This group includes all kinds of bicyclists including commuters, recreationalists, racers, and utilitarian bicyclists.

The third group can be categorized as **"Interested, but Concerned"**. They do not ride a bicycle regularly. 50-60% percent of the population falls into this category, which represents bicyclists who typically only ride on low traffic streets or bicycle paths under favorable conditions and weather. This group perceives traffic and safety as significant barriers that prevent them from bicycling more often. They may become more regular riders with encouragement, education, and experience.

The remainder of the American population – 20-30% – do not ride bicycles at all and perceive severe safety issues with riding in traffic. This group is classified as **"Not Interested".** Some people in this group may eventually give bicycling a second look and may progress to the user types above. However, a significant portion of them will never ride a bicycle under any circumstances.

University cities such as Provo offer a special environment that varies significantly in transportation modal trends from the rest of the nation and even the general population within the same city. Students, faculty, and staff on university campuses typically walk and bicycle in much higher numbers than their counterparts elsewhere. Individuals commuting to campuses choose alternative means of transportation for varying reasons – to save money, to avoid the hassle of parking, for convenience, and because it's more environmentally-friendly than driving alone.

4.2 Steering Committee

A steering committee with representation from a variety of city departments, other agencies, and citizens was formed to meet regularly, review draft documents, and generally guide development of the Provo Bicycle Master Plan. The committee met monthly during the course of the project. Table 4-1 lists the members of the steering committee along with the interests that they represented.

Table 4-1: Provo Bicycle Master Plan Steering Committee

Name	Agency/Department
Casey Serr	Provo City Engineering
David Graves	Provo City Engineering
Brian Torgersen	Provo City Engineering
Mark Crosby	Provo City Police Department
Dixon Holmes	Provo City Economic Development
Nathan Murray	Provo City Economic Development
Rob Nesbit	Provo City Streets
Doug Robins	Provo City Parks & Recreation
Phil Uhl	Provo City Information Systems
Brent Wilde	Provo City Community Development
Bill Peperone	Provo City Community Development
Sterling Beck	Provo City Council
Sam Ray	Provo School District
Ken Anson	Utah Transit Authority
Craig Hancock	UDOT Region 3
Evelyn Tuddenham	UDOT Central Bicycle & Pedestrian Office
Jim Price	Mountainland Association of Governments
Bob Ross	Brigham Young University
Zac Whitmore	Provo Bicycle Committee (citizen advocate)

4.3 Public Workshops

Two public workshops were held during the planning process. Comments from these public workshops served as the foundation for the plan and for revisions to the draft recommendations.

4.3.1 Workshop #1 – November 2011

An initial workshop was held on November 29, 2011 at the Provo City Library. There were 36 people in attendance. The open house provided opportunity for the public to ask questions, familiarize themselves with this master plan effort, review information pertaining to Provo and its existing bicycle facilities, and give input about the types of bicycling improvements they would like to see.

Interactive Presentation & Survey

A presentation and visual preference survey was conducted to gauge the bicycling behaviors and characteristics of those in attendance and also give live feedback about the types of bikeways attendees preferred. Participants were first asked a series of questions about what type of bicyclist they are, how often they ride, and factors that keep them from riding more. Results showed that those in attendance were generally more experienced cyclists, with 70% of participants rating themselves as "Enthused and Confident" or "Strong and Fearless" riders and almost half of them riding daily.

The visual preference survey aimed to educate participants about the different types of bicycle facilities and give them the opportunity to give live feedback about the bikeway types that they would most like to see implemented in Provo. People were shown images depicting various bikeway types and were then able to vote on how much they liked or disliked them. Results of the survey were displayed live on the screen immediately after each question was complete so that

» Open house participants took a visual preference survey and discussed city bicycling concerns with the project team

participants could see the overall preference of the group. People generally responded favorably to all types of the facilities described in the presentation, but liked bike lanes the most. Figure 4-2 summarizes some of the results obtained through the preference survey exercise.

Map Exercise

Several large maps were spread out on tables to show current designated bikeways. Participants were given markers and sticky notes to critique existing bicycle facilities, identify areas where improvements are needed, and make suggestions for new bikeways. This mapping exercise was very popular. Attendees contributed a wealth of information about preferred routes, barriers, and concerns.

Comment Cards

Open house participants were also invited to provide specific feedback regarding issues and suggest needed improvements on comment cards.

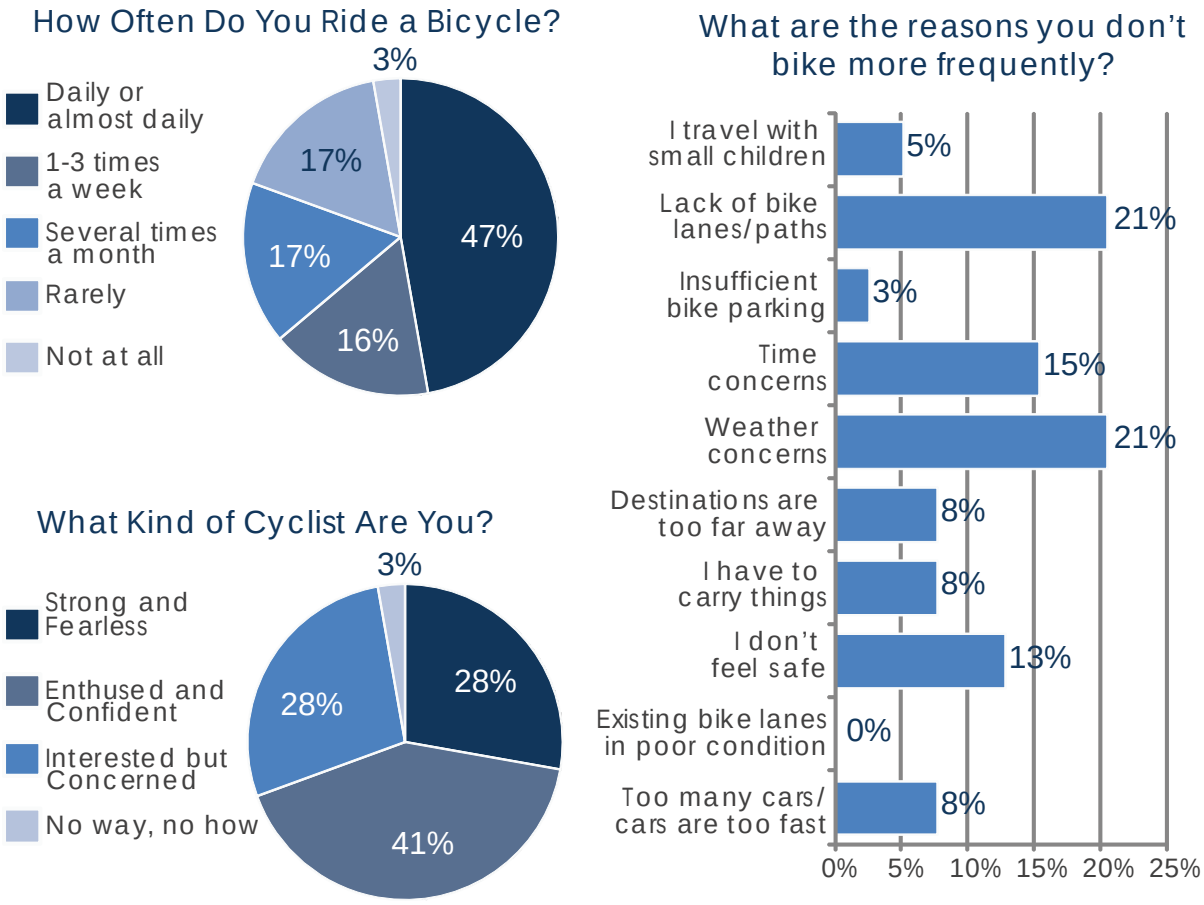
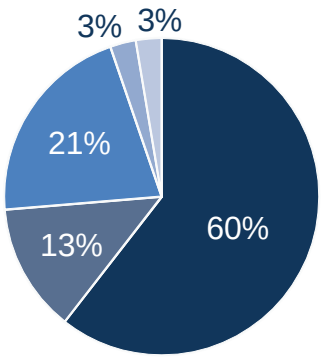


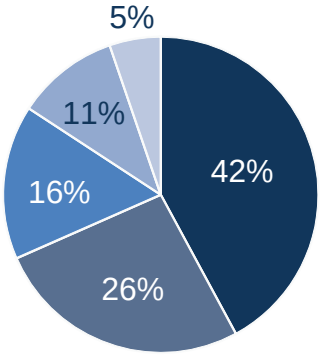
Figure 4-2: Visual Preference Survey Results

How do you feel about?:

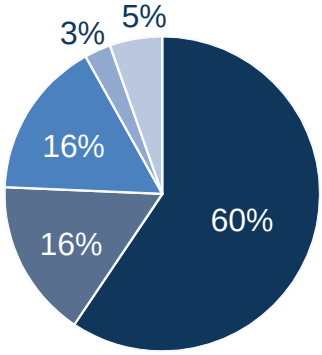
Shared-Use Paths



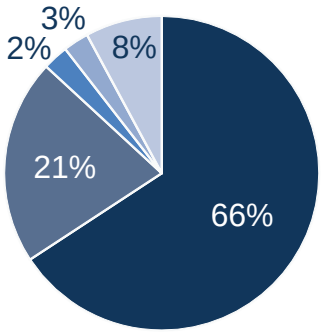
Sidepaths



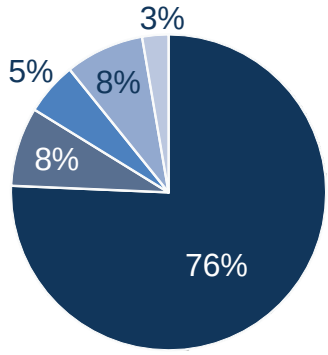
Cycle Tracks



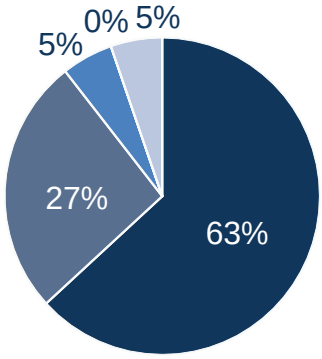
Buffered Bike Lanes



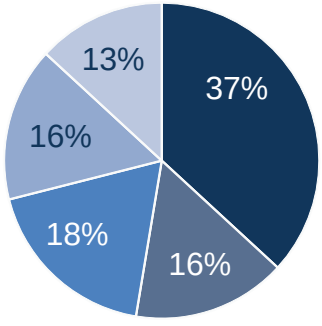
On-Street Bike Lanes



Bike Boulevards



Shared Roadways



Unpaved Trails

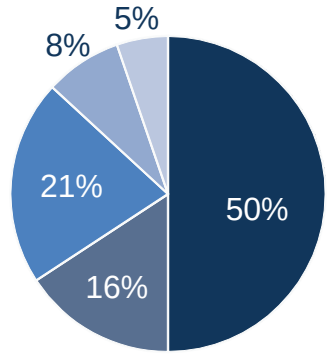


Figure 4-2: Visual Preference Survey Results (cont'd)

4.3.2 Workshop #2 – April 2012

A second workshop was held on April 10, 2012 at the Provo City Library. The purpose of this meeting was to give the public the opportunity to comment on maps showing the draft bikeway network and draft non-infrastructure program recommendations. A total of 39 people attended and provided their input via written comments on the maps and comment cards.

Map Exercise

As in the first workshop, a mapping exercise was conducted. Whereas the first workshop only displayed existing bikeways and invited attendees to make open-ended comments about what they'd like to see, the maps for this second workshop contained detailed recommendations for specific bikeway types on specific streets.

Participants gathered in groups to talk about their thoughts and provide comments about what they liked on the maps or would like to see altered. Sticky notes and pens were used to draw attention to specific areas on the maps where people liked a recommendation or wanted to express a desire for a modification.

Non-Infrastructure Programs

Boards were displayed describing possible non-infrastructure programs that could support bicycling in Provo. Attendees were given five dots each and asked to place them on the non-infrastructure program recommendations that they felt were most important.

Open house attendees wrote comments on large maps

Figure 4-3 shows the non-infrastructure program preferences demonstrated by those who voted. Staffing a bicycle coordinator position, creating a City bicycle map, and implementing a Complete Streets Policy ranked as the three top preferences.

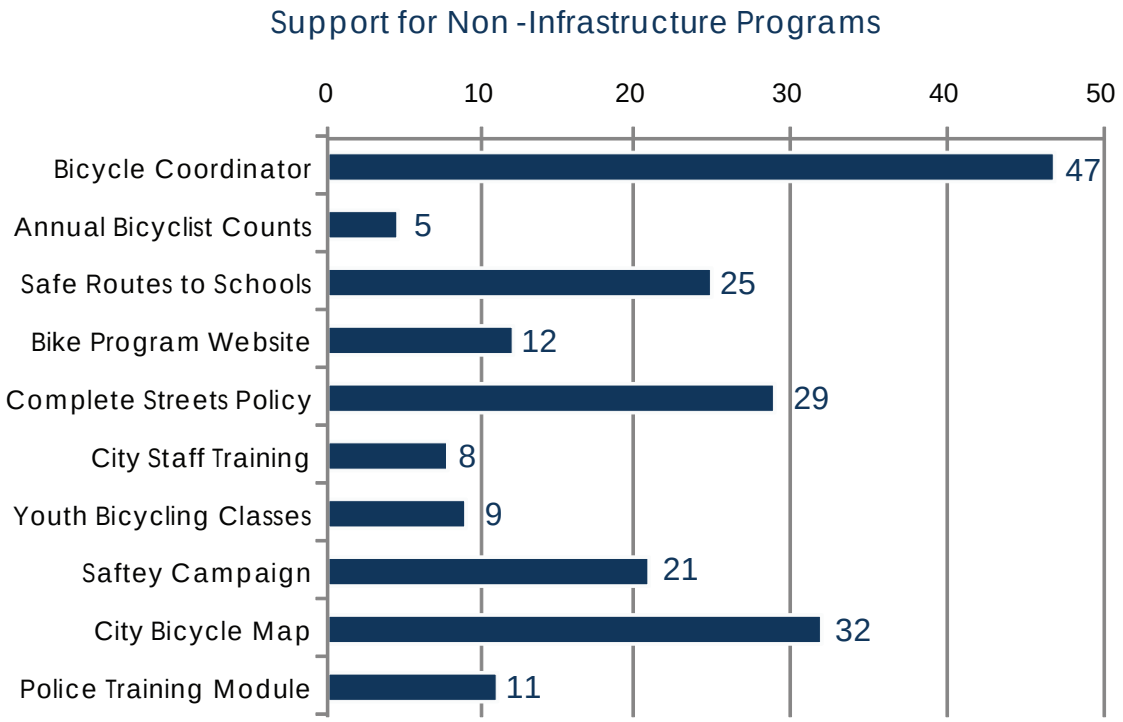


Figure 4-3: Support for Programs

» Participants ranked potential non-infrastructure programs using stickers to indicate the programs they feel would be most beneficial to Provo

4.4 Project Website & Online Survey

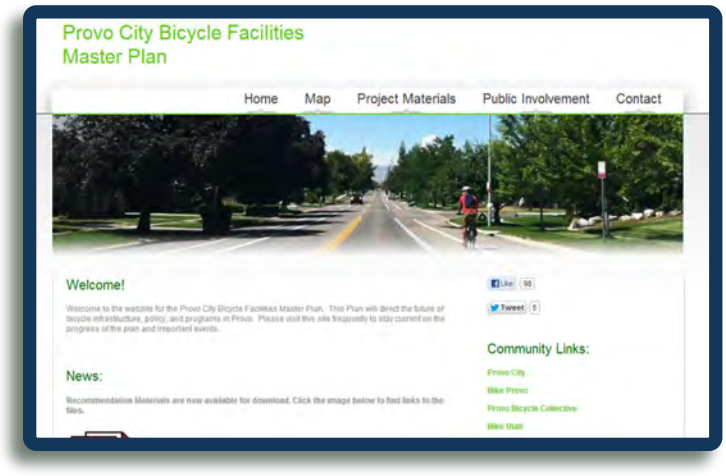
A project website (www.provobikeplan.com) was used throughout the master plan development process to announce open houses, display information, collect general comments, and conduct a detailed online survey. The online survey was offered between October 2011 and January 2012. The survey contained questions about personal characteristics and behaviors, bikeway type preferences, and demand for bikeways on specific roadways in Provo. In total, 558 responses were received. 18% of survey takers were under 25 years of age, 47% were between 26 and 44, and 32% were between 45 and 69. The gender split was 60% male and 40% female. Approximately 85% of survey takers were Provo residents.

Half of all respondents reported riding a bicycle once a week or more, while the other half's use was less frequent. When asked to specify reasons that they don't ride a bike (or don't ride more frequently), 56% of respondents specified that a lack of bikeways was a chief reason, while 46% indicated that too many cars and cars driving too fast were contributing factors. Other safety-related reasons were also frequently cited.

Survey respondents were then asked to rate the importance of bicycle facilities on specific roadways. University Avenue, 900 East, and 200 West (Freedom Boulevard) ranked as the top three most important roadways in Provo for bikeway facilities. Center Street, 500 West, State Street, Bulldog Boulevard, Canyon Road, 500 North, and Geneva Road also ranked high on the list.

The survey also asked respondents to pick their favorite bicycle destinations in and around Provo. The Provo River Parkway, BYU, and Utah Lake were the highest-rated destinations. Downtown Provo and the Provo City Library were also popular destination points.

A majority of survey respondents also said that the average distance of their bicycle trips is 5 miles or less, with recreation areas, workplaces, and neighborhood stores being the most popular destinations for riding a bicycle.



« The project website provided opportunities for public input, education, and master plan progress updates

The project website allowed visitors to submit open-ended comments to the project team about any topic that they wanted to convey. The comments covered a wide variety of topics and concerns. Table 4-2 groups the comments into general categories and shows how many comments were received for each one.

Table 4-2: Website Open-Ended Comment Summary

Accessibility	Number of Comments
lack of access/desire for additonal access	51
desire for improved bicycle facilities	50
desire for improved crossing	8
Safety	
concern for safety of exisitng conditions	22
desire for more public education	2
Convenience	
desire for more/improved bicycle parking	**10**
desire for improved roadway/bikeway maintneance	9
general support for bicycle plan	4

» Steering committee members and key elected officials ride on a cycle track during their tour of Boulder, CO

« Steering committee members and key elected officials participate in a bicycle tour of Boulder, CO

4.5 Boulder (CO) Bicycle Tour

On May 21, 2012 the steering committee and other key stakeholders flew to Colorado to participate in a bicycling tour of Boulder. The purpose of the tour was to give stakeholders a first-hand look at a community that has been working for many years to implement the types of bikeways and programs recommended within the Provo Bicycle Master Plan. Many of the elected officials that would need to support adoption of this master plan and the City staff members who would ultimately be responsible for its implementation attended the tour. A representative from Boulder's transportation planning division guided and narrated the three-hour bicycle tour. Table 4-3 lists the people who participated in this trip.

Table 4-3: Boulder Tour Participants

Name	Department/Agency
Greg Beckstrom	Public Works
Laura Cabanilla	City Council
John Curtis	Mayor
David Graves	Engineering
Craig Hancock	UDOT Region 3
Spencer Hawkes	Provo Bicycle Committee
Don Jarvis	Mayor's Sustainability Advisor
Gary McGinn	Community Development
Hal Miller	City Council
Nathan Murray	Economic Development
Doug Robins	Parks & Recreation
Casey Serr	Engineering
Matt Taylor	City Council (Admin Support)
Brian Torgerson	Engineering
Britney Ward	Engineering
Brent Wilde	Community Development
Gary Winterton	City Council

4.6 Demand & Benefits Model

4.6.1 Introduction

This section describes a model used to estimate the number of current transportation-oriented walking and bicycling trips in Provo and quantify how those trips benefit the community. The model also quantifies the future benefits of walking and bicycling given certain assumptions about the percentage of trips that will be taken using those two modes of transportation. The model uses a market segment approach to estimate the number of bicycling and walking trips taken by populations that traditionally have higher cycling and walking mode splits than work commuters (such as elementary and college students). National transportation surveys, in particular the *National Household Travel Survey* (NHTS, 2009) show that commute trips are only a fraction of the trips an individual takes on a given day. The model uses the NHTS findings to estimate the number of non-work, non-school trips so that they can be factored in with commute trips to estimate the total number of walking and bicycling trips that occur in a day.

4.6.2 Data Used in the Model

Journey-to-work information collected by the U.S. Census Bureau's American Communities Survey (ACS) is the foundation of this analysis. The most recent ACS data available for Provo City are the 2010 three-year estimates. Model variables from the ACS include:

- Total population (111,780 people)
- Employed population (52,393 people)
- School enrollment (14,176 students grade K-12; 41,453 college students)
- Travel-to-work mode split (see Table 4-4).

The 2009 NHTS provides a substantial national dataset of travel characteristics, particularly for bicycling and walking trips. Data used from this survey include:

- Student mode split, grades K-12
- Ratio of walking and bicycling work trips to non-work, non-social/recreational trips
- Ratio of work trips to social and recreational trips
- Average trip length by trip purpose and mode

Table 4-4: Provo Commute Mode Share*

	Bicycling	Walking	Source
Employed	2.38%	15.78%	2010 ACS
K-12	0.67%	10.57%	NHTS 2009
College	2.38%	15.78%	Assumed same as 2010 ACS "Employed"

* "Mode share' is the percent of trips made by a particular transportation mode.

Several of these variables provide an indirect method of estimating the number of walking and bicycling trips made for non-work reasons, such as shopping and running errands. NHTS data indicate that for every bicycle work trip there are slightly more than two utilitarian (i.e. transportation-oriented) bicycle trips made. Although these trips cannot be directly attached to a certain group of people (not all utilitarian bicycling trips are made by people who bicycle to work), these multipliers allow a high percentage of the community's walking and bicycling activity to be captured in an annual estimate.

The SRTS Baseline Data Report (2010) was used to determine the average distances of school-related walking and bicycling trips.

Disclaimer

As with any modeling projection, the accuracy of the result is dependent on the accuracy of the input data and other assumptions. Effort was made to collect the best data possible for input to the model, but in many cases national data was used where local data were unavailable. Examples of information that could improve the accuracy of this exercise include detailed results of local SRTS parent and student surveys, a regional household travel survey, and a travel survey of college students.

4.6.3 Existing Walking & Bicycling Trips

Table 4-5 shows the results of the model, which estimates that 11,636 bicycle and 136,752 walking trips occur in Provo each day for transportation purposes. The majority are non-work utilitarian trips, which include medical/dental services, shopping/errands, family or personal business, obligations, meals, and other trips.

« The Provo Towne Centre Mall is a destination for people whether they drive, walk, or ride to get there

Trips made for social or recreational purposes are not included in this model since its underlying goal is estimating the transportation benefits of bicycling and walking. However, it is worth noting that NHTS data show that there are approximately 6.5 social and recreational bicycle trips made for every bicycle commute trip. This means that there are an estimated 16,000 bicycle trips being made in Provo every day for purely social and recreational purposes that are not accounted for in the model. NHTS data estimate that 5.9 social and recreational walking trips are made for every walking commute trip. However, it is likely that the factor for Provo is much less than that given the relatively high number of walking commute trips.

Table 4-5: Model Estimate of Current Bicycle & Walking Trips

	Bicycling	Walking	Source
Work Commute Trips			
Work commuters	1,245	8,269	Employed population multiplied by mode split
Weekday trips	2,490	16,538	Number of commuters multiplied by two for return trips
K-12 School Trips			
K-12 commuters	95	1,499	School children population multiplied by mode split
Weekday trips	191	2,998	Numbers multiplied by two for return trips
College Commute Trips			
College commuters	985	6,542	College population multiplied by mode split
Weekday trips	1,970	13,085	College bicyclists multiplied by two for return trips
Utilitarian Trips			
Daily trips (includes Sat/Sun)	6,986	104,132	Adult trips (sum of work and college) multiplied by ratio of utilitarian to work trips (NHTS).
Total Current Daily Trips	**11,636**	**136,752**	

Current Trip Replacement

To estimate the total distance that Provo residents travel to work or school by walking and bicycling, the model isolates different walking and bicycling user groups and applies trip distance information by mode based on the 2009 NHTS. The model values shown in Table 4-6 estimate that 49 million bicycling and walking trips each year replace 35 million vehicle trips and nearly 27 million vehicle-miles traveled. This equates to an estimated 7% reduction in non-freeway vehicle-miles traveled within Provo City.

Table 4-6: Current Bicycling & Walking Trip Replacement

	Bicycling	Walking	Source
Commute Trips			
Weekday trips reduced	1,561	12,019	Trips multiplied by the drive-alone trip percentage to determine auto trips replaced by bicycle trips
Weekday miles reduced	5,526	8,053	Number of vehicle trips reduced multiplied by average bicycle/walking work trip length (NHTS 2009)
School Trips			
Weekday trips reduced	114	1,991	Trips multiplied by drive alone trip percentage to determine auto trips replaced by bicycle/walking trips
Weekday miles reduced	114	919	Number of vehicle trips reduced multiplied by average trip length to/from school (SRTS 2010)
College Trips			
Weekday trips reduced	1,235	8,008	Trips multiplied by drive alone trip percentage to determine auto trips replaced by bicycle/walking trips
Weekday miles reduced	1,828	5,325	Number of vehicle trips reduced multiplied by average school/daycare/religious trip length (NHTS 2009) for bicycling/walking modes
Utilitarian Trips			
Daily trips reduced (includes Sat/Sun)	4,380	75,678	Trips multiplied by drive alone trip percentage to determine auto trips replaced by bicycle/walking trips
Daily miles reduced (includes Sat/Sun)	8,292	50,452	Number of vehicle trips reduced multiplied by average utilitarian trip length (NHTS 2009) for bicycling/walking modes
Yearly Results	**Bicycling**	**Walking**	**Total**
Yearly trips by mode	3,623,891	45,495,674	49,119,566
Yearly vehicle trips replaced by mode	2,270,904	33,027,202	35,298,106
Yearly vehicle miles replaced by mode	4,850,371	21,750,242	26,600,613

Current Benefits

To the extent that bicycling and walking trips replace single-occupancy vehicle trips, they reduce emissions and have tangible economic impacts by reducing traffic congestion, crashes, and maintenance costs. In addition, the reduced need to own and operate a vehicle saves families money. These benefits are shown in Table 4-7. The current annual household transportation cost savings alone is estimated at $130 per person or $460 per household.

Table 4-7: Benefits of Current Bicycling & Walking Trips

	Bicycling	Walking	Source
Yearly vehicle miles reduced	4,850,371	21,750,242	
Air Quality Benefits			
Reduced Hydrocarbons (pounds/year)	14,543	65,213	EPA, 2005[*]
Reduced Particulate Matter (pounds/year)	108	484	EPA, 2005
Reduced Nitrous Oxides (pounds/year)	10,159	45,554	EPA, 2005
Reduced Carbon Monoxide (pounds/year)	132,596	594,593	EPA, 2005
Reduced Carbon Dioxide (pounds/year)	3,945,805	17,693,947	EPA, 2005
Economic Benefits of Air Quality			
Particulate Matter	$9,072	$40,682	NHTSA, 2011 [†]
Nitrous Oxides	$20,317	$91,107	NHTSA, 2011
Carbon Dioxide	$67,652	$303,368	U.S. Government
Reduced External Costs of Vehicle Travel			
Traffic Congestion	$339,526	$1,522,517	AAA, 2008[‡]
Vehicle Crashes	$1,503,615	$6,742,575	AAA, 2008
Roadway Maintenance Costs	$679,052	$3,045,034	Kitamura, R., Zhao, H., and Gubby, A. R., 1989[§]
Household Transportation Savings			
Reduction in HH transportation spending	$2,667,704	$11,962,633	IRS operational standard mileage rates for 2010 [**]
Total	**$5,286,938**	**$23,707,915**	

[*] From EPA report 420-F-05-022 "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks." 2005.

[†] NHTSA Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks, Table VIII-5 (http://www.nhtsa.dot.gov/ portal/site/nhtsa/ menuitem.d0b5a45b55bfbe582f57529 cdba046a0/).

[‡] "Crashes vs. Congestion – What's the Cost to Society?" http://newsroom.aaa.com/wp-content/uploads/2011/11/2011_AAA_CrashvCongUpd.pdf

[§] Kitamura, R., Zhao, H., and Gubby, A. R. (1989). Development of a Pavement Maintenance Cost Allocation Model. Institute of Transportation Studies – University of California, Davis (http://pubs.its.ucdavis.edu/ publication_detail.php?id=19). $0.08/ mile (1989), adjusted to 2010 dollars using the Bureau of Labor Statistics Inflation Calculator (http://www.bls.gov/ data/ inflation_calculator.htm).

[**] http://www.irs.gov/ newsroom/ article/ 0,,id=216048,00.html

4.6.4 Future Walking & Bicycling Trips

Estimating future benefits requires additional assumptions regarding Provo's future population and anticipated travel patterns in 2030. Future population predictions from the 2010 Provo General Plan were used in this model. Table 4-8 shows the demographics used in the future analysis.

Table 4-9 shows projected 2030 bicycling and walking trips for two assumed bicycle mode share scenarios. The first scenario assumes a 5% bicycle mode share and the second assumes a 10% mode share. For simplicity, these mode shares were assumed to apply for all trip types (commuting, utilitarian, school, etc.). Walking mode share was assumed to remain equal to current levels.

The important factor to consider with these future assumptions is not the accuracy of the mode share percentages, but the benefits that would accrue to Provo if those numbers are reached. As more cities across the country track changes in bikeway mileage over time and participate in annual bicycle counts, more data will be available to better understand and refine future mode share predictive measures.

Table 4-8: Projected 2030 Demographics

	Number	Percent of 2030 Population	Source
Population	138,450	100.00%	2010 Provo General Plan: 2030 Population Estimate (based on 0.91% annual growth rate)
Employed population	62,800	45.40%	2010 General Plan - 0.91% annual growth rate
School population, K-12	17,558	12.70%	Assumes same percent as ACS 2009 estimate
College student population	51,343	37.10%	Assumes same as 2009 ACS estimate

Future Trip Replacement

The same trip replacement factors used for the existing analysis were applied to the numbers in Table 4-10 in order to generate estimates of bicycling and walking trip replacement for the 2030 scenario. This table shows that a 5% bicycle mode share scenario would result in more than nearly 65 million annual walking and bicycling trips, which will reduce vehicle trips by more than 46 million and vehicle-miles traveled by more than 39 million. A 10% bicycle mode share would result in an estimated 74 million annual walking and bicycling trips, along with reductions of 53 million vehicle trips and nearly 54 million vehicle-miles traveled.

Future Benefits

Table 4-11 shows the air quality and economic benefits of the future projected walking and bicycling trips in Provo. For the 5% bicycle mode share assumption, annual transportation savings are estimated to accrue at a rate of $156 per person or $550 per household. A 10% bicycle mode share would result in an estimated $213 per person cost savings or $755 per household.

Table 4-9: 2030 Bicycling & Walking Trips

	Bicycling		Walking	Source
	5% Share	10% Share		
Commute Trips				
Work commuters	3,140	6,280	9,911	Employed population multiplied by mode split
Weekday trips	6,280	12,560	19,823	Number of commuters multiplied by two for return trips
School Trips				
K-12 commuters	878	1,756	1,856	School children population multiplied by mode split
Weekday trips	1,756	3,512	3,713	Numbers multiplied by two for return trips
College Trips				
College commuters	2,567	5,134	8,103	College population multiplied by mode split
Weekday trips	5,134	10,269	16,207	College bicyclists multiplied by two for return trips
Utilitarian Trips				
Daily trips	17,878	35,755	126,654	Adult trips (sum of work and college) multiplied by ratio of utilitarian to work trips (NHTS).
Total Future Weekday Trips	**31,048**	**62,096**	**166,397**	

» Good bicycle infrastructure can help to encourage investment and development in old and new neighborhoods

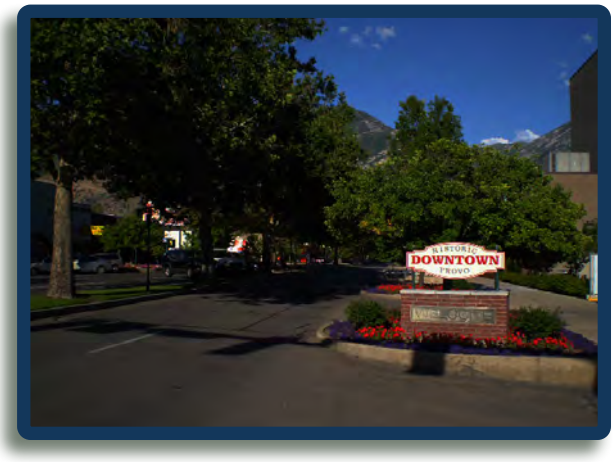


Table 4-10: 2030 Bicycling & Walking Trip Replacement

	Bicycling 5% Share	Bicycling 10% Share	Walking	Source
Commute Trips				
Weekday trips reduced	4,046	8,541	14,406	Trips multiplied by the drive-alone trip percentage to determine auto trips replaced by bicycle trips
Weekday miles reduced	14,323	30,237	9,652	Number of vehicle trips reduced multiplied by average bicycle walking work trip length (NHTS 2009)
School Trips				
Weekday trips reduced	1,098	2,318	2,466	Trips multiplied by drive alone trip percentage to determine auto trips replaced by bicycle/walking trips
Weekday miles reduced	1,096	2,314	1,139	Number of vehicle trips reduced multiplied by average trip length to/from school (SRTS 2010)
College Trips				
Weekday trips reduced	3,308	6,983	11,778	Trips multiplied by drive alone trip percentage to determine auto trips replaced by bicycle/walking trips
Weekday miles reduced	4,896	10,335	6,596	Number of vehicle trips reduced multiplied by average school/ daycare/religious trip length (NHTS 2009) for bicycling/walking modes
Utilitarian Trips				
Daily trips reduced (includes Sat/Sun)	11,518	24,316	92,046	Trips multiplied by drive alone trip percentage to determine auto trips replaced by bicycle/walking trips
Daily miles reduced (includes Sat/Sun)	21,807	46,037	61,364	Number of vehicle trips reduced multiplied by average utilitarian trip length (NHTS 2009) for bicycling /walking modes
Yearly Results				**Total**
Yearly trips by mode	9,516,434	19,032,868	55,329,723	64,846,157 (74,362,591)
Yearly vehicle trips replaced by mode	6,124,542	12,929,588	40,165,325	46,289,866 (53,094,913)
Yearly vehicle miles replaced by mode	12,874,167	27,178,797	26,444,655	39,318,822 (53,623,452)

Table 4-11: Benefits of Future Bicycling & Walking Trips

	Bicycling 5% Share	Bicycling 10% Share	Walking	Source
Yearly vehicle miles reduced	12,874,167	27,178,797	26,444,655	
Air Quality Benefits				
Reduced Hydrocarbons (pounds/year)	38,600	81,490	79,289	EPA, 2005[*]
Reduced Particulate Matter (pounds/year)	287	605	589	EPA, 2005
Reduced Nitrous Oxides (pounds/year)	26,964	56,923	55,385	EPA, 2005
Reduced Carbon Monoxide (pounds/year)	351,945	742,995	722,926	EPA, 2005
Reduced Carbon Dioxide (pounds/year)	10,473,209	22,110,107	21,512,879	EPA, 2005
Economic Benefits of Air Quality				
Particulate Matter	$24,080	$50,835	$49,462	NHTSA, 2011 [†]
Nitrous Oxides	$53,927	$113,846	$110,771	NHTSA, 2011
Carbon Dioxide	$179,566	$379,084	$368,844	U.S. Government
Reduced External Costs of Vehicle Travel				
Traffic Congestion	$901,192	$1,902,516	$1,851,126	AAA, 2008[‡]
Vehicle Crashes	$3,990,992	$8,425,427	$8,197,843	AAA, 2008
Roadway Maintenance Costs	$1,802,383	$3,805,032	$3,702,252	Kitamura, R., Zhao, H., and Gubby, A. R., 1989[§]
Household Transportation Savings				
Reduction in HH transportation spending	$7,080,792	$14,948,338	$14,544,560	IRS operational standard mileage rates for 2010 [**]
Total	**$14,032,932**	**$29,625,078**	**$28,824,858**	

[*] From EPA report 420-F-05-022 "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks." 2005.

[†] NHTSA Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks, Table VIII-5 (http://www.nhtsa.dot.gov/ portal/site/nhtsa/ menuitem.d0b5a45b55bfbe582f57529 cdba046a0/).

[‡] "Crashes vs. Congestion – What's the Cost to Society?" http://newsroom.aaa.com/wp-content/uploads/2011/11/2011_AAA_CrashvCongUpd.pdf

[§] Kitamura, R., Zhao, H., and Gubby, A. R. (1989). Development of a Pavement Maintenance Cost Allocation Model. Institute of Transportation Studies – University of California, Davis (http://pubs.its.ucdavis.edu/ publication_detail.php?id=19). $0.08/ mile (1989), adjusted to 2010 dollars using the Bureau of Labor Statistics Inflation Calculator (http://www.bls.gov/ data/ inflation_calculator.htm).

[**] http://www.irs.gov/ newsroom/ article/ 0,,id=216048,00.html

4.6.5 Comparison of Future Trip Replacement Against Baseline Conditions

A 5% bicycle mode share paired with the existing walking mode share would reduce vehicle-miles traveled by 12.7 million annually compared to existing conditions. A 10% bicycle mode share would reduce annual vehicle-miles traveled by approximately 27 million.

4.6.6 Comparison of Future Benefits Against Baseline Conditions

In order to provide some perspective about the impact of the vehicle-miles and emissions reductions described in the existing and future scenarios, the Utah Department of Air Quality (UDAQ) was contacted. UDAQ provided information about annual vehicle-miles traveled and air quality emissions attributable to on-road mobile sources. A comparision of these data showed that bicycling and walking currently reduce annual vehicle-miles traveled by an estimated 3.5%. These figures would rise to an estimated 4.2% or 5.7% in 2030 with 5% and 10% bicycle travel mode shares, respectively.

Comparison of projected air emission reductions showed that bicycling and walking reduce emissions between 0.01% and 0.80% depending upon the given emission category and time horizon selected. Bicycling and walking had the greatest reduction impact on carbon dioxide and the least effect on particulate emissions. It is likely that air emission reductions are smaller in scale than reductions in vehicle-miles traveled due to the fact that many air emissions (especially particulates) are primarily attributable to freight operations and transportation mode shifts from passenger vehicles to bicycling or walking do not reduce truck volumes.

The model predicts that a 5% bicycle mode share combined with existing walking mode share would save $6.6 million of annual external costs (congestion, crashes, and road maintenance) in Provo compared to baseline conditions, whereas a 10% bike mode share would save $14.1 million.

In terms of household transportation costs, a 5% bicycle mode share (assuming walking mode share remains the same) would save an additional $26 annually per Provo resident (or $90 per household) as compared to existing conditions. A 10% bicycle mode share would annually save $83 more per resident and $295 more per household relative to existing conditions.

4.6.7 Difficult-to-Quantify Benefits of Bicycling & Walking

Bicycling and walking are low-cost and effective means of transportation that are non-polluting, energy-efficient, versatile, healthy, and fun. Everyone is a pedestrian at some point, whether walking to a parked car, taking a lunch break, or accessing transit. In addition, bicycles offer low-cost mobility to the non-driving public. Bicycling and walking as a means of transportation has been growing in popularity as many communities work to create more balanced transportation systems and individuals seek to be healthier. In addition, more people are willing to bicycle more frequently if better bicycle facilities are provided.[1]

1. Pucher, J., Dill, J. and Handy, S. (2010). *Infrastructure, programs, and policies to increase bicycling: An international review*. Preventative Medicine 50:S106-S125.

In addition to the tangible economic benefits estimated above, bicycling and walking have many other benefits that are challenging to quantify, but which have been studied by some communities and organizations. The League of American Bicyclists reported that bicycling makes up $133 billion of the US economy, funding 1.1 million jobs.[2] The League also estimates that bicycle-related trips generate another $47 billion in tourism activity. Many communities have enjoyed a high return on their investment in bicycling. For example, the Outer Banks of North Carolina spent $6.7 million to improve local bicycle facilities, and reaped the benefit of $60 million of annual economic activity associated with bicycling.[3] Multiple studies show that walkable, bikeable neighborhoods are more livable and attractive, increasing home values[4], and resulting in increased wealth for individuals and additional property tax revenue.

Bike lanes can improve retail business directly by drawing customers and indirectly by supporting the regional economy. Patrons who walk and bike to local stores have been found to spend more money to visit local businesses than patrons who drive.[5] Other studies show that walkable, bikeable communities attract the young creative class,[6] which can help cities gain a competitive edge and diversify economic base. By replacing short car trips, bicycling can help middle-class families defray rising transportation costs. Families that drive less spend 10 percent of their income on transportation, compared to 19 percent for households with heavy car use,[7] freeing additional income for local goods and services.

Bicycling can also improve quality of life. Since bicycling is among the most popular forms of recreational activity in the U.S.[8], when bicycling is available as a daily mode of transportation, substantial health benefits result. The health benefit of bicycling for exercise can reduce the cost of spending on health care by as much as $514 a year, which provides a financial incentive to businesses that provide health coverage to their employees.[9]

---

2. Flusche, Darren for the League of American Bicyclists. (2009). *The Economic Benefits of Bicycle Infrastructure Investments*.
3. N.C. Department of Transportation, Division of Bicycle and Pedestrian Transportation. (). *The Economic Impact of Investments in Bicycle Facilities*. *atfiles.org/files/pdf/NCbikeinvest.pdf*
4. Cortright, Joe for CEOs for Cities. (2009). *Walking the Walk: How Walkability Raises Home Values in U.S. Cities*.
5. The Clean Air Partnership. (2009). *Bike Lanes, On-Street Parking and Business: A Study of Bloor Street in Toronto's Annex Neighborhood*.
6. Cortright, Joe for CEOs for Cities. (2007). *Portland's Green Dividend*.
7. Center for Neighborhood Technology. (2005). *Driven to Spend: Pumping Dollars out of Our Households and Communities*.
8. Almost 80 million people walk and 36 million people bicycle for recreation or exercise nationally. 27.3% of the population over 16 bicycles at least once over the summer. (National Sporting Goods Association survey, 2003)
9. Feifei, W., McDonald, T., Champagne, L.J., and Edington, D.W. (2004). Relationship of Body Mass Index and Physical Activity to Health Care Costs Among Employees. Journal of Occupational and Environmental Medicine.46(5):428-436

Safety concerns are another reason to improve bicycling conditions. Although the incidence of crashes involving bicycles may be low, concerns about safety have historically been the single greatest reason people do not commute by bicycle, as captured in polls as early as 1991.[10] An SRTS survey in 2004 similarly found that 30 percent of parents consider traffic-related danger to be a barrier to allowing their children to walk or bike to school. Addressing those concerns for bicyclists and pedestrians through physical and program improvements is another major objective of the Lehi Bicycle and Pedestrian Master Plan. Improving bicyclist safety can also be accomplished by increasing the number of people who walk and bike. Pedestrians in communities where twice as many people walk are 66% less likely to be injured by a motorist.[11]

10. Lou Harris Poll (2001)
11. Jacobsen, P.L. (2003). Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Injury Prevention 9:205-209.