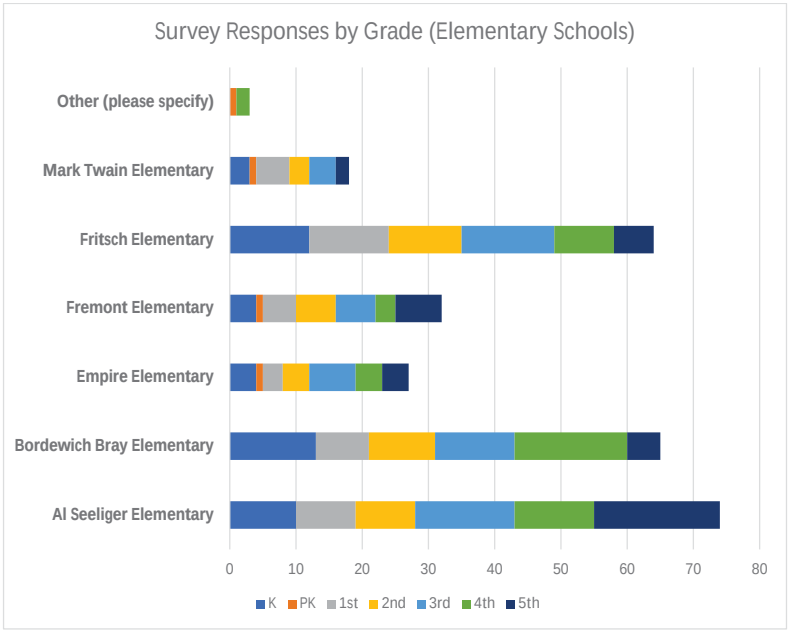
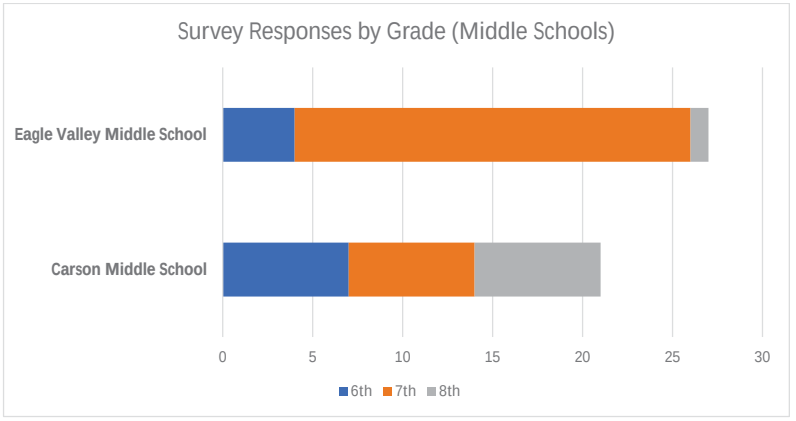
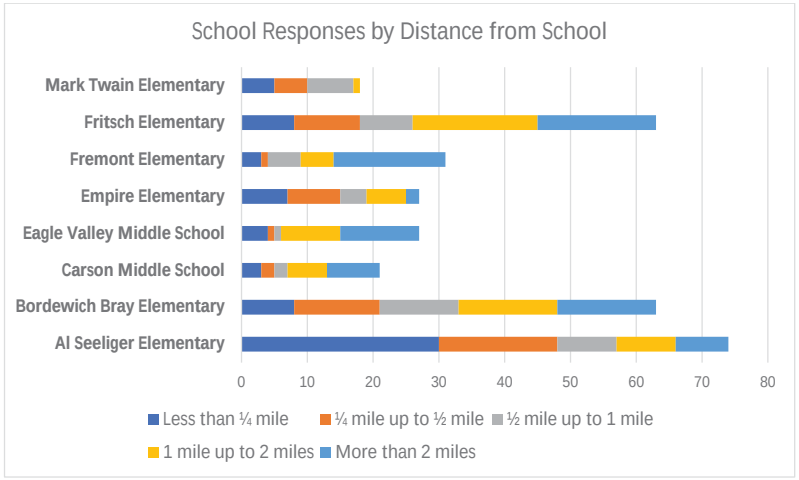
Appendix A

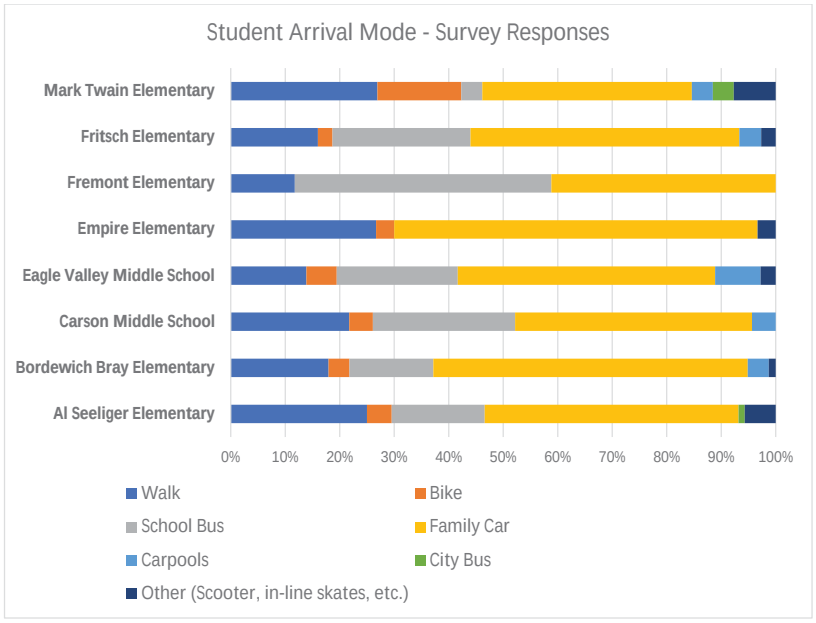
Parent & Middle School Student Survey Results

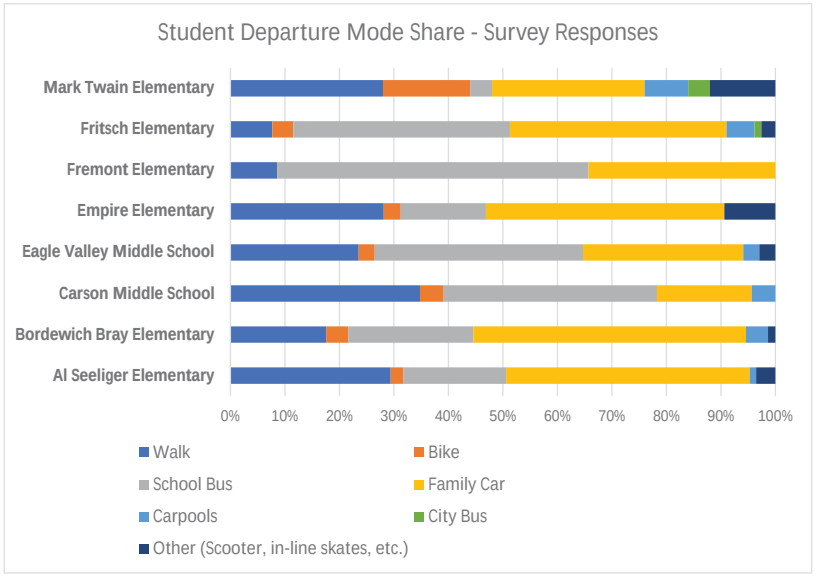
Carson City Safe Routes to School Master Plan - Parent Survey Results

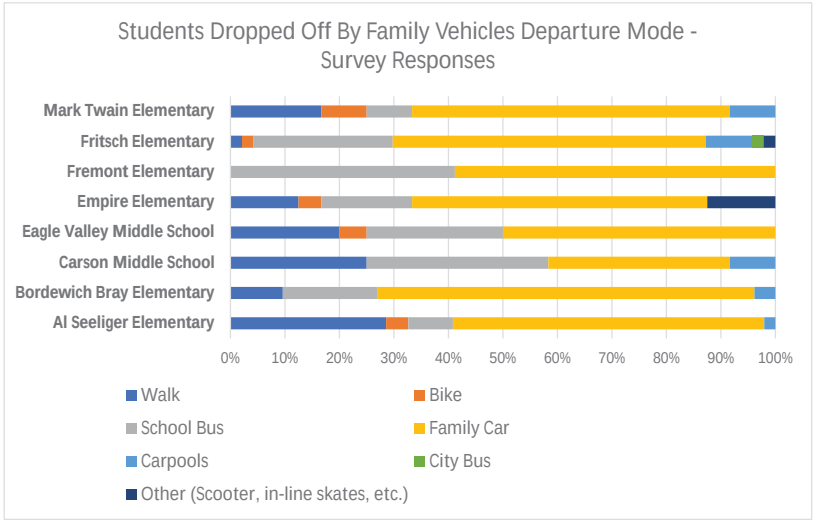


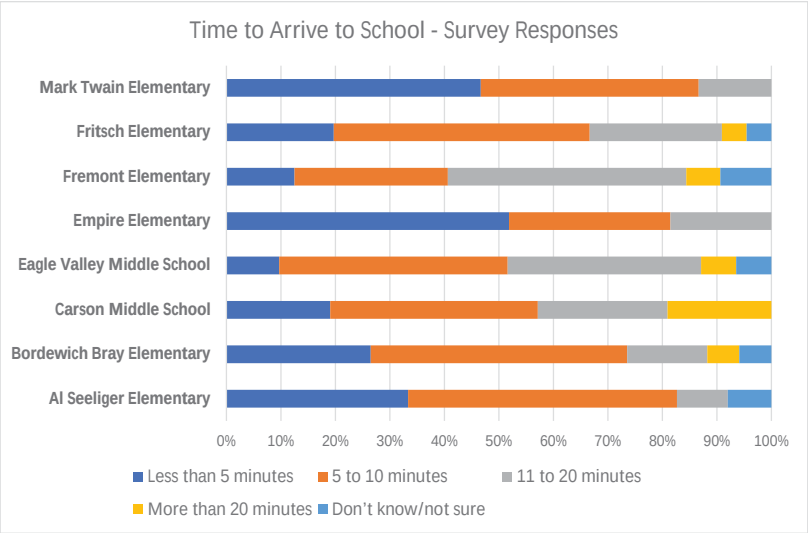


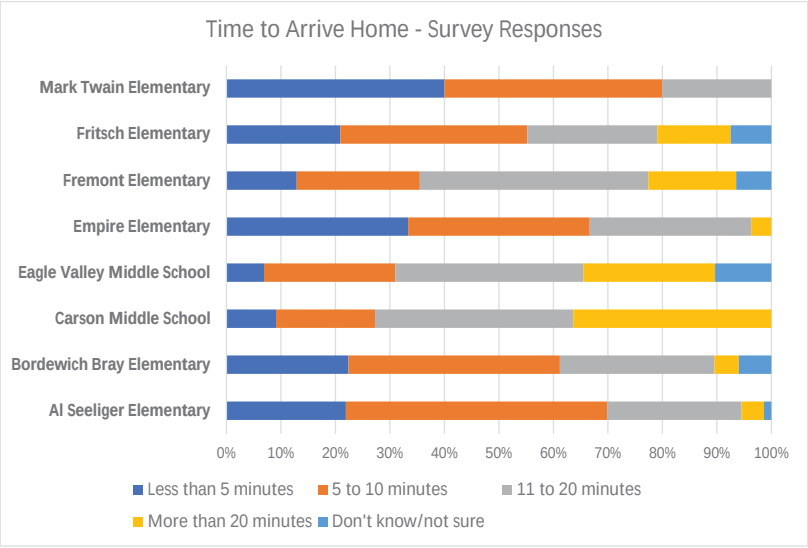

School Responses by Distance from School
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0
10
20
30
40
50
60
70
80
Less than ¼ mile
¼ mile up to ½ mile
½ mile up to 1 mile
1 mile up to 2 miles
More than 2 miles

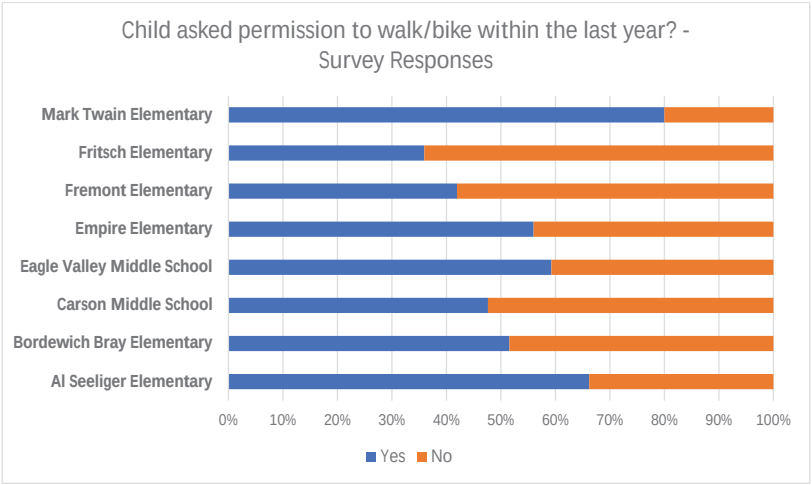

Student Arrival Mode - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Walk
Bike
School Bus
Family Car
Carpools
City Bus
Other (Scooter, in-line skates, etc.)

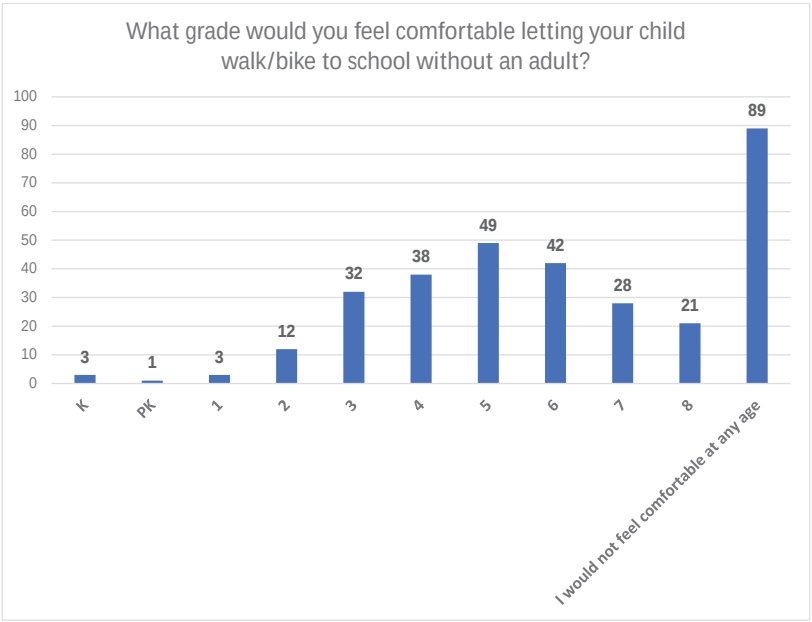

Student Departure Mode Share - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Walk
Bike
School Bus
Family Car
Carpools
City Bus
Other (Scooter, in-line skates, etc.)

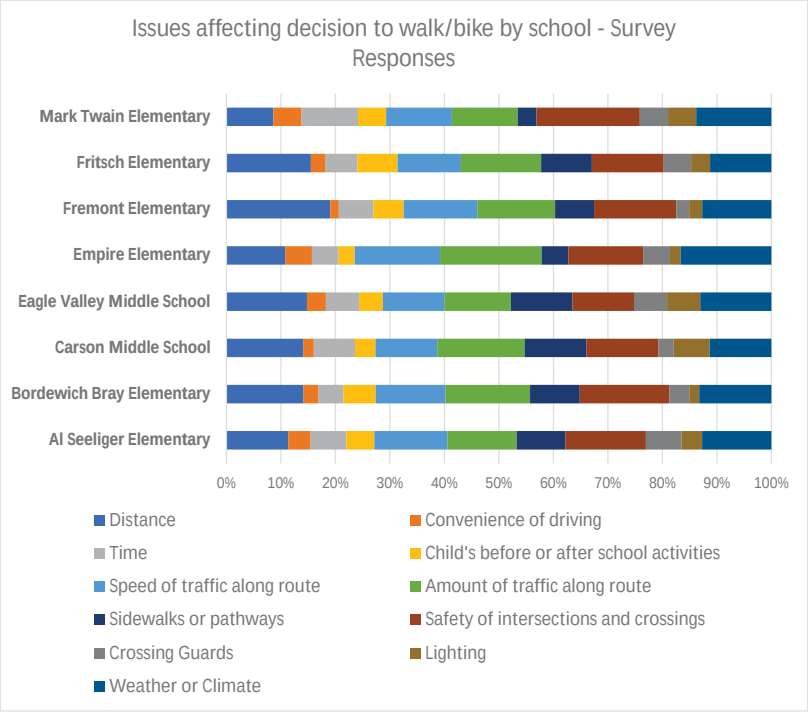

Students Dropped Off By Family Vehicles Departure Mode - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Walk
Bike
School Bus
Family Car
Carpools
City Bus
Other (Scooter, in-line skates, etc.)

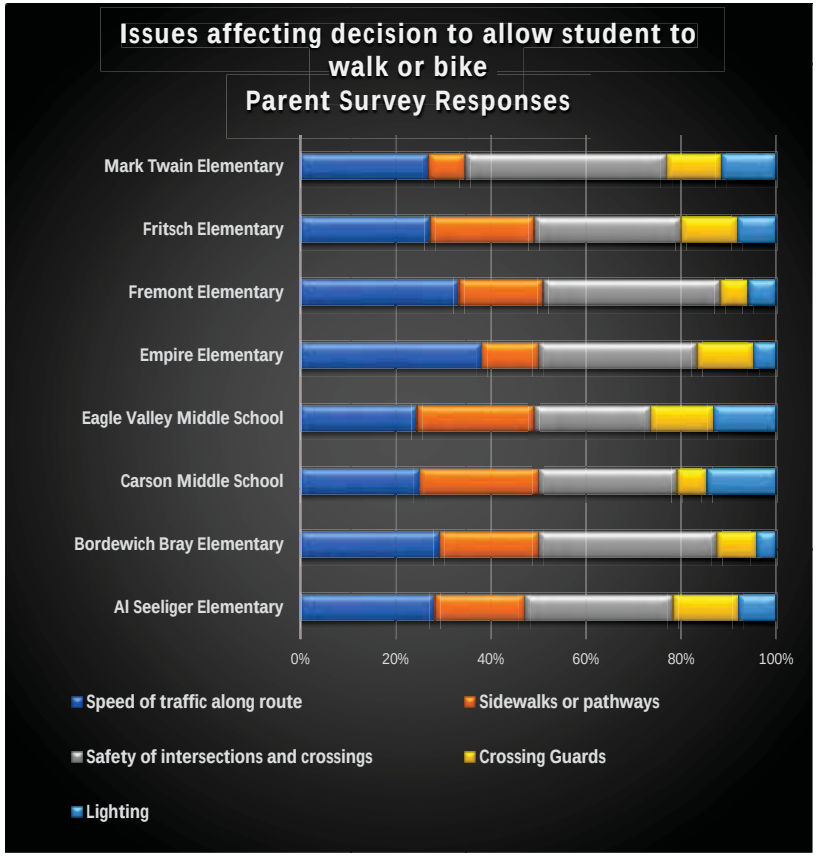

Time to Arrive to School - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Less than 5 minutes
5 to 10 minutes
11 to 20 minutes
More than 20 minutes
Don't know/not sure

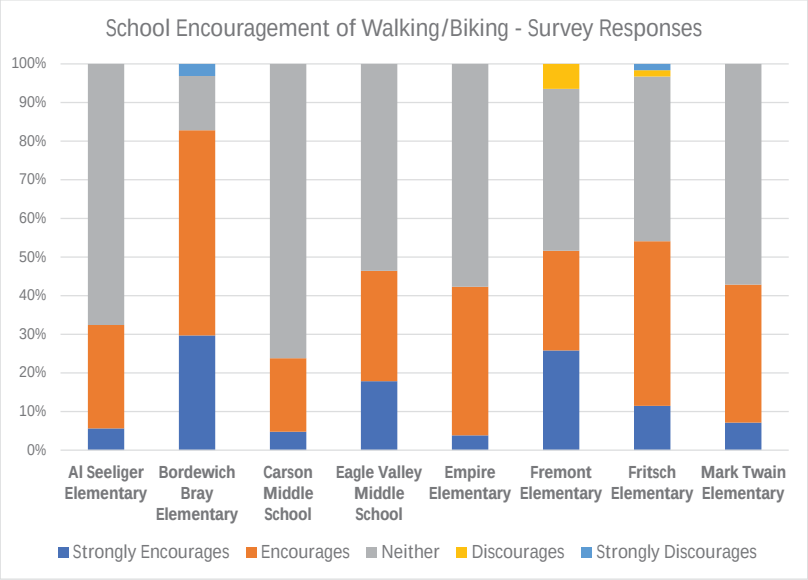

Time to Arrive Home - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Less than 5 minutes
5 to 10 minutes
11 to 20 minutes
More than 20 minutes
Don't know/not sure

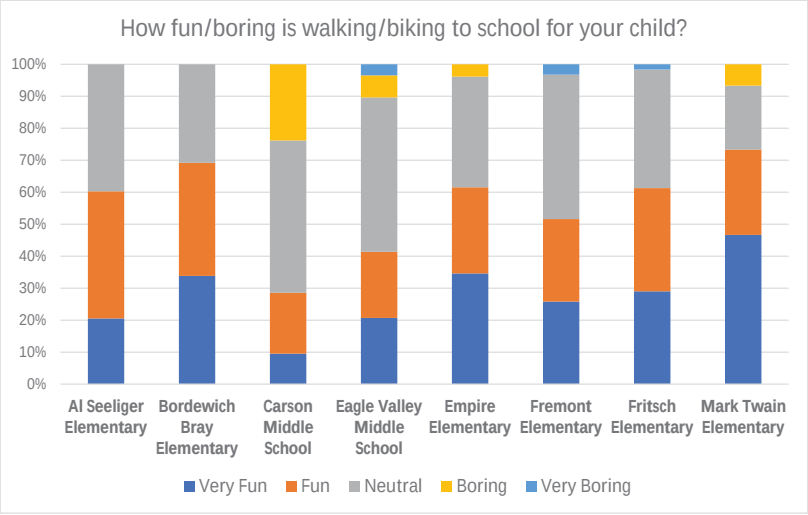

Child asked permission to walk/bike within the last year? - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Yes
No

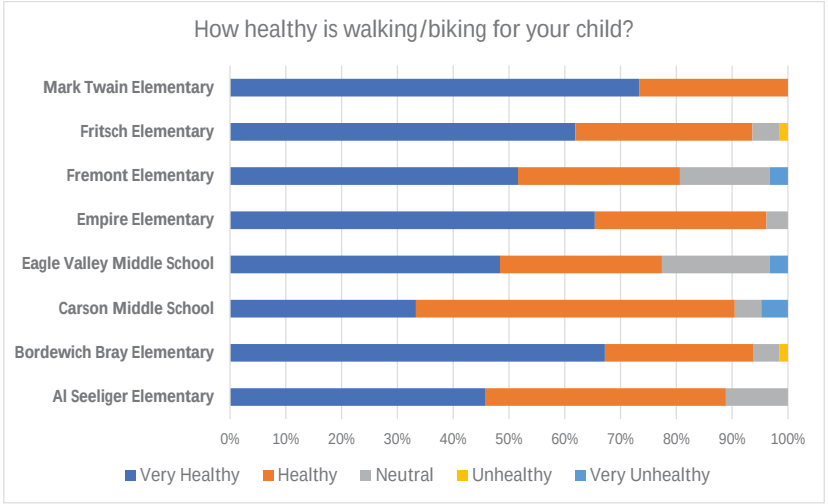

What grade would you feel comfortable letting your child walk/bike to school without an adult?
100
90
80
70
60
50
40
30
20
10
0
3
1
3
12
32
38
49
42
28
21
89
K
PK
1
2
3
4
5
6
7
8
I would not feel comfortable at any age


Issues affecting decision to walk/bike by school - Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Distance
Convenience of driving
Time
Child's before or after school activities
Speed of traffic along route
Amount of traffic along route
Sidewalks or pathways
Safety of intersections and crossings
Crossing Guards
Lighting
Weather or Climate

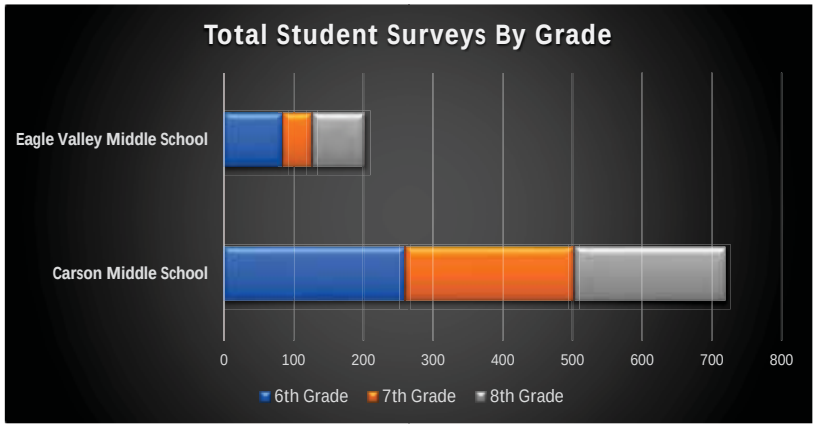

Issues affecting decision to allow student to walk or bike
Parent Survey Responses
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
20%
40%
60%
80%
100%
Speed of traffic along route
Sidewalks or pathways
Safety of intersections and crossings
Crossing Guards
Lighting

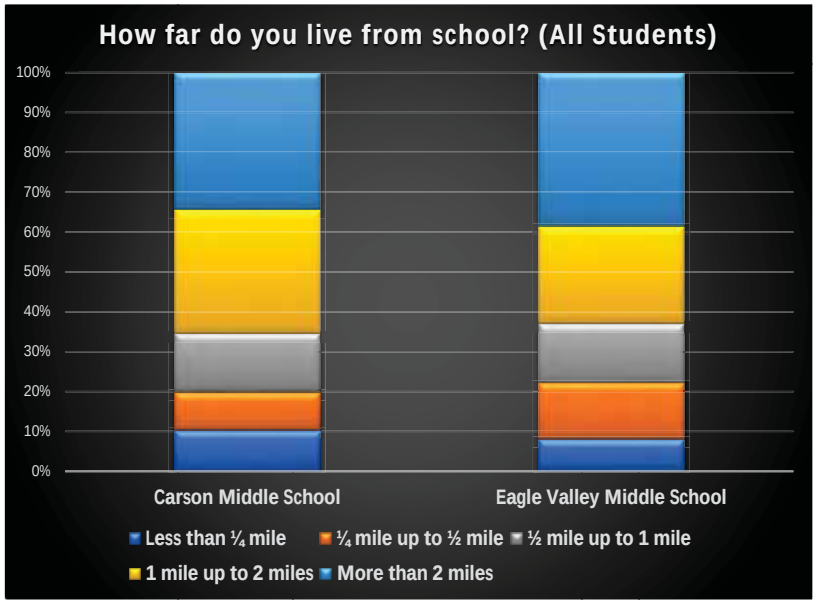

School Encouragement of Walking/Biking - Survey Responses
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Al Seeliger Elementary
Bordewich Bray Elementary
Carson Middle School
Eagle Valley Middle School
Empire Elementary
Fremont Elementary
Fritsch Elementary
Mark Twain Elementary
Strongly Encourages
Encourages
Neither
Discourages
Strongly Discourages

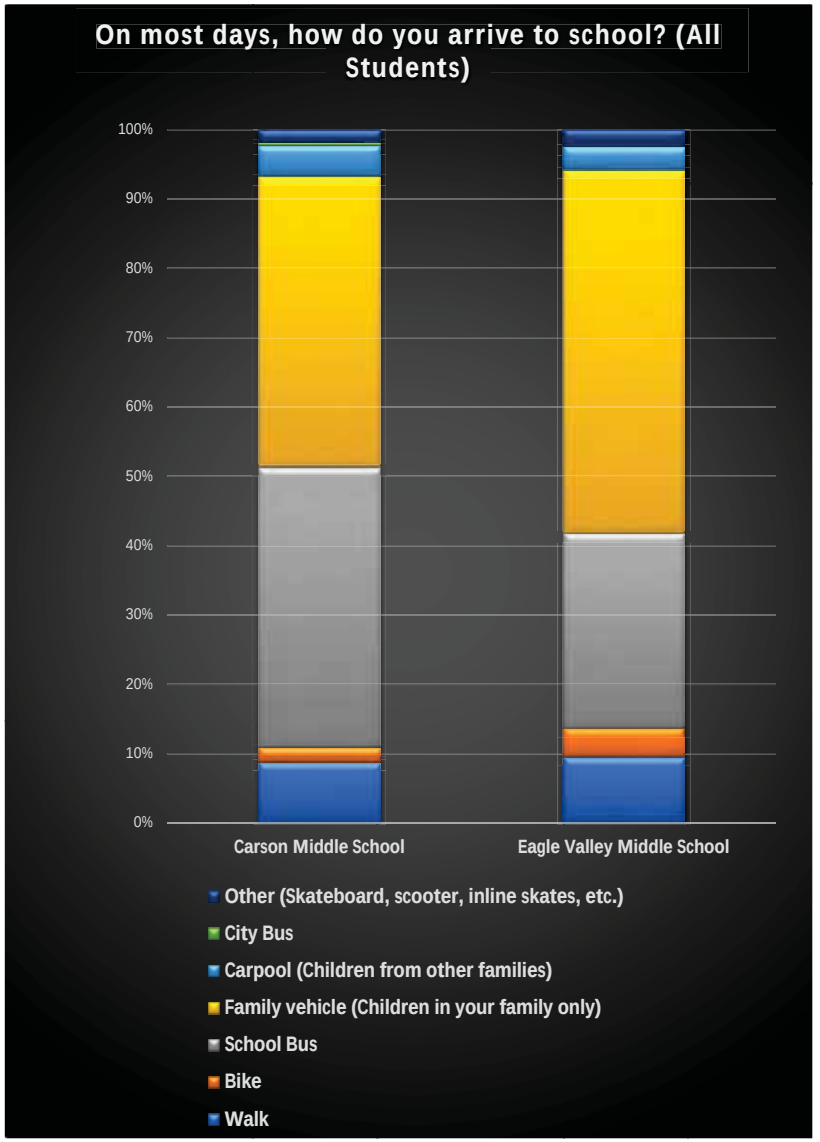

How fun/boring is walking/biking to school for your child?
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Al Seeliger Elementary
Bordewich Bray Elementary
Carson Middle School
Eagle Valley Middle School
Empire Elementary
Fremont Elementary
Fritsch Elementary
Mark Twain Elementary
Very Fun
Fun
Neutral
Boring
Very Boring

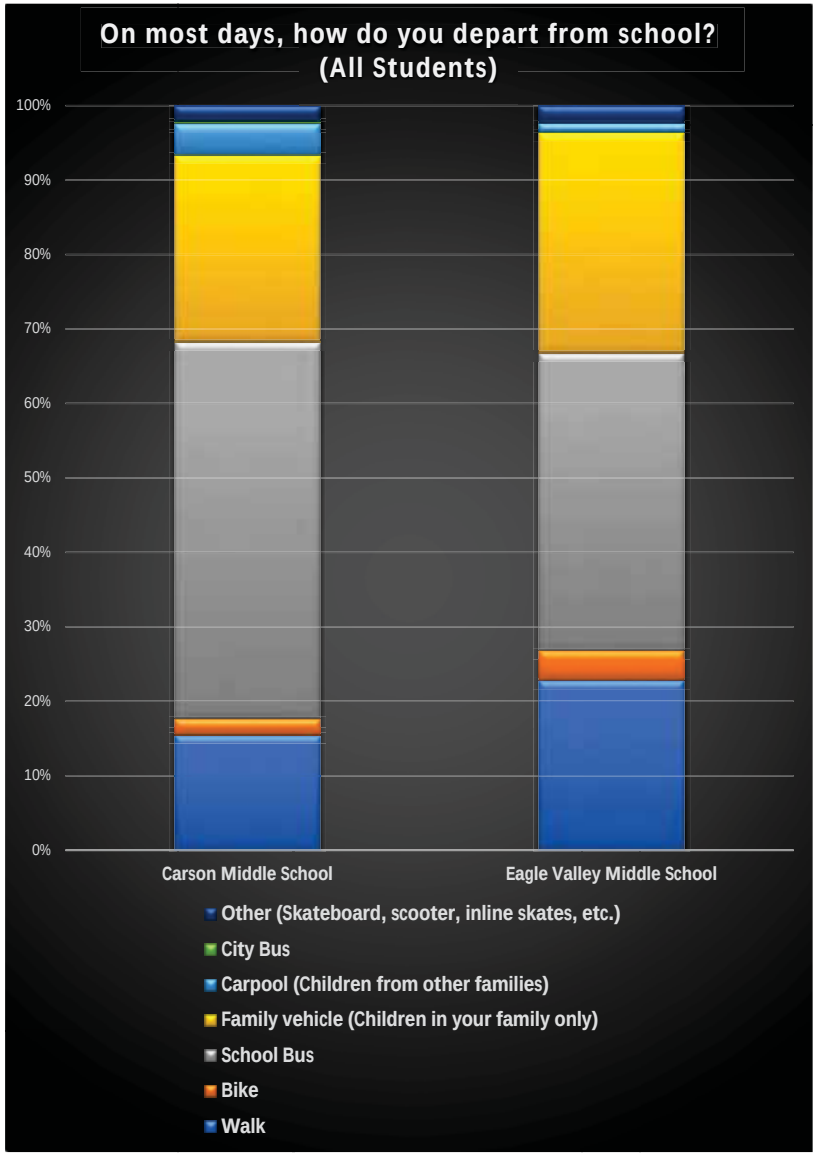

How healthy is walking/biking for your child?
Mark Twain Elementary
Fritsch Elementary
Fremont Elementary
Empire Elementary
Eagle Valley Middle School
Carson Middle School
Bordewich Bray Elementary
Al Seeliger Elementary
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Very Healthy
Healthy
Neutral
Unhealthy
Very Unhealthy

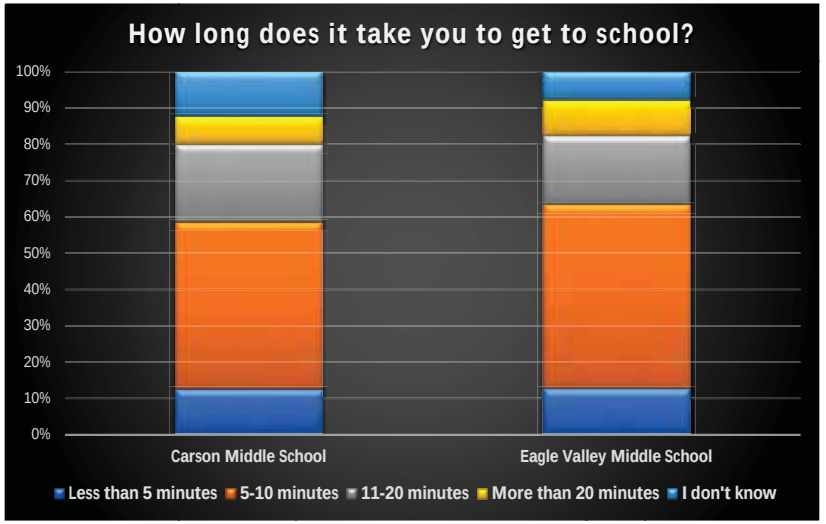
Carson City Safe Routes to School Master Plan – Middle School Student Survey Results

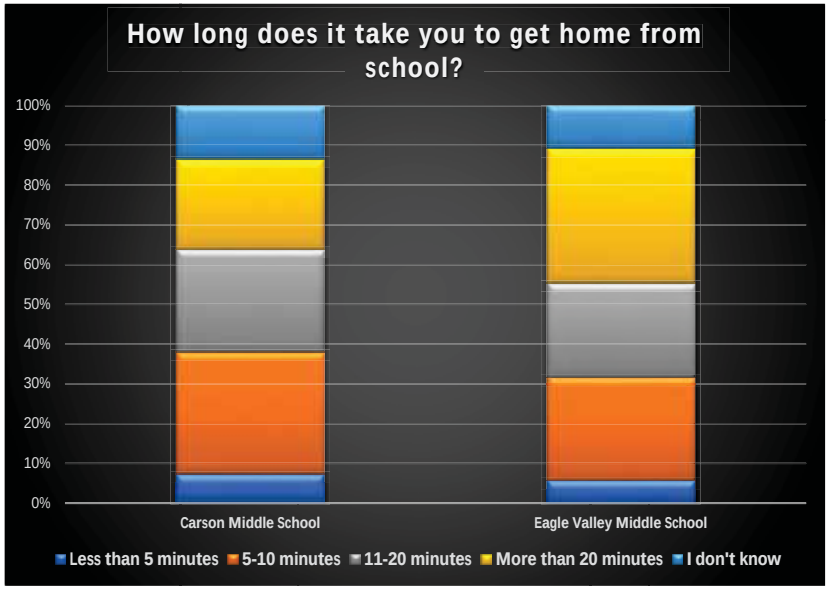


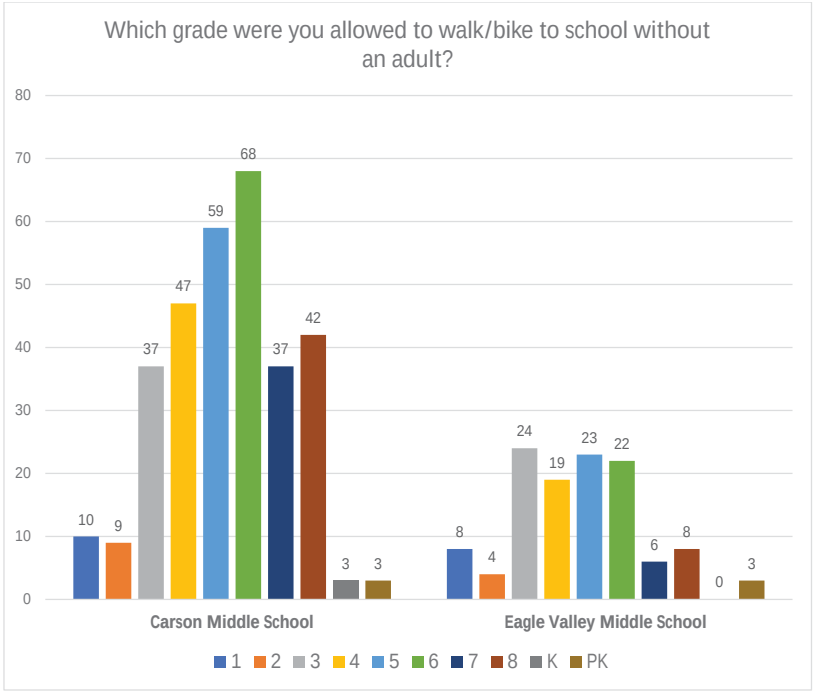


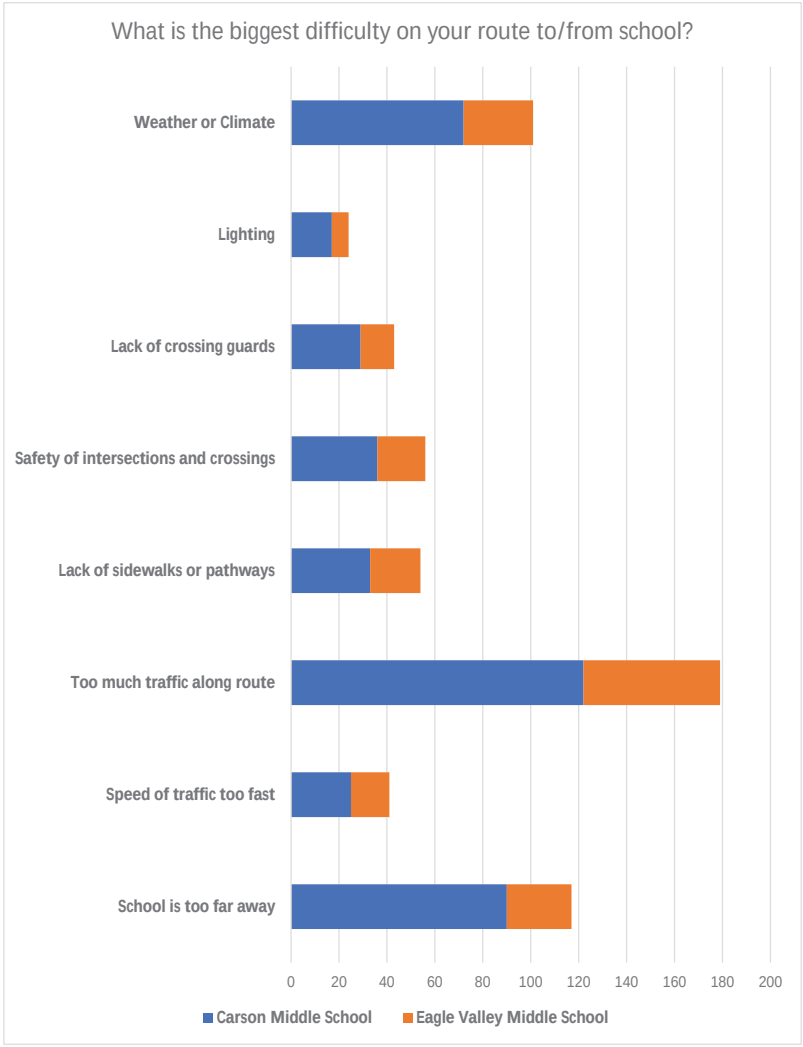


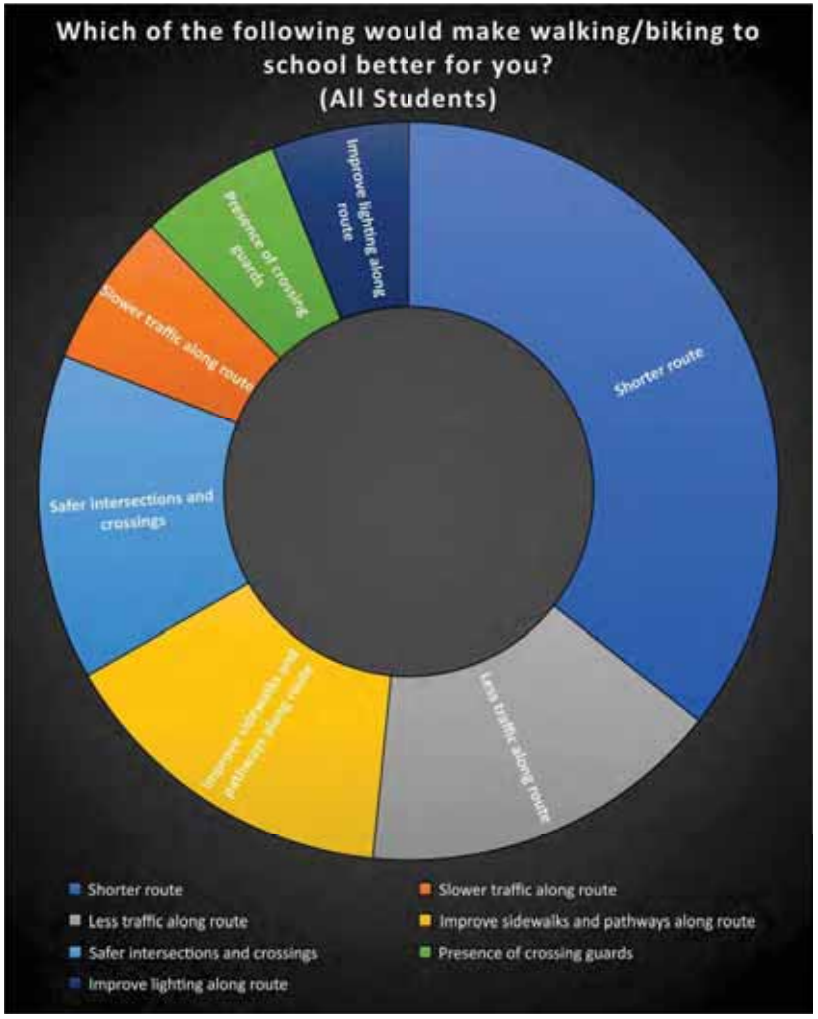

On most days, how do you depart from school? (All Students)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Carson Middle School
Eagle Valley Middle School
Other (Skateboard, scooter, inline skates, etc.)
City Bus
Carpool (Children from other families)
Family vehicle (Children in your family only)
School Bus
Bike
Walk

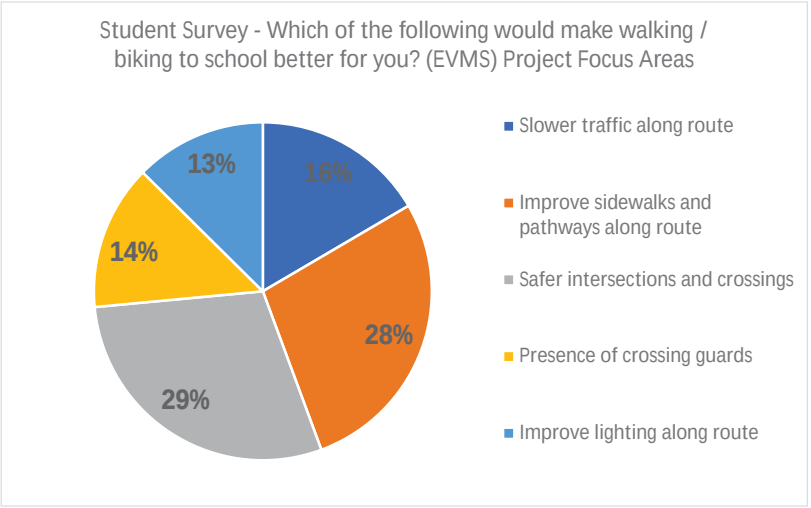

How long does it take you to get to school?
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Carson Middle School
Eagle Valley Middle School
Less than 5 minutes
5-10 minutes
11-20 minutes
More than 20 minutes
I don't know

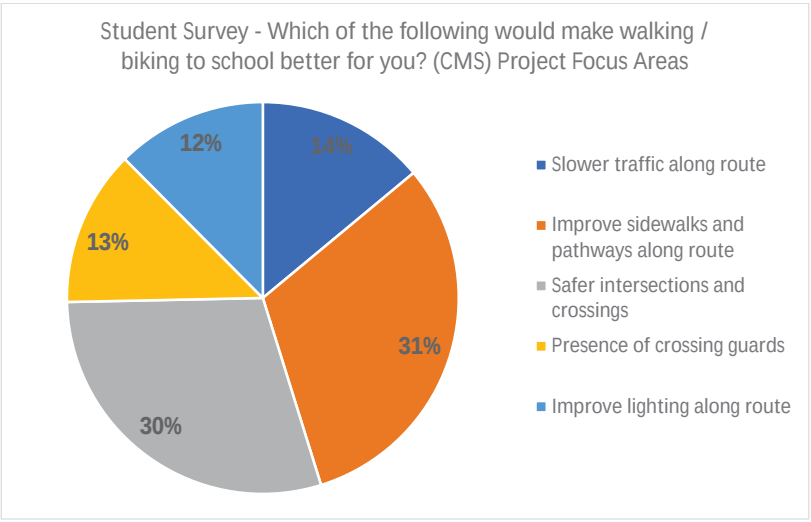

How long does it take you to get home from school?
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Carson Middle School
Eagle Valley Middle School
Less than 5 minutes
5-10 minutes
11-20 minutes
More than 20 minutes
I don't know

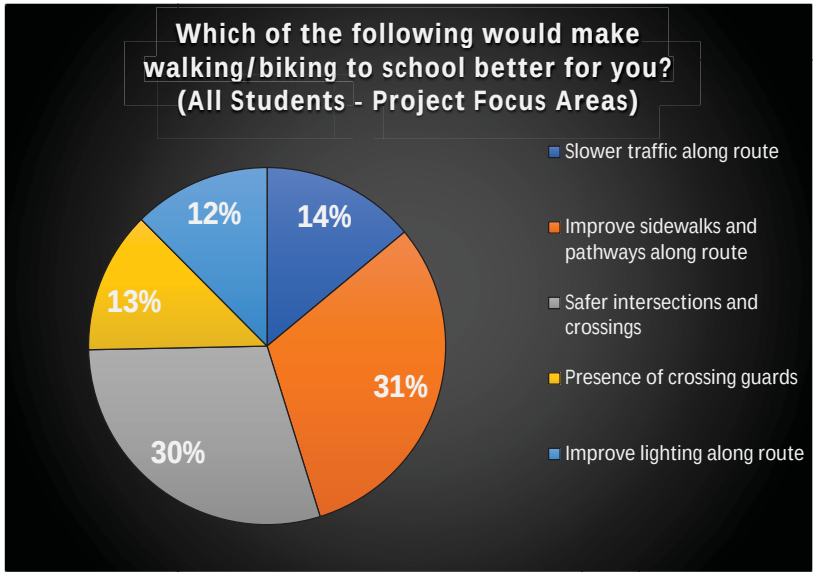

Which grade were you allowed to walk/bike to school without an adult?
80
70
60
50
40
30
20
10
0
10
9
37
47
59
68
37
42
3
3
8
4
24
19
23
22
6
8
0
3
Carson Middle School
Eagle Valley Middle School
1 2 3 4 5 6 7 8 K PK


What is the biggest difficulty on your route to/from school?
Weather or Climate
Lighting
Lack of crossing guards
Safety of intersections and crossings
Lack of sidewalks or pathways
Too much traffic along route
Speed of traffic too fast
School is too far away
0
20
40
60
80
100
120
140
160
180
200
Carson Middle School
Eagle Valley Middle School


Which of the following would make walking/biking to school better for you?
(All Students)
Shorter route
Less traffic along route
Safer intersections and crossings
Improve lighting along route
Slower traffic along route
Improve sidewalks and pathways along route
Presence of crossing guards


Student Survey - Which of the following would make walking / biking to school better for you? (EVMS) Project Focus Areas
16%
28%
29%
14%
13%
Slower traffic along route
Improve sidewalks and pathways along route
Safer intersections and crossings
Presence of crossing guards
Improve lighting along route


Student Survey - Which of the following would make walking / biking to school better for you? (CMS) Project Focus Areas
14%
31%
30%
13%
12%
Slower traffic along route
Improve sidewalks and pathways along route
Safer intersections and crossings
Presence of crossing guards
Improve lighting along route



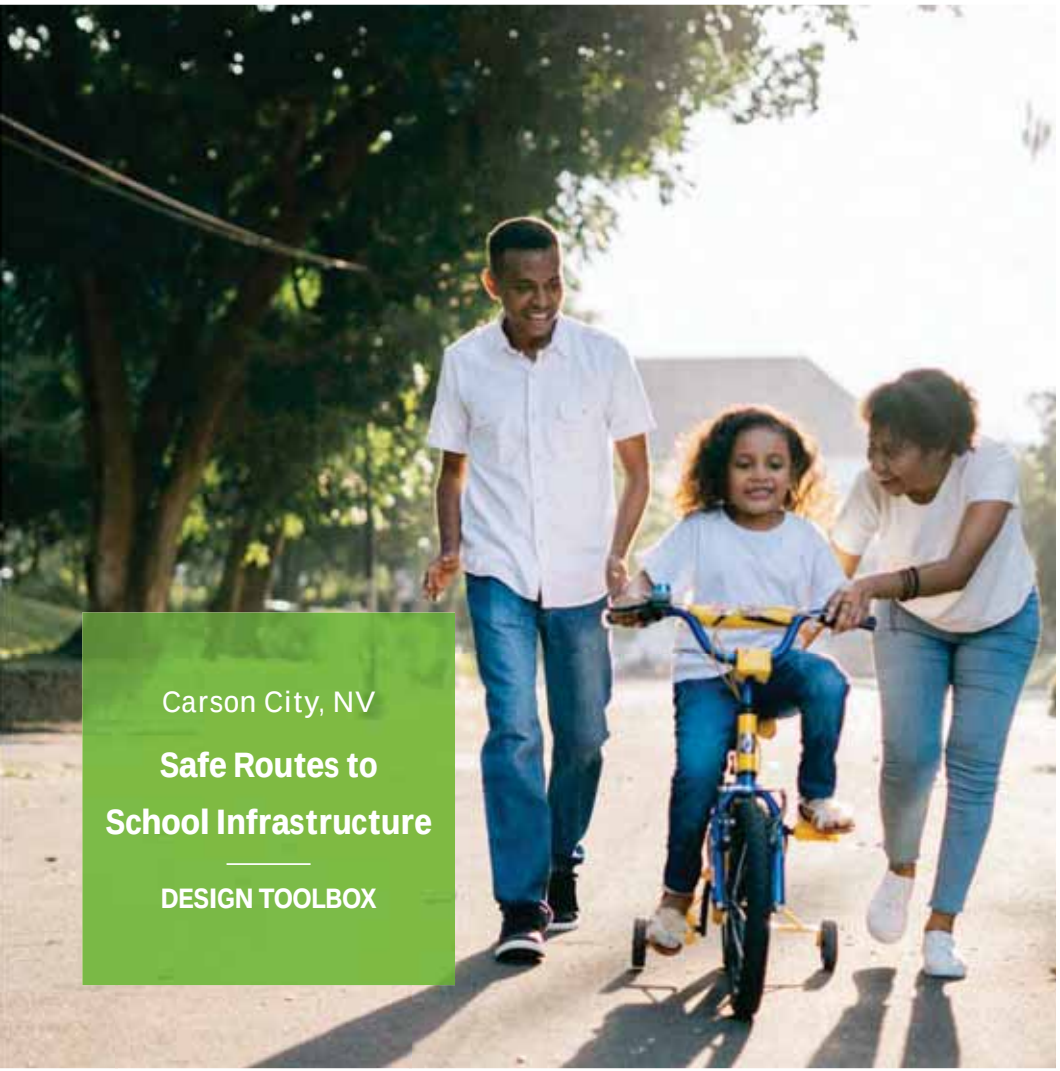
Middle School Student Survey Responses Word Cloud

Question: Please identify specific locations (or issues) that pose walking/biking difficulty along your route.

Appendix B

Safe Routes to School Infrastructure Design Toolbox

HEADWAY TRANSPORTATION



Carson City, NV

Safe Routes to School Infrastructure

DESIGN TOOLBOX

HEADWAY TRANSPORTATION

alta PLANNING + DESIGN

Table of Contents

Section I

Context

Introduction

This Design Toolbox has been developed to complement Carson City's Safe Routes to School Master Plan and to assist the City in the selection and design of facilities. The designs featured in this Toolbox work to promote pedestrian and bicycle comfort, particularly among children. The chapter presents current engineering design resources and approaches to implement bicycle and pedestrian enhancements.

What, Why, Where, When and How?

Future roadway planning, engineering, design and construction will continue to strive for a balanced transportation system that includes a seamless, accessible bicycle and pedestrian network and encourages bicycle and pedestrian travel wherever possible.

There are many reasons to integrate bicycle and pedestrian facilities into typical roadway development policy. The goal of a transportation system is to better meet the needs of people - whether in vehicles, bicyclists or pedestrians - and to provide access to goods, services, and activities.

Supporting active modes gives users important transportation choices, whether it is to make trips entirely by walking or cycling, or to access public transit. Often in urban or suburban areas, walking and cycling are the fastest and most efficient ways to perform short trips.

Convenient non-motorized travel provides many benefits, including reduced traffic congestion, user savings, road and parking facility savings, economic development, and a healthier environment.

Compatible design does more than help those who already walk or bicycle. It encourages greater use of non-motorized transportation and makes the street safer for everyone.

The design recommendations in this document are for use on Carson City roadways. Projects must not only be planned for their physical aspects as facilities serving specific transportation objectives; they must also consider effects on the aesthetic, social, economic and environmental values, needs, constraints and opportunities in a larger community setting. This is commonly known as Context Sensitive Design, and should be employed when determining which standard is applicable in each scenario.

All walkway and bikeway design guidelines in this document meet or exceed the minimums set by the Americans with Disabilities Act.

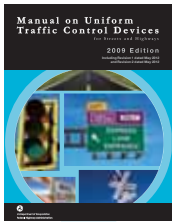
All traffic control devices, signs, pavement markings used and identified in this document must conform to the latest edition of the "Manual on Uniform Traffic Control Devices" (MUTCD).

Whenever possible and appropriate, the National Association of City Transportation Officials (NACTO)'s guidance is recommended where applicable.

Guidance Basis

The sections that follow serve as an inventory of pedestrian and bicycle design treatments and provide guidelines for their development. These treatments and design guidelines are important because they represent the tools for creating a pedestrian- and bicycle-friendly, accessible community. The guidelines are not, however, a substitute for a more thorough evaluation by a professional engineer prior to implementation of facility improvements. The following guidelines are incorporated in this Design Guide.

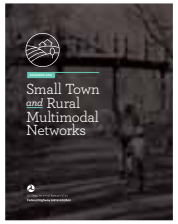
National Guidance



The Federal Highway Administration's **Manual on Uniform Traffic Control Devices (MUTCD)** *defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic.*

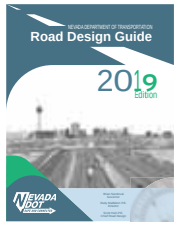
The National Association of City Transportation Officials' (NACTO) **Urban Bikeway Design Guide (2012)** *and* **Urban Street Design Guide (2013)** *are collections of nationally recognized street design standards, and offers guidance on the current state of the practice designs.*

Separated Bike Lane Planning and Design Guide (2015) *is the latest national guidance on the planning and design of separated bike lane facilities released by the Federal Highway Administration (FHWA). The resource documents best practices as demonstrated around the U.S., and offers ideas on future areas of research, evaluation and design flexibility.*



The Federal Highway Administration's **Small Town and Rural Multimodal Networks Report (2016)** *offers resources and ideas to help small towns and rural communities support safe, accessible, comfortable, and active travel for people of all ages and abilities. It connects existing guidance to rural practice and includes examples of peer communities.*

Nevada Guidance



The Nevada Department of Transportation's **Road Design Guide (2019)** *establishes uniform design criteria for Nevada roadways to supplement AASHTO's "A Policy on Geometric Design of Highways and Streets."*

Design Needs of Pedestrians

The MUTCD recommends a normal walking speed of 3.5 ft per second when calculating the pedestrian clearance interval at traffic signals. The walking speed can drop to 3 ft per second for areas with older populations and persons with mobility impairments. While the type and degree of mobility impairment varies greatly across the population, the transportation system should accommodate these users to the greatest reasonable extent.

Types of Pedestrians

Pedestrians have a variety of characteristics and the transportation network should accommodate a variety of needs, abilities, and possible impairments.

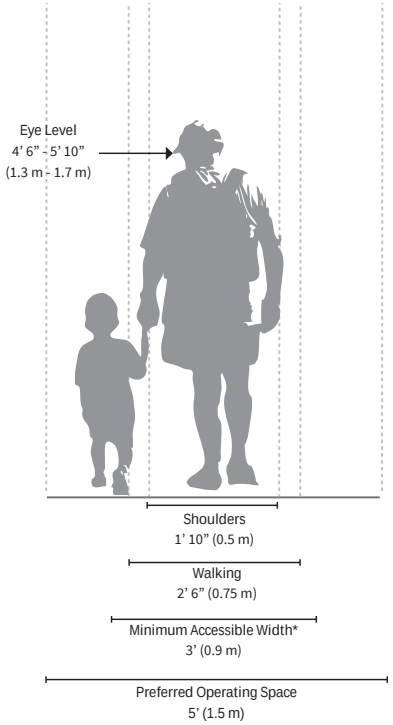
Age is one major factor that affects pedestrians' physical characteristics, walking speed, and environmental perception. Children have low eye height and walk at slower speeds than adults. They also perceive the environment differently at various stages of their cognitive development. Older adults walk more slowly and may require assistive devices for walking stability, sight, and hearing.

Disabled Pedestrian Design Considerations

The table below summarizes common physical and cognitive impairments, how they affect personal mobility, and recommendations for improved pedestrian-friendly design.

Disabled Pedestrian Design Considerations

Impairment	Effect on Mobility	Design Solution
Physical Impairment Necessitating Wheelchair and Scooter Use	Difficulty propelling over uneven or soft surfaces.	Firm, stable surfaces and structures, including ramps or beveled edges.
	Cross-slopes cause wheelchairs to veer downhill or tip sideways.	Cross-slopes of less than two percent.
	Require wider path of travel.	Sufficient width and maneuvering space.
Physical Impairment Necessitating Walking Aid Use	Difficulty negotiating steep grades and cross slopes; decreased stability and tripping hazard.	Cross-slopes of less than two percent. Smooth, non-slippery travel surface.
	Slower walking speed and reduced endurance; reduced ability to react.	Longer pedestrian signal cycles, shorter crossing distances, median refuges, and street furniture.
Hearing Impairment	Less able to detect oncoming hazards at locations with limited sight lines (e.g. driveways, angled intersections, channelized right turn lanes) and complex intersections.	Longer pedestrian signal cycles, clear sight distances, highly visible pedestrian signals and markings.
Vision Impairment	Limited perception of path ahead and obstacles; reliance on memory; reliance on non-visual indicators (e.g. sound and texture).	Accessible text (larger print and raised text), accessible pedestrian signals (APS), guide strips and detectable warning surfaces, safety barriers, and lighting.
Cognitive Impairment	Varies greatly. Can affect ability to perceive, recognize, understand, interpret, and respond to information.	Signs with pictures, universal symbols, and colors, rather than text.



At point of contact

Pedestrian Characteristics by Age

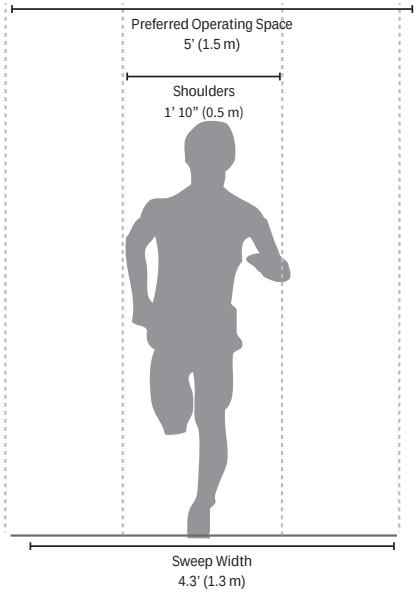
Age	Characteristics
0-4	Learning to walk
	Requires constant adult supervision
	Developing peripheral vision and depth perception
5-8	Increasing independence, but still requires supervision
	Poor depth perception
9-13	Susceptible to "darting out" in roadways
	Insufficient judgment
	Sense of invulnerability
14-18	Improved awareness of traffic environment
	Insufficient judgment
19-40	Active, aware of traffic environment
41-65	Slowing of reflexes
65+	Difficulty crossing street
	Vision loss
	Difficulty hearing vehicles approaching from behind

Source: AASHTO. Guide for the Planning, Design, and Operation of Pedestrian Facilities, Exhibit 2-1. 2004.

Design Needs of Runners

Running is an important recreation and fitness activity commonly performed on shared use paths. Many runners prefer softer surfaces (such as rubber, bare earth or crushed rock) to reduce impact. Runners can change their speed and direction frequently. If high volumes are expected, controlled interaction or separation of different types of users should be considered.

Runner Dimensions

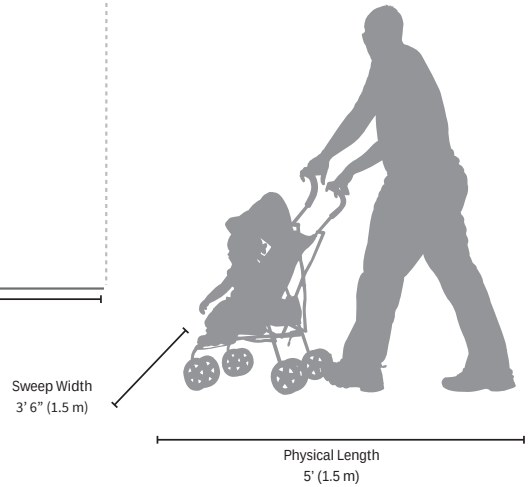


Design Needs of Strollers

Strollers are wheeled devices pushed by pedestrians to transport babies or small children. Stroller models vary greatly in their design and capacity. Some strollers are designed to accommodate a single child, others can carry 3 or more. Design needs of strollers depend on the wheel size, geometry and ability of the adult who is pushing the stroller.

Strollers commonly have small pivoting front wheels for easy maneuverability, but these wheels may limit their use on unpaved surfaces or rough pavement. Curb ramps are valuable to these users. Lateral overturning is one main safety concern for stroller users.

Stroller Dimensions



Design Needs of Wheelchair Users

As the American population ages, the age demographics in Carson City may also shift, and the number of people using mobility assistive devices (such as manual wheelchairs, powered wheelchairs) will increase.

Manual wheelchairs are self-propelled devices. Users propel themselves using push rims attached to the rear wheels. Braking is done through resisting wheel movement with the hands or arm. Alternatively, a second individual can control the wheelchair using handles attached to the back of the chair.

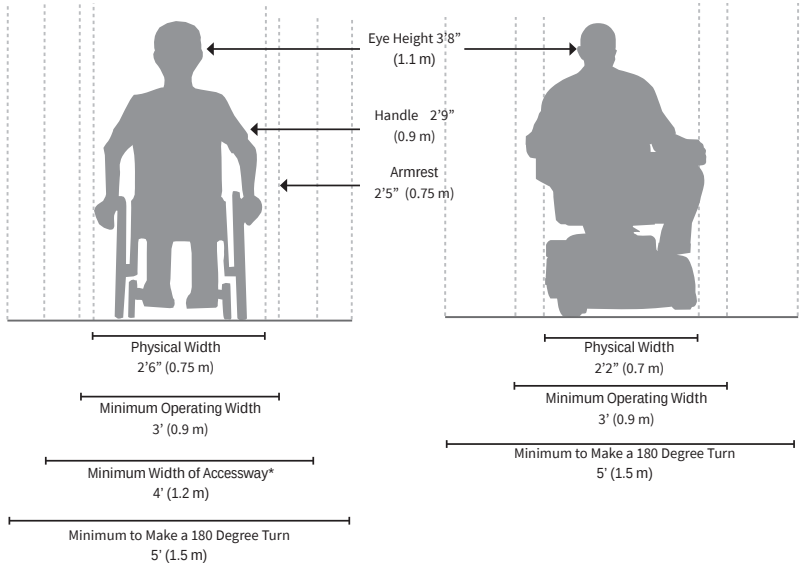
Power wheelchairs use battery power to move the wheelchair. The size and weight of power wheelchairs limit their ability to negotiate obstacles without a ramp. Various control units are available that enable users to control the wheelchair movement, based on their ability (e.g., joystick control, breath controlled, etc).

Maneuvering around a turn requires additional space for wheelchair devices. Providing adequate space for 180 degree turns at appropriate locations is an important element of accessible design.

Wheelchair User Design Considerations

Effect on Mobility	Design Solution
Difficulty propelling over uneven or soft surfaces.	Firm, stable surfaces and structures, including ramps or beveled edges.
Cross-slopes cause wheelchairs to veer downhill.	Cross-slopes of less than two percent.
Require wider path of travel.	Sufficient width and maneuvering space.

Wheelchair User Dimensions



**Provide 5' x 5' passing zone every 200' if travel way is at minimum width*

Design Needs of Bicyclists

The facility designer must have an understanding of how bicyclists operate and how their bicycle influences that operation. Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers.

By understanding the unique characteristics and needs of bicyclists, a facility designer can provide quality facilities and minimize user risk

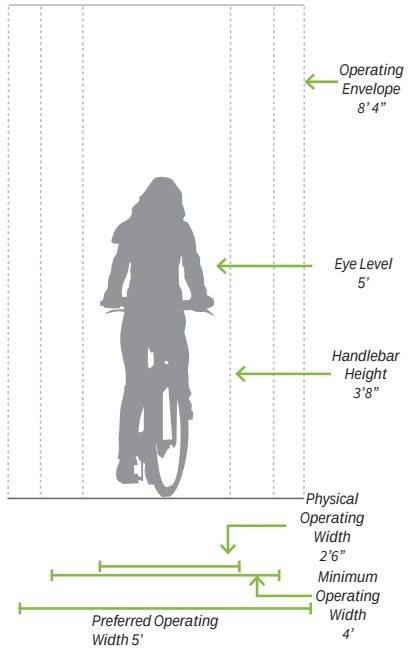
Bicycle as a Design Vehicle

Similar to motor vehicles, bicyclists and their bicycles exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle or a tricycle), and behavioral characteristics (such as the comfort level of the bicyclist). The design of a bikeway should consider reasonably expected bicycle types on the facility and utilize the appropriate dimensions.

The Bicycle Rider figure illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design. Bicyclists require clear space to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist. Bicyclists prefer five feet or more operating width, although four feet may be minimally acceptable.

In addition to the design dimensions of a typical bicycle, there are many other commonly used pedal-driven cycles and accessories to consider when planning and designing bicycle facilities. The most common types include tandem bicycles, recumbent bicycles, and trailer accessories.

Bicycle Rider - Typical Dimensions



Bicycle as Design Vehicle - Design Speed Expectations

BICYCLE TYPE	FEATURE	TYPICAL SPEED
Upright Adult Bicyclist	Paved level surfacing	8-12 mph*
	Crossing Intersections	10 mph
	Downhill	30 mph
	Uphill	5 -12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph

** Typical speed for causal riders per AASHTO 2013.*

Section 2

Pedestrian Toolbox

Marked Crosswalks

A marked crosswalk signals to motorists that they must yield to pedestrians and encourages pedestrians to cross at designated locations. Installing crosswalks alone will not necessarily enhance the comfort level of crossings. At mid-block locations, crosswalks can be marked where there is a demand for crossing and there are no nearby marked crosswalks.

Typical Use

All crosswalks should be marked at signalized intersections. At unsignalized intersections, crosswalks may be marked under the following conditions:

- At a complex intersection, to orient pedestrians in finding their way across.
- At an offset intersection, to show pedestrians the shortest route across traffic with the least exposure to vehicular traffic and traffic conflicts.
- At an intersection with visibility constraints, to position pedestrians where they can best be seen by oncoming traffic.
- At an intersection within a school zone on a walking route.

Design Features

- The crosswalk should be located to align as closely as possible with the through pedestrian zone of the sidewalk corridor.
- Users should not have to leave the crosswalk or reorient themselves from the crosswalk when accessing the curb ramp onto the sidewalk.
- See page 18 for design guidelines for curb ramps.
- High- visibility ladder, zebra, and continental crosswalk markings are preferable to standard parallel or dashed pavement markings.
- To reinforce yielding to pedestrians and reduce vehicle incursion into the crosswalk, include an advanced stop bar in advance of the crosswalk.

Marked crosswalks include standard parallel pavement markings as well as high-visibility ladder markings. Source: Google Streetview

Further Considerations

Pedestrians are sensitive to out-of-direction travel, and reasonable accommodations should be made to make crossings both convenient at locations with adequate visibility.

Continental crosswalk markings should be used at crossings with high pedestrian use or where vulnerable pedestrians are expected, including: school crossings, across arterial streets for pedestrian-only signals, at mid-block crosswalks, and at intersections where there is expected high pedestrian use and the crossing is not controlled by signals or stop signs. High-visibility crosswalks are not appropriate for all locations. Other crosswalk marking patterns are provided for in the MUTCD.

Some cities prohibit omitting or removing a marked crosswalk at intersections in order to require a three-stage pedestrian crossing. Intersections with three-stage crossings lead to arduous and increased crossing distances, pedestrian frustration, encourages jaywalking, and exhibits modal bias favoring motor vehicle level-of-service over other modes. There are circumstances when only three crosswalks are utilized and typically occur at or near interchanges and freeway ramps.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority. Thermoplastic markings offer increased durability than conventional paint.[1]

Approximate Cost

Depending on the type of material used, width of the crossing and width of the roadway, approximate installation costs are $500 for a regular striped crosswalk, $1,000 for a ladder crosswalk, and $8,000 for a patterned concrete crosswalk. In addition, the cost of a curb ramp is about $5,000-$10,000 per ramp.

Due to various number of crosswalk styles in use, signing standards, color and aesthetics, other factors will affect the final cost.

Maintenance of markings should also be considered.

1 The appropriate marking material(s) should be determined on a project basis.

Raised Pedestrian Crossings

A raised crosswalk or intersection can eliminate grade changes from the pedestrian path and give pedestrians greater prominence as they cross the street. Raised crosswalks also functions as speed tables, and encourage motorists to slow down. As such, they should be used only in cases where a special emphasis on pedestrians is desired.

Raised crosswalks are typically implemented on low-speed streets, bike boulevards and other areas of very high pedestrian activity. They are often paired with other treatments such as curb extensions for greater traffic calming effect.

Typical Use

Like a speed hump/table, raised crosswalks have a traffic slowing effect which may be unsuitable on high-speed streets, roadways with sharp curves, designated transit or freight routes, and in locations that would reduce access for emergency responders. Use detectable warnings at the curb edges to alert vision-impaired pedestrians that they are entering the roadway.

Approaches to the raised crosswalk may be designed to be similar to speed humps/tables.

Design Features

- Use detectable warnings at the curb edges to alert vision-impaired pedestrians that they are entering the roadway.
- Approaches to the raised crosswalk may be designed to be similar to speed humps.
- Drainage improvements may be required depending on the grade of the roadway.
- Special paving materials can be used to increase conspicuity of the crossing, and alert drivers to the presence of pedestrians.

Raised pedestrian crossings help reduce vehicle speeds and give pedestrians greater prominence as they cross the street.

Further Considerations

- The noise of vehicles traveling over raised crosswalks may be of concern to nearby residents and businesses.
- Refer to Americans with Disabilities Act (ADA) and California Building Code (CBC) for additional requirements.

Materials and Maintenance

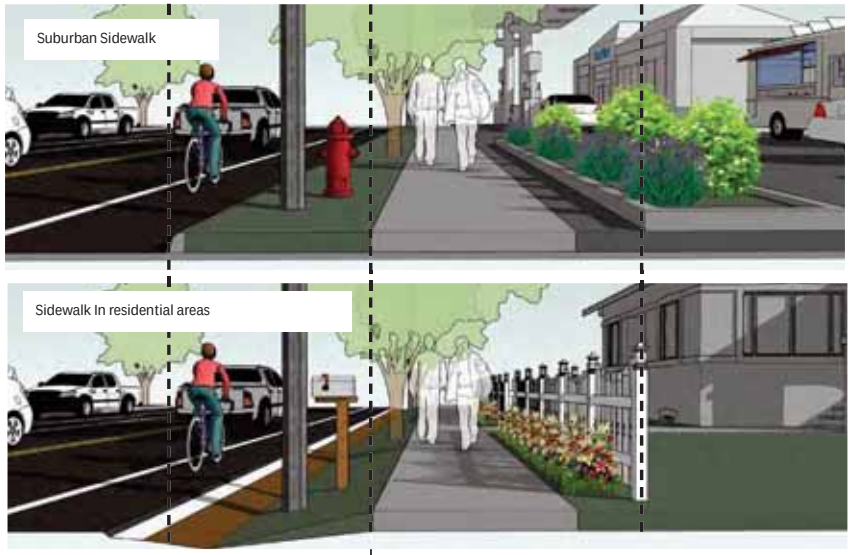
Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority. Ensure drainage used to channel stormwater past the raised intersection is kept free of debris, to prevent stormwater from backing up and pooling.

Approximate Cost

Raised crosswalks are approximately $2,000 to $15,000, depending on drainage conditions and material used.

Sidewalk Zones & Widths

Sidewalks are the most fundamental element of the walking network, as they provide an area for pedestrian travel separated from vehicle traffic. Providing adequate and accessible facilities can lead to increased numbers of people walking, improved accessibility, and the creation of social space.



Curbside Lane	Buffer Zone	Pedestrian Through Zone	Frontage Zone
The curbside lane can act as a flexible space to further buffer the sidewalk from moving traffic., and may be used for a bike lane. Curb extensions and bike corrals may occupy this space where appropriate. In the **edge zone** there should be a 6 inch wide curb.	The buffer zone, also called the furnishing or landscaping zone, buffers pedestrians from the adjacent roadway, and is also the area where elements such as street trees, signal poles, signs, and other street furniture are properly located.	The through zone is the area intended for pedestrian travel. This zone should be entirely free of permanent and temporary objects. Wide through zones are needed in downtown areas or where pedestrian flows are high.	The frontage zone allows pedestrians a comfortable “shy” distance from the building fronts. It provides opportunities for window shopping, to place signs, planters, or chairs.

Street Classification	Parking Lane/ Enhancement Zone	Buffer Zone	Pedestrian Through Zone	Frontage Zone*
Local Streets	Varies	4 - 6 ft	6 ft	N/A
Downtown and Pedestrian Priority Areas	Varies	4 - 6 ft	12 ft	2.5 - 10 ft
Arterials and Collectors	Varies	4 - 6 ft	6 - 8 ft	2.5 - 5 ft

**Indicates ideal frontage zone space. Actual frontage zone is contingent upon the City's development code and required set backs*

Typical Uses

- Wider sidewalks should be installed near schools, at transit stops, in downtown areas, or anywhere high concentrations of pedestrians exist.
- At transit stops, an 8 ft by 5 ft clear space is required for accessible passenger boarding/ alighting at the front door location per ADA requirements.
- Sidewalks should be continuous on both sides of urban commercial streets, and should be required in areas of moderate residential density (1-4 dwelling units per acre).
- When retrofitting gaps in the sidewalk network, locations near transit stops, schools, parks, public buildings, and other areas with high concentrations of pedestrians should be the highest priority.

Materials and Maintenance

Sidewalks are typically constructed out of concrete and are separated from the roadway by a curb or gutter and sometimes a landscaped boulevard. Less expensive walkways constructed of asphalt, crushed stone, or other stabilized surfaces may be appropriate. Ensure accessibility and properly maintain all surfaces regularly. Surfaces must be firm, stable, and slip resistant. Colored, patterned, or stamped concrete can add distinctive visual appeal.

Approximate Cost

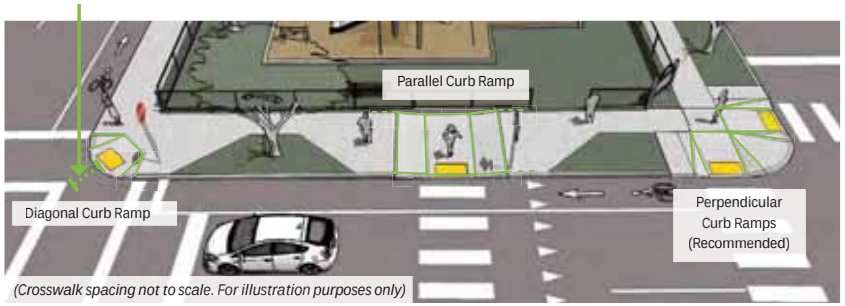
Cost of standard sidewalks range from about $25 per square foot for concrete sidewalk. This cost can increase with additional right-of-way acquisition or addition of landscaping, lighting or other aesthetic features. As an interim measure, an asphalt concrete path can be placed until such time that a standard sidewalk can be built. The cost of asphalt path can be less than half the cost of a standard sidewalk.

Curb Ramps

Curb ramps are the design elements that allow all users to make the transition from the street to the sidewalk. A sidewalk without a curb ramp can be useless to someone in a wheelchair, forcing them back to a driveway and out into the street for access. There are a number of factors to be considered in the design and placement of curb ramps.

Diagonal ramps shall include a clear space of at least 48" within the crosswalk for user maneuverability

Curb ramps shall be located so that they do not project into vehicular traffic lanes, parking spaces, or parking access aisles. Three configurations are illustrated below.



(Crosswalk spacing not to scale. For illustration purposes only)

Typical Use

- Curb ramps must be installed at all intersections and midblock locations where pedestrian crossings exist, as mandated by federal legislation (1973 Rehabilitation Act and ADA 1990). All newly constructed and altered roadway projects must include curb ramps. In addition, existing facilities must be upgraded to current standards when appropriate.
- The edge of an ADA compliant curb ramp shall be marked with a tactile warning device (also known as truncated domes) to alert people with visual impairments to changes in the pedestrian environment. Contrast between the raised tactile device and the surrounding infrastructure is important so that the change is readily evident to partially sighted pedestrians. These devices are most effective when adjacent to smooth pavement so the difference is easily detected.

Design Features

- The level landing at the top of a ramp shall be at least 4 feet long and at least the same width as the ramp itself. The slope of the ramp shall be compliant to current standards.
- If the ramp runs directly into a crosswalk, the landing at the bottom will be in the roadway.
- If the top landing is within the sidewalk or corner area where someone in a wheelchair may have to change direction, the landing must be a minimum of 4'-0" long (in the direction of the ramp run) and at least as wide as the ramp, although a width of 5'-0" is preferred.

Not recommended: diagonal curb ramp configuration. Source: Google Streetview

Recommended: Bulb-Out with bidirectional curb ramps for crossing in both directions. Source: Google Streetview

Further Considerations

Where feasible, separate directional curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp at a corner for both crosswalks. Although diagonal curb ramps might save money, they orient pedestrians directly into the traffic zone, which can be challenging for wheelchair users and pedestrians with visual impairment. Diagonal curb ramp configurations are not recommended.

Curb return radii need to be considered when designing directional ramps. While curb ramps are needed for use on all types of streets, the highest priority locations are in downtown areas and on streets near transit stops, schools, parks, medical facilities, shopping areas.

Materials and Maintenance

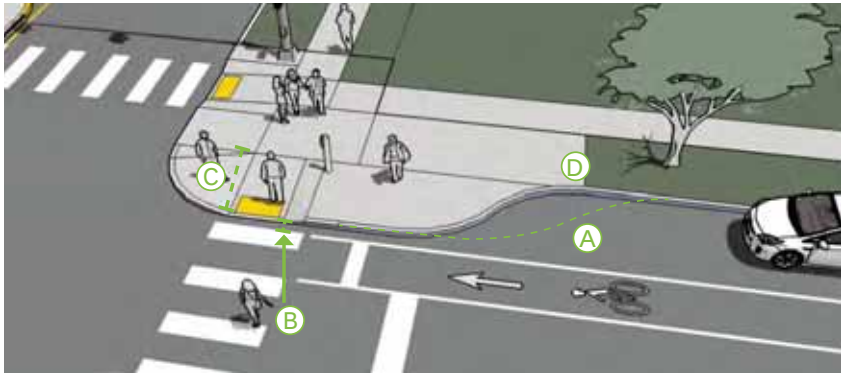
It is critical that the interface between a curb ramp and the street be maintained adequately. Asphalt street sections can develop potholes at the foot of the ramp, which can catch the front wheels of a wheelchair.

Approximate Cost

The cost is approximately $5,000-$10,000 per curb ramp depending on drainage and right-of-way.

Curb Extensions

Curb extensions minimize pedestrian exposure during crossing by shortening crossing distance and giving pedestrians a better chance to see and be seen before committing to crossing.



Typical Use

- Within parking lanes appropriate for any crosswalk where it is desirable to shorten the crossing distance and there is a parking lane adjacent to the curb.
- May be possible within non-travel areas on roadways with excess space.
- Particularly helpful at midblock crossing locations.
- Curb extensions should not impede bicycle travel in the absence of a bike lane.
- Curb extensions are often utilized as in-lane transit stops, allowing passengers to board and alight outside of the pedestrian through zone.

Materials and Maintenance

Planted curb extensions may be designed as a bioswale, a vegetated system for stormwater management. To maintain proper stormwater drainage, curb extensions can be constructed as refuge islands offset by a drainage channel or feature a covered trench drain.

Design Features

Ⓐ For purposes of efficient street sweeping, the minimum radius for the reverse curves of the transition is 10 ft and the two radii should be balanced to be nearly equal.

Ⓑ When a bike lane is present, the curb extensions should terminate one foot short of the parking lane to enhance bicyclist access.

Ⓒ Reduces pedestrian crossing distance by 6-8 ft.

Ⓓ Planted curb extensions may be designed as a bioswale for stormwater management.

Approximate Cost

The cost of a curb extension can range from $2,000 to $20,000 depending on the design and site condition, with the typical cost approximately $12,000. Green/vegetated curb extensions cost between $10,000 to $40,000.

Median Refuge Islands

Median refuge islands are located at the mid-point of a marked crossing and help improve pedestrian access by increasing pedestrian visibility and allowing pedestrians to cross one direction of traffic at a time. Refuge islands minimize pedestrian exposure at mid-block crossings by shortening the crossing distance and increasing the number of available gaps for crossing.

Typical Use

- Refuge islands an be applied on any roadway with a left turn center lane or median that is at least 6' wide. Islands are appropriate at signalized or unsignalized crosswalks.
- The refuge island must be accessible, preferably with an at-grade passage through the island rather than ramps and landings.
- The island should be at least 6' wide between travel lanes (to accommodate wheelchair users) and at least 20' long (40' minimum preferred).
- Provide double centerline marking, reflectors, and "KEEP RIGHT" signage (MUTCD R4-7a) in the island on streets with posted speeds above 25 mph.

Materials and Maintenance

Refuge islands may require frequent maintenance of road debris. Trees and plantings in a landscaped median must be maintained so as not to impair visibility, and should be no higher than 1 foot 6 inches.

Design Features

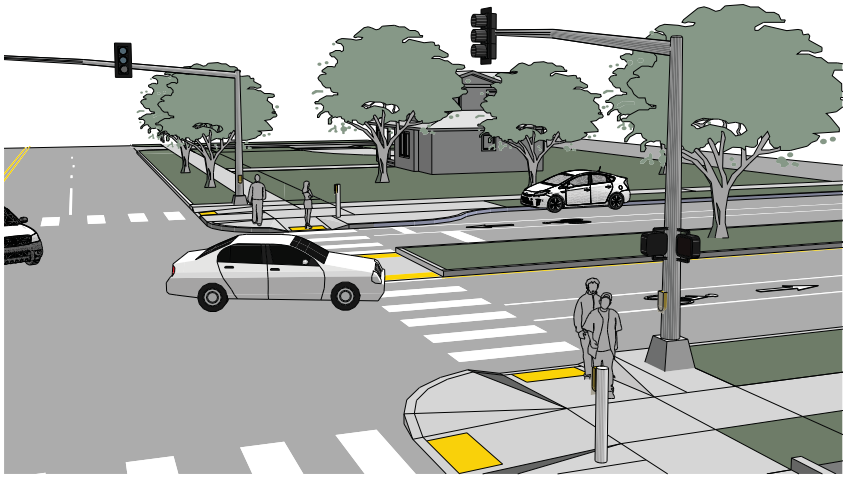
- Median refuge islands can be installed on roadways with existing medians or on multi-lane roadways where adequate space exists
- Median Refuge Islands should always be paired with crosswalks, and should include advance pedestrian warning signage when installed at uncontrolled crossings.
- On multi-lane roadways, consider configuration with active warning beacons for improved yielding compliance.

Approximate Cost

The approximate cost to install a median refuge island ranges from $500 to $1,100 per foot, or about $3,500 to $4,000, depending on the design, site conditions, landscaping, and whether the median can be added as a part of a larger street reconstruction project or utility upgrade.

Pedestrian Signalization Improvements

Pedestrian signal heads indicate to pedestrians when to cross at a signalized crosswalk. All traffic signals should be equipped with pedestrian signal indications except where pedestrian crossing is prohibited by signage. Pedestrian signals should be used at traffic signals wherever warranted, according to the MUTCD.



Typical Use

- Countdown pedestrian signals are particularly valuable for pedestrians, as they indicate whether a pedestrian has time to cross the street before the signal phase ends. Countdown signals should be used at all new and rehabilitated signalized intersections.
- Adequate pedestrian crossing time is a critical element of the walking environment at signalized intersections. The length of a signal phase with parallel pedestrian movements should provide sufficient time for a pedestrian to safely cross the adjacent street.
- There are several types of signal timing for pedestrian signals, including concurrent, exclusive, "Leading pedestrian interval" (LPI), and all-red interval. In general, shorter cycle lengths and extended walk intervals provide better service to pedestrians and encourage better signal compliance. For optimal pedestrian service, fixed-time signal operation usually works best.
- Leading Pedestrian Intervals (LPI) are used to reduce right turn and permissive left turn vehicle and pedestrian conflicts. The through pedestrian interval is initiated first, in advance of the concurrent through/right/permissive left turn interval. The LPI minimizes vehicle-pedestrian conflicts because it gives pedestrians a 3-10 second head start into the intersection, thereby making them more visible, and reducing crossing exposure time. Accessible Pedestrian Signals (APS) are recommended with an LPI.
- Automated pedestrian phases are preferred to passive or active detection, particularly in areas of high pedestrian activity.

A Pedestrian Island in large intersections helps shorten crossing distances. Source: Google Streetview

Design Features

- The MUTCD recommends that traffic signal timing assumes a pedestrian walking speed of 3.5 ft per second.[1]
- At crossings where older pedestrians or pedestrians with disabilities are expected, crossing speeds as low as 3 ft per second should be assumed. Special pedestrian phases can be used to provide greater visibility or more crossing time for pedestrians at certain intersections.
- Pedestrian pushbuttons may be installed at locations where pedestrians are expected intermittently. Otherwise, pedestrian signals should be automated with traffic signals. When used, pushbuttons should be well signed and within reach and operable from a flat surface for pedestrians in wheelchairs and with visual disabilities. They should be conveniently placed in the area where pedestrians wait to cross. Section 4E.09 within the MUTCD provides detailed guidance for the placement of pushbuttons to ensure accessibility.

Further Considerations

- When pushbuttons are used, they should be located so that someone in a wheelchair can reach the button from a level area of the sidewalk without deviating significantly from the natural line of travel into the crosswalk. Pushbuttons should be marked (for example, with arrows) so that it is clear which signal is affected.
- In areas with very heavy pedestrian traffic, consider an all-pedestrian signal phase to give pedestrians free passage in the intersection when all motor vehicle traffic movements are stopped.
- An exclusive pedestrian signal phase called a "Pedestrian Scramble" can be provided to reduce vehicle turning conflicts.

Materials and Maintenance

It is important to perform ongoing maintenance of traffic control equipment. Consider semi-annual inspections of controller and signal equipment, intersection hardware, and detectors.

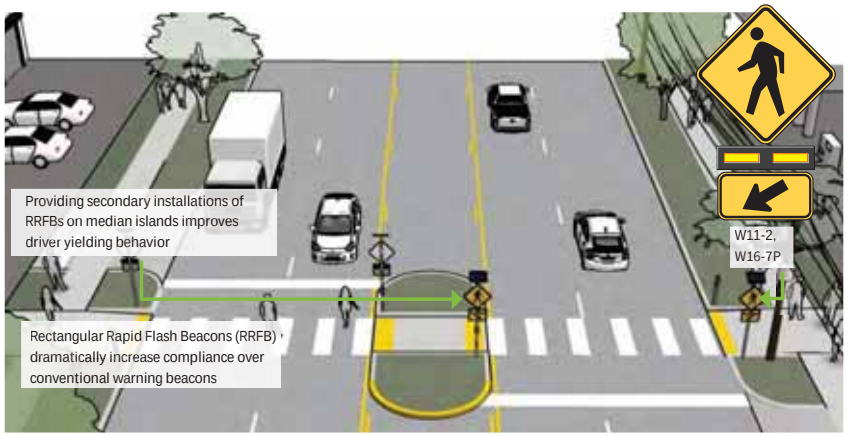
Approximate Cost

Adjusting signal timing is relatively inexpensive, as it requires only a few hours of staff time to accomplish. New signal equipment ranges from $20,000 to $140,000.

1 In Carson City, 3.5 ft per second is used for the Flashing Don't Walk (FDW) interval and 3.0 ft per second for the WALK interval.

Rectangular Rapid Flashing Beacons (RRFB)

Rectangular Rapid Flash Beacons (RRFB) are a type of active warning beacon used at unsignalized crossings. They are designed to increase motor vehicle yielding compliance on multi-lane or high-volume roadways. Guidance for marked/unsignalized crossings applies.



Typical Use

RRFBs are typically activated by pedestrians manually with a pushbutton, or can be actuated automatically with passive detection systems.

RRFBs shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.

RRFBs shall initiate operation based on user actuation and shall cease operation at a predetermined time after the user actuation or, with passive detection, after the user clears the crosswalk.

Materials and Maintenance

RRFBs should be regularly maintained to ensure that all lights and detection hardware are functional.

Design Features

Guidance for marked/unsignalized crossings applies.

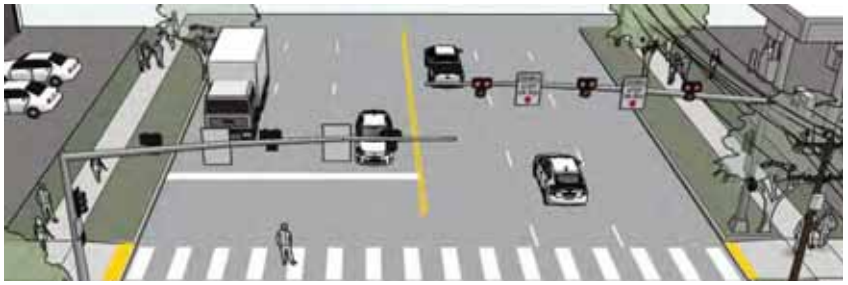
- A study of the effectiveness of going from a no-beacon arrangement to a two-beacon RRFB installation increased yielding from 18 percent to 81 percent. A four-beacon arrangement raised compliance to 88%. Additional studies of long term installations show little to no decrease in yielding behavior over time.
- See FHWA Interim Approval 21 (IA-21) for more information on device application standards.

Approximate Cost

RRFBs range in price from $5,000 to $20,000 for a solar powered unit depending on the location, width of the road and other factors.

Pedestrian Hybrid Beacon (PHB)

Hybrid beacons or High-Intensity Activated Crosswalk (HAWK) beacons are used to improve unsignalized intersections or midblock crossings of major streets. It consists of a signal head with two red lenses over a single yellow lens on the major street, and a pedestrian signal head for the crosswalk. The signal is only activated when a pedestrian and/or bicyclist is present, resulting in minimal delay for motor vehicle traffic.



Typical Use

PHBs are only used at marked mid-block crossings or unsignalized intersections. They are typically activated with a pedestrian pushbutton at each end. If a median refuge island is used at the crossing, another pedestrian pushbutton can be located on the island to create a two-stage crossing.

Design Features

- PHBs may be installed without meeting traffic signal control warrants if roadway speed and volumes are excessive for comfortable pedestrian crossings.
- If installed within a signal system, signal engineers should evaluate the need for the PHB to be coordinated with other signals.
- The MUTCD recommends but does not require that PHBs be installed at least 100 feet from side streets that are controlled by stop or yield signs. Many agencies have implemented successful projects at otherwise uncontrolled intersections.
- Parking and other sight obstructions should be prohibited for at least 100 feet in advance and at least 20 feet beyond the marked crosswalk to provide adequate sight distance.

Further Considerations

- PHBs may also be actuated by infrared, microwave, or video detectors.
- Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity, and safety.
- The installation of PHBs should also include public education and enforcement campaigns to ensure proper use and compliance.

Materials and Maintenance

PHBs are subject to the same maintenance needs and requirements as standard traffic signals. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

Approximate Cost

PHBs are more expensive than other beacons, ranging in costs from $150,000 to $250,000, but are generally less expensive than full signals. PHBs may be side mounted in some contexts or solar powered to provide additional flexibility and costs closer to a RRFB installation.

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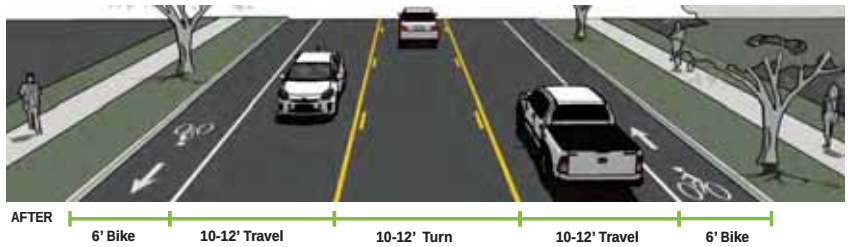
Section 3

Bicycle Toolbox

Lane Reconfigurations and Road Diets

Streets with excess roadway capacity or wider lanes often make excellent candidates for lane reconfigurations or road diet projects. The removal of a single travel lane will generally provide sufficient space for bike lanes on both sides of a street. Even if the width of the sidewalk does not increase, pedestrians benefit from the buffer that the new bike lanes create between the sidewalk and travel lanes. Although the actual roadway crossing distance has not been reduced, the addition of bike lanes reduces the number of vehicle travel lanes pedestrians must cross.



Typical Use

- Depending on a street's existing configuration, traffic operations, user needs, and comfort level, various lane reconfigurations may be appropriate.
- For instance, a four-lane street (with two travel lanes in each direction) could be modified to provide one travel lane in each direction, a center turn lane, and bike lanes.
- Prior to implementing this measure, a traffic analysis should identify potential impacts, including diversion to other parallel neighborhood streets. Road diets should also consider school, city bus, emergency service access, and other truck volumes.

Design Features

- Narrower lanes generally encourage slower vehicle speeds, higher comfort for people walking and biking.
- Vehicle lane width: Width depends on project. No narrowing may be needed if a lane is removed. Lanes along transit and freight routes may need a minimum of 11 feet to accommodate larger vehicles.
- Bicycle lane width: Standard bicycle lane width is 5-6 feet as measured from the face of the curb. A buffered bike lane requires an additional 2-3 feet.
- Number of Lanes: Generally, 3 lanes with a center turn lane can provide a capacity of 20,000 vehicles per day., with some examples carrying over 24,000 vehicles per day.

Before-and-after road reconfiguration on Duquesne Avenue in Culver City, CA. General Flow lanes were narrowed to make way for a bike lane while retaining parking.

Materials and Maintenance

Road configurations are often paired with the road repaving schedule to reduce costs. Use bicycle compatible drainage grates, and ensure they are flush with the pavement.

Approximate Cost

Adding striped shoulders can cost as little as $1,000 per mile if old paint does not need to be removed.

The cost for restriping a street to bike lanes or reducing the number of lanes to add on-street parking is approximately $11 per foot on street, depending on the number of lane lines to be removed.

The approximate cost for restriping a roadway as depicted can range from $10,000-$60,000 per mile.

Bike Boulevards

A Bike Boulevard is a low-speed, low-volume roadway that is designed to enhance comfort and convenience for people bicycling. It provides better conditions for bicycling while improving the neighborhood character and maintaining emergency vehicle access. Bike Boulevards are intended to serve as a low-stress bikeway network, providing direct, and convenient routes across Carson City. Key elements of Bike Boulevards are unique signage and pavement markings, traffic calming and diversion features to maintain low vehicle volumes, and convenient major street crossings.

Typical Use

- Parallel with, and in close proximity to major thoroughfares (1/4 mile or less) on low-volume, low-speed streets.
- Follow a desire line for bicycle travel that is ideally long and relatively continuous (2-5 miles).
- Avoid alignments with excessive zigzag or circuitous routing. The bikeway should have less than 10% out of direction travel compared to shortest path of primary corridor.
- Local streets with traffic volumes of fewer than 3,000 vehicles per day and posted speed limits of 25 miles per hour. Utilize traffic calming to maintain or establish low volumes and discourage vehicle cut through / speeding.

Design Features

- Signs and pavement markings are the minimum treatments necessary to designate a street as a bike boulevard.
- Implement volume control treatments based on the context of the bike boulevard, using engineering judgment. While motor vehicle volumes should not exceed 3,000 vehicles per day, ideal conditions are 1,500 vehicles per day or less.
- Intersection crossings should be designed to enhance comfort and minimize delay for bicyclists of diverse skills and abilities

A Painted Intersection, planters, and curb extensions to reinforce that the street is intended for local, slow-speed use instead of cut-through vehicle traffic.

An example of an large pavement marking to reinforce that the street is a Bike Boulevard.

Further Considerations

- Bike Boulevards are established on streets that improve connectivity to key destinations and provide a direct, low-stress route for bicyclists, with low motorized traffic volumes and speeds, designated and designed to give bicycle travel priority over other modes.
- Bike Boulevard retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists, these intersections can become major barriers along the Bike Boulevard.
- Traffic calming can deter motorists from driving on a street. Anticipate and monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.

Materials and Maintenance

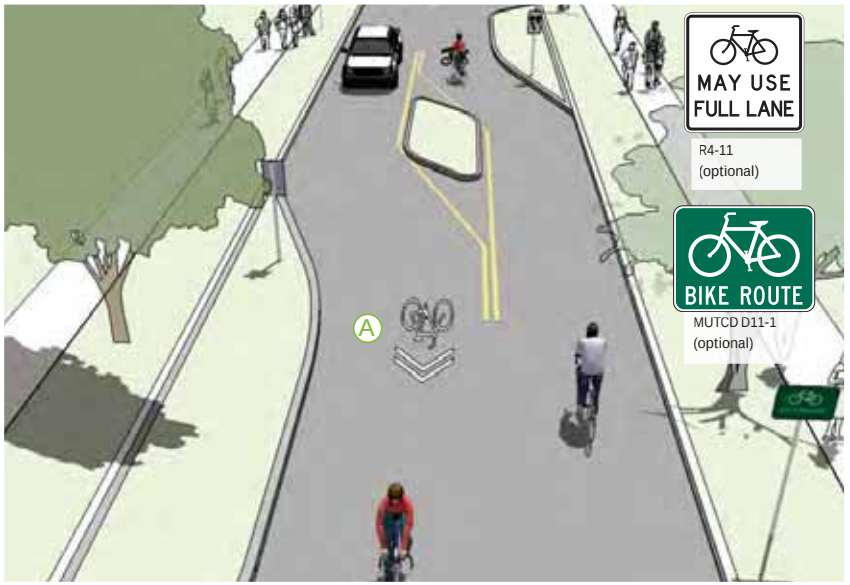
Bike Boulevards require few additional maintenance requirements to local roadways. Signage, signals, and other traffic calming elements should be inspected and maintained according to local standards.

Approximate Cost

Costs vary depending on the type of treatments proposed for the corridor. Simple treatments such as wayfinding signage and markings are most cost-effective, but more intensive treatments will have greater impact at lowering speeds and volumes, at higher cost. Costs can range from $5,000/mile on the simple end to $50,000/mile for significant horizontal deflection and diversion.

Shared Lane Markings

Shared Lane Marking (SLM) or “Sharrow” stencils are lane positioning stencils that can enhance shared roadways. The MUTCD approved pavement marking can serve a number of purposes, such as making motorists aware of the need to share the road with bicyclists, showing bicyclists the direction of travel, and, with proper placement, reminding bicyclists to bike further from parked cars to prevent collisions with drivers opening car doors.



Typical Use

- Shared Lane Markings are not appropriate on paved shoulders or in bike lanes, and should not be used on roadways that have a posted speed greater than 35 mph.
- Shared Lane Markings should be implemented in conjunction with BIKES MAY USE FULL LANE signs.

Design Features

Ⓐ Placement in the center of the travel lane is preferred in constrained conditions.

- Markings should be placed immediately after intersections and spaced at 250 foot intervals thereafter.
- The MUTCD recommends centering the marking a minimum of 11 feet from the curb face with on-street parking and a minimum of 4 feet from the curb with no parking. Larger offsets are frequently desirable.

Sharrows also serve as positional guidance and raise bicycle awareness where there is not space to accommodate a full-width bike lane. Center lane markings may or may not be necessary depending on travel lane widths. Narrower two way residential streets (less than 22 ft between parked cars) have a natural traffic calming effect without center turn lanes.

Further Considerations

- Consider modifications to signal timing to induce a bicycle-friendly travel speed for all users.
- Though not always possible, placing the markings outside of vehicle tire tracks will increase the life of the markings and the long-term cost of the treatment.
- A green thermoplastic background can be applied to further increase the visibility of the shared lane marking.

Materials and Maintenance

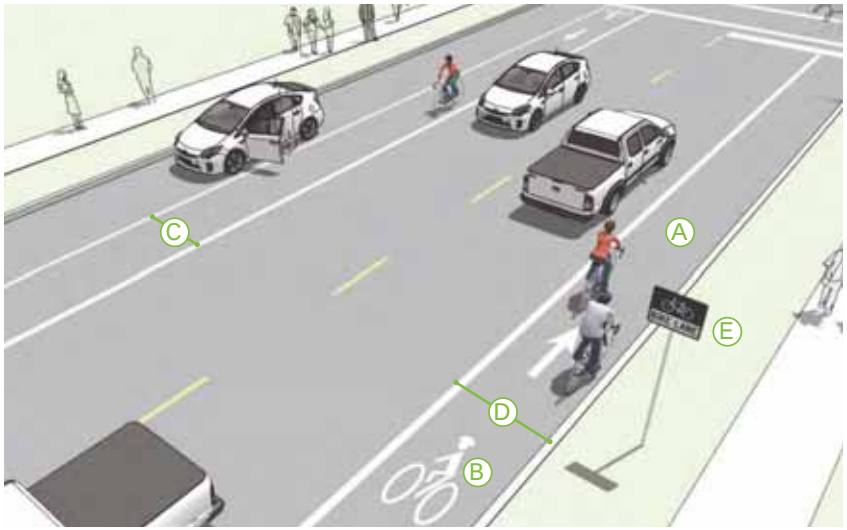
- Shared lane markings should be inspected annually and maintained accordingly, especially if located on roadways that feature high vehicle turning movements, or bus, or truck traffic. They can be placed in the center of the lane of travel to reduce wear from vehicles.

Approximate Cost

Sharrows typically cost $200 per each marking for a lane-mile cost of $4,200, assuming the MUTCD guidance of sharrow placement every 250 feet.

Bicycle Lanes

On-street bike lanes designate an exclusive space for bicyclists through the use of pavement markings and signs. The bike lane is located directly adjacent to motor vehicle travel lanes and is used in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge or parking lane.



Typical Use

- Bike lanes may be used on any street with adequate space, but are most effective on streets with moderate traffic volumes ≤ 6,000 ADT (≤ 3,000 preferred).
- Bike lanes are most appropriate on streets with lower to moderate speeds ≤ 25 mph.
- Appropriate for skilled adult riders on most streets.
- May be appropriate for children when configured as 6+ ft wide lanes on lower-speed, lower-volume streets with one lane in each direction.

Design Features

Ⓐ Mark inside line with 6" stripe. **(MUTCD 9C.04)** Mark 4" parking lane line or "Ts".

Ⓑ Include a bicycle lane marking **(MUTCD Figure 9C-3)** at the beginning of blocks and at regular intervals along the route. **(MUTCD 9C.04)**

Ⓒ 6 foot width preferred adjacent to on-street parking, (5 foot min.)

Ⓓ 5–6 foot preferred adjacent to curb and gutter (4 foot min.) or 4 feet more than the gutter pan width.

Ⓔ The R3-17 "Bike Lane" sign is optional, but recommended in most contexts.

Further Considerations

- On high speed streets (≥ 40 mph) the minimum bike lane should be 6 feet.
- It may be desirable to reduce the width of general purpose travel lanes in order to add or widen bicycle lanes.
- On multi-lane streets, the most appropriate bicycle facility to provide for user comfort may be buffered bicycle lanes or physically separated bicycle lanes.

Manhole Covers and Grates:

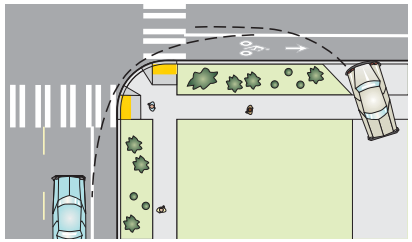
- Manhole surfaces should be manufactured with a shallow surface texture in the form of a tight, nonlinear pattern
- If manholes or other utility access boxes are to be located in bike lanes within 50 ft. of intersections or within 20 ft. of driveways or other bicycle access points, special manufactured permanent nonstick surfaces are required to ensure a controlled travel surface for cyclists breaking or turning.
- Manholes, drainage grates, or other obstacles should be set flush with the paved roadway. Roadway surface inconsistencies pose a threat to safe riding conditions for bicyclists. Construction of manholes, access panels or other drainage elements should be constructed with no variation in the surface. The maximum allowable tolerance in vertical roadway surface will be 1/4 of an inch.

Materials and Maintenance

Bike lane striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Bike lanes should also be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Bike lanes provided dedicated spaces for cyclists to ride on the street.



Place Bike Lane Symbols to Reduce Wear

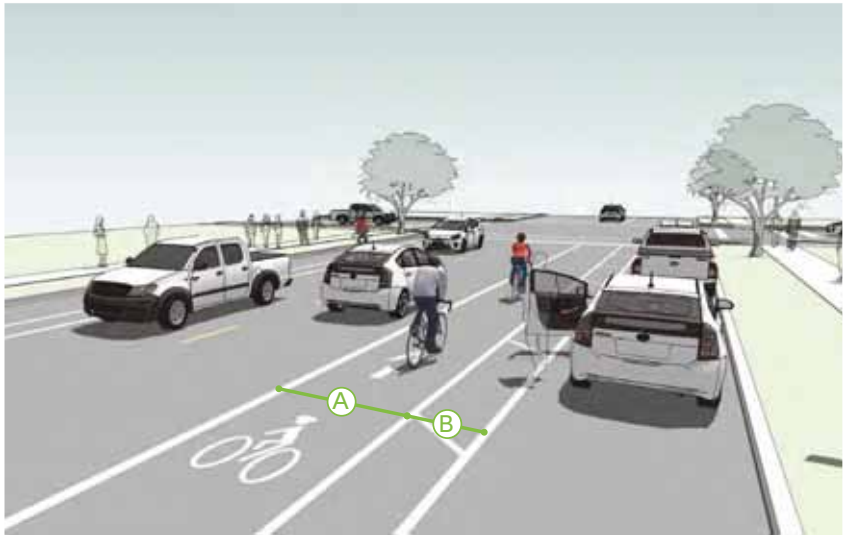
Bike lane word, symbol, and/or arrow markings ***(MUTCD Figure 9C-3)*** *shall be placed outside of the motor vehicle tread path in order to minimize wear from the motor vehicle path.* **(NACTO 2012)**

Approximate Cost

The cost for installing bicycle lanes varies and will depend on the implementation approach. Typical costs are $16,000 per mile for restriping using paint. More durable thermoplastic materials and the cost of repaving, or removing/replacing existing vehicle lane striping is not accounted for in this estimate. .

Buffered Bicycle Lanes

Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space, separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane.



Typical Use

- Anywhere a conventional bike lane is being considered.
- While conventional bike lanes are most appropriate on streets with lower to moderate speeds (≤ 25 mph), buffered bike lanes are appropriate on streets with higher speeds (+25 mph) and high volumes or high truck volumes (up to 6,000 ADT).
- On streets with extra lanes or lane width.
- Appropriate for skilled adult riders on most streets.

Design Features

Ⓐ The minimum bicycle travel area (not including buffer) is 5 feet wide.

Ⓑ Buffers should be at least 2 feet wide. If buffer area is 4 feet or wider, white chevron or diagonal markings should be used.

- For clarity at driveways or minor street crossings, consider a dotted line.
- There is no standard for whether the buffer is configured on the parking side, the travel side, or a combination of both.

Buffered bike lanes should consider both vehicular traffic and parked cars.

The use of additional pavement markings delineates space between vehicles and cyclists.

Further Considerations

- Color may be used within the lane to discourage motorists from entering the buffered lane.
- A study of buffered bicycle lanes found that, in order to make the facilities successful, there needs to also be driver education, improved signage and proper pavement markings.[1]
- On multi-lane streets with high vehicles speeds, the most appropriate bicycle facility to provide for user comfort may be physically separated bike lanes.
- NCHRP Report #766 recommends, when space is limited, installing a buffer space between the parking lane and bicycle lane where on-street parking is permitted rather than between the bicycle lane and vehicle travel lane.[2]

Materials and Maintenance

Bike lane striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Bike lanes should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Approximate Cost

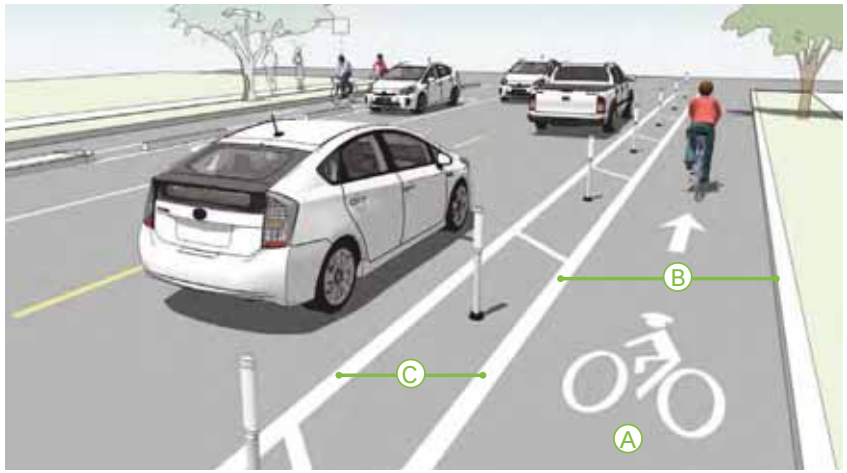
The cost for installing buffered bicycle lanes will depend on the implementation approach. Typical costs are $16,000 per mile for paint based restriping. More durable thermoplastic materials and the cost of repaving, or removing/replacing existing vehicle lane striping is not accounted for in this estimate.

1 Monsere, C.; McNeil, N.; and Dill, J., "Evaluation of Innovative Bicycle Facilities: SW Broadway Cycle Track and SW Stark/ Oak Street Buffered Bike Lanes. Final Report" (2011).Urban Studies and Planning Faculty Publications and Presentations.

2 National Cooperative Highway Research Program. Report #766: Recommended Bicycle Lane Widths for Various Roadway Characteristics.

One-Way Separated Bikeway

One-way separated bikeways, also known as protected bikeways or cycle tracks, are on-street bikeway facilities that are separated from vehicle traffic. Physical separation is provided by a barrier between the bikeway and the vehicular travel lane. These barriers can include flexible posts, bollards, parking, planter strips, extruded curbs, or on-street parking. Separated bikeways using these barrier elements typically share the same elevation as adjacent travel lanes, but the bikeway could also be raised above street level, either below or equivalent to sidewalk level.



Typical Use

- Along streets on which conventional bicycle lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high bicycle volumes, high motor traffic volumes (9,000-30,000 ADT), higher traffic speeds (25+ mph), high incidence of double parking, higher truck traffic (10% of total ADT) and high parking turnover.
- Along streets for which conflicts at intersections can be effectively mitigated using parking lane setbacks, bicycle markings through the intersection, and other signalized intersection treatments.

Design Features

Ⓐ Pavement markings, symbols and/or arrow markings must be placed at the beginning of the separated bikeway and at intervals along the facility based on engineering judgment to define the bike direction. (MUTCD 9C.04)

Ⓑ 7 foot width preferred in areas with high bicycle volumes or uphill sections to facilitate safe passing behavior (5 ft minimum).

Ⓒ When placed adjacent to parking, the parking buffer should be 3 ft wide to allow for passenger loading and to prevent door collisions.

- When placed adjacent to a travel lane, one-way raised cycle tracks may be configured with a mountable curb to allow entry and exit from the bicycle lane for passing other bicyclists or to access vehicular turn lanes.

Parked cars serve as a barrier between bicyclists and the vehicle lane. Barriers could also include flexible posts, bollards, planters, or other design elements. Source: Bike East Bay

Further Considerations

- If the buffer area is 4 feet or wider, white chevron or diagonal markings should be used. Curbs may be used as a channeling device. Grade-separation provides an enhanced level of separation in addition to buffers and other barrier types.
- Where possible, physical barriers such as removable curbs should be oriented towards the inside edge of the buffer to provide as much extra width as possible for bicycle use.
- A retrofit separated bikeway has a relatively low implementation cost compared to road reconstruction by making use of existing pavement and drainage and using a parking lane as a barrier.
- Gutters, drainage outlets and utility covers should be designed and configured as not to impact bicycle travel.
- For clarity at major or minor street crossings, consider a dotted line for the buffer boundary where cars are expected to cross.
- Special consideration should be given at transit stops to manage bicycle and pedestrian interactions.

Materials and Maintenance

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Bikeways should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

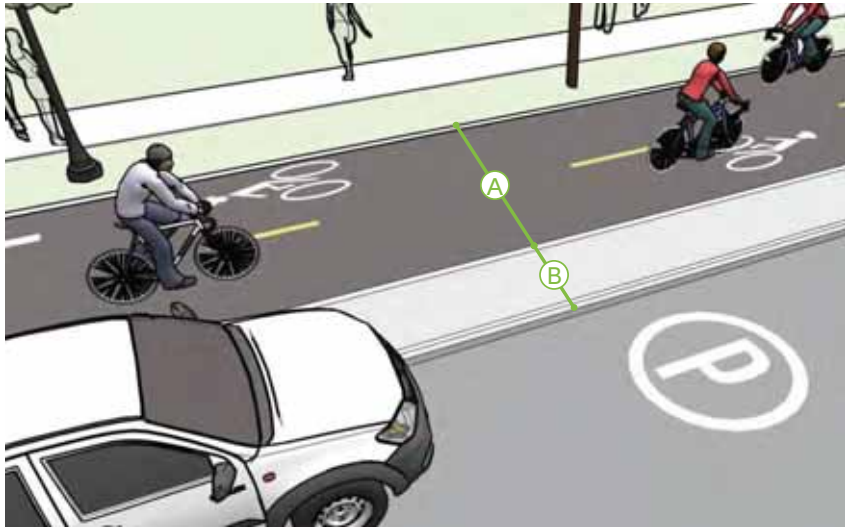
Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway,

Approximate Cost

Separated bikeway construction costs can vary drastically depending on the type of separation used, the amount of new curb and gutter, stormwater mitigation, and crossing treatments. On the lower end of the scale, construction of a striped parking protected bikeway without delineators or other vertical elements can cost as little as $16,000 per mile.

Two-Way Separated Bikeway

Two-Way Separated Bikeways are bicycle facilities that allow bicycle movement in both directions on one side of the road. Two-way separated bikeways share some of the same design characteristics as one-way separated bikeways, but often require additional considerations at driveway and side-street crossings, and intersections with other bikeways.



Typical Use

- Works best on the left side of one-way streets.
- Streets with high motor vehicle volumes and/or speeds
- Streets with high bicycle volumes.
- Streets with a high incidence of wrong-way bicycle riding.
- Streets with few conflicts such as driveways or cross-streets on one side of the street.
- Streets that connect to shared use paths.

Design Features

(A) 12 foot operating width preferred (10 ft minimum) width for two-way facility.

- In constrained locations an 8 foot minimum operating width may be considered.

(B) Adjacent to on-street parking a 3 foot minimum width channelized buffer or island shall be provided to accommodate opening doors. (NACTO, 2012

- Additional signalization and signs may be necessary to manage conflicts.

Two-Way Separated Bikeway

A two-way facility can accommodate cyclists in two directions of travel.

Further Considerations

- A two-way separated bikeway on one way street should be located on the left side.
- A two-way separated bikeway may be configured at street level or as a raised separated bikeway with vertical separation from the adjacent travel lane.
- Two-way separated bikeways should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles.

Materials and Maintenance

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Bikeways should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

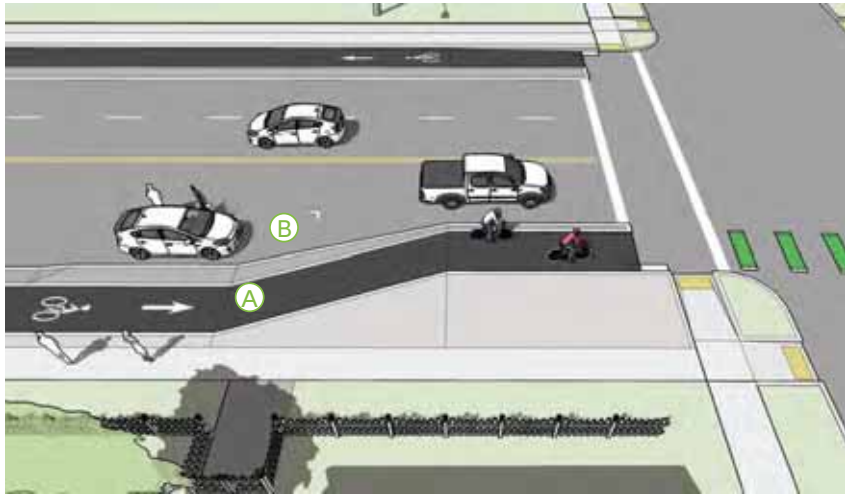
Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway.

Approximate Cost

Separated bikeway construction costs can vary drastically depending on the type of separation used, the amount of new curb and gutter, stormwater mitigation, and crossing treatments. On the lower end of the scale, construction of a striped parking protected bikeway with delineators or other vertical elements can cost as little as $15,000-$30,000 per mile.

Bend-In

To increase the visibility of bicyclists for turning motorists, a “bend-in” intersection approach laterally shifts the separated bikeway immediately adjacent to the turning lane.



Typical Use

- Bikeways separated by a visually intensive buffer or on-street parking.
- Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.
- Where space is not available to bend-out the bikeway prior to the intersection.

Design Features

Ⓐ At least 20 ft prior to an intersection, provide between 20 – 40 ft of length to shift the bikeway closer to motor vehicle traffic.

Ⓑ Where the separated bikeway uses parked cars within the buffer zone, parking must be prohibited at the start of the transition.

- Place a “Turning Vehicles Yield to Bikes” sign (modified MUTCD R10-15) prior to the intersection.
- Optional - Provide a narrow buffer with vertical delineators between the travel and lane and bikeway to increase comfort for bicycle riders and slow driver turning speed.

Clear sight lines at intersections and driveways for people on bikes and people driving are an important aspect of this design.

The approach to an adjacent crossing intersection in Vancouver, BC.

Further Considerations

- The design creates an opportunity for a curb extension, to reduce pedestrian crossing distance. This curb extension can also create public space which can be used bike parking corrals, bikeshare stations, parklets, public art exhibits, and/or stormwater features such as bioswales.
- Can be paired with intersection crossing markings such as green colored pavement to raise awareness of conflict points.

Materials and Maintenance

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

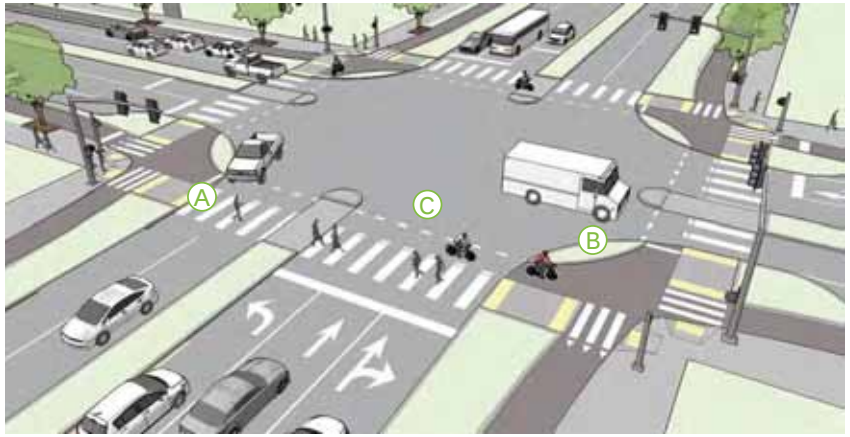
Bikeway should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Approximate Cost

The costs of the lateral shift or protected intersection elements vary depending on materials used and degree of implementation desired. Inexpensive materials can used, such as paint, concrete planters, and bollards.

Protected Intersection

A protected intersection, or "Bend Out" uses a collection of intersection design elements to maximize user comfort within the intersection and promote a high rate of motorists yielding to people bicycling. The design maintains a physical separation within the intersection to define the turning paths of motor vehicles, slow vehicle turning speed, and offer a comfortable place for people bicycling to wait at a red signal.



Typical Use

- Streets with separated bikeways protected by wide buffer or on-street parking.
- Where two separated bikeways intersect and two-stage left-turn movements can be provided for bicycle riders.
- Helps reduce conflicts between right-turning motorists and bicycle riders by reducing turning speeds and providing a forward stop bar for bicycles.
- Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.

Design Features

Ⓐ Setback bicycle crossing of 19.5 feet allows for one passenger car to queue while yielding. Smaller setback distance is possible in slow-speed, space constrained conditions.

Ⓑ Corner island with a 15-20 foot corner radius slows motor vehicle speeds. Larger radius designs may be possible when paired with a deeper setback or a protected signal phase, or small mountable aprons. Two-stage turning boxes are provided for queuing bicyclists adjacent to corner islands.

Ⓒ Use intersection crossing markings.

Protected intersections feature a corner safety island and intersection crossing markings.

Protected intersections incorporate queuing areas for two-stage left turns.

Further Considerations

- Pedestrian crosswalks may need to be further set back from intersections in order to make room for two-stage turning queue boxes.
- Wayfinding and directional signage should be provided to help bicycle riders navigate through the intersection.
- Colored pavement may be used within the corner refuge area to clarify use by people bicycling and discourage use by people walking or driving.
- Intersection approaches with high volumes of right turning vehicles should provide a dedicated right turn only lane paired with a protected signal phase. Protected signal phasing may allow different design dimensions than are described here.

Materials and Maintenance

- Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.
- Bikeways should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.
- Bikeways protected by concrete islands or other permanent physical separation, can be swept by street sweeper vehicles with narrow widths.

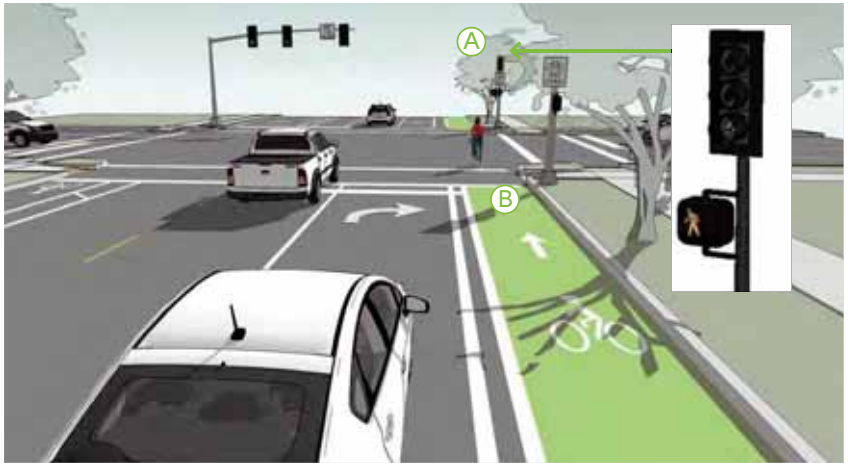
Approximate Cost

The cost of protected intersection elements vary depending on materials used and degree of implementation desired.

- Complete reconstruction costs comparable to a full intersection.
- Retrofit implementation may be possible at lower costs if existing curbs and drainage are maintained. Inexpensive materials can used, such as paint, concrete planters, and bollards.

Separated Bicycle Signal Phase

Separated bicycle lane crossings of signalized intersections can be accomplished through the use of a bicycle signal phase which reduces conflicts with motor vehicles by separating bicycle movements from any conflicting motor vehicle movements. Bicycle signals are traditional three lens signal heads with green, yellow and red bicycle stenciled lenses.



Typical Use

- Two-way protected bikeways where contraflow bicycle movement or increased conflict points warrant protected operation.
- Bicyclists moving on a green or yellow signal indication in a bicycle signal shall not be in conflict with any simultaneous motor vehicle movement at the signalized location
- Right (or left) turns on red should be prohibited in locations where such operation would conflict with a green bicycle signal indication.

Design Features

Ⓐ An additional “Bicycle Signal” sign should be installed below the bicycle signal head.

Ⓑ Designs for bicycles at signalized crossings should allow bicyclists to trigger signals via pushbutton, loop detectors, or other passive detection, to navigate the crossing.

- On bikeways, signal timing and actuation shall be reviewed and adjusted to consider the needs of bicyclists. **(MUTCD 9D.02)**

A bicycle signal head at a signalized crossing creates a protected phase for cyclists to safely navigate an intersection.

A bicycle detection system triggers a change in the traffic signal when a bicycle is detected.

Further Considerations

- A bicycle signal should be considered for use only when the volume/collision or volume/geometric warrants have been met.
- The Federal Highway Administration (FHWA) has approved bicycle signals for use, if they comply with requirements from Interim Approval 16 (I.A. 16). Bicycle Signals are not approved for use in conjunction with Pedestrian Hybrid Beacons.
- Bicyclists typically need more time to travel through an intersection than motor vehicles. Green light times should be determined using the bicycle crossing time for standing bicycles.
- Bicycle detection and actuation systems include user-activated buttons mounted on a pole, loop detectors that trigger a change in the traffic signal when a bicycle is detected and video detection cameras, that use digital image processing to detect a change in the image at a location.

Materials and Maintenance

Bicycle signal detection equipment should be inspected and maintained regularly, especially if detection relies on manual actuation. Pushbuttons and loop detectors will tend to have higher maintenance needs than other passive detection equipment.

Approximate Cost

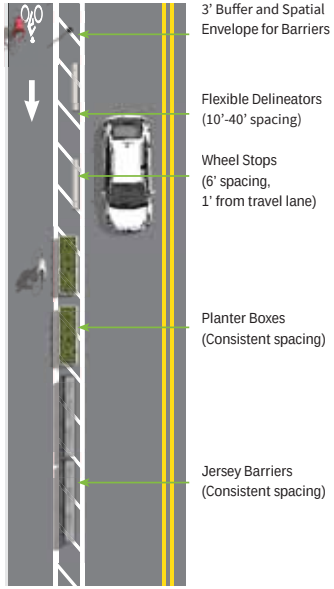
Bicycle signal heads have an average cost of $12,800.

Video detection camera system costs range from $15,000 to $25,000 per intersection.

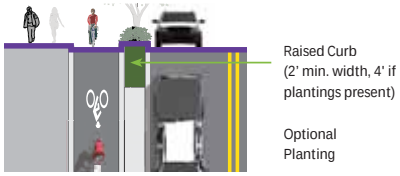
Separated Bikeway Barriers

Separated bikeways may use a variety of vertical elements to physically separate the bikeway from adjacent travel lanes. Barriers may be robust constructed elements such as curbs, or may be more interim in nature, such as flexible delineator posts.

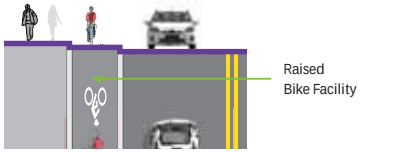
Barrier Separation



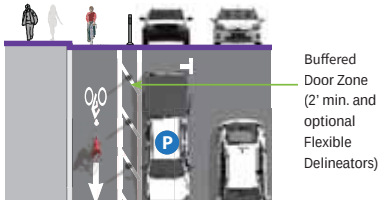
Media Separation



Grade Separation



Parking Separation



Typical Use

Appropriate barriers for retrofit projects:

- Parked Cars
- Flexible delineators
- Bollards
- Planters
- Parking stops

Appropriate barriers for reconstruction projects:

- Curb separation
- Medians
- Landscaped medians
- Raised protected bike lane with vertical or mountable curb
- Pedestrian Refuge Islands

Raised separated bikeways are bicycle facilities that are vertically separated from motor vehicle traffic.

Design Features

- Maximize effective operating space by placing curbs or delineator posts as far from the through bikeway space as practicable.
- Allow for adequate shy distance of 1 to 2 feet from vertical elements to maximize useful space.
- When next to parking allow for 3 feet of space in the buffer space to allow for opening doors and passenger unloading.
- The presences of landscaping in medians, planters and safety islands increases comfort for users and enhances the streetscape environment.

Further Considerations

- With new roadway construction, a raised separated bikeway can be less expensive to construct than a wide or buffered bicycle lane because of shallower trenching and sub base requirements.
- Parking should be prohibited within 30 feet of the intersection to improve visibility.

Materials and Maintenance

Separated bikeways protected by concrete islands or other permanent physical separation, can be swept by smaller street sweeper vehicles.

Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway.

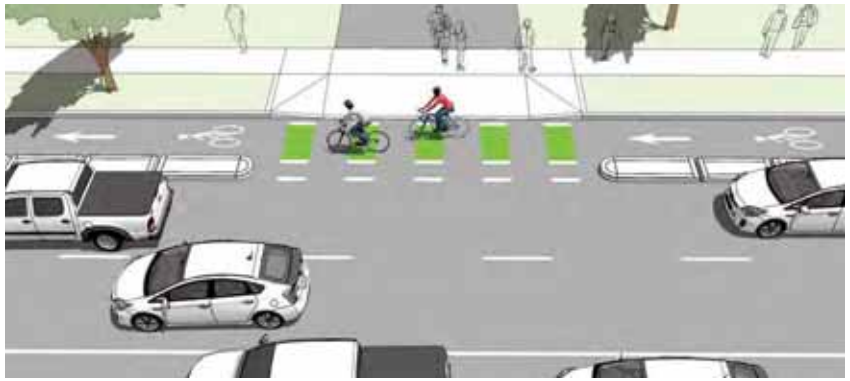
Approximate Cost

Separated bikeway barrier material costs can vary greatly, depending on the type of material, the scale, and whether it is part of a broader construction project.

Separated Bikeways at Driveways (and Minor Streets)

The added separation provided by separated bikeways creates additional considerations at intersections and driveways when compared to conventional bicycle lanes. Special design guidelines are necessary to preserve sightlines and denote potential conflict areas between modes, especially when motorists turning into or out of driveways may not be expecting bicycle travel opposite to the main flow of traffic.

At driveways and crossings of minor streets, bicyclists should not be expected to stop if the major street traffic does not stop.



Typical Use

- Along streets with separated bikeway where there are intersections and driveways.
- Higher frequency driveways or crossings may require additional treatment such as conflict markings and signs.

Design Features

- Remove parking to allow for the appropriate clear sight distance before driveways or intersections to improve visibility. The desirable no-parking area is at least 30 feet from each side of the crossing.
- Use colored pavement markings and/or shared line markings through conflict areas at intersections.
- If a raised bikeway is used, the height of the lane should be maintained through the crossing, requiring automobiles to cross over.
- Motor vehicle traffic crossing the bikeway should be constrained or channelized to make turns at sharp angles to reduce travel speed prior to the crossing.
- Driveway crossings may be configured as raised crossings to slow turning cars and assert physical priority of travelling bicyclists.
- Motor vehicle stop bar on cross-streets and driveways is setback from the intersection to ensure that drivers slow down and scan for pedestrians and bicyclists before turning.

Intersection crossing markings can be used at high volume driveway and minor street crossings, as illustrated above.

Further Considerations

- Removing obstructions and providing clear sight distance at crossings increases visibility of bicyclists.
- Treatments designed to constrain and slow turning motor vehicle traffic will slow drivers to bicycle-compatible travel speeds prior to crossing the separated bikeway.

Materials and Maintenance

Green conflict striping and markings, will require higher maintenance where vehicles frequently traverse over them at driveways and minor intersection. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

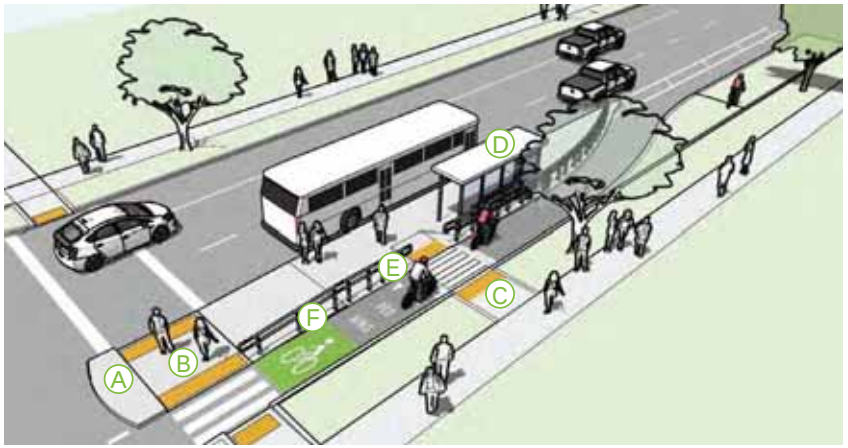
Approximate Cost

The cost for installing high visibility colored crossing markings will depend on the materials selected and implementation approach. Typical costs range from $1.20/sq. ft. installed for paint to $14/sq. ft. installed for thermoplastic. Colored pavement is more expensive than standard asphalt installation, costing 30-50% more than non-colored asphalt.

Separated Bikeways at Transit Side Boarding Islands

A transit side boarding island is a channelized lane for bicyclists designed to provide a path for bicyclists to pass stopped transit vehicles, and clarify interactions between pedestrians, bicyclists, and passengers, boarding and alighting.

This is particularly helpful on corridors with high volumes of transit vehicles and bicyclists, where "leapfrogging" may occur, and on separated bikeway corridors where maintaining physical separation is important to maintain user comfort.



Typical Use

- Routes where bike lanes or separated bikeways and transit operations overlap.
- Provides an in-lane stop for buses, reducing delay at stops.
- Median refuge also provides a shorter crossing for pedestrians at intersections

Design Features

(A) Pedestrian median refuge island (optional) shortens the crossing distance at intersections.

(B) Pedestrian ramp into crosswalks should be ADA compliant with detectable warning surfaces.

(C) Direct pedestrians to crossing locations to minimize conflicts between modes.

(D) High volume stops should have room for appropriately sized shelters and transit amenities.

(E) Pavement markings and signage should clarify expectations among users. The bikeway could also ramp up to sidewalk level at this crossing to reduce bicycle speeds and enhance ADA access to the stop.

(F) Pavement markings on the bikeway should define the bicycle path of travel to minimize intrusion by pedestrians, except at designated crossings.

A transit side boarding island clarifies user spaces and minimizes conflict between bicyclists. pedestrians, transit passengers, buses, and vehicles.

Further Considerations

- Transit island should be wide enough to accommodate mobility devices. An 8'x 5' accessible clear space is required at the front door per ADA requirements.
- Transit platforms should feature pedestrian scale lighting.
- Side boarding island will require detectable warning surfaces along full length of platform if greater than 6" high.

Materials and Maintenance

Similar to median refuge islands, side boarding islands may require frequent maintenance of road debris. If at street grade, the bikeway can be swept by street sweeper vehicles with narrow widths.

Approximate Cost

The approximate cost of a side boarding island is similar to median refuge islands ranging from $500 to $1,100 per foot, or about $3,500 to $4,000, depending on the design, and site conditions. This cost is exclusive of transit shelters and amenities, landscaping, and lighting.

Bicycle Box

A bicycle box is an experimental treatment, designed to provide bicyclists with a safe and visible space to get in front of queuing traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box. On a green signal, all bicyclists can quickly clear the intersection. This treatment received Interim Approval from the FHWA in 2016.

Typical Use

- At potential areas of conflict between bicyclists and turning vehicles, such as a right or left turn locations.
- At signalized intersections with high bicycle volumes.
- At signalized intersections with high vehicle volumes.
- Not to be used on downhill approaches to minimize the right hook threat potential during the extended green signal phase.

Design Features

Ⓐ 14 foot minimum depth from back of crosswalk to motor vehicle stop bar. **(NACTO, 2012)**

Ⓑ A "No Turn on Red" **(MUTCD R10-11)** sign shall be installed overhead to prevent vehicles from entering the Bike Box. A "Stop Here on Red" **(MUTCD R10-6)** sign should be post mounted at the stop line to reinforce observance of the stop line.

Ⓒ A 50 foot ingress lane should be used to provide access to the box.

- Use of green colored pavement is recommended.

A bike box allows for cyclists to wait in front of queuing traffic, providing high visibility and a head start over motor vehicle traffic.

Further Considerations

- This treatment positions bicycles together and on a green signal, all bicyclists can quickly clear the intersection, minimizing conflict and delay to transit or other traffic.
- Pedestrian also benefit from bike boxes, as they experience reduced vehicle encroachment into the crosswalk.
- Bike boxes require permission from the FHWA to implement, and jurisdictions must receive approval prior to implementation. A State may request Interim Approval for all jurisdictions in that State.[1]
- Bike boxes should not be used to accommodate bicyclist turns at intersections that have substantial parallel green time as bicyclists cannot safely occupy the box when arriving on green.

Materials and Maintenance

Bike boxes are subject to high vehicle wear, especially turning passenger vehicles, buses, and heavy trucks. As a result, bike boxes with green coloring will require more frequent replacement over time. The life of the green coloring will depend on vehicle volumes and turning movements, but thermoplastic is generally a more durable material than paint.

Approximate Cost

Costs will vary due to the type of paint or thermoplastic used and the size of the bike box, as well as whether the treatment is added at the same time as other road treatments.

Typical costs range from $1.20/sq. ft. installed for paint to $14/sq. ft. installed for thermoplastic.

1 *FHWA. Interim Approval for Optional Use of an Intersection Bicycle Box (IA-18). 2016.*

Colored Pavement Treatment

Colored pavement within a bicycle lane may be used to increase the visibility of the bicycle facility, raise awareness of the potential to encounter bicyclists, and reinforce priority of bicyclists in conflict areas.

Typical Use

- Within a weaving or conflict area to identify the potential for bicyclist and motorist interactions and assert bicyclist priority.
- Across intersections, driveways and Stop or Yield-controlled cross-streets.
- At bike boxes and two-stage turn boxes

Design Features

Ⓐ Typical white bike lane striping (solid or dotted 6” stripe) is used to outline the green colored pavement.

Ⓑ In weaving or turning conflict areas, preferred striping is dashed, to match the bicycle lane line extensions.

- The colored surface should be skid resistant and retro-reflective **(MUTCD 9C.02.02).**
- In exclusive use areas, such as bike boxes, color application should be solid green.

Green colored conflict striping indicates the path of travel of people on bicycles, and alerts people intending to turn across the bike lane to yield when bicyclists are present.

Further Considerations

- Green colored pavement shall be used in compliance with FHWA Interim Approval (FHWA IA-14.10).[1]
- While other colors have been used (red, blue, yellow), green is the recommended color in the US.
- The application of green colored pavement within bicycle lanes is an emerging practice. The guidance recommended here is based on best practices in cities around the county.

Materials and Maintenance

As intended, paint or thermoplastic are placed in locations that are trafficked by vehicles, and are subject to high vehicle wear. Colored pavement treatments will experience higher rates of wear at locations with higher turning vehicles, buses, and heavy trucks. At these locations, green coloring will require more frequent replacement over time.

The life of the green coloring will depend on vehicle volumes and turning movements, but thermoplastic is a more durable material than paint.

Approximate Cost

The cost for installing colored pavement markings will depend on the materials selected and implementation approach. Typical costs range from $1.20/sq. ft installed for paint to $14/sq. ft installed for thermoplastic. Colored pavement is more expensive than standard asphalt installation, costing 30-50 percent more than non-colored asphalt.

1 *FHWA. Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14). 2011.*

Short-Term Bicycle Parking

People need a safe, convenient place to secure their bicycle when they reach their destination. This may be short-term parking of 2 hours or less, or long-term parking for employees, students, residents, and commuters.

Information on short- and long-term bike parking has been informed by the Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guide, which is updated frequently and is available online at www.apbp.org.

Application

Bike Racks

- Bike racks provide short-term bicycle parking and are meant to accommodate visitors, customers, and others expected to depart within two hours. It should be an approved standard rack, appropriate location and placement.

Bike Corrals

- On-street bike corrals (also known as on-street bicycle parking) consist of bicycle racks grouped together in a common area within the street traditionally used for automobile parking.
- Bicycle corrals are reserved exclusively for bicycle parking and provide a relatively inexpensive solution to providing high-volume bicycle parking. Bicycle corrals can be implemented by converting one or two on-street motor vehicle parking spaces into on-street bicycle parking.
- Each motor vehicle parking space can be replaced with approximately 6-10 bicycle parking spaces.

Design Features

Bike Racks

- When placed on sidewalks, 2 feet minimum from the curb face to avoid 'dooring.'
- 4 feet between racks to provide maneuvering room.
- Locate close to destinations; 50 feet maximum distance from main building entrance.
- Minimum clear distance of 6 feet should be provided between the bicycle rack and the property line.
- While bike racks could be installed perpendicular or parallel to the curb, it is important to ensure there is sufficient room for pedestrian traffic, even when a bike is locked to the rack.

Bike Corrals

- Bicyclists should have an entrance width from the roadway of 5-6 feet.
- Can be used with parallel or angled parking.
- Parking stalls adjacent to curb extensions are good candidates for bicycle corrals since the concrete extension serves as delimitation on one side.

Further Considerations

- Where the placement of racks on sidewalks is not possible (due to narrow sidewalk width, sidewalk obstructions, street trees, etc.), bicycle parking can be provided in the street where on-street vehicle parking is allowed in the form of on-street bicycle corrals.
- Some types of bicycle racks may meet design criteria, but are discouraged except in limited situations. This includes undulating "wave" racks, schoolyard racks, and spiral racks. These discouraged racks are illustrated on the following page.
- Bike racks should be made of thick stainless steel to reduce the chance of thieves cutting through the racks to take bicycles. Square tubing can provide further protection from cutting, as well.
- If a bike rack is installed as surface mount, countersink bolts or expansion bolts should be used to keep the rack in place. Covering the bolts with putty or epoxy can provide additional protection.

References

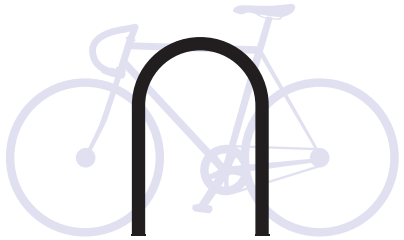
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- APBP. Bicycle Parking Guide 2015.

Inverted-U racks provide two points of contact.

Racks with square tubing, good spacing, and a concrete base likewise offer two points of contact.

Types of Bike Racks to Use

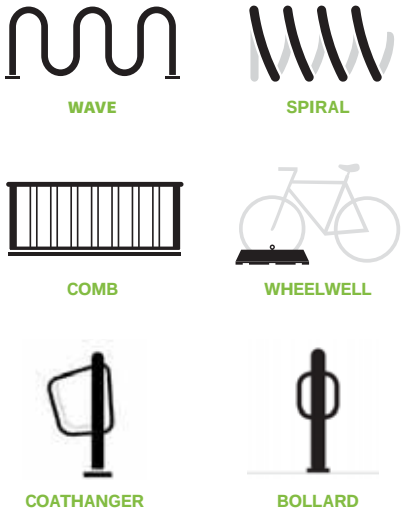
These racks provide two points of contact with the bicycle, accommodate varying styles of bike, allow for the frame of a bicycle and at least one wheel to be secured by most U-locks, and are intuitive to use.



Communities may consider purchasing branded U-racks for installation on sidewalks.

Types of Bike Racks to Avoid

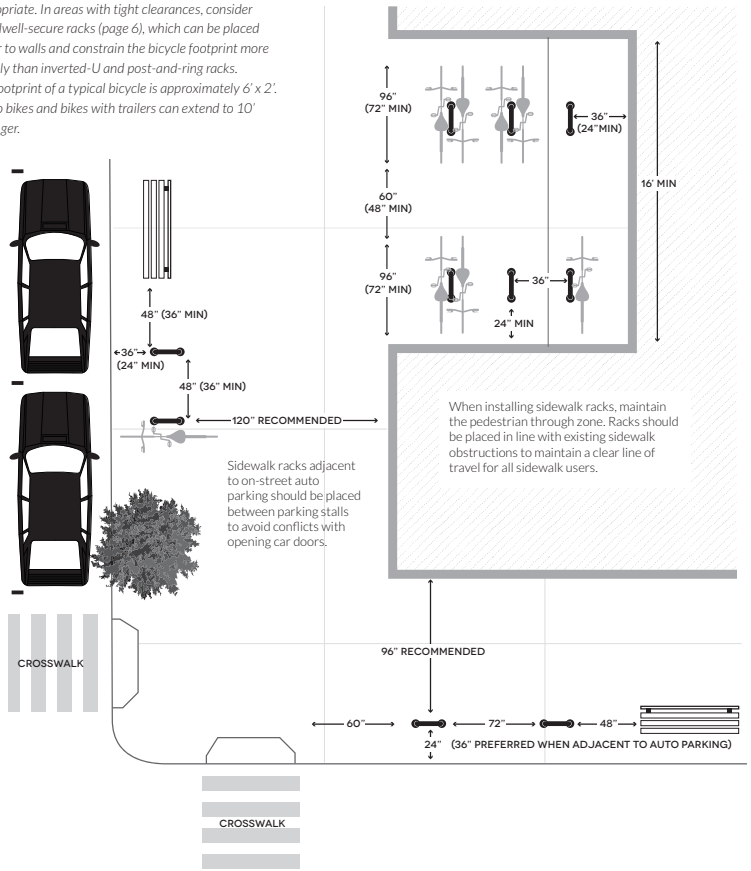
These racks do not provide support at two places on the bike, can damage the wheel, do not provide an opportunity for the user to lock the frame of their bicycle easily, and are not intuitive to use. Because of performance concerns, the APBP Essentials of Bike Parking Report recommends selecting other racks instead of these.



Graphics courtesy of Association of Pedestrian and Bicycle Professionals Essentials of Bike Parking report (2015).

Space Requirements

The following minimum spacing requirements apply to some common installations of fixtures like inverted-U or post-and-ring racks that park one bicycle roughly centered on each side of the rack. Recommended clearances are given first, with minimums in parentheses where appropriate. In areas with tight clearances, consider wheelwell-secure racks (page 6), which can be placed closer to walls and constrain the bicycle footprint more reliably than inverted-U and post-and-ring racks. The footprint of a typical bicycle is approximately 6' x 2'. Cargo bikes and bikes with trailers can extend to 10' or longer.



Long-Term Bicycle Parking

Users of long-term parking generally place high value on security and weather protection. Long-term parking is designed to meet the needs of employees, residents, public transit users, and others with similar needs.

Information on short and long term bike parking has been obtained from the APBP Bicycle Parking Guide, which is updated frequently and is available online at www.apbp.org.

Application

- At transit stops, bike lockers or a sheltered secure enclosure may be appropriate long term solutions.
- On public or private property where secure, long-term bike parking is desired.
- Near routine destinations, such as workplaces, universities, hospitals, etc.

Design Features

Bike Lockers

- Minimum dimensions: width (opening) 2.5 feet; height 4 feet; depth 6 feet.
- 4 foot side clearance and 6 foot end clearance. 7 foot minimum distance between facing lockers.

Secure Parking Area

- Closed-circuit television monitoring or on-site staff with secure access for users.
- Double high racks & cargo bike spaces.
- Bike repair station with bench and bike tube and maintenance item vending machine.
- Bike lock "hitching post" – allows people to leave bike locks.

Further Considerations

- As the APBP Bike Parking Guide notes, increasing density of bike racks in a long-term facility without careful attention to user needs can exclude users with less-common types of bicycles which may be essential due to age, ability, or bicycle type.
- To accommodate trailers and long bikes, a portion of the racks should be on the ground and should have an additional 36" of in-line clearance.

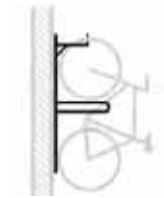
References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- APBP. Bicycle Parking Guide 2015.

High Density Bike Racks

Racks may be used that increase bike parking density, like the ones below. While these types of racks provide more spaces, racks that require lifting should not be used exclusively. People with heavier bikes (i.e. cargo bikes) or people with disabilities or people who are simply small in stature may be unable to lift their bikes easily.

STAGGERED WHEELWELL-SECURE



VERTICAL

TWO-TIER

Bike Parking Rooms

Long term bike parking may be available in dedicated rooms in residential and commercial buildings. Bicycle parking can be accommodated in 15 square feet per space or less.

Bike lockers

Secured parking areas

Where should parking be located?

Well-located bike parking will be:

- Visible to the public.
- Near primary entrances/exits, as close to the entrance as the first motor vehicle parking spot not designated for people with disabilities when possible.
- Easily accessed without dismounting a bike.
- Clear of obstructions which might limit the circulation of users and their bikes.
- In areas that are well-lit.
- Installed on a hard, stable surface that is unaffected by weather.

How much parking should be provided?

APBP's Essentials of Bicycle Parking Recommendations

The Association of Pedestrian and Bicycle Professionals' (APBP) has published recommendations for bicycle parking locations and quantities. These guidelines and recommendations are based on industry best practices as well as APBP's Essentials of Bicycle Parking Recommendations, but can be adjusted to meet the context and needs of each community.

Recommendations for Bicycle Parking Locations and Quantities

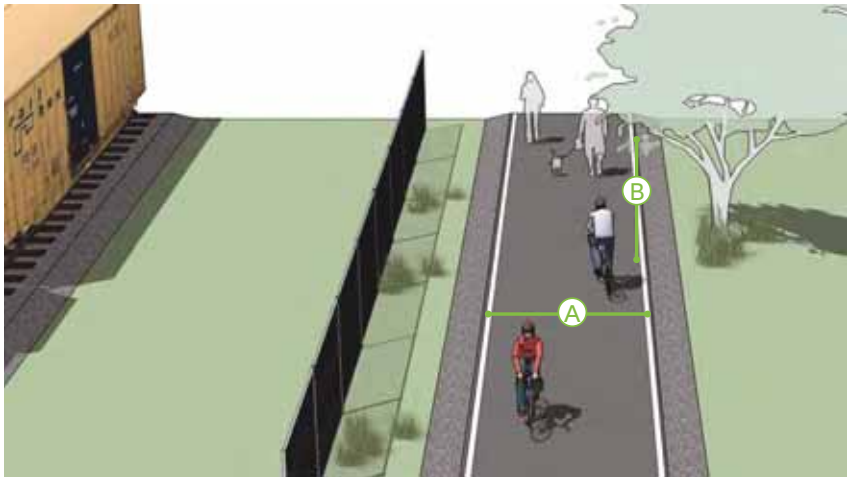
Land Use or Location	Physical Location	Quantity (Minimum)
Parks	Adjacent to restrooms, picnic areas, fields, and other attractions	8 bicycle parking spaces per acre
Schools	Near office and main entrance with good visibility	8 bicycle parking spaces per 40 students
Public Facilities (e.g., libraries, community centers)	Near main entrance with good visibility	8 bicycle parking spaces per location
Commercial, Retail, and Industrial Developments (over 10,000 square feet)	Near main entrance with good visibility	1 bicycle parking space per 15 employees or 8 bicycles per 10,000 square feet
Shopping Centers (over 10,000 square feet)	Near main entrance with good visibility	8 bicycle parking spaces per 10,000 square feet
Transit Stations	Near platform, security or ticket booth	1 bicycle parking space or locker per 30 automobile parking spaces
Multi-Family Residential	Near main entrance with good visibility	1 short-term bicycle parking space per 10 residential units and 1 long-term bicycle parking space per 2 residential units

Section 4

Mixed Use Toolbox

Shared Use Path

Shared use paths are off-street facilities that can provide a desirable transportation and recreation connection for users of all skill levels who prefer separation from traffic. They often provide low-stress connections to local and regional attractions that may be difficult, or not be possible on the street network.



Typical Use

- In abandoned rail corridors (commonly referred to as Rails-to-Trails or Rail-Trails.
- In active rail corridors, trails can be built adjacent to active railroads (referred to as Rails-with-Trails).
- In utility corridors, such as power line and sewer corridors.
- In waterway corridors, such as along canals, drainage ditches, rivers, and creeks.
- Along roadways.

Design Features

Ⓐ 8 ft is the minimum width (with 2' ft shoulders) allowed for a two-way bicycle path and is only recommended for low traffic situations.

- 10 ft is recommended in most situations and will be adequate for moderate to heavy use.
- 12 ft is recommended for heavy use situations with high concentrations of multiple users. A separate track (5' minimum) can be provided for pedestrian use.

Lateral Clearance

- A 2 ft or greater shoulder on both sides of the path should be provided. An additional ft of lateral clearance (total of 3') is required by the MUTCD for the installation of signage or other furnishings.
- If bollards are used at intersections and access points, they should be colored brightly and/or supplemented with reflective materials to be visible at night.

Overhead Clearance

Ⓑ Clearance to overhead obstructions should be 8 ft minimum, with 10 ft recommended.

Striping

- When striping is required, use a 4 inch dashed yellow centerline stripe with 4 inch solid white edge lines.
- Solid centerlines can be provided on tight or blind corners, and on the approaches to roadway crossings.

Further Considerations

- The provision of a shared use path adjacent to a road is not a substitute for the provision of on-road accommodation such as paved shoulders or bike lanes, but may be considered in some locations in addition to on-road bicycle facilities.
- To reduce potential conflicts in some situations, it may be better to place one-way sidepaths on both sides of the street.
- The design of the trail should conform to Crime Prevention Through Environmental Design (CPTED) principles. CPTED is a framework that encourages intuitive visual cues to guide path users, increase the visibility of the corridor and adjacent landmarks and properties, careful design that indicates active use and upkeep, and manages conflicting uses, and regular maintenance to prevent improper or illegal uses.

Shared Use Paths offer pedestrians and bicyclists space to be active away from vehicle traffic. Source: Peter Stetson.

Materials and Maintenance

Shared use paths must be regularly maintained so that they are free of potholes, cracks, root lift, and debris. Signage and lighting should also be regularly maintained to ensure shared use path users feel comfortable, especially where visibility is limited.

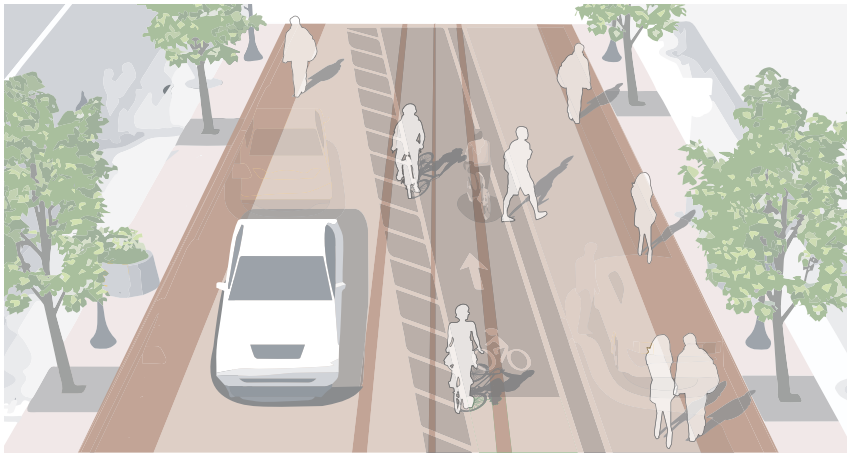
Adjacent landscaping should be regularly pruned, to allow adequate sightlines, daylight, and pedestrian-scale lighting, and so as not to obstruct the path of travel of trail users.

Approximate Cost

The cost of a shared use path can vary, but typical costs are between $65,000 per mile to $4 million per mile. These costs vary with materials, such as asphalt, concrete, boardwalk and other paving materials, lighting, and ROW acquisition.

Shared Street

A shared street is a street with no designated space for bicyclists, pedestrians or vehicles. Pedestrian and bicycle travel is prioritized, speeds are limited by the speed of pedestrians and bicyclists, and pavement materials, landscaping and amenities communicate that this is not a standard road. Vehicle volumes should be very low with only local vehicles (no through travel) using the street.



Typical Use

- Utilized in areas with high pedestrian activity that need to maintain limited access for vehicles and loading / unloading delivery trucks at designated hours.
- In commercial areas, a shared street environment should be considered in places where pedestrian activity is high and vehicle volumes are either low or discouraged.
- In residential areas, a shared street should be considered in places where sidewalks are limited, pedestrian activity and use of streets as public space is high, and vehicle volumes are low.

Design Features

- Vehicle use should be limited to destinations along the shared street (residences, parking garages, maintenance and emergency access vehicles).
- Vehicle speeds should be no more than 15 mph.
- The entrance to the shared street should be designed so that the shared street is clearly recognizable (through signage, surface material, amenities and landscaping).
- Landscaping should include canopy trees for shade and to enhance the bicycle and pedestrian environment, but should not restrict visibility.
- Amenities such as benches, cafe seating, and moveable landscaping elements should be included to communicate the prioritization of pedestrians and bicyclists, but should not restrict visibility.
- A clear width (void of vertical objects) should be provided to ensure emergency vehicle access.

Shared streets in active commercial areas become destinations themselves.

In residential areas, shared streets expand public space and create new places for people to play.

Additional References and Guidelines

FHWA, Achieving Multimodal Networks: Applying Design Flexibility & Reducing Conflicts, "Shared Streets". 2016.

Examples:

- Jack London Square, Oakland, CA
- Wall Street, Asheville, NC
- Bell Street Park, Seattle, WA
- Old Firehouse Alley, Fort Collins, CO
- Calle Guanajuato, Ashland, OR
- Winthrop Street, Cambridge, MA
- First Street North, Jacksonville Beach, FL

Materials and Maintenance

Pavement materials should be similar to that of a pedestrian pathway or plaza using concrete, colored concrete, paving stones or similar materials. Pavement materials and depths should be designed to accommodate vehicular travel, but should clearly signal to all roadway users that pedestrians have priority.

Approximate Cost

The cost of a shared street can vary depending on materials (such as asphalt, concrete, and other paving materials), lighting, landscaping, and ROW acquisition.

Sidepath Design

A sidepath is a bidirectional shared use path located immediately adjacent and parallel to a roadway. Sidepaths can offer a high-quality experience for users of all ages and abilities.

Typical Use

Sidepaths should be considered where one or more of the following conditions exist:

- The adjacent roadway has relatively high volume and/or high-speed motor vehicle traffic that might discourage many people bicycling from riding on the roadway to achieve the targeted low stress. Sidepaths do not preclude the installation or maintenance of existing bike lanes.
- Along corridors with few intersections with minor streets and driveways.
- To provide continuity between existing segments of shared use paths.
- For use near schools, neighborhoods, and mixed use commercial areas, where increased separation from motor vehicles is desired, and there are few roadway and driveway crossings.

Design Features

- Sidepaths shall be designed to meet transportation standards as defined by AASHTO, PROWAG, and MUTCD.
- Materials: Asphalt is the standard paving material for sidepaths.
- Minimum Width: Minimum width of a sidepath is 10'. Where user volumes are high, additional width, as well as parallel facilities such as bike lanes and sidewalk can provide needed space.
- Roadway Separation: The preferred minimum roadway separation width is 6.5 - 16.5' **(Schepers, 2011).** Absolute minimum separation width of 5' **(AASHTO Bike Guide 2012, p. 5-11).**
- Roadway Separation: Separation from roadway traffic is an essential design feature of sidepaths. Separation should increase as volumes and speed of adjacent roadway increase **(AASHTO Bike Guide 2012, p. 5-11).**

A sidepath provides a continuous path of travel along roadway corridors with few driveways or intersections. Depending on the anticipated volumes and context, the sidepath can be constructed in lieu of sidewalk and/or bike lanes. Oftentimes, anticipated volumes, mix of skills, or other factors such as route continuity will also be considered in the decision to also include bike lanes and sidewalks.

- Horizontal Clearance: A lateral clearance to landscaping, street furnishings and signs is required. MUTCD identifies minimum clearance. Signs and other street furniture should be placed outside of the minimum path width.
- Vertical Clearance: Standard clearance to overhead obstructions is 10'.
- Cross Slope and Running Slope: As sidepaths are typically located within public rights of way, their designs are governed by ADA guidelines.

Further Considerations

- Sight Lines: It is important to keep approaches to intersections and major driveways clear of obstructions due to parked vehicles, shrubs, and signs on public or private property.
- Corner radii at driveways and minor streets should be minimized to facilitate vehicle turning speeds of 10-15 mph.

Materials and Maintenance

Like shared use paths, Sidepaths must be regularly maintained so that they are free of potholes, cracks, root lift, and debris. Signage and lighting should also be regularly maintained to ensure sidepath users feel comfortable, especially in areas where visibility is limited.

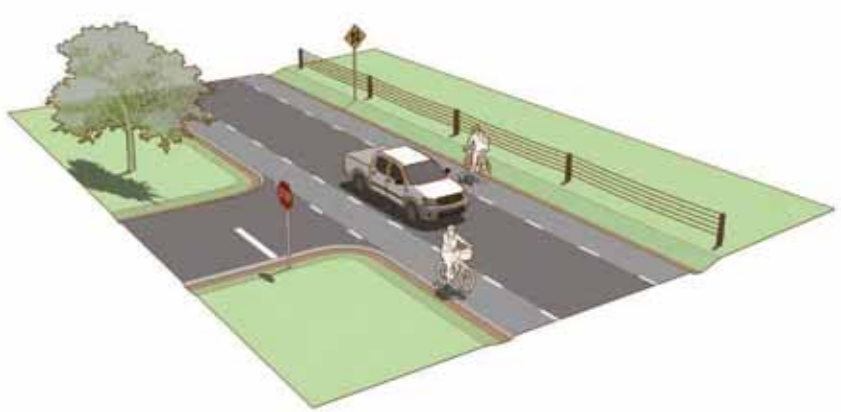
Adjacent landscaping should be regularly pruned, to allow adequate sightlines along the path and at minor street crossings and driveways, allow for daylight, and pedestrian-scale lighting, and so as not to obstruct the path of travel of trail users.

Approximate Cost

The cost of a sidepath can vary, but typical costs are similar to shared use paths between $90,000 per mile to $4 million per mile. These costs vary with materials, such as asphalt, concrete, boardwalk, and other paving materials, and ROW acquisition.

Advisory Shoulder

Roads with advisory shoulders accommodate low to moderate volumes of two-way motor vehicle traffic and provide a prioritized space for bicyclists with little or no widening of the paved roadway surface. An approved Request to Experiment is required to implement Advisory Shoulders, called "dashed bicycle lanes" in the FHWA experimentation process.



Typical Use

- Most appropriate on streets with low to moderate volumes and moderate speeds of motor vehicles.
- Roadways in built-up areas with constrained connections, bicycle and pedestrian demand, and limited available paved roadway space.
- Advisory shoulder designs work best on road segments without frequent stop or signal controlled intersections.

Design Features

- The preferred width of the advisory shoulder space is 6 ft. Absolute minimum width is 4 ft when no curb and gutter is present.
- Consider using contrasting paving materials between the advisory shoulder and center travel lane to differentiate the advisory shoulder from the center two-way travel lane in order to minimize unnecessary encroachment and reduce regular straddling of the advisory shoulder striping.
- Preferred two-way center travel lane width is 13.5–16 ft although may function with widths of 10–18 ft. **(Small and Rural Multimodal Networks Report, Table 2-2)**
- A broken lane line used to delineate the advisory shoulder should consist of 3 ft line segments and 6 ft gaps.
- Use signs to warn road users of the special characteristics of the street.

Advisory shoulders create usable shoulders for bicyclists on a roadway that is otherwise too narrow to accommodate one. The shoulder is delineated by pavement marking and optional pavement color. Motorists may only enter the shoulder when no bicyclists are present and must overtake these users with caution due to potential oncoming traffic.

Further Considerations

- Unlike a conventional shoulder, an advisory shoulder is a part of the traveled way, and it is expected that vehicles will regularly encounter meeting or passing situations where driving in the advisory shoulder is necessary and safe
- Advisory shoulders may function as an interim measure where plans include shoulder widening in the future.
- Where additional edge definition is desired, stripe a normal solid white edge line in addition to the broken advisory shoulder line.
- In general, do not mark a center line on the roadway. Short sections may be marked with center line pavement markings to separate opposing traffic flows at specific locations, such as around curves, over hills, on approaches to at-grade crossings, and at bridges.
- Strive to maintain the visual definition of the advisory shoulder through all driveways and street crossings, and provide a conventional shoulder at controlled intersections.
- Advisory shoulders as described here are not intended for use by pedestrians. When advisory shoulders are intended for use by pedestrians, they must meet accessibility guidelines.

Materials and Maintenance

Shoulder striping will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Advisory shoulders should also be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Approximate Cost

The cost for installing advisory shoulders will depend on the implementation approach. Typical costs are $6,000 per mile when used on a street with no markings.

Appendix C
Project Prioritization Memorandum

MEMORANDUM

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To: Cole Peiffer, Senior Planner, Headway Transportation

From: Sam Corbett, Principal, Alta Planning + Design

Date: August 7, 2020

Re: Carson City SRTS Prioritization of Final Recommendations

Prioritization Strategy

To guide implementation of the proposed SRTS improvements, a prioritization framework was developed to evaluate the relative priority of proposed bicycle and pedestrian projects. This enables the City to identify priority projects and phase the implementation of projects over a period of time. The prioritization focused on three categories of projects:

- **Tier 1. Quick Win Projects:** These projects can be implemented rapidly across the community at minimal expense. These projects can be implemented quickly as they are fairly inexpensive and will not need to compete with larger projects for scarce resources. It is expected that the Quick Win projects will be the first course of action the City will take in implementing the SRTS improvements.
- **Tier 2. SRTS Core Projects (Constrained List):** Recommendations in this category represent projects which are in close proximity to study schools, do not require lane reductions or significant parking removal, and could realistically be implemented within the next five to ten years with the existing funding and political conditions. These Tier 2 projects focus heavily on sidewalk gap closures, making key connections to schools, bicycle facilities which do not impact parking or capacity, and intersection crossing improvements. These projects were individually prioritized to further guide the City with implementation.
- **Tier 3. Aspirational Projects (Unconstrained List):** This category includes projects which are transformational in nature and require significant effort through engineering, funding, or building political consensus. These projects may be further away from study schools and may result in a greater benefit to the larger community as compared to SRTS Core Projects, which are tailored towards school-aged children. These projects are deemed "unconstrained" due to their unknown timeframe for completion. Tier 3 Projects were not individually prioritized as they will be implemented in the medium to long term based on available opportunities.

Tier 1. Quick Win Projects

Projects involving minimal capital and infrastructure improvements, such as changes to signage or red curb striping, were identified as **Quick Win Projects** and have been excluded from project prioritization (see Table 1). It is expected that the City will implement these projects as soon as possible to gain immediate benefits for students walking, biking, and riding buses to school.

Table 1. Quick Win Projects

Project Number	Street	Extent (Or Cross Street)	Description	Cost
Q-1	Seeliger Paths	Footpaths to Seeliger Elementary School from: Cortez Street, Schell Avenue, and off Shady Oak Drive	Repave paths and extend pavement to school grounds	$15,000
Q-2	Appion Way	150 ft East & West of Muldoon Street	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-3	Bath Street	At FrES Parent Drop-Off Loop Exit	Extend existing red curb by 20 feet to the east	$400
Q-4	Bonanza Drive	W. Sutro Terrace to Manzanita Terrace	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$4,000
Q-5	Carriage Crest Drive	At MTES Parent Drop-Off Exit	Relocate existing "No Left-Out" signage to more visible location	$750
Q-6	Cochise Street	150 ft North & South of Overland / Cochise Street Intersection	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-7	Combs Canyon Road	Lakeview Road to Meadowood Road	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$4,000
Q-8	Combs Canyon Road	Harvard Drive to Dartmouth Drive	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$6,000
Q-9	De Ann Drive / Lompa Lane	150 ft on all sides of De Ann Drive / Lompa Lane Intersection	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$4,000
Q-10	Deer Run Road	150 feet on either side of Deer Run Road / BLM Access (located 2,150 feet south of Brunswick Canyon Road)	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-11	EVMS Drop Off Loop	Parking Area in Drop Off Loop	Restrict parking to staff & deliveries only in front of school (reroute traffic around parking lot immediately in front of school)	$5,000
Q-12	FES Drop Off Loop	At existing temporary "Single Lane Pick-Up" Sign	Install permanent sign	$500
Q-13	Firebox Road	At Saliman Road	Install in-road message sign stating No Left-Out	$1,500
Q-14	Firebox Road	At Saliman Road	Update existing red curb along Firebox Road to be more visible	$3,000
Q-15	Gentry Lane	200 ft South of Heidi Circle	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-16	Goni Road	Jefferson Drive to Franklin Road	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$4,000
Q-17	Hidden Meadows Drive	Eagle Valley MS Bus Entrance	Install marked crosswalk	$2,500

Project Number	Street	Extent (Or Cross Street)	Description	Cost
Q-18	Kelvin Road	200 ft East and West of Kelvin Road / Salk Road intersection	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-19	Prospect Drive	Timberline Drive to Lotus Circle	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-20	Rabe Way	400 ft West of Coffey Drive & 150 ft East of Parker Drive	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$3,000
Q-21	S. Sutro Terrace	Bryce Drive to Emerson Drive	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$5,000
Q-22	Saliman Road	At Cardinal Way	Install RRFB at existing crosswalk south of Cardinal Way	$95,000
Q-23	Salk Road	150 ft North & South of Avery Road	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$2,000
Q-24	Siskiyou Drive	Stanton Drive	Install marked crosswalk	$2,500
Q-25	Telegraph Street	3 Intersections: Telegraph Street & Mountain Street Telegraph Street & Division Street Telegraph Street & Richmond Avenue	Install marked crosswalk	$30,000
Q-26	Timberline Drive	Prospect Drive to 100 ft East of Westwood Drive	Utilize temporary signage to increase awareness of bus stop locations (ENG-4)	$4,000

Tier 2. SRTS Core Projects

The **SRTS Core Projects** involving more significant capital and infrastructure improvements were evaluated using prioritization criteria summarized in Table 2. These criteria included findings from the community survey, ability to address key safety issues, connections to schools and other community facilities, demographic data, cost efficiency and feasibility, and consistency with the City's planned capital improvements. For each criterion, Tier 2 projects received an individual score and a composite score was developed based on the sum of all eight factors evaluated. Total scores falling within the top third are considered **"Near Term"**; total scores falling in the middle third are considered **"Medium Term"**; and scores falling in the lower third are considered **"Long Term"** projects.

Table 2. Project Prioritization Criteria

Category	Rationale	*Description	Range of Points	Maximum Points Possible
Survey	School administrators, parents, students, and community members noted specific locations needing improvements in the community survey. Addressing this feedback is a priority of the Plan.	Improvement is at a location specifically identified by 6 or more survey participants *(10 points)* Improvement is at a location specifically identified by 3 to 5 survey participants *(8 points)* Improvement is at a location specifically identified by 1 to 2 survey participants *(6 points)*	Tiered: *10, 8, 6, 0*	**10**

Category	Rationale	*Description	Range of Points	Maximum Points Possible
		Improvement is not at a location identified by survey participants *(0 points)*		
Addresses Known Safety Issue	Improving safety is a core goal of this Plan. Community members shared that vehicle speeds, intersections, and sidewalks/pathways are the most important improvements needed.	Project reduces vehicle speeds *(3 points)* Project improves an intersection *(3 points)* Project improves existing or recommends new sidewalks/pathways *(3 points)* Project does not reduce vehicle speeds, improve an intersection, and/or improve existing or recommends new sidewalks/pathways *(0 points)*	Cumulative: *9, 6, 3, or 0*	**9**
Equity	Lower-income households are disproportionately represented in severe and fatal injuries. This criterion considers median household income to prioritize disadvantaged areas, using thresholds for Medicaid eligibility, median household income in Carson City, and median household income in Nevada.	Project is located in a block group with a median household income of $34,638 or less *(6 points)* Project is located in a block group with a median household income between $34,638.01 and $52,034 *(4 points)* Project is located in a block group with a median household income between $52,034.01 and $57,598 *(2 points)* Project is located in a block group with a median household income $57,598.01 and above *(0 points)*	Tiered: *6, 4, 2, 0*	**6**
Proximity to School(s) in Study	Improving access to schools in this study is a primary purpose of this Plan.	Project is located within 1/8-mile (660 ft) of a school in the study *(16 points)* Project is located within ¼-mile (1,320 ft) of a school in the study *(12 points)* Project is located within ½-mile (2,640 ft) of a school in the study *(4 points)* Project is located more than ½-mile (2,640 ft) of a school in the study *(0 points)*	Tiered: *16, 12, 4, 0*	**16**
Proximity to Community Facilities	Projects in areas of high demand provide benefit to a greater number of people. This criterion uses data about pedestrian and bicycle activity generators to prioritize areas of higher demand.	Project is located within ¼-mile of more than 10 community facilities (park, hospital, senior center, library, school not in the study, and/or other community facility) *(6 points)* Project is located within ¼-mile of 5 to 10 community facilities (park, hospital, senior center, library, school not in the study, and/or other community facility) *(4 points)* Project is located within ¼-mile of 1 to 4 community facilities (park, hospital, senior center, library, school not in the study, and/or other community facility) *(2 points)* Project is not located within ¼-mile of a park, hospital, senior center, library, school not in the study, and/or other community facility *(0 points)*	Tiered: *6, 4, 2, 0*	**6**
Demand	Projects in areas of high demand provide benefit to a greater number of people. This criterion uses data about pedestrian and bicycle activity generators to prioritize areas of higher demand.	Population density within ¼-mile of the project is more than 7,000 people per square mile *(4 points)* Population density within ¼-mile of the project is between 4,000 and 6,999 people per square mile *(2 points)* Population density within ¼-mile of the project is less than 4,000 people per square mile *(0 points)*	Tiered: *4, 2, 0*	**4**
Cost Efficiency / Feasibility	Lower cost projects can generally be implemented more rapidly and allow limited resources to be distributed more widely. Implementation is a strong focus of this Plan, and this criterion prioritizes lower-cost and less complex projects.	**For non-point improvements:** Estimated Total Project Cost: • <$50,000 *(4 points)* • $50,001 – $200,000 *(3 points)* • $200,001 – $500,000 *(2 points)* • >$500,000 *(0 points)* **PLUS** Estimated Cost Per Mile: • <$100,000 *(4 points)* • $100,001 – 500,000 *(3 points)* • $500,000 – $1 million *(2 points)* • >$1 million *(0 points)* **For point improvements (Crossing Safety projects):** Estimated Total Project Cost: • <$50,000 *(8 points)* • $50,001 – $200,000 *(6 points)* • $200,001 – $500,000 *(4 points)* • >$500,000 *(0 points)*	**For non-point improvements:** Cumulative: *8, 7, 6, 5, 4, 3, 2, 0* **For point improvements:** Tiered: *8, 6, 4, 0*	**8**
In CIP	This Plan aims to support the City's Capital Improvement Program (CIP), and prioritizes recommendations that are consistent with or complement projects within the CIP.	Project is within the CIP *(8 points)* Project partially overlaps with the CIP *(4 points)* *Project is not in the CIP, and does not complement other projects in the CIP (0 points)*	Tiered: *8, 4, 0*	**8**
*Note: For projects that span a larger geography than point recommendations (i.e., bikeways), points were awarded if one part of the segment meets any of the listed criteria (e.g., proximity to schools, median household income, population density).				**67**

The results of the prioritization process are considered to be a starting point for assisting the City with implementation of Tier 2 projects. Some projects may be able to be implemented as part of routine roadway maintenance programs; in fact, projects received points if they overlap with the City's Capital Improvement Program (CIP). As funding sources become available and the CIP is updated, it is expected that the City will take

advantage of all available opportunities to implement proposed projects as quickly as possible. Should opportunities arise to complete Tier 2 medium or long term projects, or projects from other tiers of SRTS projects (Tiers 1 and 3), it is recommended that they should be taken as well. For example, if a new development is required to provide a public benefit along these corridors, the proposed bikeways/walkways on these prioritized lists should be considered as an option. If the City plans to repave a corridor that has a recommended bikeway or sidewalk, the City should consider including the proposed improvements as the street is repaved.

Near Term Projects

Near Term Projects, listed in Table 3, reflect the proposed improvements that scored the highest through the prioritization process. Therefore, it is recommended that the City prioritize Near Term Projects by seeking funding for and dedicating resources to planning, designing, and constructing these projects in the immediate years. Since many of these projects are of a larger-scale and are transformational in nature, they will require community engagement and dedicated funding sources. Developing timelines for outreach and identification of funding sources should be a high priority and immediate next step for the City. The Near Term Projects that are less infrastructure-intensive and lower in cost should be considered for immediate implementation in the coming fiscal years.

Table 3. Tier 2, Near Term Projects

Project Number	Street	Extent (Or Cross Street)	Description	Cost	Priority Score
C-7	W. King Street	Thames Lane to Curry Street	**A**. Construct multi-use path from Thames Lane to Canyon Park Court **B.** Add physical buffer for bike lane at CMS & BBES C. Close sidewalk gaps between Curry Street and Ormsby Boulevard **D.** Install intersection crossing enhancements at Tacoma Avenue, Richmond Avenue, Mountain Street, Thompson Street, Minnesota Street, Division Street	$1,180,000	47
WZ-33	Telegraph Street	Richmond Avenue to Mountain Street	Construct sidewalk on south side of roadway to eliminate sidewalk gaps and enhance existing sidewalks, as possible	$480,000	47
CS-4	Monte Rosa Drive	Stanton Avenue to Gordonia Avenue	Add intersection crossing enhancements to Stanton Drive & Gordonia Avenue intersections, including striping to prohibit parking close to existing crosswalks	$20,000	45
WZ-28	Saliman Road	Fairview Drive to Koontz Lane	**A.** Intersection crossing enhancements at Sonoma Street **B.** RRFB at Damon Road crosswalk **C.** Sidewalk east side Colorado Street to Fairview Drive **D.** Enhance existing sidewalk as possible"	$687,000	43
WZ-29	Saliman Road	E. 5th Street to Fairview Drive	Enhance existing sidewalk as possible	$410,000	43
WZ-21	Mountain Street	Nye Lane to King Street	**A**. Close sidewalk gaps & enhance existing sidewalk where possible **B**. Add intersection crossing enhancements at Winnie Lane, Bath Street, Long Street, Washington Street, Telegraph Street, Musser Street	$2,831,000	42
CS-1	Carriage Crest Drive	Slide Mountain Drive to Mountain Park Drive	**A.** Add intersection crossing enhancements at Mountain Park Drive and Slide Mountain Drive intersections **B.** Add center median 70' south of Slide Mountain Drive to Parent Drop-Off Loop entrance **C.** Consider parking restrictions or removal on Carriage Crest Drive during school pick-up and drop-off periods	$330,000	39
WZ-16	Gordonia Avenue	Monte Rosa Drive to La Loma Drive	**A.** Widen existing sidewalks on the north side of the roadway **B.** Add center median from Monte Rosa Drive to La Loma Drive	$321,000	39
WZ-32	Stanton Drive	Monte Rosa Drive to Fairview Drive	Widen existing sidewalk on south side and create center median	$161,000	39
WZ-11	Division Street	Bath Street to W. 5th Street	**A.** Add Intersection crossing enhancements at minor side streets **B**. Enhance & upgrade existing crosswalks throughout the corridor including Musser Street, Telegraph Street, and Long Street **C.** Close sidewalk gaps with widen sidewalks as possible	$1,850,000	38

Project Number	Street	Extent (Or Cross Street)	Description	Cost	Priority Score
WZ-34	Thompson Street	King Street to 550 ft. S. of San Marcus Drive	**A.** Close sidewalk gaps on east side (King Street to 5th Street) **B**. Close sidewalk gaps on west side (5th Street to San Marcus Drive) **C**. Create intersection crossing enhancements at existing W. 2nd St, W. 3rd St, and W. 4th St crosswalks	$380,000	38
C-6	Sonoma Street	Carson Street to Saliman Road	**A.** Construct Bike Lanes **B.** Add intersection crossing enhancement at Silver Sage Drive	$53,000	36
CS-3	Fairview Drive	Desatoya Drive to Walker Drive	**A.** Install RRFB at Desatoya Drive **B.** Install RRFB with pedestrian refuge island (painted or hardscape) between Walker Drive and Stanton Drive **C.** Construct Sidewalk on the west side of Fairview Drive from Walker Drive to Edmonds Drive **D**. Enhanced existing sidewalk on east side from Lepire Drive to multi-use path **E.** Enhance existing sidewalk on west side from Desatoya Drive to multi-use path south of Butti Way	$274,000	36
WZ-35	W. 5th Street	Richmond Avenue to Carson Street	**A.** Close sidewalk gaps and enhance existing sidewalk where possible **B.** Add intersection crossing enhancements at Thompson Street & Division Street	$2,470,000	36
WZ-10	Desatoya Avenue	Airport Road to Fairview Drive	Widen sidewalks on south side of roadway	$175,000	35
C-4	E. 5th Street	Fairview Drive to Mexican Ditch Trail	**A.** Construct bike lanes from Fairview Drive to Carson River Road **B.** Construct buffered bike lane from Carson River Road to Mexican Ditch Trail **C.** Add marked crosswalk with pedestrian refuge (painted or hardscape) at Parkhill Drive **D.** Construct pedestrian refuge at Regent Court (painted or hardscape) **E.** Relocate existing crosswalk at Carson River Road & Hells Bells Road approximately 15 feet to the east, add pedestrian refuge Island (painted or hardscape) and RRFB	$101,000	34

Project Number	Street	Extent (Or Cross Street)	Description	Cost	Priority Score
WZ-3	Bath Street	Mountain Street to Carson Street	**A**. Close Sidewalk Gap between Curry Street & Mountain Street **B**. Add Intersection crossing enhancement (paint or hardscape) at existing mid-block crosswalk and Division street crosswalks **C**. Add missing & repair damaged ADA Ramps **D**. Repair and enhance existing sidewalks as possible	$616,000	34
WZ-36	Winnie Lane	Carson Street to Mountain Street	Enhance existing sidewalks as possible	$257,000	34

Medium Term Projects

Table 4 presents **Medium Term Projects** which scored in the middle of Tier 2 projects and are recommended for implementation after the Near Term Projects have been completed. As appropriate, these projects may be combined with Near Term Projects to strengthen the walking and cycling network, address gap closures, and to complement other projects.

Table 4. Tier 2, Medium Term Projects

Project Number	Street	Extent (Or Cross Street)	Description	Cost	Priority Score
C-8	Winnie Lane	Mountain Street to Ormsby Blvd	**A.** Enhance existing sidewalks where possible **B.** Add bike lanes from Mountain Street to Ormsby Boulevard **C.** Add wayfinding signage at Victoria Avenue directing bicyclists towards the multi-use path on north side **D.** Enhance crosswalks at Ormsby Boulevard, Mountain Street, and Victoria Avenue **E.** Enhance street lighting at Mountain Street and Winnie Lane **F.** Remove overgrown vegetation to improve visibility	$160,000	33
C-1	Airport Road	Butti Way to E. 5th Street	**A.** Construct bike lane from Butti Way to Highway 50 **B.** Add intersection crossing enhancements at Airport Road / Douglas Drive and Airport Road / Menlo Dr**ive**	$186,500	31

Project Number	Street	Extent (Or Cross Street)	Description	Cost	Priority Score
WZ-12	Division Street	5th Street to southern terminus of Division Street	Close sidewalk gaps	$222,500	31
WZ-6	Carson Street	Bath Street to 420 ft. N. of Bath Street	Construct sidewalk	$87,500	30
WZ-20	Long Street	Curry Street to Sierra Circle & Fall Street to Stewart Street	**A.** Close sidewalk gaps (Curry Street to Sierra Circle & Fall Street to Stewart Street) **B.** Crosswalks and Intersection Enhancements at Division Street, Curry Street, and Marian Avenue	$853,000	30
B-3	Winnie Lane	Carson Street to Roop Street	Construct buffered bike lanes from Carson Street to Roop Street	$75,000	29
WZ-26	Roop Street	Winnie Lane to E. 5th Street	**A.** Close sidewalk gaps (Telegraph Street to E. 5th Street) **B.** Enhance existing sidewalks as possible	$860,000	29
C-3	E. 5th Street	Saliman Road to Carson Street	**A.** Enhance existing sidewalks **B.** Widen existing bike lane to 5'	$655,000	27
WZ-27	S. Iris Street	4th Street to King Street	Construct sidewalk	$500,000	27
WZ-19	Lepire Drive	Snake Mountain Multi-Use Path to Cassidy Court	Construct sidewalk from Snake mountain multi-use path to the existing sidewalk on the north side of Lepire Drive	$143,000	26
WZ-23	Musser Street	Richmond Avenue to Winters Drive	Construct sidewalk	$72,500	26
C-2	Carmine Street	Airport Road to Lompa Lane	**A.** Traffic Circle at Dori Way & Carmine Street **B**. Close sidewalk gaps between Airport Road & Dori Way **C**. Intersection crossing enhancements at Dori Way, Lompa Lane, and Airport Road	$952,000	25
B-1	Colorado Street	Carson Street to Roop Street	Construct buffered bike lanes from Carson Street to existing bike lanes	$10,000	23
CS-2	Carson Street	Nye Lane	**A.** Construct RRFB **B.** Add Crosswalk on south intersection leg **C.** Add Pedestrian Refuge Island (painted or hardscape)	$220,000	23
WZ-1	Airport Road	Nye Lane to Highway 50	**A.** Close sidewalk gaps **B.** Enhance existing sidewalk as possible	$1,550,000	23
WZ-13	S. Edmonds Drive	Fairview Drive to Colorado Street Bridge	Construct multi-use path on west/north side to connect to existing path	$220,000	22

Long Term Projects

Table 5 presents the projects scoring in the lowest third of the prioritization process for Tier 2 projects, referred to as **Long Term Projects**. Many of the projects in this category did not receive any public comments through the community survey, are not proximate to multiple community facilities, and do not overlap with projects in the City's CIP. However, these projects help to complete a full active transportation network, increasing access to schools for our youth. Should the City have the opportunity to implement projects from any of the three Tier 2 levels, it is recommended as all projects have been developed to close network gaps and improve walking, biking, and connecting to the bus for Carson City students and residents.

Table 5. Tier 2, Long Term Projects

Project Number	Street	Extent (Or Cross Street)	Description	Cost	Priority Score
C-5	Nye Lane	Lompa Lane to Highway 50	Construct bike lanes & close sidewalk gaps	$5,404,000	21
WZ-17	Hillview Drive	Kingsley Lane to Clearview Drive	Construct paved shoulder or multi-use path to connect with existing multi-use path on Saliman Road at Kingsley Lane	$230,000	21
WZ-25	Robinson Street	Richmond Avenue to Mountain Street	Construct sidewalk	$390,000	21
WZ-37	Winnie Lane	Ash Canyon Road to Ormsby Boulevard	Extend multi-use path on north side to Ash Canyon Road	$200,000	21
WZ-8	Colorado Street	Colorado Terminus to Edmonds Drive	**A.** Construct multi-use bridge over I-580 from Colorado Street terminus to Edmonds Drive **B.** Marked Crosswalk with RRFB at Colorado Street & Edmonds Drive intersection (Due to funding constraints, the City may select one pedestrian bridge project to pursue, either **WZ-15** or **WZ-8**)	$4,855,000	20
B-2	E. 5th Street	Saliman Road to I-580	Construct multi-use path or separated facility with connection to existing multi-use path on either side of I-580	$940,000	19
WZ-5	Camille Drive	Sunland Drive	Install staircase and ramp for multi-use connectivity	$200,000	18
WZ-14	N. Edmonds Drive	320 ft N. of Reeves to 100 ft N. Brown Street	Construct sidewalk on west side of roadway	$200,000	18
WZ-24	Reavis Lane	Create Pedestrian Connection to Multi-Use Path	Construct multi-use bridge between existing multi-use trail and sidewalk on southside of Reavis Lane	$140,000	18
CS-5	Roop Street/Silver Sage Drive	Fairview Drive to Sonoma Avenue	Add intersection crossing enhancements at minor side-street approaches south of Fairview Drive	$310,000	17
WZ-4	Brown Street	420 ft. N. of Reeves Street to 170 ft. S. of Reeves Street	Construct sidewalk	$207,500	17
WZ-22	Musser Street	Harbin Avenue to Anderson Street	**A.** Close sidewalk gaps **B.** Enhance sidewalk where possible	$270,000	17
WZ-30	Sherman Lane	Lompa Lane to Chanel Lane	Construct sidewalk	$2,000,000	17
WZ-7	Clearview Drive	Oak Street to I-580	Construct paved shoulder for bikes/pedestrians/bus stop accessibility	$255,000	16
WZ-9	Colorado Street	Birch Street to 125 ft W. of Utah Street	Construct sidewalk	$235,000	15
WZ-18	Koontz Lane	Center Drive to I-580	Construct paved shoulder for bikes/pedestrians/bus stop accessibility	$629,000	15
WZ-31	Stampede Drive	Gregg Street East to Existing Sidewalk	Construct sidewalk on south side corner to existing sidewalk	$133,000	14
WZ-15	Edmonds Sports Complex	Between Edmonds Sports Complex and Appion Way / Hillview Drive intersection	**A.** Construct multi-use bridge over I-580 from the southeastern corner of Appion Way / Hillview Drive intersection to the Edmonds Sports Complex (Due to funding constraints, the City may select one pedestrian bridge project to pursue, either **WZ-15** or **WZ-8**)	$6,000,000	12
CS-6	Silver Sage Drive	Sonoma Avenue to Koontz Lane	**A**. Add Crosswalk at Pioche St **B.** Add intersection crossing enhancements at Koontz Lane intersection and minor side-street approaches between Koontz Lane & Sonoma Avenue	$810,000	11
WZ-2	Baker Drive	Koontz Lane to 175 ft. S. of Kerinne Circle	Construct sidewalk	$292,500	9

Tier 3: Aspirational Projects (Unconstrained List)

Table 6 details the City's **Tier 3 Aspirational Projects**. These projects are transformational, and will remain on the City's "unconstrained" plan until the Tier 1 and 2 projects have been implemented. Should resources and community demand present opportunities to implement these projects, the City will work to do so.

Table 6. Tier 3: Aspirational Projects (Unconstrained List)

Project Number	Street	Extent (Or Cross Street)	Description	Cost
A-1	Airport Road	Nye Lane to Highway 50	**A.** Construct buffered bike lanes or similar multi-modal improvement **B.** Protected intersection at Airport Road / Highway 50 or similar multi-modal improvement	$1,450,000
A-2	Ash Canyon / Ormsby Boulevard	Longview Way to Washington Street	Construct multi-use path from Longview Way to Washington Street or similar multi-modal improvement	$650,000
A-3	Carmine Street	Airport Road to Lompa Lane	Construct bike boulevard or similar multi-modal improvement	$130,000
A-4	Carriage Crest Drive	Northridge Drive to Sunland Ave	Construct bike boulevard or similar multi-modal improvement	$37,000
A-5	Division Street	Bath Street to W. 5th Street	Construct bike boulevard or similar multi-modal improvement	$1,795,000
A-6	Fairview Drive	Nye Lane to Butti Way	Construct protected cycle track with protected intersection at Highway 50 or similar multi-modal improvement	$1,000,000
A-7	Fairview Drive	Edmonds Drive to Saliman Road	Construct protected cycle track / multi-use path or similar multi-modal improvement	$500,000
A-8	Little Lane	Saliman Road to Roop Street	Construct buffered bike lanes or similar multi-modal improvement	$12,000
A-9	Long Street	Mountain Street to Russell Way	**A**. Buffered bike lane from Mountain Street to Saliman Road or similar multi-modal improvement **B.** Bike lane from Saliman Road to Russell Way or similar multi-modal improvement	$435,000
A-10	Mountain Street	Nye Lane to King Street	Construct buffered bike lanes or similar multi-modal improvement	$2,891,000
A-11	Northgate Lane	Arrowhead Drive to Nye Lane	Construct protected cycle track or similar multi-modal improvement	$320,000
A-12	Ormsby Boulevard	Oak Ridge Drive to Winnie Lane	Construct bike lanes or similar multi-modal improvement	$3,000

Appendix D
Vehicle Speed Data

The following maps and tables represent vehicle speed data collected by Carson City Public Works within school zones across Carson City, NV. Data was collected using pneumatic hose counters and speed feedback sign data.

Pneumatic Hose Counter Data

Data was collected by pneumatic hose counters at the following locations:

1. Carriage Crest Drive - Mark Twain Elementary School
2. Ormsby Boulevard - Carson Middle School
3. Saliman Road - Fremont Elementary School
4. Saliman Road - Seeliger Elementary School

The collected data was analyzed by hour to identify vehicle speeds and volumes during school zones. It is important to note vehicle speeds were collected in both directions and captured vehicle speeds within the school zone as well as at the beginning and end of the zone. This strategy helps identify the difference in vehicle speeds as they travel through the school zone.

Speed Feedback Sign Data

Speed feedback signs alert drivers to the speed of their vehicle. As vehicles travel past the speed feedback sign, the vehicle speed is recorded. Downloading this data helps provide insights into the speed of vehicles as they are entering a school zone. Data recorded between fall 2019 and February 2020 by speed feedback signs at the following school zone locations was downloaded by Carson City Public Works and is included in this Appendix:

1. W. King Street - Bordewich-Bray Elementary School
2. W. King Street - Carson Middle School
3. Gordonia Avenue - Empire Elementary School
4. Fairview Drive - Empire Elementary School & Eagle Valley Middle School
5. Saliman Road - Fremont Elementary School & Seeliger Elementary School
6. Bath Street - Fritsch Elementary School

Table 1. Carriage Crest Drive - 85th Percentile Speeds

Carriage Crest Drive - Mark Twain Elementary School Zone (85th Percentile Speed)									
Time Period		Northbound				Southbound			
		Location 1	Location 2	Location 3	Average	Location 1	Location 2	Location 3	Average
Monday	AM	24.2	20.6	25.2	23.3	20.1	19.0	23.3	20.8
	Lunch	23.3	27.1	27.6	26.0	19.0	23.3	26.9	23.1
	PM	23.6	22.9	24.7	23.7	20.6	22.8	24.4	22.6
	Daily	23.8	28.2	26.5	26.2	19.7	26.3	27.5	24.5
Tuesday	AM	24.0	21.1	24.2	23.1	19.0	19.0	23.9	20.6
	Lunch	21.5	24.0	26.3	23.9	18.9	23.4	25.8	22.7
	PM	22.1	26.0	28.4	25.5	19.4	23.1	24.5	22.3
	Daily	23.8	28.3	26.6	26.2	19.7	26.5	27.1	24.4
Wednesday	AM	24.3	23.5	24.1	24.0	19.5	18.9	25.4	21.3
	Lunch	21.8	26.9	27.5	25.4	17.3	23.9	27.7	23.0
	PM	22.8	26.2	28.5	25.8	19.7	25.8	26.6	24.0
	Daily	23.8	28.7	27.7	26.7	19.9	27.8	28.1	25.3
Thursday	AM	23.9	20.2	24.2	22.8	19.7	18.6	23.7	20.7
	Lunch	24.3	23.4	28.0	25.2	19.7	21.9	27.6	23.1
	PM	23.9	25.5	28.8	26.1	19.3	25.0	26.2	23.5
	Daily	23.8	27.8	26.0	25.9	19.9	26.1	27.2	24.4
Friday	AM	23.3	22.6	24.4	23.4	19.4	18.9	24.1	20.8
	Lunch	23.5	26.9	27.1	25.8	18.9	25.1	24.5	22.8
	PM	22.3	26.1	26.0	24.8	19.1	24.6	24.2	22.6
	Daily	23.3	28.4	26.4	26.0	19.6	27.2	27.4	24.7

Table 2. Carriage Crest Drive - Average 85th Percentile Speeds by Time Period

Carriage Crest Drive - Daily 85th Percentile Speeds									
Date	Day of the Week	Northbound				Southbound			
		24 hours	AM	Lunch	PM	24 hours	AM	Lunch	PM
11/18/2019	Monday	26.2	23.3	26.0	23.7	24.5	20.8	23.1	22.6
11/12/19 - 11/19/19	Tuesday	26.2	23.1	23.9	25.5	24.4	20.6	22.7	22.3
11/13/2019	Wednesday	26.7	24.0	25.4	25.8	25.3	22.7	23.0	24.0
11/14/2019	Thursday	25.9	22.8	25.2	26.1	24.4	22.3	23.1	23.5
11/15/2019	Friday	26.0	23.4	23.5	22.3	24.7	20.8	22.8	22.6
Average		26.2	23.3	24.8	24.7	24.7	21.5	22.9	23.0

Table 3. Carriage Crest - 85th Percentile Speeds by Location & Time Period

Carriage Crest Drive - 85th Percentile Speeds By Time Period								
Time Period	Northbound				Southbound			
	Location 1	Location 2	Location 3	Average	Location 1	Location 2	Location 3	Average
AM	23.94	21.60	24.42	23.32	19.54	18.88	24.08	20.83
Lunch	22.88	25.66	27.30	25.28	18.76	23.52	26.50	22.93
PM	22.94	25.34	27.28	25.19	19.62	24.26	25.18	23.02
Daily	23.70	28.28	26.64	26.21	19.76	26.78	27.46	24.67

Table 4. Carriage Crest Drive - Traffic Volumes By Location & Time Period

Carriage Crest Drive - Mark Twain Elementary School (Volumes)									
Time Period		Northbound				Southbound			
		Location 1	Location 2	Location 3	Average	Location 1	Location 2	Location 3	Average
Monday	AM	43	32	68	48	23	129	100	84
	Lunch	15	37	45	32	9	40	26	25
	PM	9	27	55	30	26	58	35	40
	Daily	205	511	516	411	252	717	511	493
Tuesday	AM	45	29	79	51	27	151	94	91
	Lunch	6	25	25	19	13	38	25	25
	PM	20	43	34	32	10	44	26	27
	Daily	203	520	487	403	242	753	498	498
Wednesday	AM	34	33	36	34	20	101	34	52
	Lunch	1	20	23	15	4	19	15	13
	PM	24	39	30	31	14	27	24	22
	Daily	367	212	391	323	405	381	391	392
Thursday	AM	45	42	69	52	22	146	88	85
	Lunch	19	33	23	25	18	32	16	22
	PM	17	33	26	25	8	43	32	28
	Daily	149	499	475	374	159	730	477	455
Friday	AM	42	39	84	55	28	160	101	96
	Lunch	11	28	28	22	12	29	15	19
	PM	18	33	30	27	8	42	30	27
	Daily	206	570	548	441	245	814	524	528

Table 5. Carriage Crest Drive - Average Traffic Volumes by Time Period

Carriage Crest Drive Mark Twain School Zone (Volumes, Average of all days)								
Time Period	Northbound				Southbound			
	Location 1	Location 2	Location 3	Average	Location 1	Location 2	Location 3	Average
AM	42	35	67	48	24	137	83	82
Lunch	10	29	29	23	11	32	19	21
PM	18	35	35	29	13	43	29	28
Daily	226	462	483	391	261	679	480	473

Table 1. 85th Percentile Speeds (Ormsby Blvd, at Carson Middle School)

Ormsby Blvd – Carson Middle School (85th Percentile Speeds)			
Time Period		Northbound	Southbound
Monday	AM	37.8	35.8
	Lunch	38.7	38.5
	PM	35.2	37.9
	Daily	37.7	38.8
Tuesday	AM	40.3	39.3
	Lunch	36.7	34.4
	PM	36.9	36.4
	Daily	36.8	38.5
Wednesday	AM	38.4	37.8
	Lunch	36.8	38.1
	PM	35.5	36.2
	Daily	37.4	38.6
Thursday	AM	37.8	37.9
	Lunch	36.6	36.3
	PM	37.5	38.2
	Daily	37.1	38.6
Friday	AM	33.0	42.1
	Lunch	37.9	37.9
	PM	37.2	38.2
	Daily	37.7	38.7

Table 2. 85th Percentile Speeds by Time Period (Ormsby Blvd, at Carson Middle School)

Ormsby Blvd - Carson Middle School (85th Percentile Speeds)		
Time Period	Northbound	Southbound
AM	37.5	38.6
Lunch	37.3	37.0
PM	36.5	37.4
Daily	37.3	38.6

Table 3. Total Peak Hour & Daily Volumes (Ormsby Blvd, at Carson Middle School)

Ormsby Blvd - Peak Hour & Daily Volumes (Carson Middle)			
Time Period		Northbound	Southbound
Monday	AM	12	8
	Lunch	41	33
	PM	68	63
	Daily	677	579
Tuesday	AM	16	15
	Lunch	34	39
	PM	43	55
	Daily	752	681
Wednesday	AM	14	11
	Lunch	31	35
	PM	39	44
	Daily	716	630
Thursday	AM	11	16
	Lunch	44	41
	PM	40	46
	Daily	729	681
Friday	AM	6	15
	Lunch	32	44
	PM	36	45
	Daily	699	631

Table 4. Average Peak Hour & Daily Volumes (Ormsby Blvd, at Carson Middle School)

Ormsby Blvd – Average Peak Hour & Daily Volumes (Carson Middle)		
Time Period	Northbound	Southbound
AM	12	13
Lunch	36	38
PM	45	51
Daily	715	640


School Zone Speed Counter Locations
11/12/19 - 11/19/19
10:00AM 9:00AM
A
B
C
Al Seeliger
Legend
Carson City School Zones
Carson City School Speed Counter Locations
CC_SRTS_Schools
Carson City speed counter locations

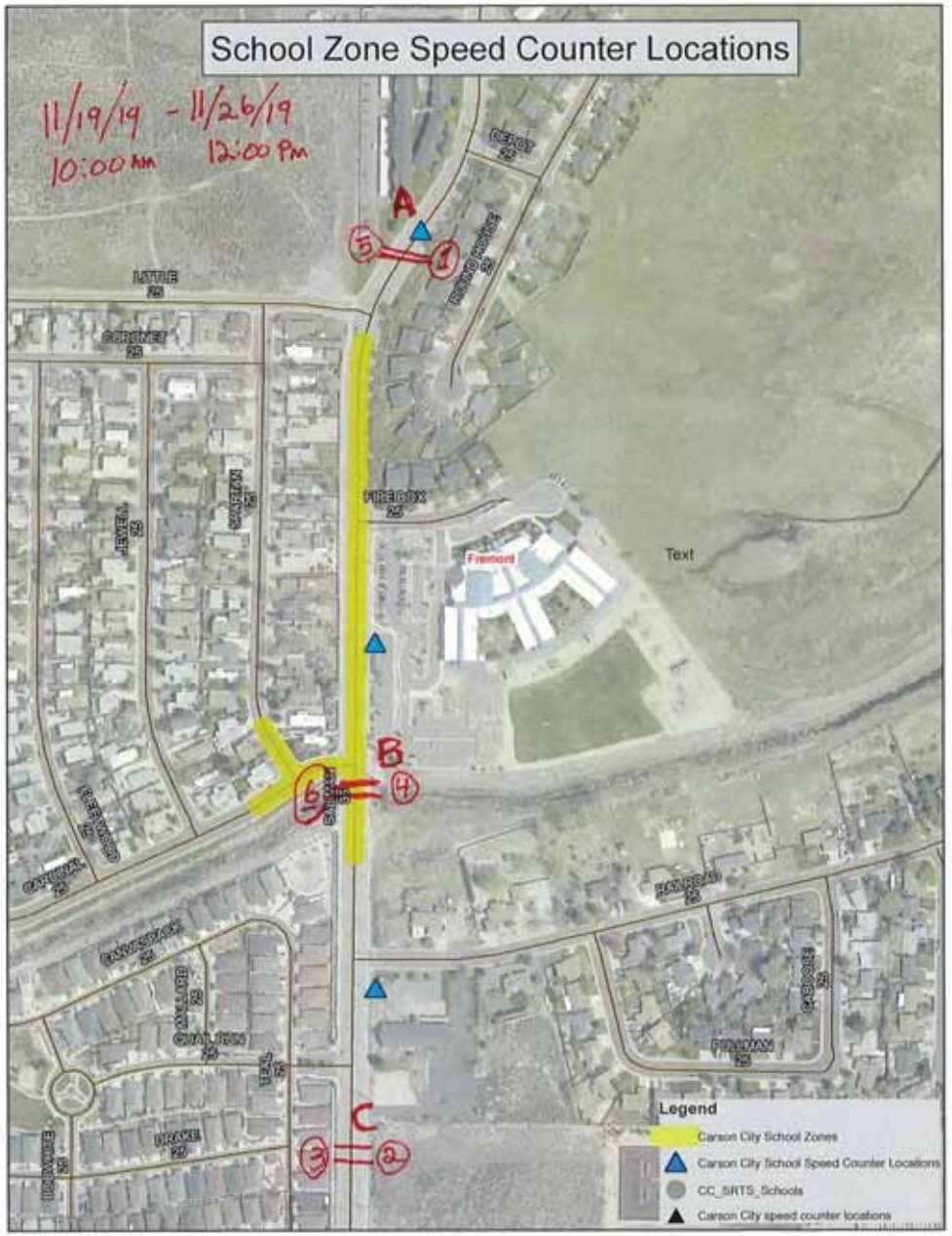

School Zone Speed Counter Locations
11/19/19 - 11/26/19
10:00 AM 12:00 PM
A
B
C
Fremont
Text
Legend
Carson City School Zones
Carson City School Speed Counter Locations
CC_SRTS_Schools
Carson City speed counter locations

Table 1. 85th Percentile Speeds (Al Seeliger School Zone)

Saliman Road - Al Seeliger School Zone (85th Percentile Speed)									
Time Period		Northbound				Southbound			
		Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
Monday	AM	33.6	27.8	38.5	33.3	32.6	27.8	36.4	32.3
	Lunch	34.8	33.7	39.5	36.0	34.5	33.7	38.4	35.5
	PM	33.8	30.5	37.8	34.0	34.1	30.5	35.8	33.5
	Daily	34.8	33.7	39.3	35.9	34.3	33.7	37.6	35.2
Tuesday	AM	33.8	27.7	38.2	33.2	32.6	27.7	37.0	32.4
	Lunch	36.2	32.8	38.5	35.8	34.3	32.8	35.6	34.2
	PM	33.3	29.4	38.3	33.7	33.9	29.4	36.3	33.2
	Daily	34.6	33.3	38.9	35.6	34.1	33.3	36.6	34.7
Wednesday	AM	33.4	26.4	39.1	33.0	32.4	26.4	36.2	31.7
	Lunch	34.6	33.4	38.2	35.4	34.6	33.4	37.4	35.1
	PM	33.0	29.4	38.0	33.5	33.1	29.4	34.4	32.3
	Daily	34.8	33.4	39.2	35.8	34.2	33.4	36.6	34.7
Thursday	AM	33.1	28.0	38.0	33.0	32.1	28.0	36.1	32.1
	Lunch	34.7	33.1	38.5	35.4	34.6	33.1	37.7	35.1
	PM	33.1	29.5	36.7	33.1	33.9	29.5	35.5	33.0
	Daily	34.7	33.5	39.3	35.8	34.2	33.5	37.2	35.0
Friday	AM	33.1	27.8	38.7	33.2	31.8	27.8	36.6	32.1
	Lunch	34.7	33.0	39.2	35.6	35.0	33.0	37.2	35.1
	PM	33.6	29.3	38.4	33.8	33.4	29.3	36.8	33.2
	Daily	35.1	34.2	39.5	36.3	34.6	34.2	37.5	35.4
	Missing data replaced with Southbound data for location B.								

Table 2. 85th Percentile Speeds (Fremont School Zone)

Saliman Road - Fremont School Zone (85th Percentile Speed)									
Time Period		Northbound				Southbound			
		Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
Monday	AM	34.0	37.0	34.5	35.2	32.1	38.0	30.2	33.4
	Lunch	37.2	38.4	39.1	38.2	35.1	40.6	39.4	38.4
	PM	36.0	37.5	38.9	37.5	34.0	39.3	38.5	37.3
	Daily	38.2	39.1	40.0	39.1	34.8	39.9	39.0	37.9
Tuesday	AM	35.3	36.7	38.3	36.8	29.9	36.5	38.2	34.9
	Lunch	37.5	38.8	39.6	38.6	34.7	39.7	38.8	37.7
	PM	36.8	37.4	39.1	37.8	33.1	37.5	37.3	36.0
	Daily	37.8	39.1	39.5	38.8	34.6	39.9	38.4	37.6
Wednesday	AM	34.6	36.2	37.4	36.1	31.5	38.4	37.3	35.7
	Lunch	36.4	38.7	39.2	38.1	34.5	39.9	38.2	37.5
	PM	34.7	36.3	37.4	36.1	33.0	38.4	37.0	36.1
	Daily	37.4	38.8	39.2	38.5	34.5	39.8	38.2	37.5
Thursday	AM	34.3	36.1	38.0	36.1	31.8	37.6	38.0	35.8
	Lunch	36.7	38.7	39.7	38.4	34.4	39.4	39.1	37.6
	PM	34.8	36.3	39.0	36.7	33.8	38.6	38.2	36.9
	Daily	37.8	38.9	39.5	38.7	34.8	39.8	38.7	37.8
Friday	AM	34.8	35.7	38.6	36.4	31.8	38.3	38.1	36.1
	Lunch	37.7	38.9	39.7	38.8	34.7	39.2	38.3	37.4
	PM	34.9	36.1	38.7	36.6	33.6	37.7	37.5	36.3
	Daily	37.9	39.1	39.7	38.9	35.0	39.8	38.6	37.8

Table 3. Average 85th Percentile Speeds by Time Period (Al Seeliger School Zone)

Saliman Road - Al Seeliger School Zone (85th Percentile Speed, Avg. of all days)								
Time Period	Northbound				Southbound			
	Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
AM	33.40	27.54	38.50	33.15	32.30	27.54	36.46	32.10
Lunch	35.00	33.20	38.78	35.66	34.60	33.20	37.26	35.02
PM	33.36	29.62	37.84	33.61	33.68	29.62	35.76	33.02
Daily	34.80	33.62	39.24	35.89	34.28	33.62	37.10	35.00
	Missing data replaced with Southbound data for location B.							

Table 4. 85th Percentile Speeds by Time Period (Fremont School Zone)

Saliman Road - Fremont School Zone (85th Percentile Speed, Avg. of all days)								
Time Period	Northbound				Southbound			
	Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
AM	34.60	36.34	37.36	36.10	31.42	37.76	36.36	35.18
Lunch	37.10	38.70	39.46	38.42	34.68	39.76	38.76	37.73
PM	35.44	36.72	38.62	36.93	33.50	38.30	37.70	36.50
Daily	37.82	39.00	39.58	38.80	34.74	39.84	38.58	37.72

Table 5. Total Volumes by Location (Al Seeliger School Zone)

Saliman Road - Al Seeliger School Zone (Volumes)									
Time Period		Northbound				Southbound			
		Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
Monday	AM	258	95	97	150	95	95	164	118
	Lunch	132	88	87	102	143	88	150	127
	PM	177	114	114	135	215	114	228	186
	Daily	2239	1941	1132	1771	2293	1941	1223	1819
Tuesday	AM	249	95	82	142	158	95	143	132
	Lunch	144	80	76	100	120	80	140	113
	PM	175	120	89	128	200	120	232	184
	Daily	1874	1781	904	1520	2028	1781	976	1595
Wednesday	AM	248	91	81	140	144	91	161	132
	Lunch	112	82	45	80	131	82	152	122
	PM	147	103	97	116	166	103	210	160
	Daily	2218	1960	1067	1748	2319	1960	1143	1807
Thursday	AM	263	91	105	153	121	91	155	122
	Lunch	140	74	58	91	124	74	136	111
	PM	189	126	106	140	186	126	219	177
	Daily	2268	2055	1107	1810	2338	2055	1236	1876
Friday	AM	261	81	98	147	137	81	167	128
	Lunch	122	84	63	90	126	84	149	120
	PM	196	127	90	138	201	127	246	191
	Daily	2358	2216	2276	2283	2476	2216	1388	2027
	Missing data replaced with Southbound data for location B.								

Table 6. Total Volumes by Location (Fremont School Zone)

Saliman Road - Fremont School Zone (Volumes)									
Time Period		Northbound				Southbound			
		Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
Monday	AM	207	46	72	108	178	283	135	199
	Lunch	279	235	238	251	230	241	205	225
	PM	287	262	227	259	287	303	203	264
	Daily	3800	3041	3178	3340	3389	2608	3493	3163
Tuesday	AM	300	285	260	282	232	179	38	150
	Lunch	256	229	223	236	217	253	226	232
	PM	303	274	250	276	299	334	222	285
	Daily	4125	3488	3650	3754	3569	2755	3619	3314
Wednesday	AM	294	271	240	268	241	336	95	224
	Lunch	239	204	191	211	220	229	134	194
	PM	316	274	243	278	275	279	106	220
	Daily	3860	3260	3439	3520	3531	1885	3543	2986
Thursday	AM	312	278	276	289	230	326	75	210
	Lunch	223	224	209	219	217	252	210	226
	PM	315	267	239	274	259	302	198	253
	Daily	4052	3509	3633	3731	3869	2821	3612	3434
Friday	AM	276	265	250	264	227	325	98	217
	Lunch	280	260	249	263	231	237	219	229
	PM	330	275	253	286	335	364	253	317
	Daily	4156	3693	3844	3898	3983	3103	3854	3647

Table 7. Average Total Volume by Time Period (Al Seeliger School Zone)

Saliman Road - Al Seeliger School Zone (Volumes, Average of all days)								
Time Period	Northbound				Southbound			
	Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
AM	256	91	93	146	131	91	158	127
Lunch	130	82	66	92	129	82	145	119
PM	177	118	99	131	194	118	227	180
Daily	2191	1991	1297	1826	2291	1991	1193	1825
	Missing data replaced with Southbound data for location B.							

Table 8. Average Total Volume by Time Period (Fremont School Zone)

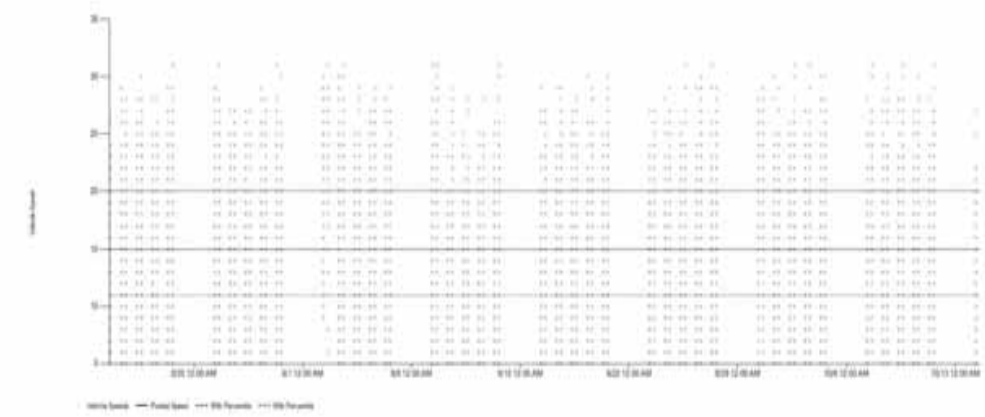
Saliman Road - Fremont School Zone (Volumes, Average of all days)								
Time Period	Northbound				Southbound			
	Location A	Location B	Location C	Total	Location A	Location B	Location C	Total
AM	278	229	220	242	222	290	88	200
Lunch	255	230	222	236	223	242	199	221
PM	310	270	242	274	291	316	196	268
Daily	3999	3398	3549	3649	3668	2634	3624	3309

Speed Feedback Sign Location	Average Speed (During School Zone Times)	85th Percentile Speed (During School Zone Times)
Bordewich-Bray (W. King Street)	11	20
Carson Middle School (W. King Street)	16	25
Empire Elementary (Gordonia Dr)	15	21
Empire Elementary - Fairview Drive (Southbound)	22	34
Empire Elementary - Fairview Drive (Northbound)	31	38
Fremont Elementary (Saliman Rd - Northbound)	23	34
Fremont Elementary (Saliman Rd - Southbound)	24	32
Fritsch Elementary (Bath St)	15	22
Seeliger Elementary (Saliman Rd)	17	25

Posted school zone speeds in Nevada are 15mph. Data analyzed above was captured from Carson City Public Works speed feedback signs at the locations described above during the 2019-2020 school year. The table above is a summary of the following data. For more information on the raw data, please contact Carson City Public Works.

Vehicle Speed Report

Data File: Bordewich Eastbound Dec-12-19 15;22.csv
Date Range: 8/19/19 1:50 PM to 10/14/19 1:38 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:30:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Number of data points:	14571
Average daily volume:	365
Posted speed:	15
Average speed:	12.2
Percentiles:	
85th:	20
50th:	11

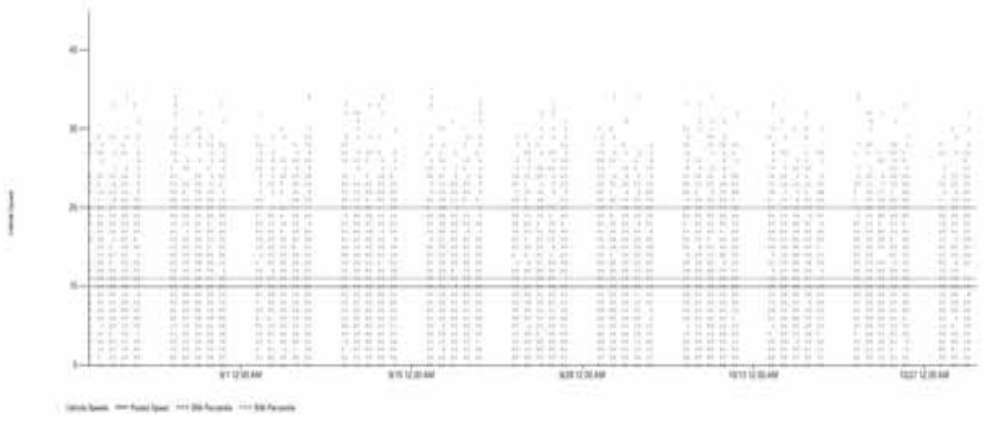
Percentage Compliance

carmanah®

Report Date: 1/13/2020

Vehicle Speed Report

Data File: King St Eastbound Dec-12-19 14;56.csv
Date Range: 8/19/19 1:20 PM to 10/31/19 7:21 AM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Number of data points:	8784
Average daily volume:	154
Posted speed:	15
Average speed:	16.8
Percentiles:	
85th:	25
50th:	16

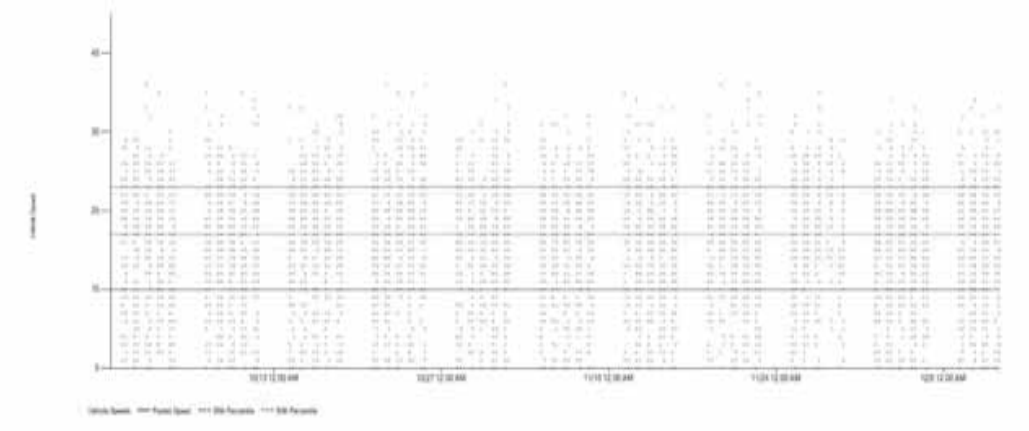
Percentage Compliance

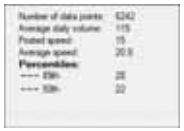
carmanah®

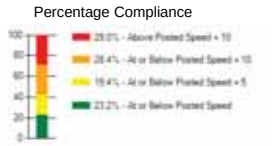
Report Date: 1/13/2020

Vehicle Speed Report

Data File: Empire school Dec-12-19 15;06.csv
Date Range: 9/29/19 9:00 AM to 12/12/19 3:04 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average







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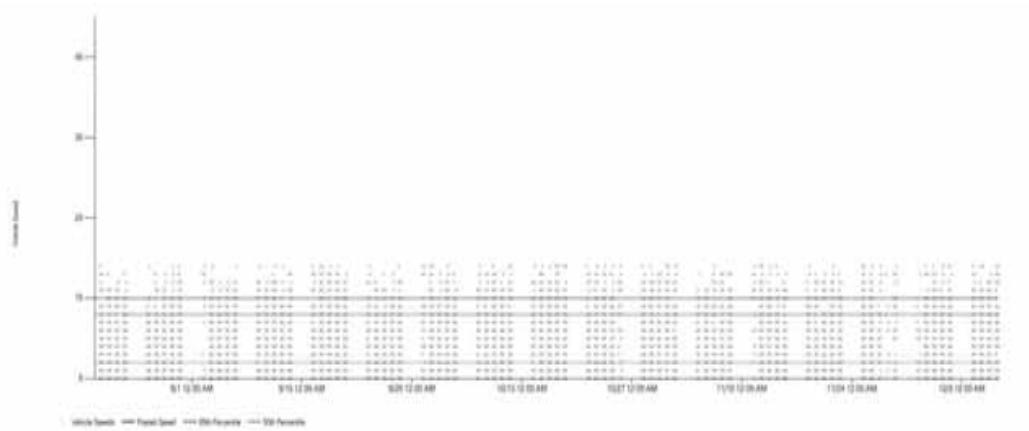
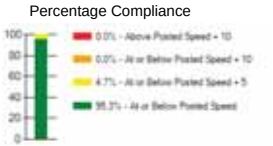
Report Date: 1/13/2020

Vehicle Speed Report

Data File: Empire elementary sb Dec-12-19 14;53.csv
Date Range: 8/19/19 3:48 PM to 12/12/19 2:53 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average





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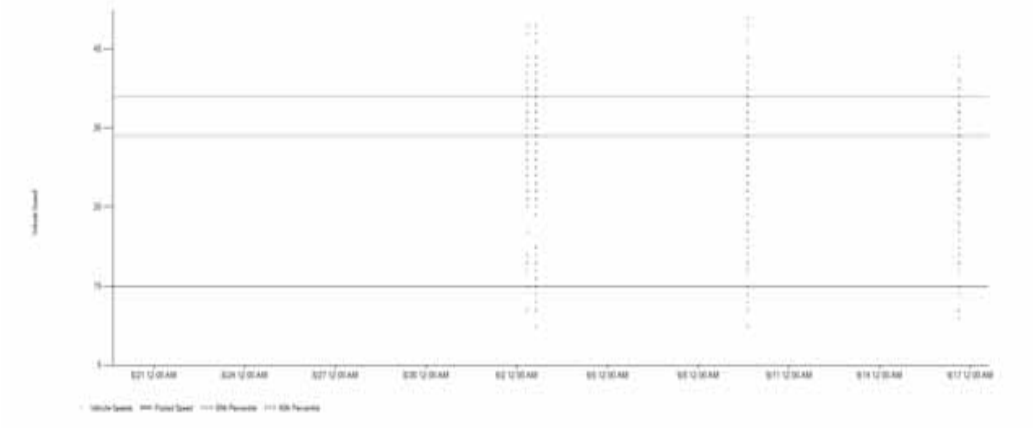
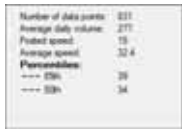
Report Date: 1/13/2020

Vehicle Speed Report

Data File: Fairview Dr Northbound Dec-12-19 14;42.csv
Date Range: 8/19/19 3:38 PM to 9/17/19 2:13 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average





Percentage Compliance

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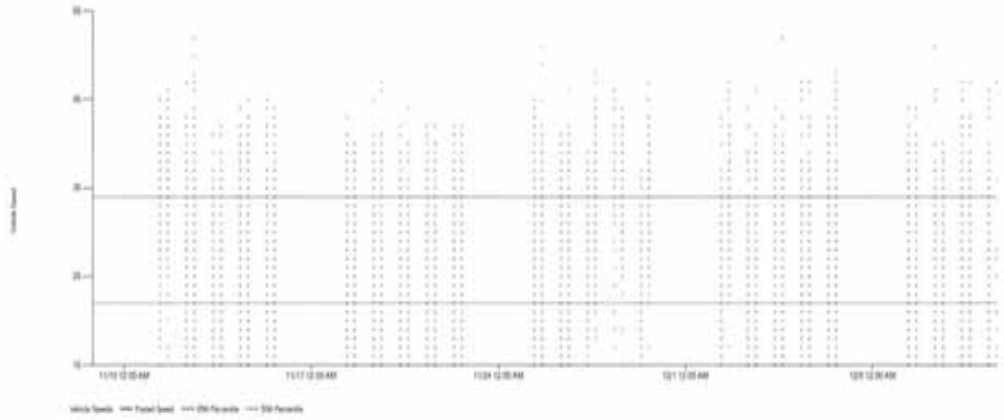
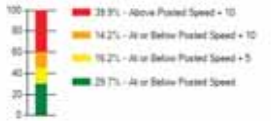
Report Date: 1/13/2020

Vehicle Speed Report

Data File: Fairview Dr Southbound Dec-12-19 14;47.csv
Date Range: 11/8/19 8:00 PM to 12/12/19 2:46 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Percentage Compliance



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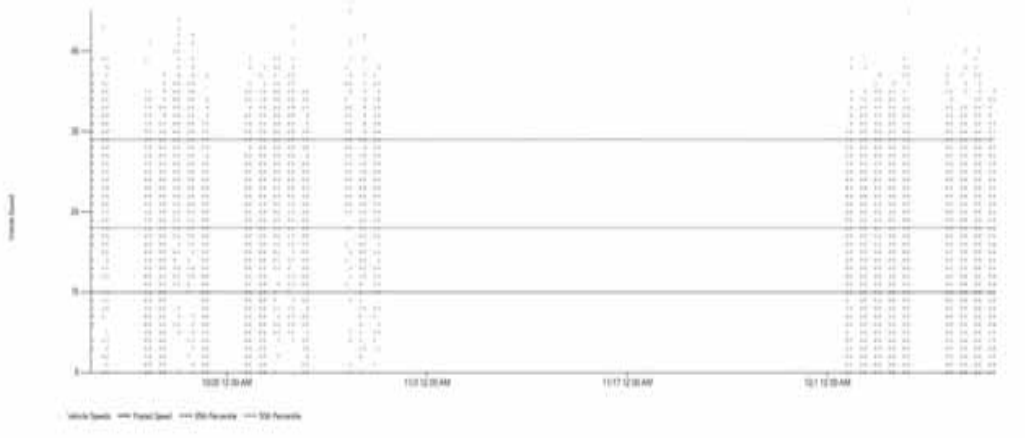
Report Date: 1/13/2020

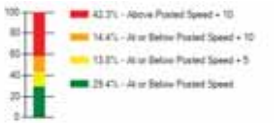
Vehicle Speed Report

Data File: S Fremont Northbound Dec-12-19 15;10.csv
Date Range: 10/10/19 12:00 PM to 12/12/19 3:10 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Number of data points:	10715
Average daily volume:	446
Posted speed:	15
Average speed:	22.4
Percentiles:	
--- 85th:	34
--- 50th:	23

Percentage Compliance



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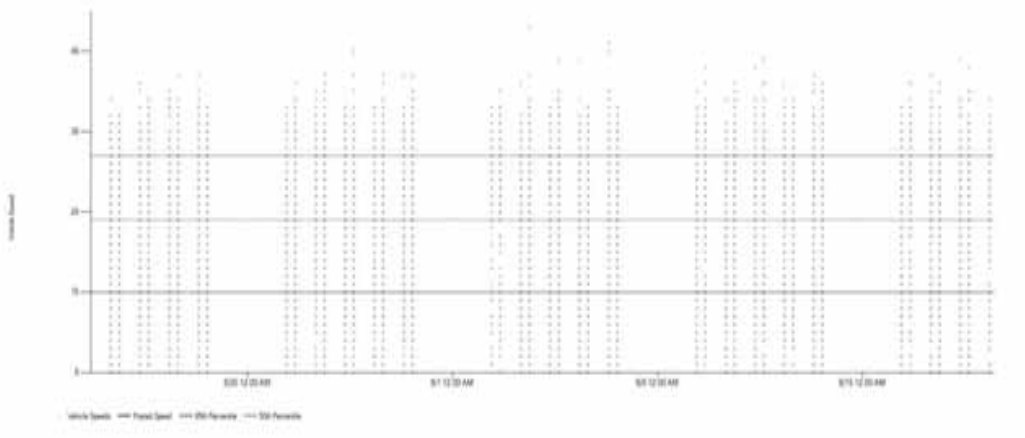
Report Date: 1/13/2020

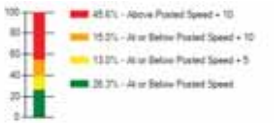
Vehicle Speed Report

Data File: Fremont Southbound Dec-12-19 14;49.csv
Date Range: 8/19/19 3:44 PM to 9/19/19 11:48 AM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Number of data points:	10535
Average daily volume:	458
Posted speed:	15
Average speed:	22.8
Percentiles:	
--- 85th:	32
--- 50th:	24

Percentage Compliance



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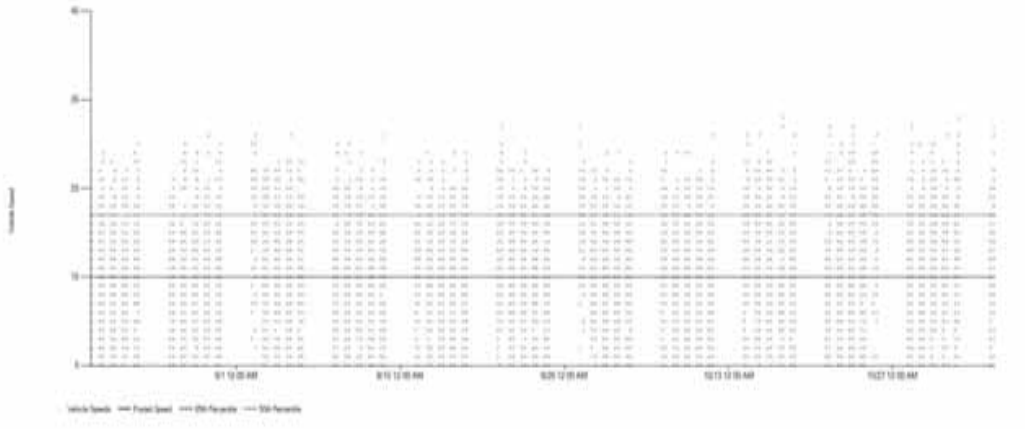
Report Date: 1/13/2020

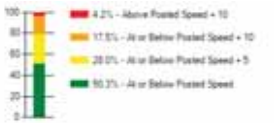
Vehicle Speed Report

Data File: Fritsch Northbound Dec-12-19 15;31.csv
Date Range: 8/19/19 2:14 PM to 11/4/19 4:04 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Number of data points:	11023
Average daily volume:	196
Posted speed:	15
Average speed:	15.4
Percentiles:	
--- 85th:	22
--- 50th:	16

Percentage Compliance



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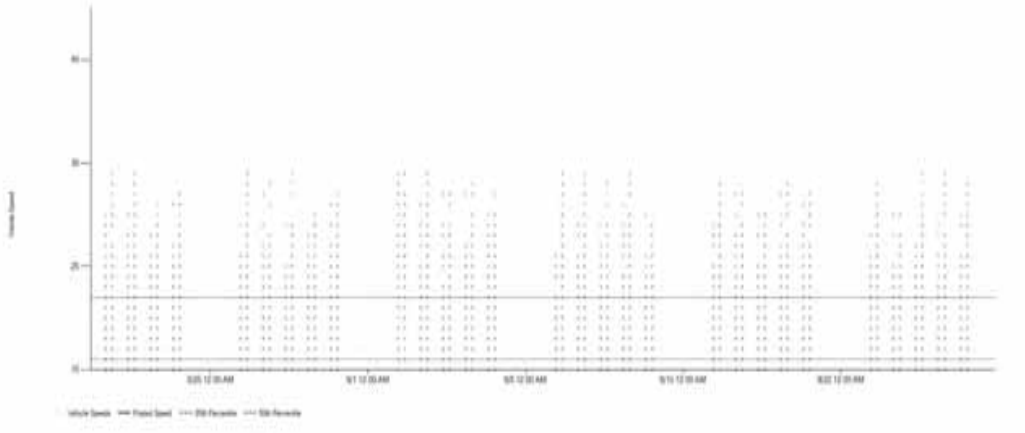
Report Date: 1/13/2020

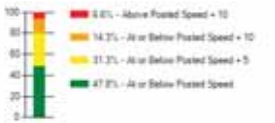
Vehicle Speed Report

Data File: S Seeliger Northbound Dec-12-19 15;21.csv
Date Range: 8/19/19 4:26 PM to 9/28/19 7:37 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Number of data points:	14672
Average daily volume:	305
Posted speed:	15
Average speed:	16.1
Percentiles:	
--- 85th:	22
--- 50th:	16

Percentage Compliance



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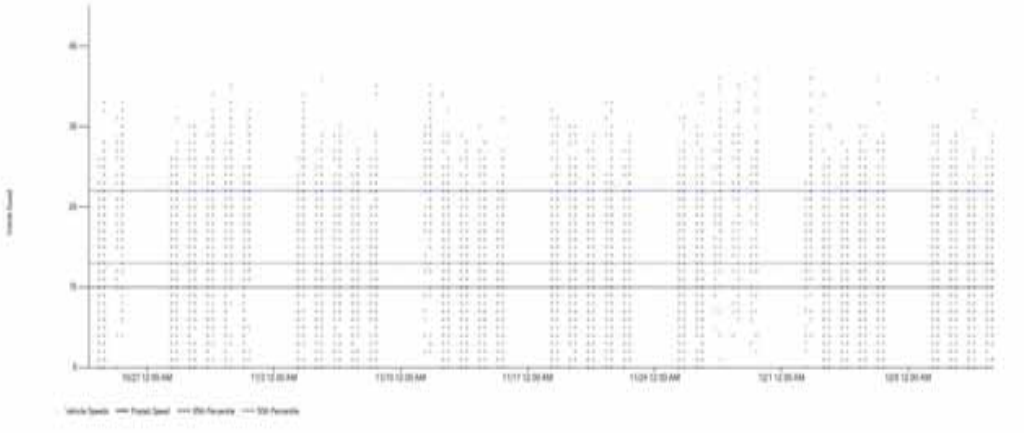
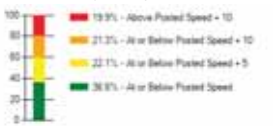
Report Date: 1/13/2020

Vehicle Speed Report

Data File: N Seeliger Southbound Dec-12-19 15;11.csv
Date Range: 10/23/19 7:00 PM to 12/12/19 3:11 PM
Included days: Monday, Tuesday, Wednesday, Thursday, Friday
Included hours: 07:45:00 to 08:15:00, 14:45:00 to 15:15:00
Excluded speeds greater/less than: 3 std. deviations from average



Percentage Compliance



Report Date: 1/13/2020

Appendix E
Crash History Maps

Appendix E: Crash History Maps

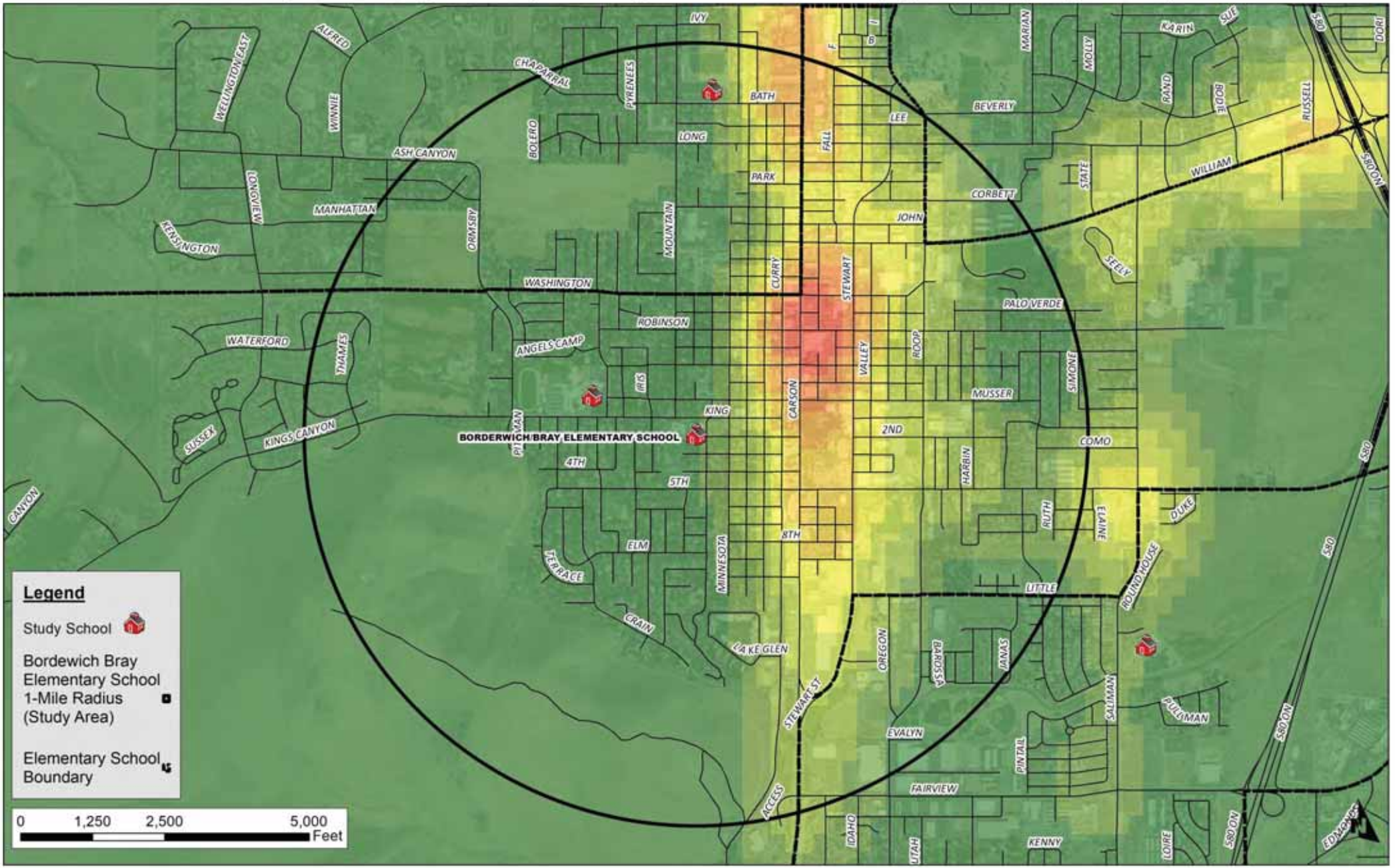
An extended Table 1, below, from page 2-2 represents Top Ten Pedestrian/ Bicyclist Crash Corridors during School Hours with the addition of contributing factors, severity and crash types. Analyzing contributing factors, severity and crash types points to mitigating engineering solutions to increase safety in school zones.

The following maps illustrate fatal and injurious hot spots and individual pedestrian and bicyclist crash locations with severity and crash type centered around elementary and middle schools in Carson City.

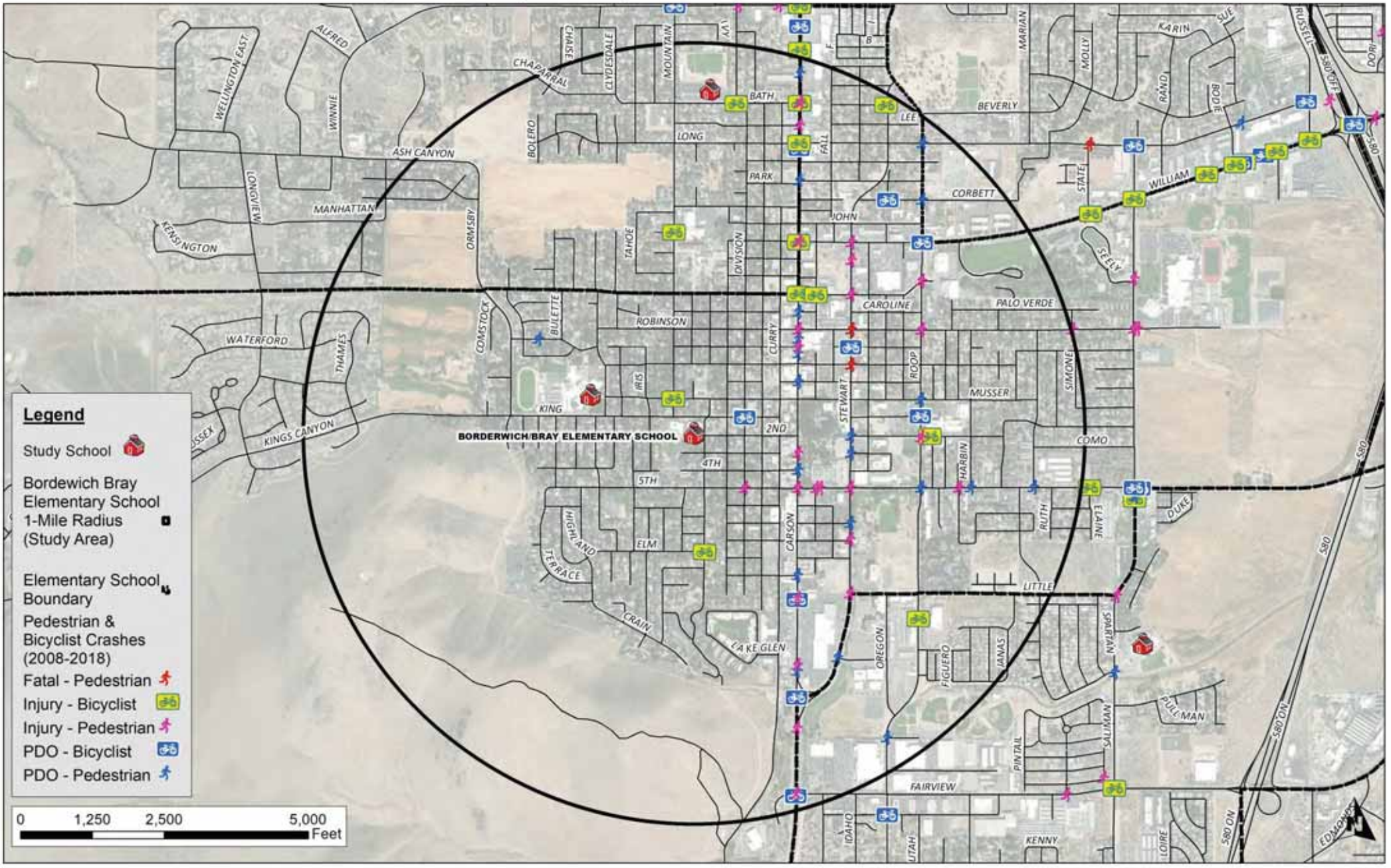
Corridor	Crashes	Contributing Factors	Severity	Crash Types
1. Carson Street	45	Speed, Inattention/ Distracted, Improper Driving, Fell Asleep, Drinking, Drugs, Impairment, Obstructed view	1 Fatality, Injuries, PDO *	Rear End, Angle, Side Swipe, Non- Collision, Pedestrian, Bicyclist
2. William Street/ US 50	25	Speed, Inattention/ Distracted, Improper Driving, Fell Asleep, Drinking, Drugs, Impairment, Obstructed view	2 Fatalities, Injuries, PDO	Rear End, Angle, Side Swipe, Non- Collision, Backing, Head-On, Bicyclist, Pedestrian
3. S. Roop Street	13	Fell, Asleep, Inattention/ Distracted, Drinking, Speed	Injuries, PDO	Rear End, Angle, Side Swipe, Head-On, Pedestrian, Bicyclist
4. S. Saliman Street	12	Inattention/ Distracted, Improper Driving, Fell Asleep, Drinking, Impairment, Obstructed view	Injuries, PDO	Rear End, Angle, Side Swipe, Head-On, Non-collision, Pedestrian, Bicyclist
5. S. Stewart Street	11	Fell asleep, Physical impairment, Inattention/ Distracted, Speed, Erratic, careless driving	2 Fatalities, Injuries, PDO	Rear End, Angle, Side Swipe, Head-On, Non-collision, Pedestrian, Bicyclist
6. W. 5th Street	10	Speed, Follow too closely, disregarded traffic signs, unsafe backing	Injuries, PDO	Rear End, Angle, Pedestrian
7. Fairview Drive	9	Speed, Inattention/ Distracted, Improper Driving, Fell Asleep, Drinking, Drugs, Impairment	Injuries, PDO	Rear End, Angle, Side Swipe, Non- Collision, Pedestrian, Bicyclist
8. E. College Parkway	6	Inattention/ Distracted, Improper Driving, Fell Asleep, Drinking, Illness, Speed, Follow too closely	Injuries, PDO	Rear End, Angle, Side Swipe, Non- Collision, Backing, Head-On, Pedestrian, Bicyclist
9. SR 529	5	Inattention/ Distracted, Speed, Improper Driving, Fell Asleep, Drinking, Physical Impairment	Injuries, PDO	Rear End, Angle, Side Swipe, Non- Collision, Backing, Head-On, Rear to Rear, Pedestrian, Bicyclist
10. W. Robinson Street	5	Speed, Improper turn, unsafe backing, fail to yield right of way	Injuries, PDO	Rear End, Angle, Side Swipe, Pedestrian

* Property Damage Only (PDO)

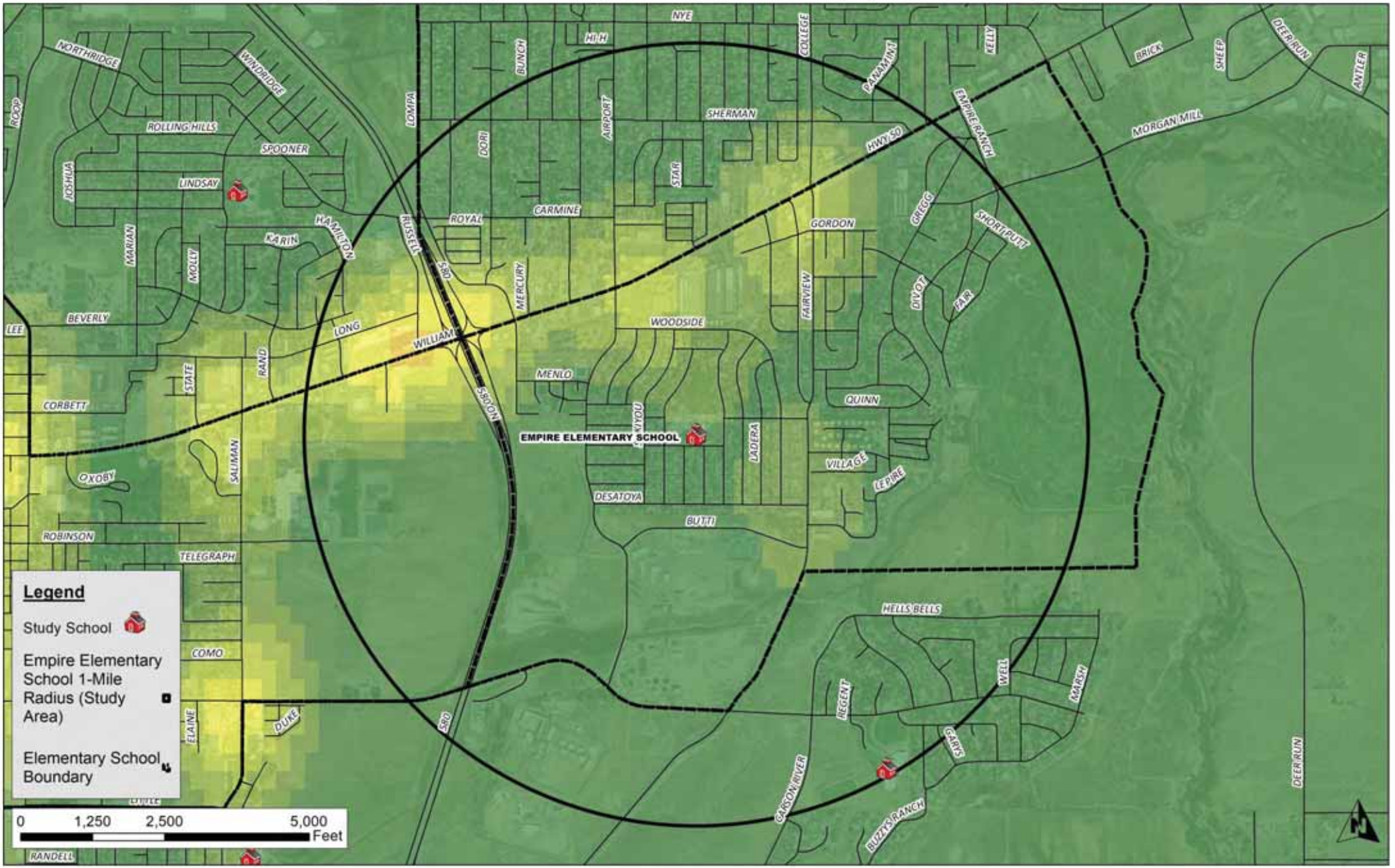
Bordewich-Bray Elementary School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



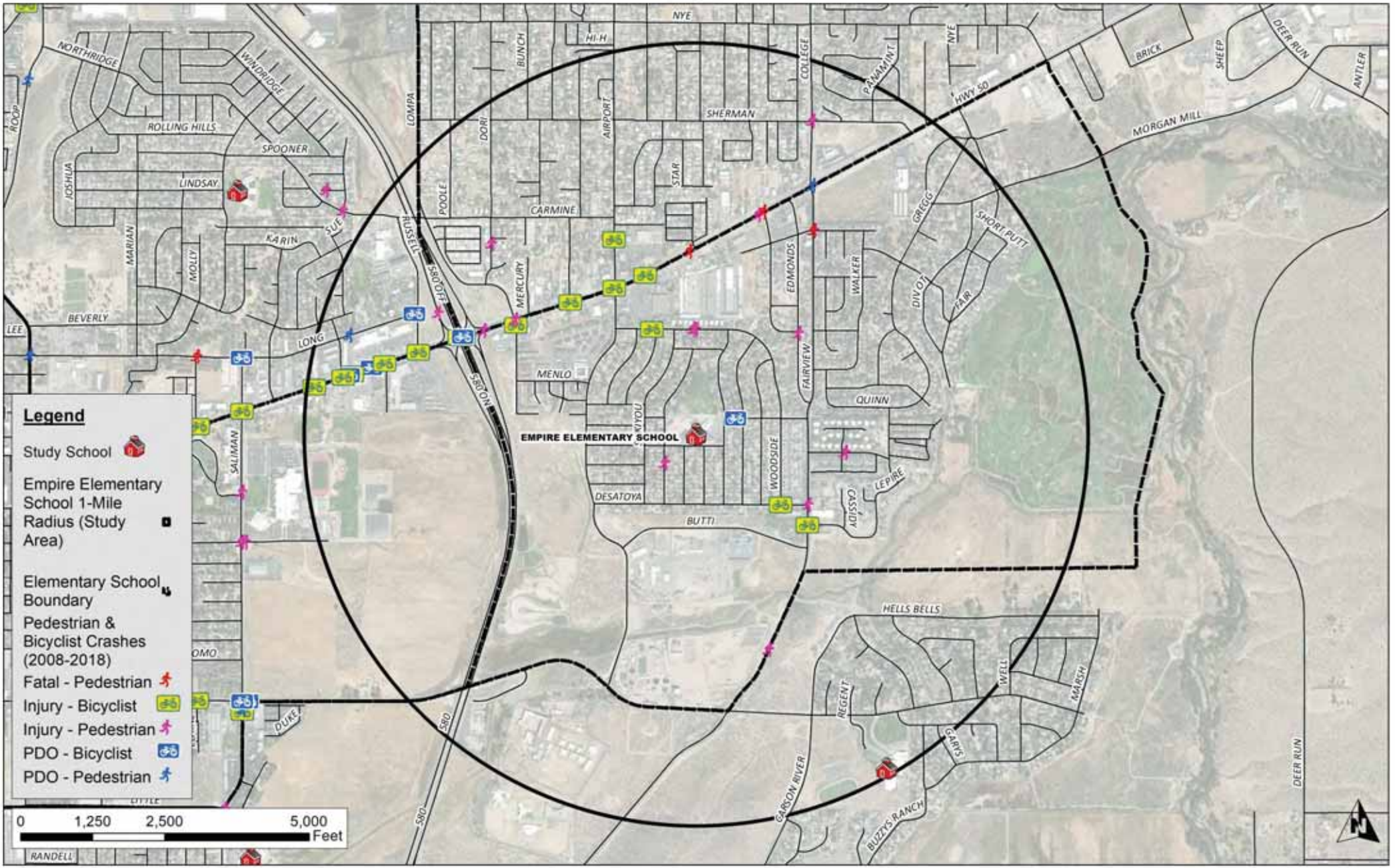
Bordewich-Bray Elementary School Bicycle & Pedestrian Crashes (2008-2018)



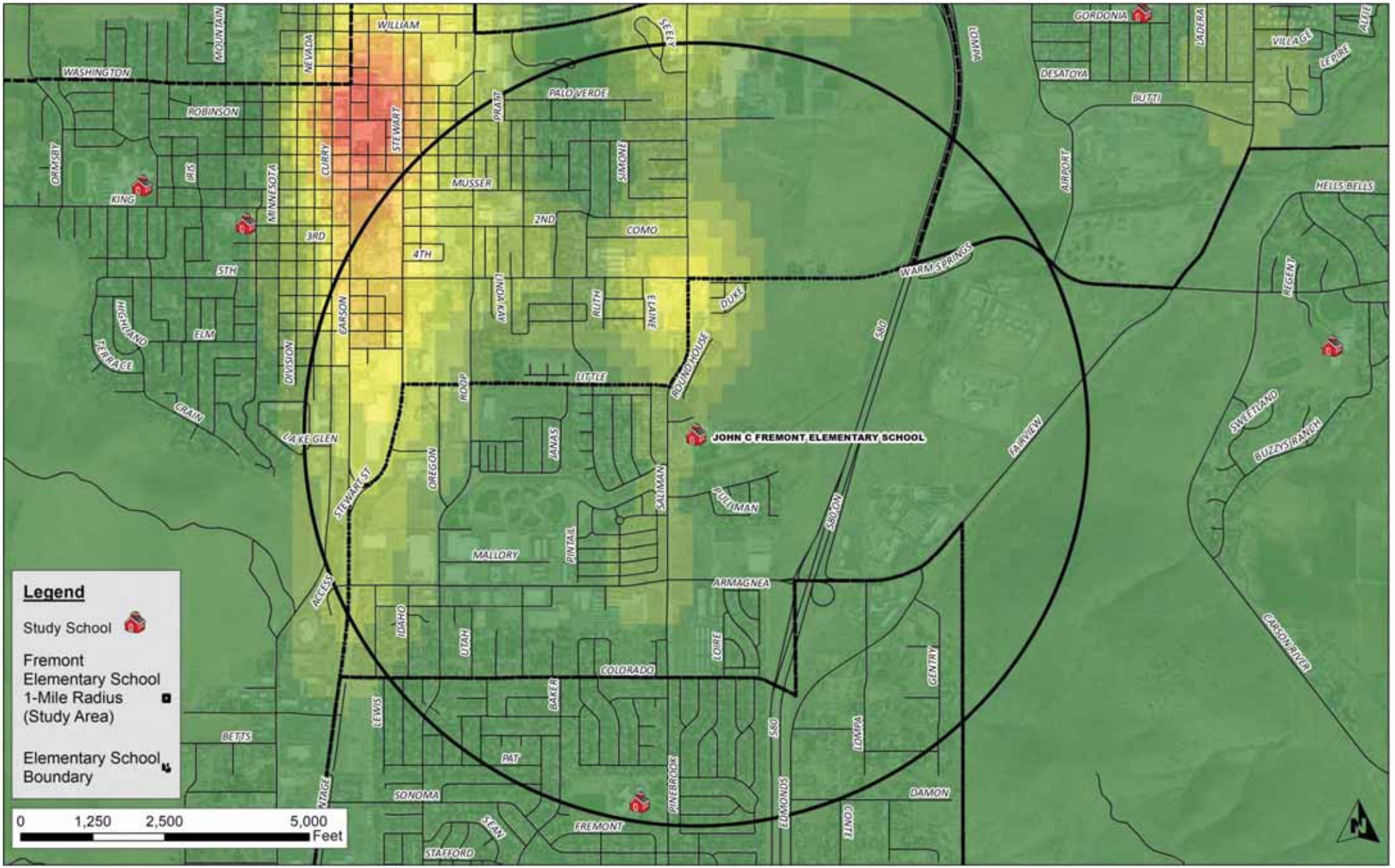
Empire Elementary School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



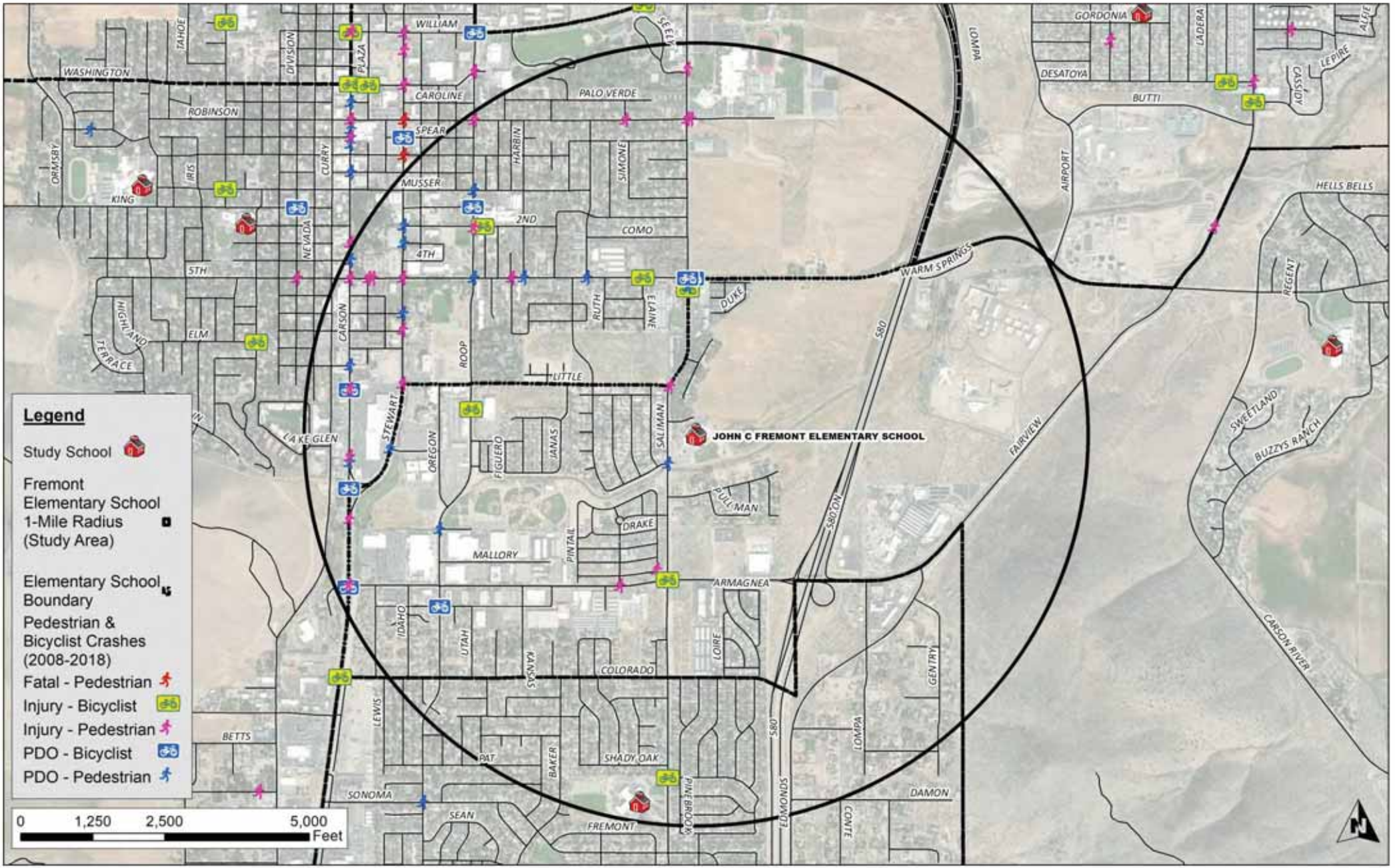
Empire Elementary School Bicycle & Pedestrian Crashes (2008-2018)



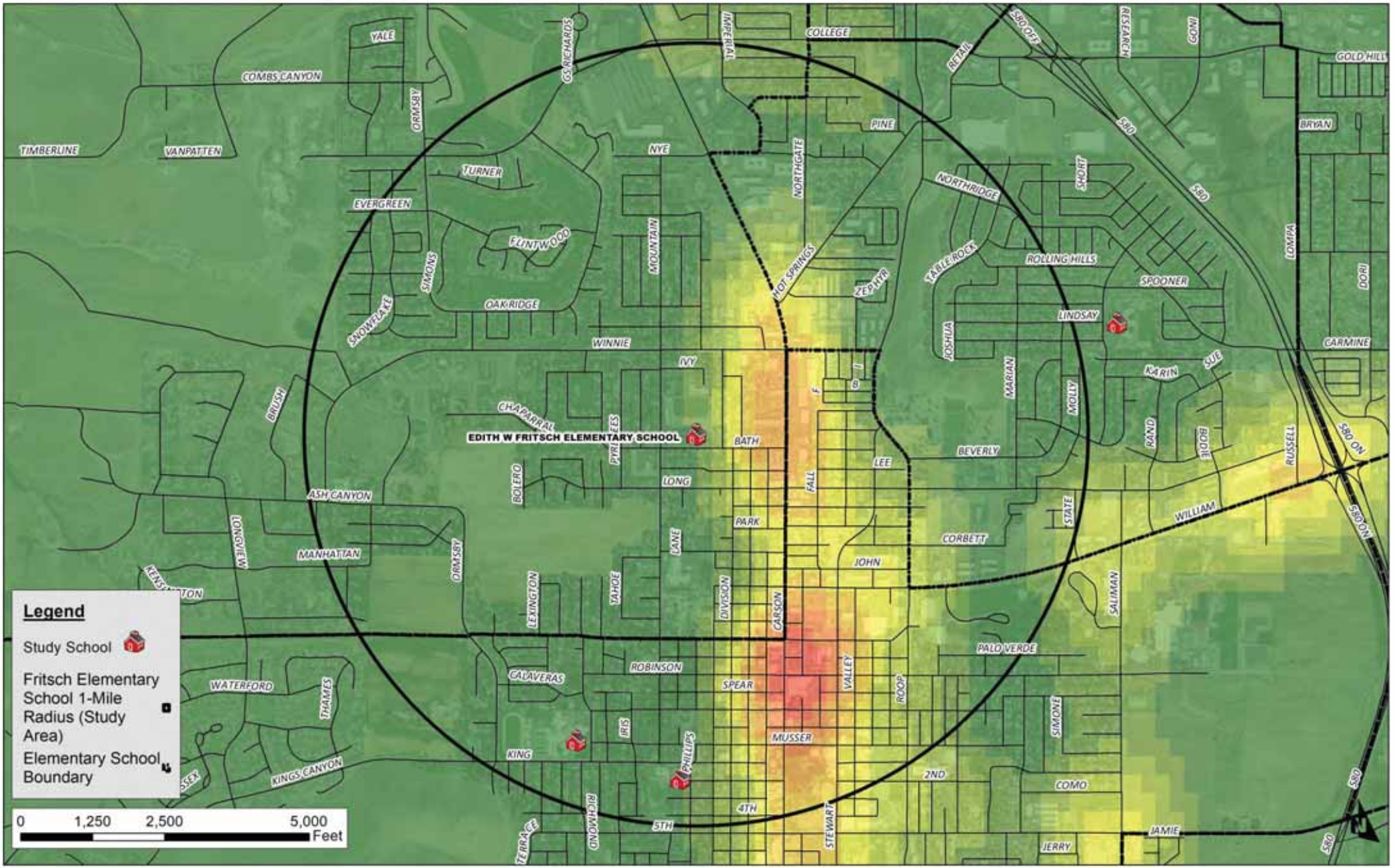
Fremont Elementary School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



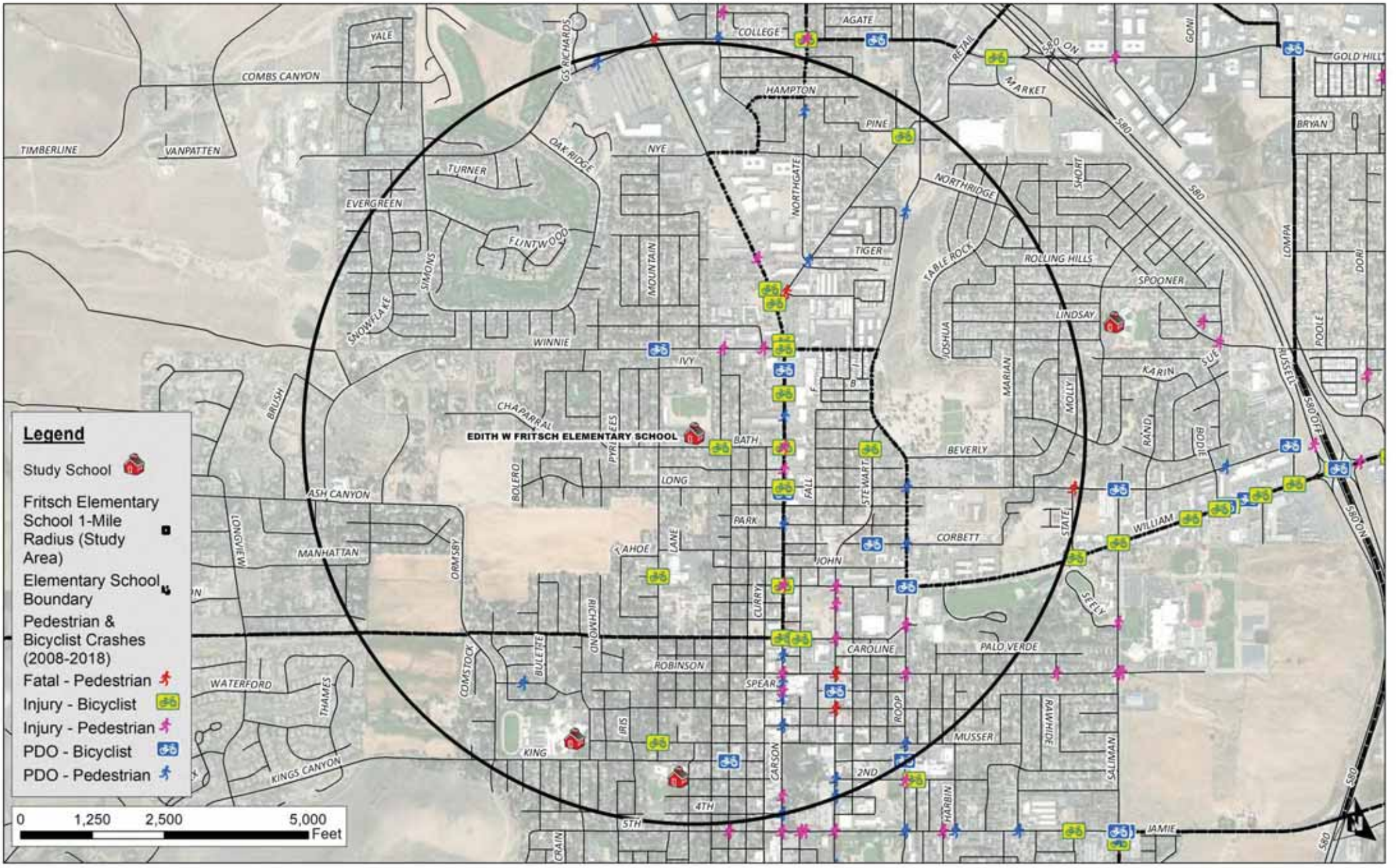
Fremont Elementary School Bicycle & Pedestrian Crashes (2008-2018)



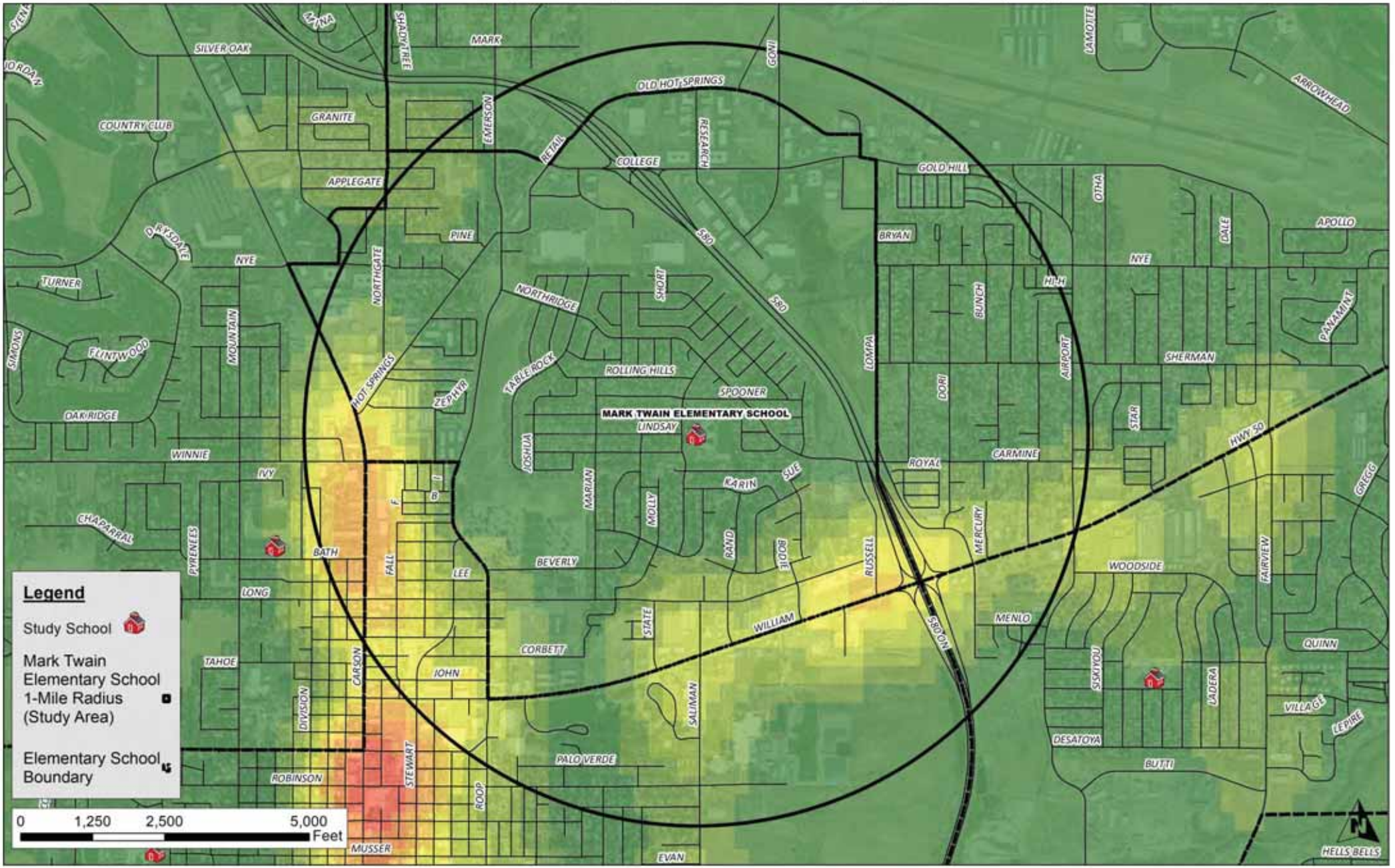
Fritsch Elementary School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



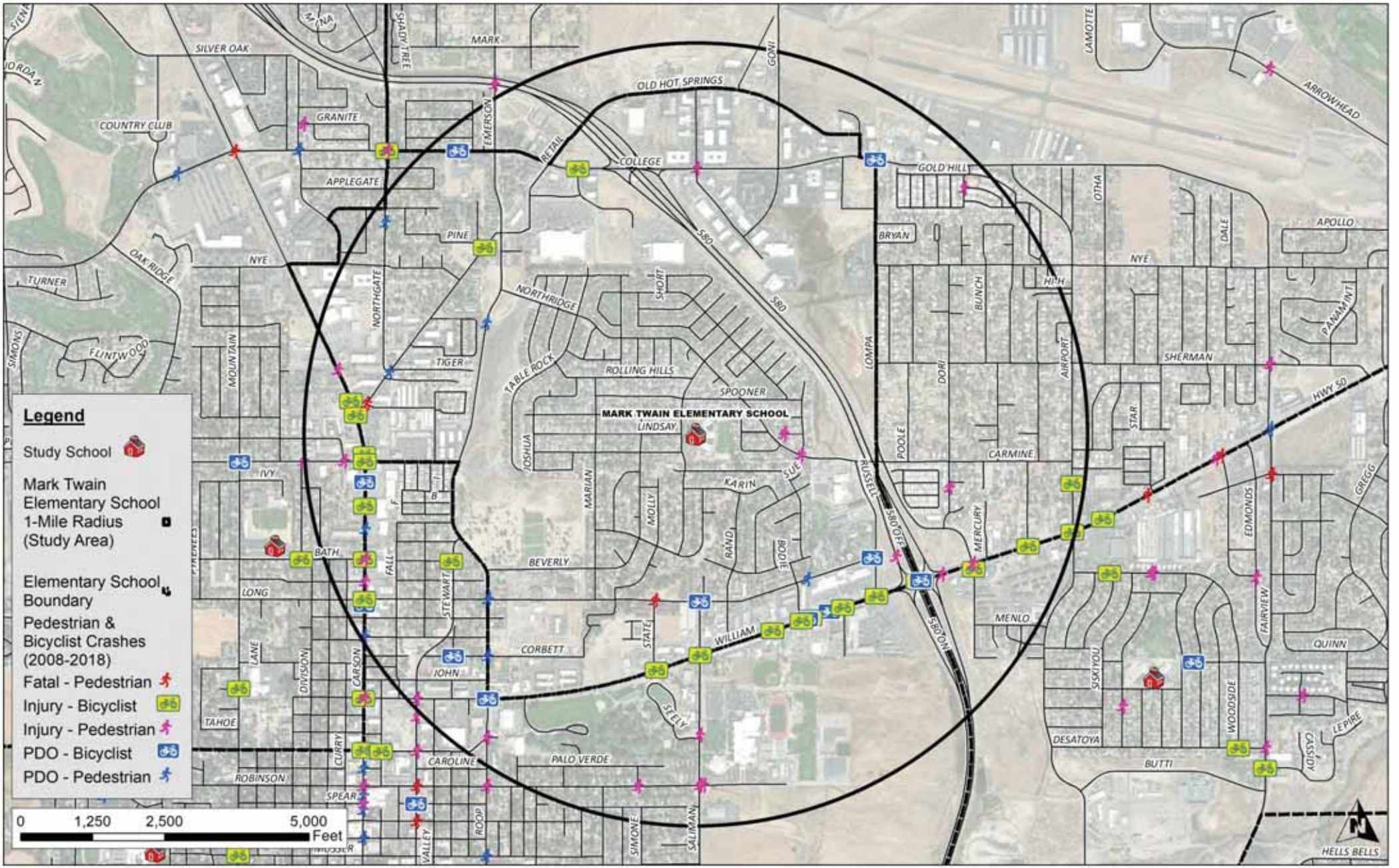
Fritsch Elementary School Bicycle & Pedestrian Crashes (2008-2018)



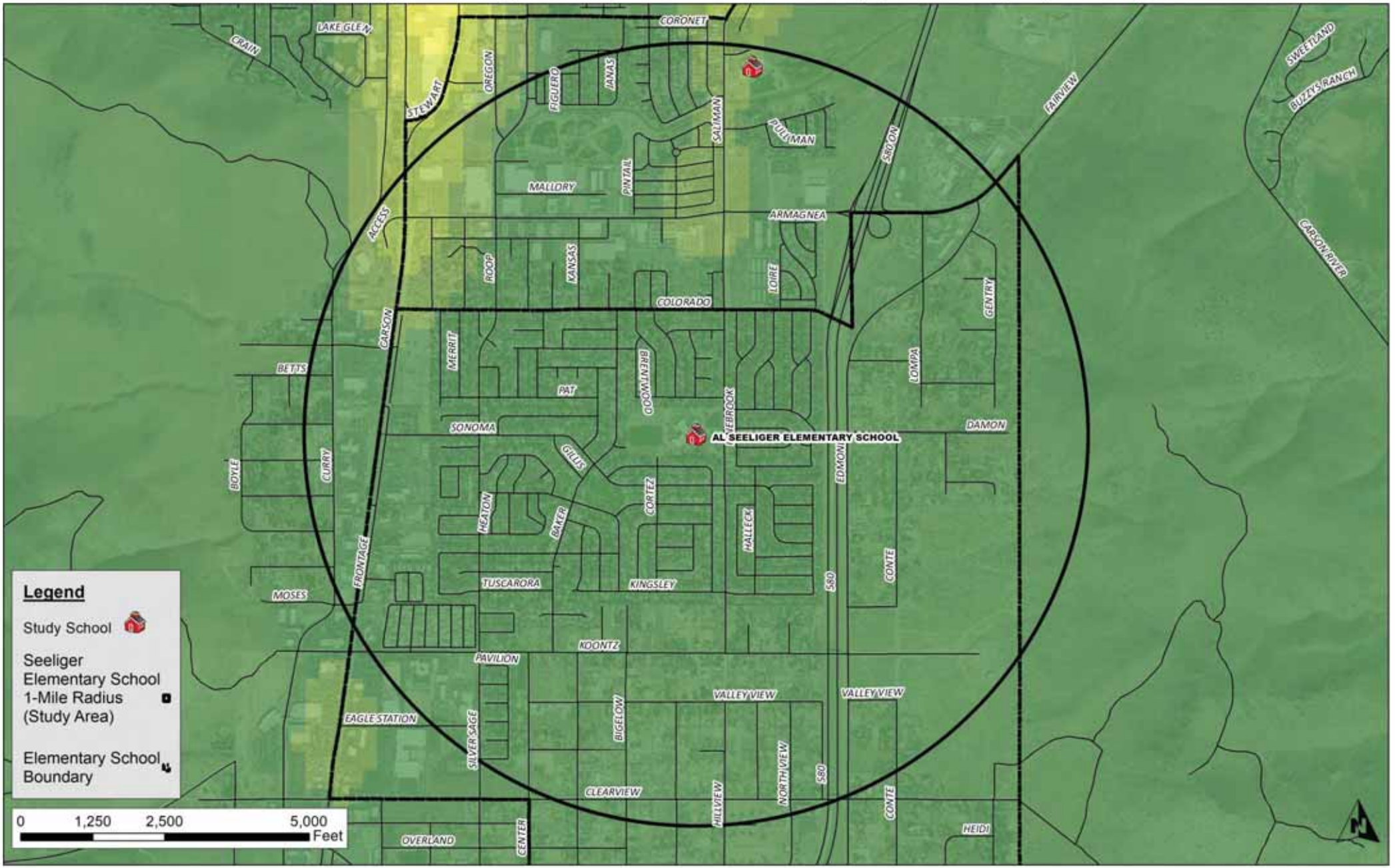
Mark Twain Elementary School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



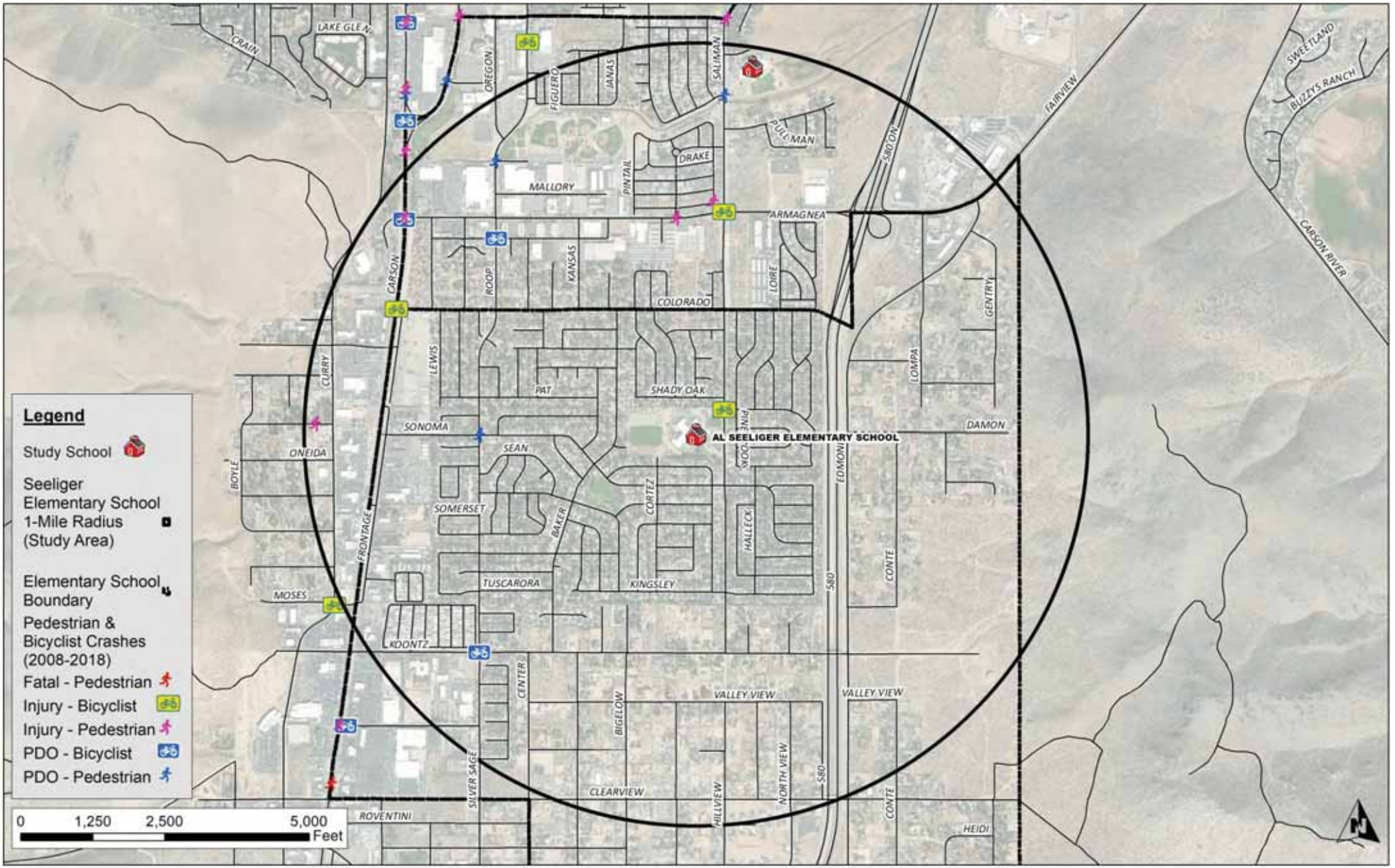
Mark Twain Elementary School Bicycle & Pedestrian Crashes (2008-2018)



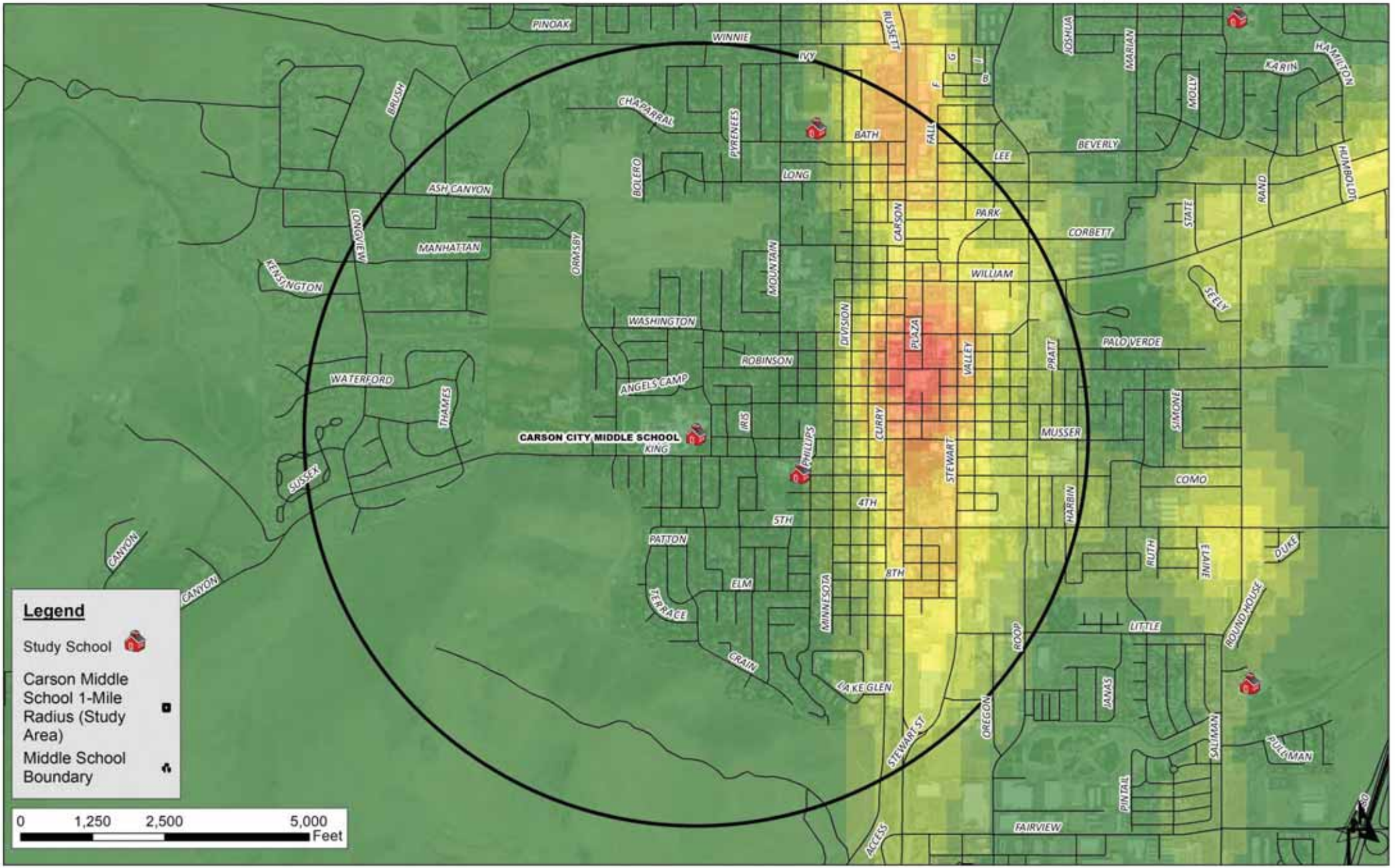
Al Seeliger Elementary School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



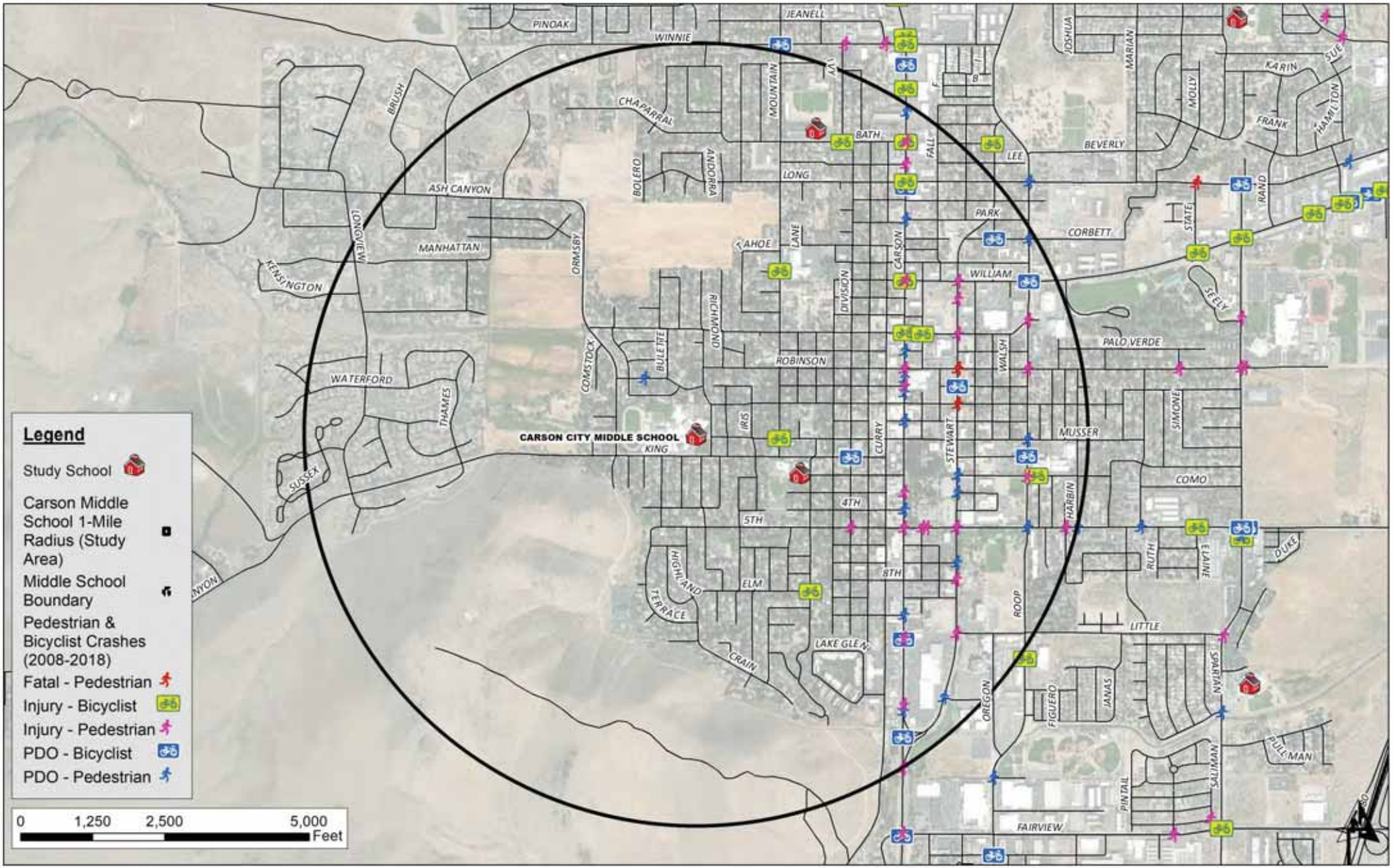
Al Seeliger Elementary School Bicycle & Pedestrian Crashes (2008-2018)



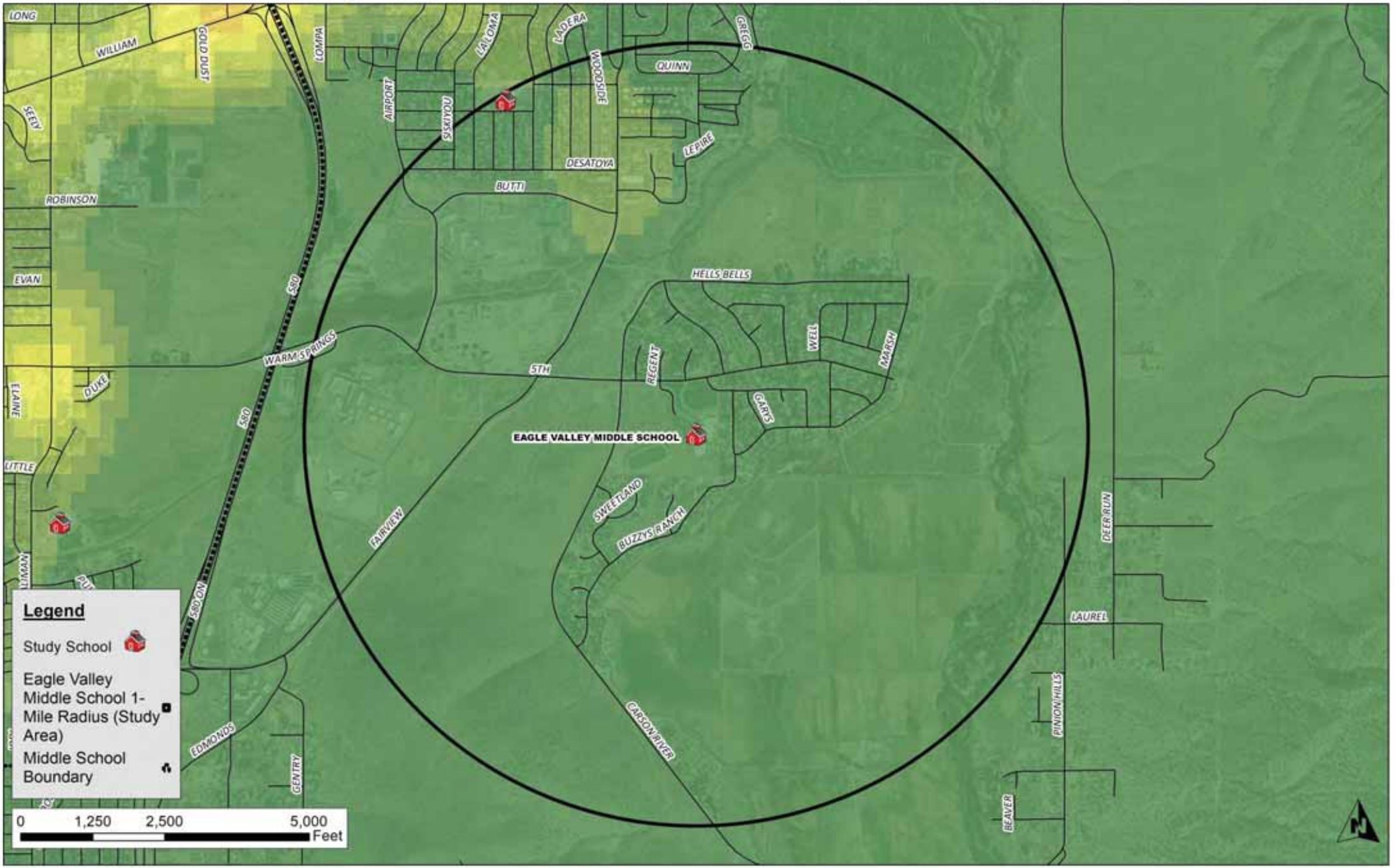
Carson Middle School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



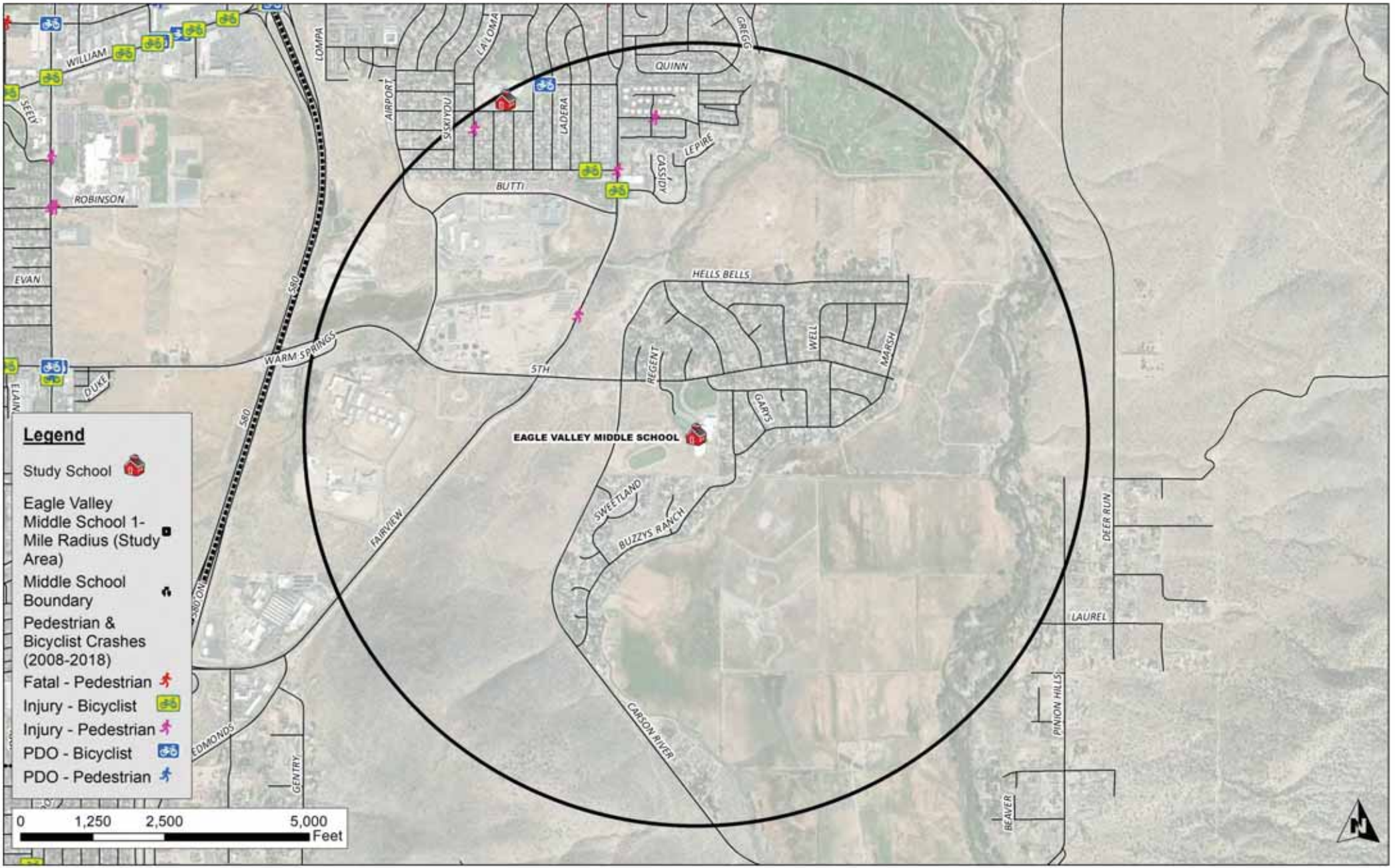
Carson Middle School Bicycle & Pedestrian Crashes (2008-2018)



Eagle Valley Middle School Bicycle & Pedestrian Fatal & Injury Crash Hot Spots (2008-2018)



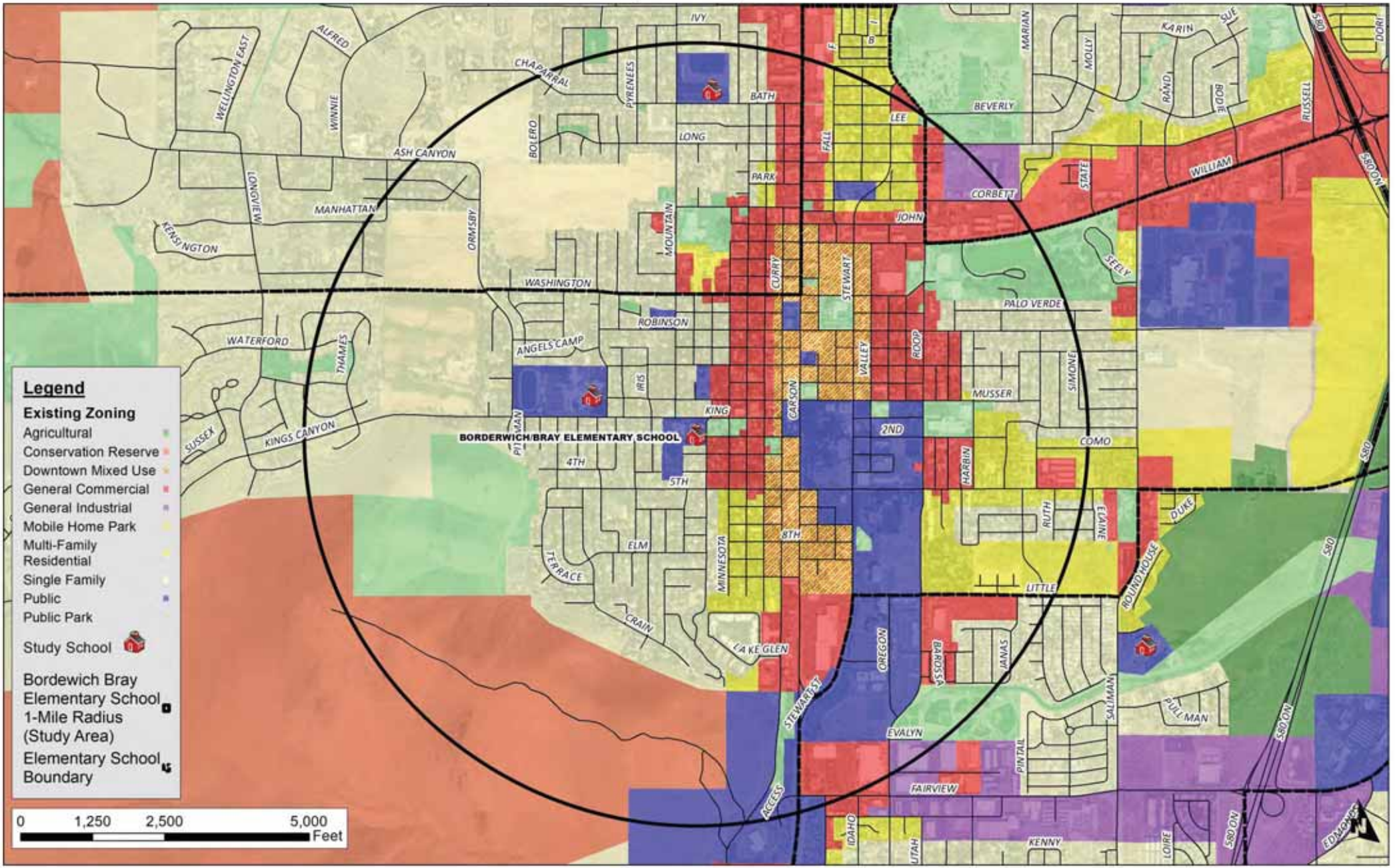
Eagle Valley Middle School Bicycle & Pedestrian Crashes (2008-2018)



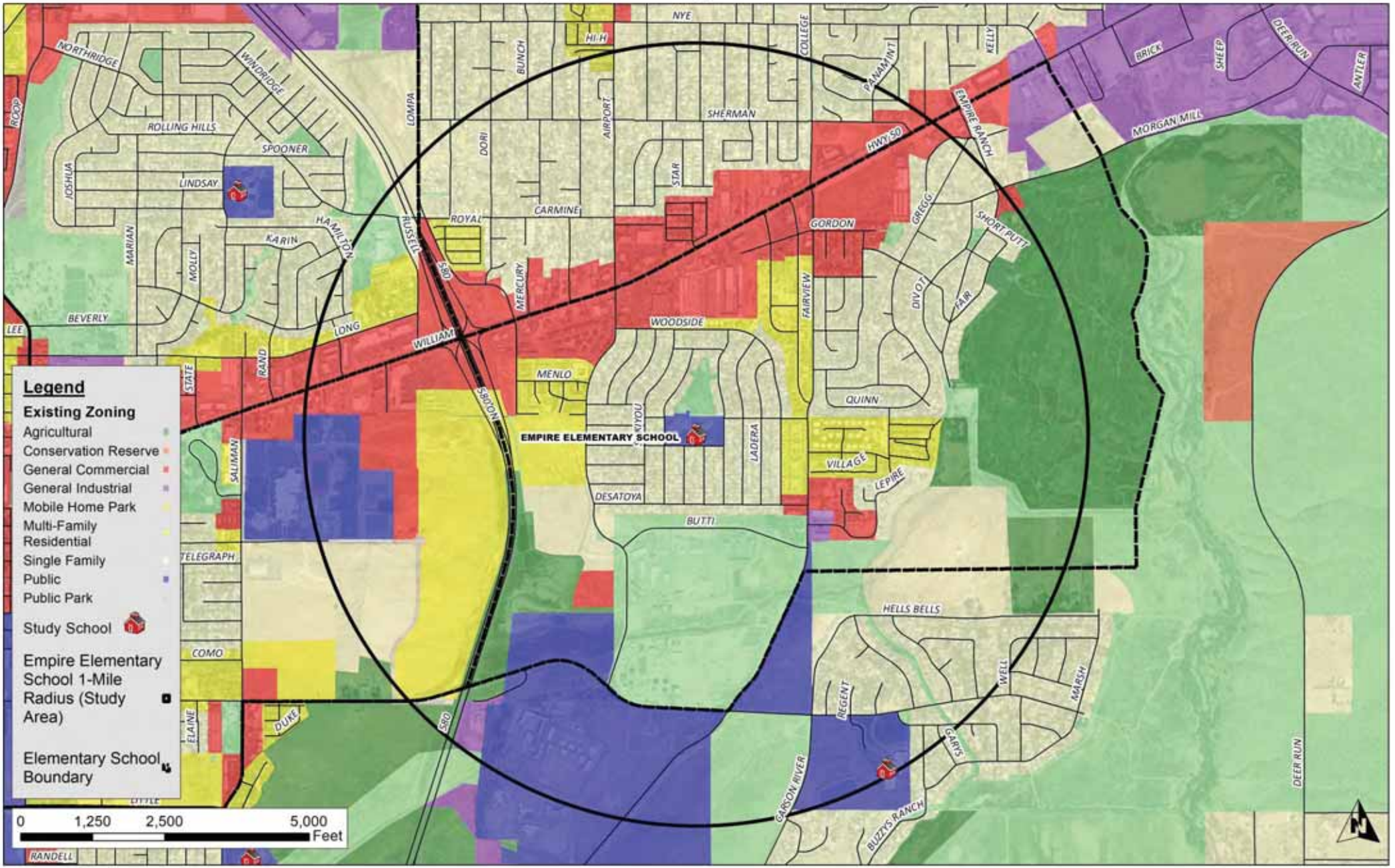
Appendix F
Zoning Maps

HEADWAY TRANSPORTATION

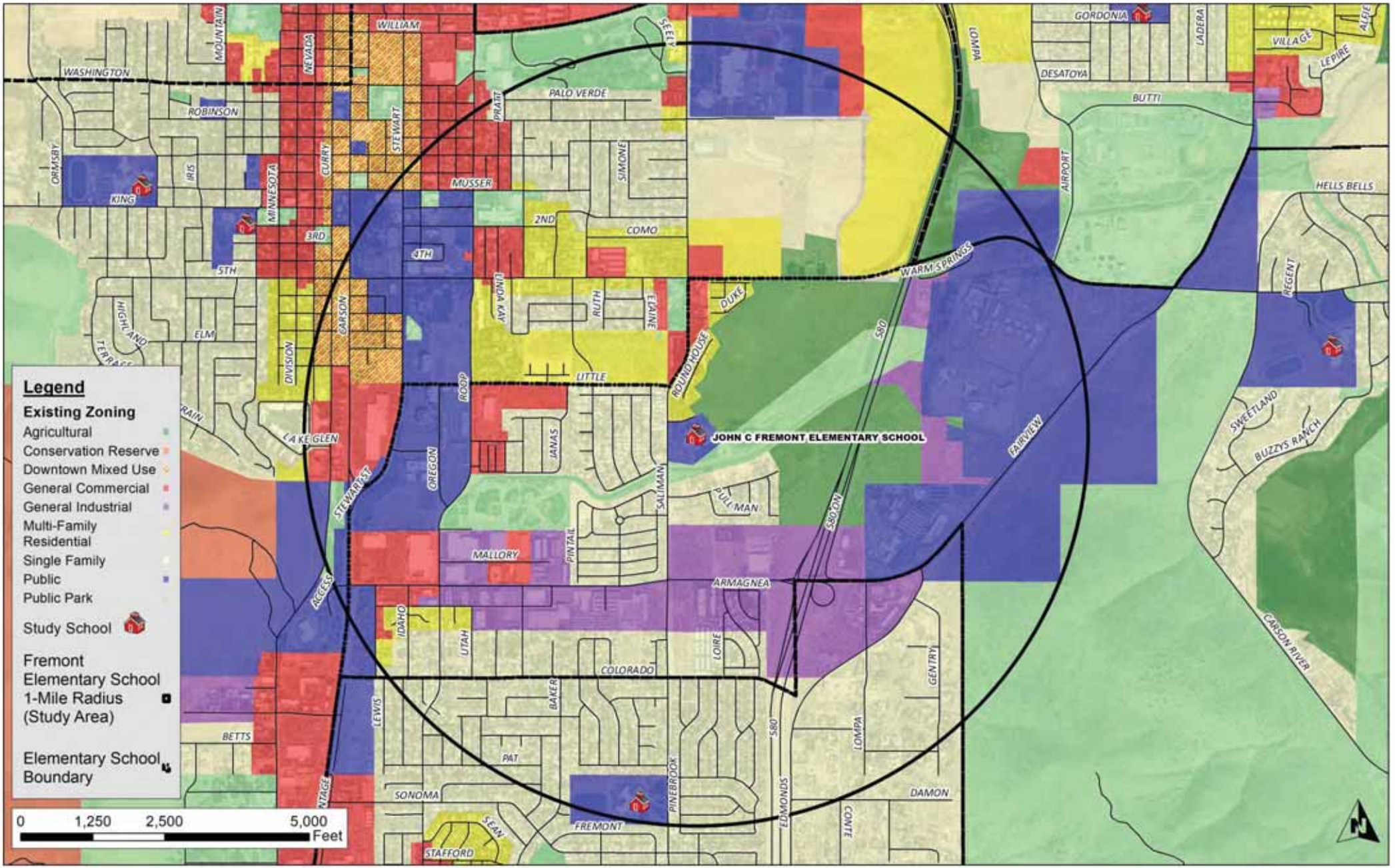
Bordewich-Bray Elementary School Existing Zoning



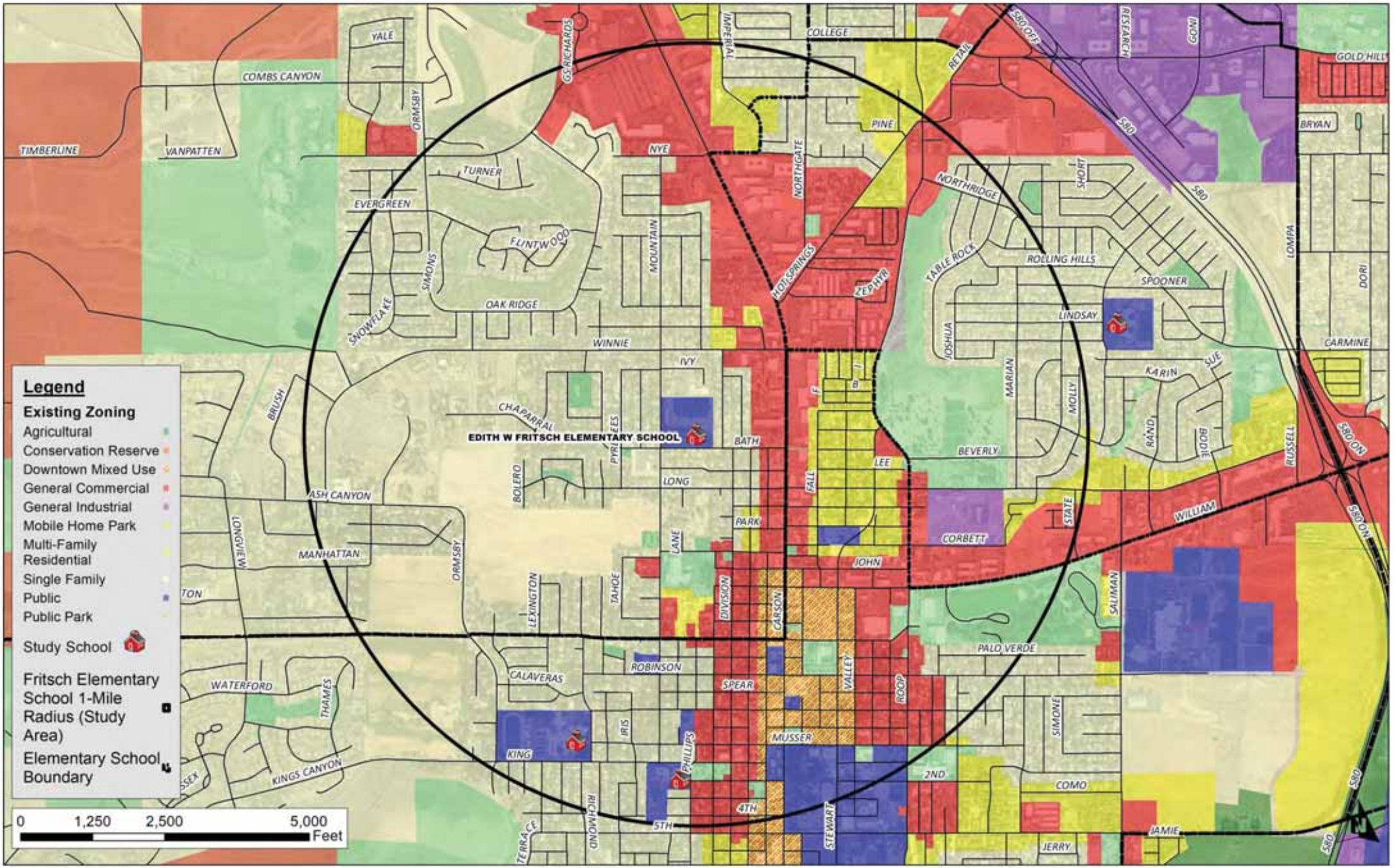
Empire Elementary School Existing Zoning



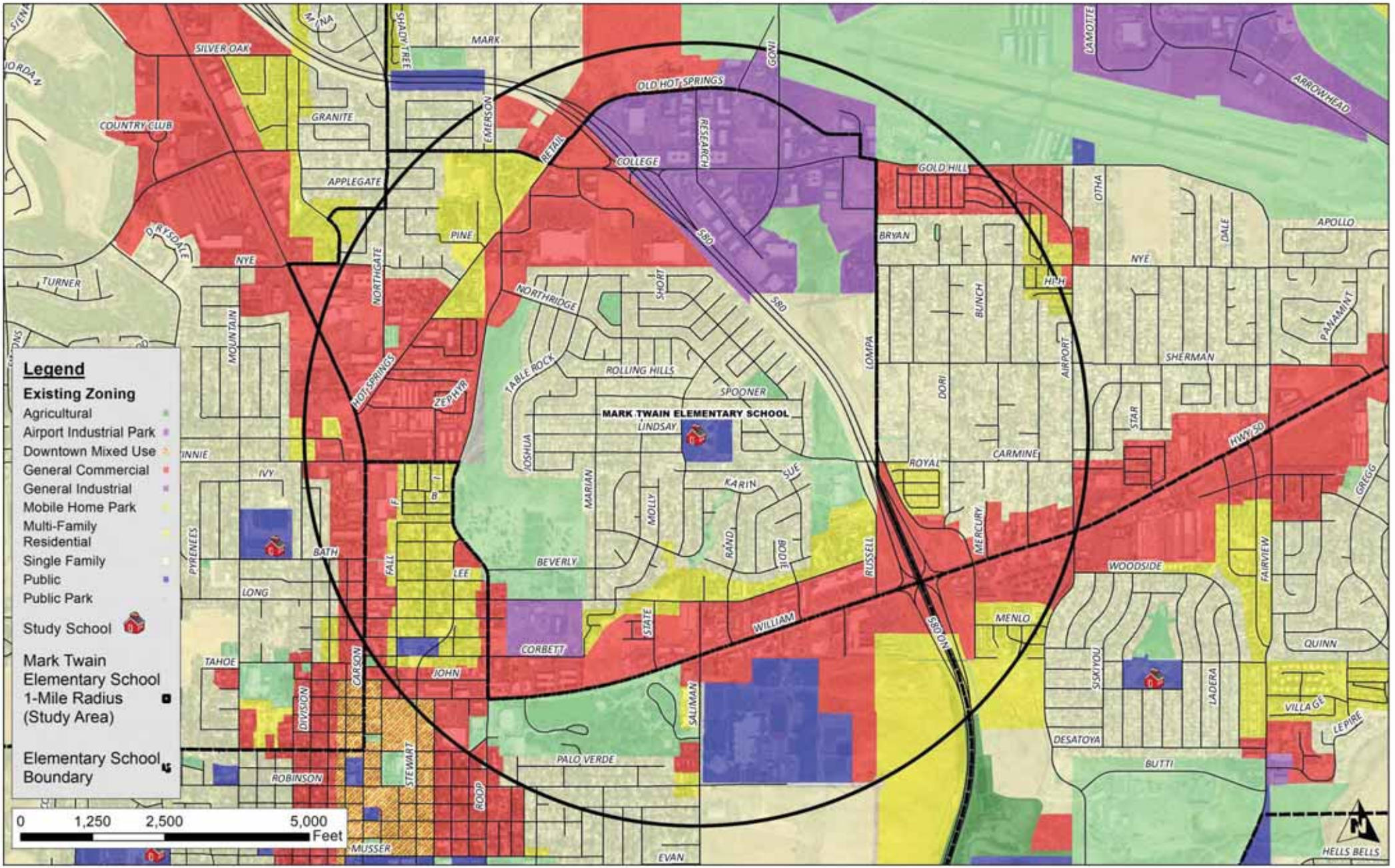
Fremont Elementary School Existing Zoning



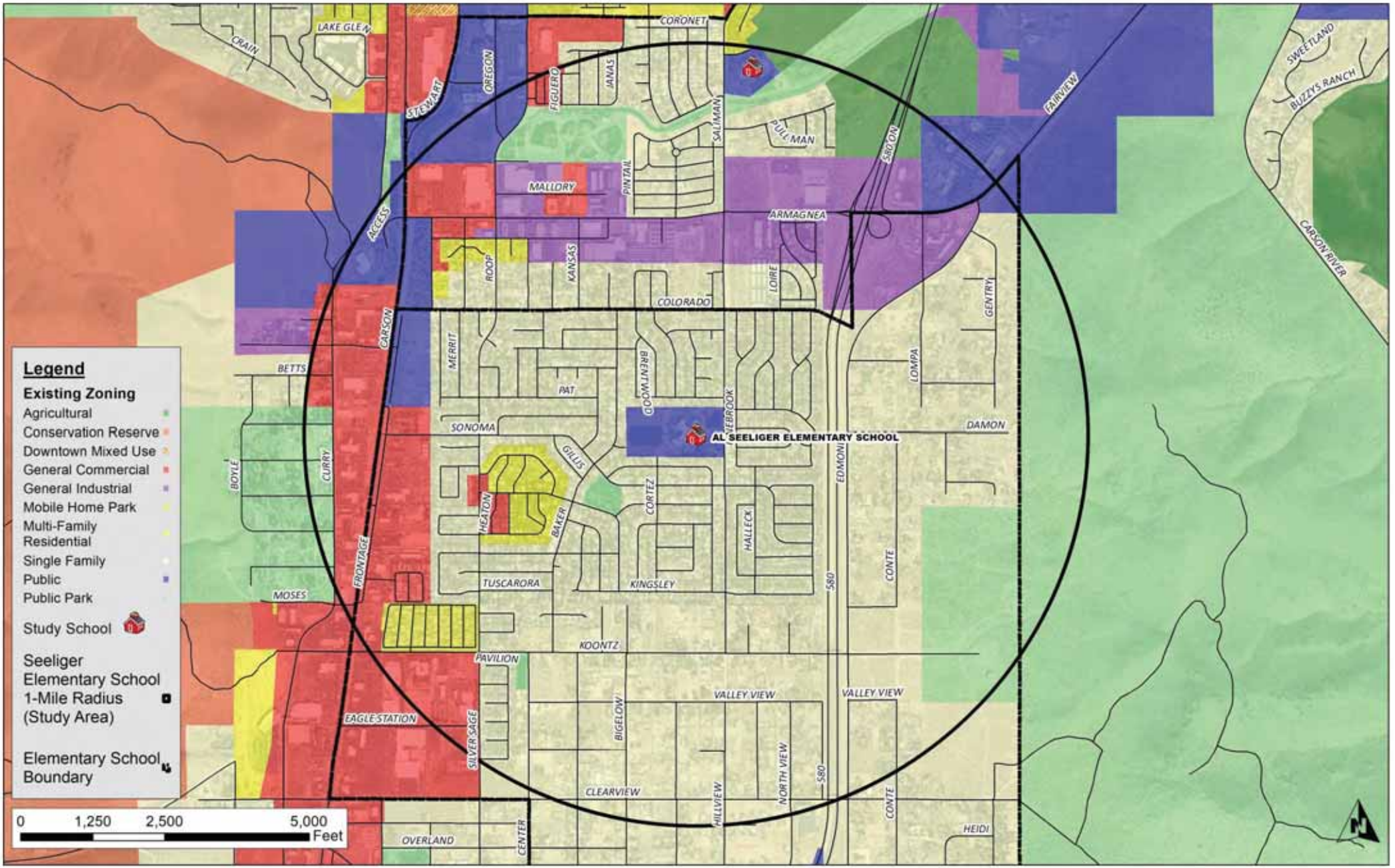
Fritsch Elementary School Existing Zoning



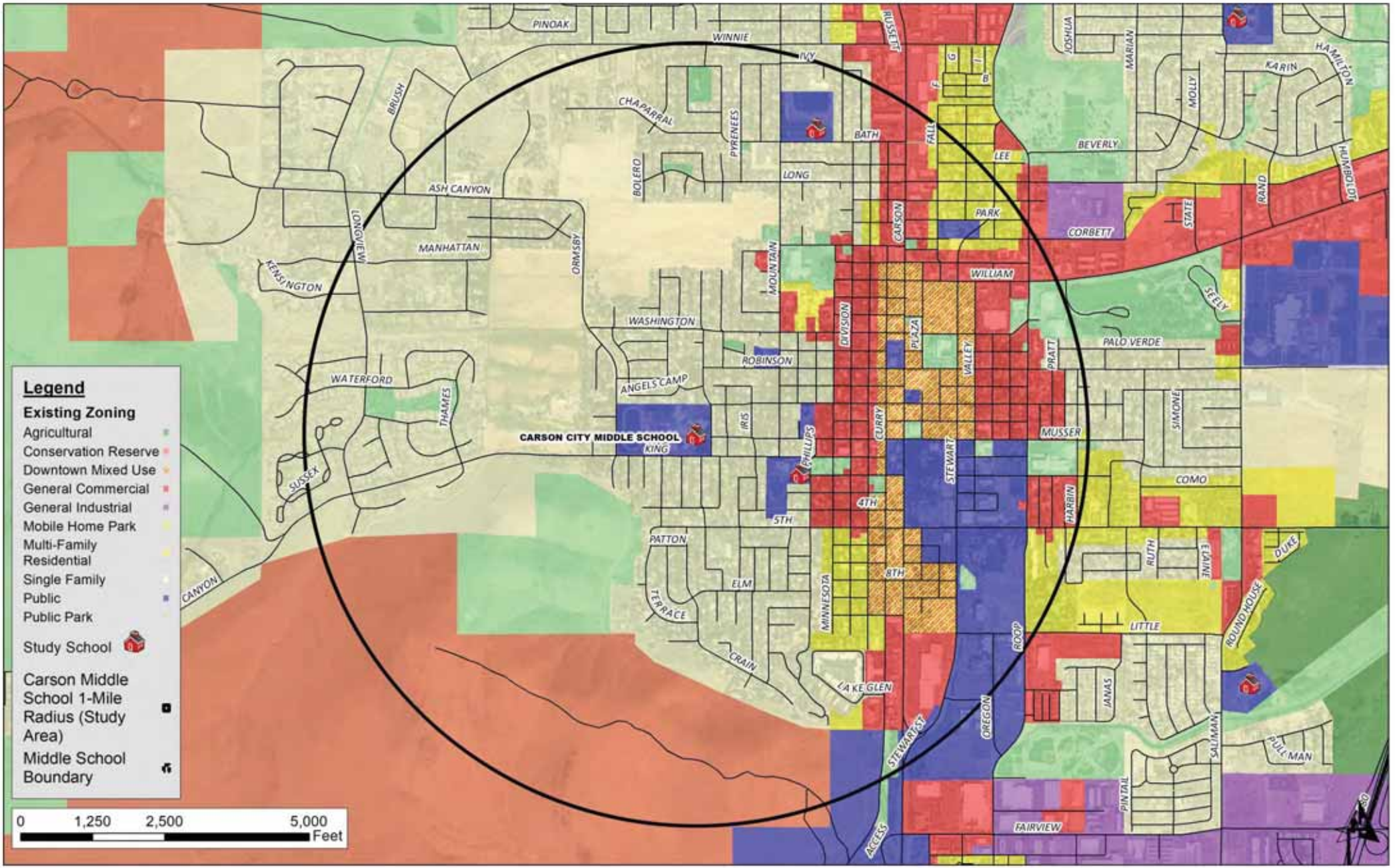
Mark Twain Elementary School Existing Zoning



Al Seeliger Elementary School Existing Zoning



Carson Middle School Existing Zoning



Eagle Valley Middle School Existing Zoning